Programme Structure

Sharda School of Computing Science & Engineering

Bachelor of Technology
(Computer Science & Engineering
And
Specialization)

Programme Code: SET0101

Batch: 2026-2030

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

1.2 Vision and Mission of Sharda School of Computing Science & Engineering

Vision of the School

To become a global institute of higher learning in Computing Science and Engineering, promoting excellence in research, innovation, and entrepreneurship to provide sustainable solutions for the challenges of progressive society.

Mission of the School

- **To impart quality education with strong industry and academia collaborations in the expanding and allied fields of Computing Science & Engineering, fostering a conducive and transformative learning environment.**
- **To produce eco-conscious socially and ethically responsible technocrats equipped with professional skills and experiential learning, to empower them for adopting emerging technologies.**
- **To inculcate a culture of multidisciplinary research, disruptive innovation and accelerated entrepreneurship, while providing sustainable solutions to address multifaceted challenges of growing society.**
- **To promote collaborative learning and critical thinking through effective mentoring and counselling, with the aim of creating future leaders to serve communities worldwide.**

Core Values

- **Industry & Academic Connectivity**
- **Experiential learning**
- **Interdisciplinary research**
- **Global**

1.3.1 Programme Educational Objectives (PEO)

PEO1: The graduates will establish themselves as professionals by solving real-life problems using exploratory and analytical skills acquired in the field of Computer Science and Engineering.

PEO2: The graduates will provide sustainable solutions to ever changing interdisciplinary global problems through their Research & Innovation capabilities.

PEO3: The graduates will become employable, successful entrepreneur as an outcome of Industry-Academia collaboration.

PEO4: The graduates will embrace professional code of ethics while providing solution to multidisciplinary social problems in industrial, entrepreneurial and research environment to demonstrate leadership qualities

1.3.2 Map PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1:	**3**	**3**	**2**	**2**
PEO2:	**2**	**3**	**2**	**2**
PEO3:	**2**	**2**	**3**	**3**
PEO4:	**2**	**2**	**2**	**3**

1.3.3 Programme Outcomes

POs	Program Outcome
PO1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization.
PO2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Programme Specific Outcomes

PSO1	Experiment and prepare programming concepts and provide new ideas and innovations towards research and societal issues.
PSO2	Analyse and develop computer programs in the areas related to algorithms, system software, cloud computing, artificial intelligence & machine learning, bioinformatics, big data analytics, block chain, cyber security and networking for efficient design of computer based systems of varying complexity.
PSO3	Apply standard software engineering practices and strategies in software project development using open- source programming environment to deliver a quality product for business success.

1.3.4 Mapping of Programme Outcome Vs Programme Educational Objectives

	PEO1	PEO2	PEO3	PEO4
PO1	3	3	2	1
PO2	3	3	3	1
PO3	2	2	3	3
PO4	2	2	3	2
PO5	2	3	2	2
PO6	1	2	2	3
PO7	1	1	2	3
PO8	1	1	2	3
PO9	1	2	3	1
PO10	1	1	3	2
PO11	2	3	1	1
PSO1	2	3	1	3
PSO2	3	3	2	2
PSO3	3	3	2	2

1.3.5 Programme Outcome Vs Courses Mapping Table:
1.3.5.1 Course Articulation Matrix

Semester-I														
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 1300	Programming for Problem Solving	2.50	2.14	2.33	1.75	2.33	1.80	3.00	2.50	1.50	2.00	2.13	2.22	2.30	2.38
CSCR 1507	Digital Prototyping	2.00	2.50	2.40	–	2.00	–	–	2.33	1.67	1.33	2.50	2.00	2.17	2.00
PHT 1136	Engineering Physics	2.50	2.14	2.33	1.75	2.33	1.80	3.00	2.50	1.50	2.00	2.13	2.22	2.30	2.38
CSCR 1100	Introduction to Problem Visualization	1.83	2.5	2.2	1.5	2.0	1.0	1.0	1.75	1.75	1.0	1.83	2.2	1.5	1.83
MTT 1113	Calculus and Abstract Algebra	3.0	3.0	2.16	2.16	2.16	1.3	1.0	1.0	1.0	1.0	1.0	3.0	3.0	2.16
SKT 1100	Professional Communication	1.00	1.83	1.25	1.00	1.00	-	-	2.00	2.17	3.00	2.00	2.17	2.33	1.20
IKT 1001	IKS	1.50	2.17	2.17	1.33	1.83	1.67	2.00	1.83	1.83	1.50	1.83	1.50	2.17	2.17

Semester-II														
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 1302	Application based Programming in Python	2.17	1.57	1.66	1.00	1.62	1.5	2.00	1.66	2.00	1.00	1.75	2.00	2.30	1.54
CSCR 1504	Design and Creativity Lab	2.83	2.33	2.50	2.4	2.8	2.2	-	1.75	2.25	2.80	2.00	2.20	-	-
BTT 1102	Introduction to Computational Biology	3	1.5	2.0	1.6	1.5	0.83	0.5	1.00	2.3	0	0	2.1	1.8	1.75
IKT 1105	Human Values and Professional Ethics	1	1	-	1	-	1.5	2	2.17	1	1	1	1	1	-
EEE 1101	Basics of Electrical and Electronics Engineering	1.50	2.14	2.33	1.75	2.33	1.80	3.00	2.50	1.50	2.00	2.13	2.22	2.30	2.38
MTT 1214	Probability and Statistics	3.0	2.5	1.6	2.16	2.16	1.33	1.0	1.0	1.0	1.33	1.0	3.0	2.5	2.16
CSCR 1301	Object Oriented Programming Using Java	2.38	2.5	2.5	2.0	2.33	2.0	2.0	3.0	3.0	3.0	2.0	2.5	2.62	2.5

CVT 1103	Environmental Studies	1.25	2.25	1.4	1.6	2.0	2.0	1.75	1.0	1.5	2.0	2.25	1.75	1.75	2.2
Semester-III															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 2310	Computer Networks	2.5	2.1	2.0	1.8	1.9	1.8	1.67	1.5	1.5	1.0	1.38	2.1	2.5	2.25
CSCR 2111	Discrete Structures	2.5	2.7	2.25	2.4	2	–	–	–	–	1.5	1.3	2.5	2.6	1.5
CSCR 2312	Principles of Operating System	2.5	2.14	2.33	2.25	2.0	1.67	3.0	2.0	2.2	1.86	2.29	2.38	2.25	2.0
CSCR 2113	Computer Organization and Architecture	3.0	2.83	2.67	2.33	2.33	–	–	–	1.0	1.17	1.0	2.83	2.67	2.0
CSCR 2311	Data Structure	2.5	2.14	2.33	1.75	2.33	1.8	3	2.5	1.5	2	2.13	2.22	2.3	2.38
CSCR 2600	Project Based Learning (PBL) -1 (Mini-Hackathon Based)	3	2.7	0.34	1.84	0.67	0.67	0.84	0.5	3	3	2	1	1.4	0.5

SKP 2301	Professional Skills, Data Structures & Web Technologies	2.5	2.67	2.4	–	2.17	–	–	2.33	2.5	2.0	2.5	2.33	2.17	2.0
Semester-IV															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 2314	Data Base Management System	2.7	2.7	2.5	2.6	2.5	2.1	-	2.3	2.8	-	2.2	2.5	2.7	2.8
CSCR 2115	Theory of Computation	2.67	2.5	2.8	2.75	1.0	–	–	2.4	2.6	2.14	2.33	2.0	2.66	2.2
CSCR 2117	Introduction to Cloud Computing	2.67	3	2.5	2.67	2.17	–	1	1.83	1.83	1.83	1.83	1.83	2.67	2.5
CSCR 2315	Software Engineering and Testing Methodologies	2.5	2.14	2.33	1.75	2.33	1.8	3.0	2.5	1.5	2.0	2.13	2.22	2.3	2.38
CSCR 2601	Project Based Learning (PBL) -2 (Research Methodology Based)	3.0	2.67	2.0	2.75	2.0	2.33	3.0	3.0	3.0	2.0	3.0	2.0	2.0	1.0
Program Elective-1															
CSCR 2200	Data Analytics using Visualization Tools	1.5	1.83	1.5	1.5	2.5	2	1	2	1.25	1.5	1.25	2	2.3	1.4

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CSCF 2302	Machine Learning for Cyber Security	2.67	2.83	2.0	1.83	2.17	1.67	1.5	1.0	1.0	1.33	2.17	2.5	2.5	2.5
CSAI 2200	Human Computer Interaction	2.67	2.83	2.4	2.2	1.0	1.5	1.0	1.0	1.0	1.0	1.67	1.33	1.33	1.33
CSCF 2303	Open Source Tools for Cybersecurity & Forensics	2.83	3.0	2.83	2.25	2.33	2.25	2.75	3.0	2.75	2.5	2.67	2.75	2.25	2.67
SKP 2401	Integrated Professional Communication and Intelligent Computing	2.00	2.50	1.83	1.75	1.60	1.0	1	2.17	2.83	2.33	2.50	2.35	2.35	1.83
Semester-V															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 3310	AI & Machine Learning	2.0	2.67	2.5	2.6	2.5	3.0	1.8	1.67	1.67	1.75	2.33	2.5	2.5	1.6
CSCR 3311	Design and Analysis of Algorithm	3.0	2.83	2.17	1.67	2.5	-	-	-	1.0	-	1.67	3.0	2.5	1.0
CSCR 3600	Project Based Learning (PBL) -3 (Hackathon Based)	1.8	2.3	2.2	1.6	2.5	1.0	-	1.0	2	1.4	1.5	2.6	1.8	1.0

CSCR 3110	Data Mining & Warehousing	2.33	2.33	2.25	2.2	2.5	2.0	1.0	1.0	1.0	1.0	1.40	2.0	2.50	2.25
CSCR 3700	Summer Internship-I	1.0	0.7	0.5	1.2	1.0	0.3	1.2	1.0	1.0	-	1.0	1.0	1.3	0.7
Program Elective-2															
CSCR 3203	Intro to LLMs	2.33	2.5	3.0	3.0	2.5	2.0	-	2.0	-	1.5	2.0	2.0	2.0	2.0
CSAD 3510	Web & Text Analysis	2.5	2.14	2.33	1.75	2.33	1.8	1.0	2.5	1.5	2.0	2.13	2.22	2.3	2.38
CSOT 3200 /CSOT 3201	Raspberry Pi and its Programming /Raspberry Pi and its Programming Lab	2.4	2.0	2.0	2.5	3	2	2.2	2.4	2.4	2.5	2.7	2.4	2.0	2.0
CSCF 3200	Disaster Recovery Management	2.8	2.67	2	2	2	2.25	2.5	1.5	2	2	2.2	2.25	2	2.8
CCP 3001	Community Connect	1	0.83	1	1	-	1.2	1.2	1	1.33	1.33	1.33	-	1	1

SKP 3501	Communication , Coding & Career Readiness Skills	2.0	2.83	2.5	2.2	2.5	1.4	1.6	1.75	2.67	2.83	2.5	2.67	2.83	2.33
Semester-VI															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 3313	Compiler Design	2.5	2.14	2.33	1.75	2.33	1.8	3.0	2.5	1.5	2.0	2.13	2.22	2.3	2.38
CSCR 3314	Cryptography and Network Security	2.71	2.63	2.56	2.0	2.38	2.13	2.8	3.0	2.75	2.25	2.6	2.43	2.25	2.57
CSCR 3113	Digital Image Processing	2.67	2.33	2.8	2.75	1.0	–	–	2.0	2.2	1.67	2.33	1.25	2.5	2.2
Program Elective-3															
CSHC 3102	Brain Computer Interface	3.0	3.0	2.33	3.0	2.75	2.17	2.33	2.67	3.0	2.0	2.33	2.67	3.0	3.0
CSAI 3103	Deep Learning & Its Applications	2.67	2.17	2.4	2.4	2.2	-	-	-	-	-	1.33	1.83	1.67	2.0
CSOT 3206	Data Analytics for IoT	2.7	2.8	3.0	2.0	2.3	3.0	2.0	2.0	2.0	2.0	2.0	2.3	1.3	0
CSCF 3202	Web Application Security	3.0	2.83	2.33	3.0	2.25	3.0	3.0	2.67	2.5	3.0	3.0	3.0	3.0	3.0
CSCR 3601	Project Based Learning (PBL) -4 (Product Based)	3.0	2.2	1.0	1.5	1.7	0.7	1.2	2.0	1.0	2.0	1.0	2.0	1.5	1.2

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BST 3351	Management for Engineers	1.0	1.5	1.8	-	-	1.0	-	1.0	1.0	1.0	1.5	-	-	1.83
SKP 3601	Strategic Professionalism and Computational Informatics	2.33	2.5	2.0	1.75	1.4	–	–	2.0	2.0	2.17	2.0	2.0	2.17	2.17
	Open Elective - 1														
Semester-VII															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 4600	Capstone - 1	2.2	2.2	2	1.8	2	-	-	1	2	1.6	1.5	2.8	1.8	1.0
CSCR 4700	Summer Internship-II	1.67	2.33	1.67	1.5	1.33	1.25	1.0	2.0	1.83	2.0	2.0	2.33	1.25	1.0
Program Elective-4															
CSAI 4200	Introduction to Natural Language Processing														
CSDS 4302	Healthcare Analytics	2.0	2.0	3.0	2.25	2.0	-	3.0	2.0	3.0	3.0	2.83	-	3.0	-
CSOT 4200	Image Processing with IoT	3.0	2.6	2.6	2.6	2.8	2.5	3.0	2.0	2.2	2.2	2.5	2.3	2.0	2.3

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CSCF 4200	Cloud Security	1.67	2	1.5	2.16	1	1.33	1.67	1.5	1.67	1.67	1.83	1.16	2.33	1.5
Program Elective-5															
CSAI 4201	Recommender Systems	3.0	3.0	3.0	3.0	1.83	1.67	1.0	1.33	2.0	1.0	3.0	2.67	2.67	2.17
CSDS 4303	Applied Pattern Recognition	2.8	2.4	2.67	2.6	3.0	2.4	2.2	2.75	2.17	2.0	2.0	3.0	2.0	2.0
CSOT 4204	Fog Computing and IoT	2.83	2.33	2.8	2.6	2.75	1.66	1.25	2.25	2.0	2.0	2.25	2.66	2.66	2.4
CSCF 4202	Exploit Writing	2.67	2.83	2.0	1.83	2.6	2.5	2.33	2.0	2.0	2.0	2.17	2.5	2.5	2.5
Program Elective-6															
CSAI 4202	Robotics and Intelligent Systems	3.0	3.0	3.0	3.0	2.83	2.33	1.17	2.33	3.0	2.67	3.0	3.0	3.0	2.67
CSDS 4304	Applied Computer Vision	2.83	2.5	3	3	2	0	0	0	0	0	1.33	2	2.33	1.83
CSOT 4206	IoT in Healthcare	2.83	2.4	2.8	2.6	2.4	1.6	1.8	2.25	1.67	1.5	2.25	2.4	2.33	2.5
CSCF 4204	Digital Watermarking & Steganography	3.0	2.4	2.0	2.25	3.0	2.0	-	-	2.0	2.0	2.0	3.0	2.83	2.0

	Open Elective - 2														
Semester-VIII															
Programme Outcome →		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Course Code	Course Name														
CSCR 4601	Capstone - 2	1.83	2.0	2.33	2.0	2.83	2.0	2.0	2.0	2.33	2.0	1.5	1.5	2.5	2.5
	Open Elective - 3														
	Open Elective - 4 (min. 12 Week Course)														

Structure of FY UG Programme

The Semester wise and Broad Course Category-wise distribution of credits of the Undergraduate Programme:

Semester	Discipline Core Major (60/80 Credits)	Minor (24/32 Credits)	Inter/Multi - disciplinary courses (09 Credits)	Ability Enhancement courses (AEC) (08 Credits)	Skill Enhancement Courses (SEC) (09 Credits)	Common Value Added Courses (06-08 Credits)	Summer Internship (02-04 Credits)	Research Project (12 Credits)	Total Credits (120/160)	Total Credits (120/160)	(Cummulative Minimum Credits) Required for Award of Diploma / Degree
I	Programming for Problem Solving (4), Digital Prototyping (2) & Introduction to Problem Visualization (2) **8**		Engineering Physics (4), Calculus and Abstract Algebra (4) **8**		Professional Communication (3) **3**				19	40	First Minor Core is fixed course for each school. VAC Courses include -Environment -Indian Knowledge System -Mulya Pravah VAC/SEC/Multidis/AEC can be taken from NPTEL
II	Application based Programming in Python (4), Design and creativity Lab (2) & Object Oriented		Introduction to Computational Biology (2), Human Values and Professional Ethics (2),			VAC (0)			21		

	Programming Using Java (3) **9**	**0**	Basics of Electrical and Electronics Engineering (4) & Probability and Statistics (4) **12**	**0**	**0**	**0**					
	Students who exit the programme after securing 40 credits will be awarded UG certificate in the relevant Discipline, provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credit from skill - based courses earned during first and second semester										
III	Computer Networks (4), Discrete Structures (3), Principles of Operating System (3), Computer Organization and Architecture (3), Data Structure (4), Project Based Learning (PBL) -1				Professional Skills, Data Structures & Web Technologies (3)				21	44	

	(Mini-Hackathon Based) (1) **18**	**0**	**0**	**0**	**3**	**0**	**0**	**0**			
IV	Data Base Management System (4), Theory of Computation (4), Introduction to Cloud Computing (3), Software Engineering and Testing Methodologies (4) & Project Based Learning (PBL) -2 (Research Methodology Based) (2)	PE-1 (3)			Integrated Professional Communication and Intelligent Computing (3)				23		

	17	**3**	**0**	**0**	**3**	**0**	**0**	**0**			
	Students who exit the programme after securing 80 credits will be awarded UG Diploma in the relevant Discipline, provided they secure additional 4 credits in skill based vocational courses offered during first year or second year summer term or Internship										
V	AI & Machine Learning (4), Design and Analysis of Algorithm (4), Project Based Learning (PBL) -3 (Hackathon Based) (2), Data Mining & Warehousing (3) **13**	PE-2 (3) **3**		Community Connect (2) **2**	Communication, Coding & Career Readiness Skills (3) **3**		Summer Internship-I (2) **2**	**0**	23	46	3- Year UG Degree inclusive of optional Apprenticeship
VI	Compiler Design (4), Cryptography and Network Security (4), Digital Image Processing (2), Project Based Learning	Program Elective-3 (3) & Open Elective – 1 (2)			Strategic Professionalism and Computational Informatics (3)				23		

	(PBL) -4 (Product Based) (2) & Management for Engineers (3) **15**	**5**	**0**	**0**	**3**	**0**	**0**	**0**			
	Students who want to undertake 3-year UG programme will be awarded UG Degree in the relevant Discipline / Subject upon securing 120 credits										
VII	Capstone – 1 (2) **2**	Program Elective-4 (3), Program Elective-5 (3), Program Elective-6 (3), Open Elective – 2 (2) **11**					Summer Internship-II (2) **2**		15	30	***ONLY for students going for Apprenticeship & requires Minor with Major Degree** 4- Year UG Degree (Honours) inclusive of optional Apprenticeship

VIII	Capstone – 2 (10) **10**	Open Elective – 3 (2) Open Elective - 4 (min. 12 Week Course) (3) **5**							15		
										160	

Students wil be awarded UG Degree (Honours) with Research in the relevant Discipline / Subject provided they secure min. 160 credits

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List of Courses: Semester Wise

Bachelor of Technology (CSE)	Credits	Practical/ Theory/Integrated	Type	Total Credits
Sem- 1				**19**
1. Programming for Problem Solving	4	Integrated	Core	
2. Digital Prototyping	2	Practical	Practical/Tutorial/Studios	
3. Introduction to Problem Visualization	2	Theory	Core	
4. Engineering Physics	4	Integrated	MDC	
5. Calculus and Abstract Algebra	4	**Theory**	**MDC**	
6. Professional Communication	3	**Theory**	**SEC**	
7. IKS	0	**Theory**	**Audit**	
Sem- 2				**21**
1. Application based Programming in Python	4	Integrated	Core	
2. Design and Creativity Lab	2	Practical	Practical/Tutorial/Studios	
3. Object Oriented Programming Using Java	3	Integrated	Core	
4. Introduction to Computational Biology	2	Theory	**MDC**	
5. Human Values and Professional Ethics	2	Theory	**SEC**	
6. Basics of Electrical and Electronics Engineering	4	Theory	**MDC**	
7. Probability and Statistics	4	Integrated	**MDC**	
8. Environmental Studies	0	Theory	**AECC**	
9. Value Added Course	0	Theory	**VAC**	
Sem- 3				**21**
1. Computer Networks	4	Integrated	Core	
2. Discrete Structures	3	Theory	Core	

3.	Principles of Operating System	3	Integrated	Core	
4.	Computer Organization and Architecture	3	Theory	Core	
5.	Data Structure	4	Integrated	Core	
6.	Project Based Learning (PBL) -1 (Mini-Hackathon Based)	1	Project	Field Projects/RBL	
7.	Professional Skills, Data Structures & Web Technologies	3	Practical	**SEC**	
Sem - 4					**23**
1.	Data Base Management System	4	Integrated	Core	
2.	Theory of Computation	4	Theory	Core	
3.	Introduction to Cloud Computing	3	Theory	Core	
4.	Software Engineering and Testing Methodologies	4	Integrated	Core	
5.	Project Based Learning (PBL) -2 (Research Methodology Based)	2	Project	Field Projects/RBL	
6.	Program Elective-1	3	Theory	Minor Electives	
7.	Integrated Professional Communication and Intelligent Computing	3	Practical	**SEC**	
Sem - 5					**23**
1.	AI & Machine Learning	4	Integrated	Core	
2.	Design and Analysis of Algorithm	4	Integrated	Core	
3.	Project Based Learning (PBL) -3 (Hackathon Based)	2	**Project**	Field Projects/RBL	
4.	Data Mining & Warehousing	3	**Theory**	Core	
5.	Summer Internship-I	2	**Internship**	**Internship**	
6.	**Program Elective-2**	3	**Theory**	Minor Electives	

7.	Community Connect	2	**Project**	**AEC**	
8.	Communication, Coding & Career Readiness Skills	3	**Practical**	**SEC**	
Sem - 6					**23**
1.	Compiler Design	4	Theory+Practical	Core	
2.	Cryptography and Network Security	4	Theory+Practical	Core	
3.	Digital Image Processing	2	Theory	Core	
4.	Project Based Learning (PBL) -4 (Product Based)	2	Project	Field Projects/RBL	
5.	Management for Engineers	3	Theory	**AEC**	
6.	**Program Elective-3**	3	Theory	Minor Electives	
7.	**Open Elective – 1**	2	MOOC	Minor Electives	
8.	Strategic Professionalism and Computational Informatics	3	Practical	**SEC**	
Sem - 7					**15**
1.	Capstone - 1	2	**Project**	Dissertation/Capstone Project	
2.	Summer Internship-II	2	**Internship**	**Internship**	
3.	**Program Elective-4**	3	**Theory**	Minor Electives	
4.	**Program Elective-5**	3	**Theory**	Minor Electives	
5.	**Program Elective-6**	3	**Theory**	Minor Electives	
6.	**Open Elective - 2**	2	**MOOC**	Minor Electives	
Sem - 8					**15**
1.	Capstone - 2	10	**Project**	Dissertation/Capstone Project	
2.	**Open Elective - 3**	2	**MOOC**	Minor Electives	
3.	**Open Elective - 4 (min. 12 Week Course)**	3	**MOOC**	Minor Electives	

Programme wise Credit Distribution

Course Category	Programme wise Credit Distribution	
	Bachelor of Technology (Computer Science & Engineering)	
	4 Year	
	No. of Courses	Total credits
Core Courses (CC)	19	66
Multidisciplinary Courses	5	18
Minor Electives	10	27
Dissertation/Capstone Project	2	12
Ability Enhancement Courses (AEC)	3	5
Skill Enhancement Courses (SEC)/ Vocational Courses	6	17
Practical/Tutorials/Studios	2	4
Internship	2	4
Field Projects/RBL	4	7
VAC	1	0
Total	**54**	**160**

Type	Courses x Credits	Credits	Total Credits
Core	11x4 + 6x3 + 2x2	66	112
DSE-Discipline Specific Elective	6x3	18	
GE-General Elective	3x2 + 1x3	9	
AECC-Ability Enhancement Cumpulsary Courses	1x2 + 1x3	5	
SEC-Skill Enhancement Courses	3x4 + 1x2	14	

Course Modules

Semester 1, Credits: 19	
COURSE CODE	**COURSE NAME**
CSCR1300	Programming for Problem Solving
CSCR1507	Digital Prototyping
CSCR1100	Introduction to Problem Visualization
PHT1136	Engineering Physics
MTT1113	Calculus and Abstract Algebra
SKT1100	Professional Communication
IKT1001	IKS

COURSE PLAN

Programming for Problem Solving (CSCR1300)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR1300
2	**Course Title**	**Programming for Problem Solving (PPS)**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	2-0-4-2
5	**Course Status**	Core
6	**Course Objective**	To introduce the fundamentals of programming using C and develop problem-solving skills through structured lab practice, design exercises, ethical coding, and collaborative project work.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Recall and list fundamental concepts of C programming such as keywords, data types, operators, and syntax. CO2 (Understand – L2): Explain the working of operators, control structures, functions, arrays, and preprocessing directives in C programming. CO3 (Apply – L3): Develop C programs using control statements, functions, arrays, and strings to solve basic computational problems. CO4 (Analyze – L4): Analyze and debug C programs involving pointers, recursion, structures, and dynamic memory allocation. CO5 (Evaluate – L5): Evaluate different programming approaches and optimize C programs using appropriate data structures, file handling, and memory management techniques. CO6 (Create – L6): Design, implement, and demonstrate complete C-based solutions by integrating functions, pointers, structures, and file handling to solve real-world problems. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Implement C programs using professional tools (gcc, Linux CLI, debuggers); configure experimental setups; demonstrate system operation; maintain structured lab records.

		CO8 (Create – L5/L6): Design and develop modular C applications addressing real-world problems with societal awareness; propose solutions with planning considerations; evaluate outcomes analytically. CO9 (Apply – L2/L3): Demonstrate professional, ethical, and responsible practices; perform skill self-assessment; reflect on learning to cultivate lifelong professional growth. CO10 (Apply – L3): Collaborate and communicate effectively in team-oriented lab activities; plan, implement, and present programming solutions; apply project management principles.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. Coding Problems on HackerRank/LeetCode — 15 coding problems minimum. 2. Virtual Labs (NPTEL): C programming experiments. 3. MOOC course on C/Data Structures (SWAYAM/Coursera).
11	**References**	Textbook: Kernighan, B. & Ritchie, D. — The C Programming Language (2nd Ed.), Prentice Hall. Reference: Balagurusamy, E. — Programming in ANSI C (8th Ed.), McGraw-Hill. Reference: Kanetkar, Y. — Let Us C (17th Ed.), BPB Publications.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction to C Programming (4-0-10-6 = 20 hrs)**	
A	Introduction to C language, Variables, Constants, Identifiers and Keywords	CO1, CO2, CO3
B	Data Types: Format specifiers, modifiers, type casting	
C	Operators: Category, Expressions: Associativity & Precedence	
Tools Used	Linux Environment, Whiteboards, sticky notes, gcc compiler, Virtual Labs	

Activities	**Objective:** To familiarize students with Linux commands and develop a clear understanding of the C programming environment along with its basic tokens.
	• Study of Linux Commands
	  ○ Working with Directories
	  ○ Handling Files
	  ○ Understanding of gcc compiler, writing code in C, compiling and executing on Linux Environment.
	• Demonstration and use of different data types, variables, constants, Operators
	• Implementing some programs based on mathematical expression with the consideration of associativity and precedence.	

Unit 2	**Control Statements (6-0-12-6 = 24 hrs)**	
A	Decisions: if, if-else, Nested if-else, if-else-if ladder, Switch Case	CO3, CO4

B	Iterations: While, Do While, For Loop, Nested Looping, Pattern Printing	
C	Execution Sequence: GOTO, Break, Continue	
Tools Used	Linux Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To apply decision-making and iterative constructs for designing efficient solutions with appropriate program control flow. • Identify the suitability of selection statements (if, if-else, conditional operator) and implement programs by applying more suitable form of selection statement. • Demonstrate the use of switch statement with the help of menu-driven programs.	
Unit 3	**Functions & Arrays (8-0-16-6 = 30 hrs)**	
A	Functions: Definition, Declaration/Prototyping, Calling, Types, Recursion, Storage Classes	CO2, CO3, CO4, CO5, CO6
B	Pre-processors: Directives, Operators (#, ##, \), Macros: Types, Use, Predefined Macros	
C	Arrays: 1D & 2D — Declaration, Initialization, Traversal, Manipulation	
Tools Used	Linux Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To understand the concept of functions, recursive solution, recursion and Arrays, manipulating array elements, arrays of unknown or varying size. • Apply Top-Down approach for finding solutions and implement it with the help of functions. • Identify need of manipulating actual parameters and demonstrate call by value and call by reference. • Implementation of recursive functions for various recursively defined problems. • Implementing one dimensional array: Initialization, manipulation, traversing. • Implement programs to search and sort a given array. • Writing some problems based on matrix manipulation. • Analyze need of partial compilation, named constants and function like Macros. Demonstrate use of them with the help of suitable problem statements.	
Unit 4	**Pointers & Strings (6-0-12-6 = 24 hrs)**	
A	Pointer: Introduction, Declaration, Pointer arithmetic, Array of Pointers, Pointer to Pointer	CO3, CO4, CO5
B	Dynamic Memory Allocation (malloc, calloc, realloc, free), Call by Reference, Passing/Returning Arrays	
C	Strings: Introduction, Predefined string functions, Manipulation, Command Line Arguments	
Tools Used	Linux Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	

Activities	**Objective:** To understand addresses, pointers, dynamic memory allocation, and strings, and apply these concepts for efficient string handling and implementation of string functions. • Demonstration of pointer arithmetic and indirection operator. • Manipulation on strings (extraction, matching, concatenation) • Implement dynamic memory allocation to create array of variable size.	
Unit 5	**User-Defined Data Types & File Handling (6-0-10-6 = 22 hrs)**	
A	Structures, Unions, typedef & Enumeration: Introduction, Declaration, Differences, Application	CO2, CO3, CO4, CO5, CO6
B	Nested structure, self-referential structure, Array of structures, Passing structures to functions	
C	Files: Introduction, I/O Streaming, Sequential/Random access, Creating, Opening, Closing, R/W operations	
Tools Used	Linux Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To understand file operations, sorting algorithms, and user-defined structures, and apply them for efficient data organization and processing. • Implementation of binding heterogeneous/composite information for a single entity using structure. • Implementation of organizing data as Linked node with the help of self-referential structures. • Demonstrate the use of Union in memory sharing. • Creation and manipulation of data stored in a file on auxiliary memory. • Demonstration of reading data from file and execution of program to perform operations.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		

15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	
CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to C language, Variables, Constants, Identifiers, Keywords	Unit 1	4
DD/MM/YY	Data Types: Format specifiers, modifiers, type casting		
DD/MM/YY	Operators: Category		
DD/MM/YY	Operators: Expressions — Associativity & Precedence		
DD/MM/YY	Decisions: if, if-else, Nested if-else	Unit 2	6
DD/MM/YY	Decisions: if-else-if ladder, Switch Case		
DD/MM/YY	Iterations: Importance of iterative construct, While		
DD/MM/YY	Iterations: For Loop, Do While		
DD/MM/YY	Iterations: Nested Looping, Pattern Printing		
DD/MM/YY	Execution Sequence: GOTO, Break, Continue		
DD/MM/YY	Functions: Definition, Declaration/Prototyping, Calling, Types	Unit 3	8
DD/MM/YY	Functions: Parameter passing — Call by value, Recursion		
DD/MM/YY	Recursive Functions, Tail Recursion, Storage Classes		

DD/MM/YY	Pre-processors: Directives, Operators (#, ##, \)		
DD/MM/YY	Macros: Types, Use, Predefined Macros		
DD/MM/YY	Arrays: Definitions, Concepts, Memory representation		
DD/MM/YY	Arrays: 1D and 2D — Declaration, Initialization		
DD/MM/YY	Arrays: Array manipulation		
DD/MM/YY	Pointer: Introduction, Declaration, demonstration of memory address	**Unit 4**	**6**
DD/MM/YY	Pointer: Arithmetic, Array of Pointers, Pointer to Pointer		
DD/MM/YY	Dynamic Memory Allocation: malloc, calloc, realloc, free		
DD/MM/YY	Call by Reference, Passing and Returning Arrays from Functions		
DD/MM/YY	Strings: Introduction, Predefined string functions		
DD/MM/YY	Strings: Manipulation of text data, Command Line Arguments		
DD/MM/YY	Structures: Introduction, Declaration, Application	**Unit 5**	**6**
DD/MM/YY	Unions, typedef & Enumeration: Introduction, Declaration		
DD/MM/YY	Nested structure, self-referential structure, Array of structures		
DD/MM/YY	Files: Introduction, I/O Streaming, Sequential and Random access		
DD/MM/YY	Files: Creating, Opening, Closing; I/O operations		
DD/MM/YY	Files: Retrieving and updating files in Sequential/Random mode		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Setting up environment: Linux commands, gcc, first C program — professional tool setup	**CO7**	3.0
	S-1.2	Calculate average of three integers; Four-fours digit problem	**CO7**	
W2	S-2.1	Currency denominations (Rs. 10, 50, 100); Gross salary calculator	**CO7**	3.0
	S-2.2	Reverse a 5-digit number; Interchange contents of two variables	**CO7**	
W3	S-3.1	Calculate area of triangle; Area & circumference of circle	**CO7**	3.0
	S-3.2	Bitwise operations on a number: set, check, toggle, and clear a bit	**CO7**	
W4	S-4.1	Character classification; Find roots of quadratic equation	**CO7**	3.0
	S-4.2	Find youngest of three (Ram, Shyam, Ajay); Leap year check	**CO7**	
W5	S-5.1	Check vowel/consonant via Switch-Case; Calculator for +, –, ×, ÷	**CO7**	3.0
	S-5.2	Income tax calculator with personal allowance and child allowance slabs	**CO7**	
W6	S-6.1	Check if a number is Armstrong (e.g., 153 = $1^3+5^3+3^3$)	**CO7**	3.0
	S-6.2	Print star patterns up to Nth line: pyramid and diamond shapes	**CO7**	
W7	S-7.1	Calculate Permutation & Combination; refactor into modular functions	**CO7**	3.0
	S-7.2	Recursive function for sum of array; recursive exponentiation	**CO7**	

W8	S-8.1	Menu-driven 1D array: display, sum, average	**CO7**	3.0
	S-8.2	Extend W8.1: minimum, maximum, search, bubble sort — all via functions	**CO7**	
W9	S-9.1	Menu-driven 2D arrays: row sums, column sums, diagonal sums	**CO7**	3.0
	S-9.2	Extend W9.1: matrix addition and multiplication via functions	**CO7**	
W10	S-10.1	Dynamic 1D array; functions for insert and delete operations	**CO7**	3.0
	S-10.2	Extend W10.1: Linear Search vs Binary Search with performance comparison	**CO7**	
W11	S-11.1	Extract characters at Fibonacci index positions from string; name formatter	**CO7**	3.0
	S-11.2	Count character frequency; word count in a string; print frequency table	**CO7**	
W12	S-12.1	Dynamic array of size n1; expand by n2; print all values	**CO7**	3.0
	S-12.2	Dynamic array with auto-doubling at 75% occupancy — efficiency analysis	**CO7**	
W13	S-13.1	Structure 'product': name, price, qty, amount — real-world application with SDG context	**CO8**	3.0
	S-13.2	Structure 'student_record' with nested 'date'; array of structures — societal relevance discussion	**CO8**	
W14	S-14.1	Complex number ADT using structures: design, document, and reflect — CO9 reflection form submitted	**CO8/CO9**	3.0
	S-14.2	Implement simple linked list — team implementation, role assignment, peer review session	**CO8/CO10**	
W15	S-15.1	Merge & sort files — ethical data handling; skill self-assessment form submitted	**CO8/CO9**	3.0
	S-15.2	Text file to lowercase; frequency counts — team code review, final presentation, group reflection	**CO9/CO10**	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall keywords, data types, operators, I/O constructs, and syntax; identify correct terminology	CO1 | L1–L2	MTE Sec A | ETE Sec A

TS2	**Conceptual Explanation & Logical Interpretation**	Explain constructs and working; interpret program flow; predict output through step-by-step reasoning	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply constructs to write correct programs solving standard computational problems	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Trace execution manually; detect bugs; assess correctness; explain algorithmic behaviour	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Compare approaches; evaluate time/space trade-offs; justify optimal choice with evidence	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design well-structured, modular, documented C programs for complex specifications	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Program writing; program tracing — detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III
LABORATORY ASSESSMENT FRAMEWORK
Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note

> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment (gcc, IDE, Linux CLI, debugger)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8

CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1	–
CO2	3	2	–	–	–	–	–	–	1	–	2	2	2	–
CO3	3	3	2	–	2	2	–	–	1	–	2	3	2	2
CO4	2	3	2	2	2	–	–	–	–	–	2	2	3	2
CO5	2	3	3	2	2	–	–	–	–	–	2	2	3	2
CO6	2	2	3	2	3	2	–	2	1	1	3	3	3	3
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	**2.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**3.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Digital Prototyping (CSCR1507)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030

Lab-Only Course Plan — All 6 Lab COs (CO1–CO6) | New AICTE 11-PO Framework | Full Skill Mapping

PART I COURSE SYLLABUS *Course Identification, Details, Outcomes, BTL Mapping & Lab Session Plan*

1. Course Identification

School:	SSCSE	**Batch:**	2025–2029
Program:	B.Tech	**Current Academic Year:**	2025–26
Branch:	CSE	**Semester:**	II
Course Code:	CSCR1507	**Course Type:**	Core — Lab Only

2. Course Details

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.

1	**Course Code**	CSCR1507
2	**Course Title**	Digital Prototyping
3	**Credits**	2
4	**Contact Hours (L-T-P-SL)**	0-1-2-1 (Tutorial: 15 hrs | Lab: 30 hrs | Self Learning: 15 hrs | Total: 60 hrs)
5	**Course Status**	Core — Lab Only (No Theory Lecture Component)
6	**Course Objectives**	The objective of this course is to introduce students to hands-on digital prototyping using basic electronic components, simulation tools, and microcontrollers. Students will learn to design, simulate, and implement real-world systems using Arduino and sensors, culminating in a working prototype-based project.
7	**Course Outcomes (COs)**	After completion of the course, students will be able to: **CO1 (Remember – L1):** Identify and recall basic electronic components, Arduino hardware, and tools. **CO2 (Understand – L2):** Explain working principles of circuits, sensors, and Arduino programs. **CO3 (Apply – L3):** Build and simulate basic circuits using Tinkercad and Arduino. **CO4 (Analyze – L4):** Debug and analyse circuit behavior and Arduino code. **CO5 (Evaluate – L5):** Compare and select appropriate sensors and components for applications. **CO6 (Create – L6):** Design and develop a complete Arduino-based prototype solving a real-world problem.
8	**Course Description**	This course introduces students to the fundamentals of digital prototyping through a highly hands-on and experiential learning approach. It covers basic electronic components, circuit design, and simulation using tools like Tinkercad, followed by practical implementation using Arduino boards. Students learn to interface various sensors and develop real-time applications through guided lab activities. The course emphasizes problem-solving, debugging, and iterative design thinking. It culminates in a mini project where students design and build a functional prototype addressing a real-world problem. Overall, it bridges the gap between theoretical concepts and practical engineering skills.
9	**Teaching & Learning Scheme**	Lab Instructions (LI): 30 hrs | Tutorial (T): 15 hrs | Self Learning (SL): 15 hrs | Total: 60 hrs | Credits: 2
10	**Mode of Examination**	Lab Only. CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
11	**Self Learning (SL: 15 hrs)**	Problem Solving / Coding Problems on coding platforms (Tinkercad). 15 small real-life problems of 1 hour each. Total = 15 hrs. Evaluation: Based on problem solution submitted and test cases passed.

12	**Textbook**	Getting Started With Arduino by Massimo Banzi and Michael Shiloh
13	**References**	1. Electronics is a hands-on instructional book by Charles Platt 2. Arduino Projects with Tinkercad is a practical guidebook by Johannes Wild 3. IoT & Arduino Lab Workbook by Dr. Zatin Gupta

3. Outline Syllabus — Lab Units with CO Mapping

All CO mappings refer to Lab COs (CO1–CO6). This is a lab-only course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit 1: Basics of Electronics & Prototyping	
A	Introduction to Digital Prototyping, Breadboard, Power supply, Basic components: Resistor, Capacitor, LED, Switch	CO1
B	Ohm's Law, Series & Parallel Circuits (practical understanding), Circuit connections and safety	CO1
C	Hands-on: LED blinking, push-button control, Introduction & Usage of multimeter	CO1
	Unit 2: Tinkercad Simulation	
A	Introduction to Tinkercad Circuits environment, Virtual circuit design	CO2
B	Simulating basic circuits (LED, switch, buzzer), Debugging in simulation	CO3
C	Arduino simulation in Tinkercad, Basic code structure (setup, loop)	CO3
	Unit 3: Arduino Fundamentals	
A	Introduction to Arduino Uno, IDE installation, Digital I/O, pin configuration	CO3
B	Programming basics: Variables, digitalRead, digitalWrite, delay, Serial monitor O/P	CO3
C	Hands-on: LED patterns, button input, buzzer control	CO3
	Unit 4: Sensors & Interfacing	
A	Introduction to sensors: LDR, Temperature, Ultrasonic, Analog vs Digital signals	CO4, CO6
B	Sensor interfacing with Arduino, Analog input handling	CO4, CO6
C	Design Real Life Applications like Automatic light system, Distance measurement, etc.	CO4, CO6
	Unit 5: Prototype Development Project	
A	Project idea and problem identification	CO5, CO6
B	Project Design, circuit building, implementation & coding	CO5, CO6
C	Testing, debugging, and final demonstration	CO5, CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

Sr. No	Topic	L1	L2	L3	L4	L5	L6
1	1.A - Introduction to Digital Prototyping, Breadboard, Power supply, Basic components: Resistor, Capacitor, LED, Switch		✓				
2	1.B - Ohm's Law, Series & Parallel Circuits (practical understanding), Circuit connections and safety		✓	✓			
3	1.C - Hands-on: LED blinking, push-button control, Introduction & Usage of multimeter		✓	✓			
4	2.A - Introduction to Tinkercad Circuits environment, Virtual circuit design		✓	✓			
5	2.B - Simulating basic circuits (LED, switch, buzzer), Debugging in simulation		✓	✓			

6	2.C - Arduino simulation in Tinkercad, Basic code structure (setup, loop)			✓	✓		
7	3.A - Introduction to Arduino Uno, IDE installation, Digital I/O, pin configuration	✓	✓				
8	3.B - Programming basics: Variables, digitalRead, digitalWrite, delay, Serial monitor O/P		✓	✓			
9	3.C - Hands-on: LED patterns, button input, buzzer control			✓	✓		
10	4.A - Introduction to sensors: LDR, Temperature, Ultrasonic, Analog vs Digital signals			✓	✓		
11	4.B - Sensor interfacing with Arduino, Analog input handling			✓	✓		
12	4.C - Design Real Life Applications like Automatic light system, Distance measurement, etc.				✓	✓	✓
13	5.A - Project idea and problem identification				✓	✓	✓
14	5.B - Project Design, circuit building, implementation & coding				✓	✓	✓
15	5.C - Testing, debugging, and final demonstration				✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

i Only strong/dominant alignments are mapped. Lab COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**A1**	**A2**	**A3**	**A4**	**A5**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
CO1		✓											✓	✓				
CO2		✓					✓						✓	✓				
CO3		✓					✓						✓	✓				
CO4		✓	✓					✓						✓	✓			
CO5			✓	✓				✓							✓	✓		
CO6			✓	✓	✓				✓						✓	✓	✓	

Legend: ✓ = Strong / Dominant mapping only.

6. Lab Session Plan — List of Experiments

W1–W12: Core experiments developing CO1–CO5 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO6 design, optimization, and integration experiments — all assessed under CA and CE.

Week	Session	Experiment	Lab CO	Marks
W1	Session-1.1 DD/MM/YY	Experiment 1: Identification of Components • Identify resistor, LED, capacitor, switch • Read resistor colour codes • Measure values using multimeter	**CO1**	3.0
	Session-1.2 DD/MM/YY	Experiment 2: Basic LED Circuit • LED connection with resistor • Polarity testing • LED brightness variation	**CO1**	
W2	Session-2.1 DD/MM/YY	Experiment 3: Series & Parallel Circuits • Series LED circuit • Parallel LED circuit • Compare brightness	**CO1**	3.0

	Session-2.2 DD/MM/YY	Experiment 4: Switch Controlled Circuit • Push button LED control • Toggle operation • Debouncing concept (basic)	CO1	
W3	Session-3.1 DD/MM/YY	Experiment 5: Tinkercad Interface • Create account & workspace • Add components • Simulate simple circuit	CO1	3.0
	Session-3.2 DD/MM/YY	Experiment 6: LED Simulation • LED ON/OFF simulation • Multiple LED connections • Error debugging	CO1	
W4	Session-4.1 DD/MM/YY	Experiment 7: Buzzer Circuit Simulation • Connect buzzer • Create alarm circuit • Debug faulty wiring	CO2	3.0
	Session-4.2 DD/MM/YY	Experiment 8: Switch + LED Simulation • Switch-controlled LED • Multi-switch logic • Troubleshooting	CO2	
W5	Session-5.1 DD/MM/YY	Experiment 9: Arduino IDE Setup • Install Arduino IDE • Board selection • Upload first program	CO3	3.0
	Session-5.2 DD/MM/YY	Experiment 10: LED Blink Program • Basic blink • Modify delay • Multiple LEDs	CO3	
W6	Session-6.1 DD/MM/YY	Experiment 11: LED Pattern Generation • Sequential blinking • Traffic light system • Pattern design	CO3	3.0
	Session-6.2 DD/MM/YY	Experiment 12: Buzzer Interfacing • Buzzer ON/OFF • Alarm tone • Conditional buzzer	CO3	
W7	Session-7.1 DD/MM/YY	Experiment 13: Push Button Input • Button reading • LED control • Toggle logic	CO4	3.0
	Session-7.2 DD/MM/YY	Experiment 14: Multiple Inputs • Two-button control • AND/OR logic • Debugging input issues	CO4	
W8	Session-8.1 DD/MM/YY	Experiment 15: Potentiometer Reading • Analog input reading • Display on serial monitor • Mapping values	CO4	3.0
	Session-8.2 DD/MM/YY	Experiment 16: PWM Output • Control LED brightness • AnalogWrite usage • Smooth fading	CO4	
W9	Session-9.1 DD/MM/YY	Experiment 17: LDR Interface • Read light intensity • Serial output • Calibration	CO4	3.0
	Session-9.2 DD/MM/YY	Experiment 18: Automatic Street Light • Threshold-based LED • Day/Night detection • Optimization	CO4	

W10	Session-10.1 DD/MM/YY	Experiment 19: Temperature Sensor Interface • Read temperature values • Display on serial monitor • Calibration	**CO5**	3.0
	Session-10.2 DD/MM/YY	Experiment 20: Temperature Alert System • Threshold alert • Buzzer activation • Real-time monitoring	**CO5**	
W11	Session-11.1 DD/MM/YY	Experiment 21: Distance Measurement • Sensor interfacing • Measure distance • Display output	**CO5**	3.0
	Session-11.2 DD/MM/YY	Experiment 22: Obstacle Detection • LED/buzzer alert • Range control • Debugging	**CO5**	
W12	Session-12.1 DD/MM/YY	Experiment 23: Multi-Sensor Integration • Combine LDR + LED • Combine temperature + buzzer • Logic building	**CO6**	3.0
	Session-12.2 DD/MM/YY	Experiment 24: Smart System Prototype • Mini automation system • Multi-output control • Optimization	**CO6**	
W13	Session-13.1 DD/MM/YY	Experiment 25: Smart Lighting System • LDR + PWM control • Energy-efficient lighting • Performance tuning	**CO6**	3.0
	Session-13.2 DD/MM/YY	Experiment 26: Smart Alarm System • Ultrasonic + buzzer • Multi-condition alert • Testing scenarios	**CO6**	
W14	Session-14.1 DD/MM/YY	Experiment 27: Project Design & Planning • Problem identification • Block diagram • Component selection	**CO6**	3.0
	Session-14.2 DD/MM/YY	Experiment 28: Circuit Implementation • Hardware setup • Code development • Integration	**CO6**	
W15	Session-15.1 DD/MM/YY	Experiment 29: Testing & Debugging • Error handling • Performance testing • Optimization	**CO6**	3.0
	Session-15.2 DD/MM/YY	Experiment 30: Final Demonstration • Working prototype • Presentation • Viva	**CO6**	

ℹ Instructions: Write programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.

PART II LAB ASSESSMENT FRAMEWORK *CA Rubric, CE Structure, ESE Pattern, Lab Skill Dimensions*

7. Lab Skill Dimensions (LS1–LS8)

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE).

Eight Lab Skill Dimensions — mapping progressively from L3 to L6 — correspond to the six COs. They define exactly what competency is measured in each component of CA, CE, and ESE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
LS1	**Problem Definition & Tool Setup**	Define experiment goal; configure tool	CO1 | L3	CA | CE Sec A
LS2	**Implementation & Execution**	Write syntactically and logically correct code; compile and execute to produce expected output	CO1–CO3 | L3	CA | CE Sec A
LS3	**Data Structure Design & ADT Implementation**	Design and implement the hardware	CO4 | L4	CA | CE Sec B
LS4	**Algorithm Analysis & Complexity Evaluation**	Analyse & Caliber, the delay	CO5 | L5	CA | CE Sec B | ESE Sec B
LS5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations from expected results	CO3–CO5 | L4	CA | ESE Sec B
LS6	**Documented Outcome & Verification**	Record final outcome formally with aim, algorithm, code, output, and result; verify against problem statement	CO1–CO5 | L3	CA (Lab Record)
LS7	**Algorithmic Design & Solution Planning**	Produce algorithm/pseudocode/flowchart before coding; justify design choices with respect to complexity and structure	CO4, CO6 | L4–L6	CA | ESE Sec B/C
LS8	**Innovation & Code Optimisation**	Formulate improved solutions; re-engineer existing code; benchmark improvements	CO6 | L6	CE Sec C | ESE Sec C

8. CO × Lab Skill Dimension Mapping (6 COs × 8 Dimensions)

Each CO maps primarily to one or two LS dimensions (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this lab course.

CO	LS1 Prob.Def.	LS2 Implement.	LS3 DS Design	LS4 Algo.Anal.	LS5 Output Anal.	LS6 Doc.Outcome	LS7 Algo.Design	LS8 Innovation
CO1	H	H				H		
CO2		H				H		
CO3		H			H	H		
CO4			H	M	M	M	H	
CO5			M	H	H	M	M	
CO6				M			H	H

H = High / Primary M = Medium / Secondary Blank = No direct alignment

9. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	**30**	All Lab COs: CO1–CO6 | LS1–LS7 | Per-experiment rubric
Course Examination (CE)	30%	**30**	CO1–CO6 | LS1–LS8 | Practical + Viva
End Semester Examination (ESE)	40%	**40**	CO1–CO6 | LS4–LS8 | Program writing + Analysis + Design
TOTAL	**100%**	**100**	All COs assessed across all three instruments

10. Continuous Assessment (CA) — 30 Marks

10.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Lab Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	1.0	LS1 — Problem definition, tool configuration LS7 — Algorithm/pseudocode/flowchart before coding	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO1–CO4
Code Implementation & Execution	1.0	LS2 — Code correctness and compilation LS3 — Data structure implementation quality	1.0: Correct & runs | 0.5: Minor errors | 0: Does not compile	CO1–CO5
Output Analysis & Lab Documentation	0.75	LS5 — Output analysis LS6 — Lab record: aim, algo, code, output, result	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO3–CO5
Professional & Ethical Conduct	0.25	LS8 — Responsible coding practice, record integrity	0.25: Consistent | 0.10: Occasional | 0: Absent	CO6
Total	**3.0**	All 8 LS dimensions covered		CO1–CO6

10.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
>10	Best 10	**30 Marks**	Best 10 of all sessions (3 marks × 10 = 30)
< 10	All attended	**≤ 30 Marks**	Each missed session = zero; cannot be compensated

11. Continuous Evaluation (CE) — 30 Marks

ℹ CE is a mid-point practical examination covering Units 1–3 (CO1–CO3). CO4, CO5, and CO6 are assessed in ESE only. CE maps to LS1–LS5.

Section	Marks	Lab Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	LS1 — Tool Setup LS2 — Code Implementation	CO1, CO2	Write and execute a program on pointers or structures; demonstrate tool setup; expected output must match
Sec B	10	LS3 — DS Design LS5 — Output Analysis	CO2, CO3	File handling or ADT implementation; trace and explain output; justify file type selection
Sec C (Viva)	10	LS6 — Lab Record LS7 — Algo Design	CO1–CO3	Lab record verification; oral questions on algorithm design, complexity, and output interpretation; lab record must be complete
TOTAL	**30**	LS1–LS7	CO1–CO3	Units 1–3. CO4, CO5, CO6 assessed in ESE only.

12. End Semester Examination (ESE) — 40 Marks

ℹ ESE is comprehensive — all 5 units and all 6 COs. Full progression from LS2 (implementation) through LS8 (innovation). Minimum 16/40 required to pass.

Section	Marks	Lab Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	LS2 — Implementation LS3 — DS Design	CO1, CO2, CO4	Program writing: implement a given linked list operation, pointer-based program, or data structure; output must match expected
Sec B	20	LS4 — Algo Analysis LS5 — Output Interpretation LS7 — Algo Design	CO3, CO4, CO5	Algorithm tracing & complexity analysis; sort/search program with performance comparison; file operations with analysis; pseudocode design before coding
Sec C	10	LS7 — Algo Design LS8 — Innovation	CO5, CO6	Design and optimise: re-engineer given inefficient code; propose improved algorithm with Big-O justification; or design a novel data structure solution
TOTAL	**40**	LS2–LS8 (all)	CO1–CO6	Minimum 16/40 to pass. Scaled from 100-mark paper if needed.

12.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	LS Dims	PO Primary
CO1	Identify and recall basic electronic components, Arduino hardware, and tools.	✓	✓	✓	LS1, LS2, LS6	PO1, PO2, PO5
CO2	Explain working principles of circuits, sensors, and Arduino programs.	✓	✓	✓	LS2, LS6	PO1, PO3
CO3	Build and simulate basic circuits using Tinkercad and Arduino.	✓	✓	✓	LS2, LS3, LS5, LS6	PO1, PO2, PO3
CO4	Debug and analyse circuit behavior and Arduino code.	✓	—	✓	LS3, LS4, LS5, LS7	PO1, PO2, PO3
CO5	Compare and select appropriate sensors and components for applications.	✓	—	✓	LS4, LS5, LS7	PO1, PO2, PO8, PO9, PO10
CO6	Design and develop a complete Arduino-based prototype solving a real-world problem.	✓	—	✓	LS7, LS8	PO1, PO2, PO10, PO11

⚠ CO4 and CO5 are NOT assessed in CE (only Units 1–3 are covered at the course examination). They are assessed in CA (lab sessions) and ESE.

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

13. CO–PO and CO–PSO Mapping Matrix

ℹ Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	-	-	-	-	2	1	1
CO2	1	2	3	-	-	-	-	-	-	-	-	1	3	1
CO3	2	3	3	-	-	-	-	-	-	-	-	2	2	3
CO4	2	3	1	-	-	-	-	2	2	1	-	2	2	2
CO5	3	2	-	-	-	-	-	3	2	1	2	3	2	2
CO6	2	3	3	-	-	-	-	2	1	2	3	2	3	3
Avg	2.00	2.50	2.40	–	2.00	–	–	2.33	1.67	1.33	2.50	2.00	2.17	2.00

14. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M		M							M		
CO2		M	H										H	
CO3	M	H	H									M	M	H
CO4	M	H	M					M	M	M		M	M	M
CO5	H	M						H	M	M	M	H	M	M
CO6	M	H	H					M	M	M	H	M	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

ℹ OBE Compliance Statement: This is a lab-only course. All 6 COs span all three domains — Cognitive (L3–L6) as the primary domain, Psychomotor (P3–P6) for implementation and design skills, and Affective (A2–A4) for professional and collaborative conduct — reflecting the skill-based, hands-on nature of laboratory assessment.

16. Attendance Policy & Pass/Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Lab / Practical Sessions	**75%**	All lab sessions	Debarred from ESE if below threshold
Self-Learning Submissions	All activities	SL activities (15 hrs — coding problems)	Incomplete SL affects CA score directly

⚠ Lab attendance must meet 75% minimum. Missing SL activities (coding platform submissions) directly impacts CA marks and is not compensable by examination performance.

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 16 / 40**	**MANDATORY**	40% of ESE marks required; failing ESE means failing the course regardless of CA + CE performance
Overall Total (CA + CE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 30 + CE 30 + ESE 40 = 100; 40% overall minimum required

CSCR1505 — LAB-ONLY COURSE PLAN — MEASUREMENT ARCHITECTURE
11 Programme Outcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments → 8 Lab Skill Dimensions (LS1–LS8)
CO1–CO3: Apply/Analyse → LS1–LS3, LS6 → CA + CE + ESE
CO4–CO5: Analyse/Evaluate → LS3–LS5, LS7 → CA + ESE
CO6: Create → LS7–LS8 → CA + ESE Sec C
Marks: CA 30 + CE 30 + ESE 40 = Total 100

COURSE PLAN

Introduction to Problem Visualization (CSCR1100)

Sharda School of Computer Science & Engineering | B.Tech. CSE | Semester I | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE Sharda School of Computer Science & Engineering	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I
Course Code:	CSCR1100	**Course Type:**	Core — Theory Only

2. Course Details

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

S.No	Attribute	Details
1	**Course Code**	**CSCR1100**
2	**Course Title**	**Introduction to Problem Visualization**
3	**Credits**	2
4	**Contact Hours (L-T-P-SL)**	2-0-0-2 (Theory: 30 hrs. Classroom + 30 hrs. Self-Learning = 60 hrs. total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Introduce first-year CSE students to systematic problem-solving strategies through visual thinking, 2. Enable them to decompose complex problems, represent logic and data graphically. 3. Develop clear solution blueprints before coding 4. Build foundational computational thinking habits essential for all future CSE courses.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Remember – L1 / Understand – L2): Classify and differentiate appropriate visual representations for various computational problems based on problem characteristics and requirements. CO2 (Understand – L2 / Apply – L3): Develop and demonstrate problem solutions using flowcharts, pseudocode, trace tables, and decision diagrams for given computational tasks.

		CO3 (Apply – L3): Implement decomposition, pattern recognition, and abstraction techniques to systematically break down and represent real-world problems. CO4 (Apply – L3 / Analyze – L4): Construct and analyze visual models including UML diagrams, ER sketches, data tables, and algorithm visualizations for specified scenarios. CO5 (Analyze – L4 / Evaluate – L5): Examine and evaluate problems to identify entities, relationships, constraints, and logical sequences through structured visual solution plans. CO6 (Evaluate – L5 / Create – L6): Design, integrate, and present comprehensive visual solution blueprints collaboratively for complex computational problems.
8	**Course Description**	This foundational course builds visual problem-solving skills for CSE students through hands-on diagramming, flowcharts, UML modeling, and interactive visualizations before coding. Students practice computational thinking through learning-by-doing activities such as sketching scenarios, tracing algorithm execution, and creating collaborative visual solution packs.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 30 hrs | Self Learning (SL): 30 hrs | Total: 60 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1. Roam D. - The Back of the Napkin (Expanded Edition): Solving Problems and Selling Ideas with Pictures, Portfolio Publishers (2008) 2. Craig M. - Thinking Visually: Business Applications of Fourteen Core Diagrams, Financial Times/Prentice Hall (2004)
12	**References**	1. Paul Curzon and Peter W. McOwan – 'The Power of Computational Thinking: Games, Magic and Puzzles to Help You Become a Computational Thinker', World Scientific (2017) 2. Claus O. Wilke – 'Fundamentals of Data Visualization', O'Reilly Media (2019) 3. Edward R. Tufte – 'The Visual Display of Quantitative Information (2nd Edition)', Graphics Press (2001)

3. Outline Syllabus with CO Mapping

All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.

	Topic	CO Mapping
	Unit 1: Visual Thinking and Problem Understanding	
A	Introduction to problem visualization: mental models vs external representations, benefits for computational thinking	**CO1**
B	Types of visual tools: sketches, mind maps, lists, tables, timelines, storyboards	**CO2**
C	Computational thinking fundamentals: decomposition, pattern recognition, abstraction, algorithmic thinking through visuals	**CO3**
	Unit 2: Visualizing Processes and Logic	
A	Flowchart fundamentals: symbols, control structures, branching, loops, input-output	**CO2**
B	Decision tables and truth tables for logical conditions	**CO2**
C	Step-by-step execution tracing: dry runs, state tables, variable tracking	**CO3, CO5**

	Unit 3: Decomposition, Patterns, and Reuse	
A	Problem decomposition: breaking tasks into subtasks using familiar contexts (event organization, trip planning)	**CO3**
B	Pattern recognition: identifying repeated structures and common subproblems	**CO3**
C	Abstraction: focusing on essential details, ignoring irrelevant information	**CO4**
	Unit 4: Visualizing Simple Systems and Data	
A	Entity identification: extracting key components and relationships from problem descriptions	**CO4**
B	Simple UML-style diagrams: boxes for entities, lines for relationships (informal notation)	**CO4**
C	Data representation: tables, rows, columns, keys, consistency checks	**CO5**
	Unit 5: Visual Solution Blueprinting and Team Communication	
A	Integrating multiple visual tools: requirements sketch → flowcharts/UML → algorithm visualizations	**CO5**
B	Visual solution packs: comprehensive problem-to-solution documentation	**CO6**
C	Clear and ethical visual communication principles	**CO5**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C			✓			
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓	✓	
7	3.A			✓			
8	3.B			✓			
9	3.C				✓	✓	
10	4.A			✓	✓		
11	4.B			✓	✓		
12	4.C				✓	✓	
13	5.A				✓	✓	

14	5.B					✓	✓
15	5.C				✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains

Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓					✓					✓						
CO2			✓					✓						✓				
CO3			✓	✓					✓						✓			
CO4			✓	✓					✓						✓	✓		
CO5				✓	✓					✓						✓	✓	
CO6					✓	✓					✓							✓

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 30 Lectures / 30 Hours)

Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Mental models vs external representations; benefits of visualization in computational thinking	UNIT-1	4
DD/MM/YY	Sketches, mind-maps, lists, tables, timelines, storyboards		
DD/MM/YY	Decomposition, pattern recognition, abstraction through visuals		
DD/MM/YY	Studio activity: convert real-life text problems into three visual forms		
DD/MM/YY	Flowchart symbols, sequencing, branching, loops, input-output	UNIT-2	6
DD/MM/YY	Decision tables and truth tables for logical conditions		
DD/MM/YY	Dry run techniques, state tables, variable tracing		
DD/MM/YY	Flowchart design for max of three numbers and factorial		

DD/MM/YY	Pair-work conversion: partner visual to pseudocode		
DD/MM/YY	Debugging incorrect flowcharts and trace tables		
DD/MM/YY	Problem decomposition with familiar contexts	UNIT-3	6
DD/MM/YY	Pattern recognition across multiple problem statements		
DD/MM/YY	Abstraction: essential vs irrelevant details		
DD/MM/YY	Reusable visual templates for search, count, filter		
DD/MM/YY	Group decomposition posters		
DD/MM/YY	Visual library design exercise		
DD/MM/YY	Entity identification from system descriptions	UNIT-4	6
DD/MM/YY	Simple UML-style diagrams and relationship sketches		
DD/MM/YY	Data tables, rows, columns, keys, consistency checks		
DD/MM/YY	Storyboards and interaction flow visualization		
DD/MM/YY	Algorithm/data structure visualization observation task		
DD/MM/YY	Case study: hostel mess and library borrowing systems		
DD/MM/YY	Integrated solution blueprinting	UNIT-5	8
DD/MM/YY	Visual solution packs for problem-to-solution documentation		
DD/MM/YY	Ethical and clear visual communication		
DD/MM/YY	Linkage to programming, DSA, DBMS, and software engineering		
DD/MM/YY	Team mini-project planning		
DD/MM/YY	Solution pack development workshop		
DD/MM/YY	Team presentation with Q and A		
DD/MM/YY	Design critique comparing alternative approaches		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Visual Recognition and Representation Selection**	Ability to identify suitable visual forms such as sketches, mind maps, flowcharts, and tables for a given problem.	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Problem Illustration and Logic Expression**	Ability to express problem statements through flowcharts, pseudocode, trace tables, and decision diagrams.	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Decomposition and Abstraction Application**	Ability to break problems into manageable parts and apply pattern recognition and abstraction	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Visual Model Construction**	Ability to construct UML-style diagrams, ER sketches, data tables, and algorithm visualizations	CO4 | L3–L4	CA | MTE Sec B | ETE Sec B
TS5	**Analytical Critique of Visual Solutions**	Ability to analyze relationships, constraints, and logical flow, and critique alternative visual plans.	CO5 | L4–L5	CA, ETE Sec B/C
TS6	**Integrated Blueprint Design and Communication**	Ability to combine multiple representations into one coherent solution blueprint and present it effectively in teams.	CO6 | L5–L6	CA, ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H					
CO2	M	H				
CO3		M	H			
CO4				H	M	
CO5				M	H	M
CO6					M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5	5 assignments	**15**	CO1, CO2, CO3, CO4, CO5	TS1, TS2, TS3, TS4, TS5
Visual Studio Workbook / Portfolio	1 portfolio	**5**	CO2, CO4, CO5	TS2, TS4, TS5
Team Mini-Project and Presentation	1 project	**5**	CO4, CO5, CO6	TS4, TS5, TS6
Total	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1: Visual Thinking - sketches, mind maps, and problem framing (everyday campus problem)	CO1	TS1, TS2	5h SL	Submission: set of annotated sketches + one-page problem statement; evaluated for correct representation, clarity, and relevance (30%), completeness (40%), reflection on choice (30%).
Assignment 2	Unit 2: Flowcharts, pseudocode & trace-tables for simple algorithms (billing, grading, search)	CO2	TS3, TS4	5h SL	Submission: flowchart + pseudocode + two trace-table examples; evaluated for correctness of logic (50%), completeness of traces (30%), neatness & standard symbols (20%).
Assignment 3	Unit 3: Decomposition & pattern recognition - task tree and reusable visual blocks for a chosen scenario	CO3	TS5, TS6	5h SL	Submission: decomposition tree + 2 reusable visual templates; evaluated for quality of decomposition (40%), identification of patterns (35%), reusability of templates (25%).
Assignment 4	Unit 4: Lightweight modeling - simple UML/ER sketch and sample data table for a mini-system (e.g., library/mess)	CO4	TS7, TS3	5h SL	Submission: use-case sketch + class/ER sketch + sample table (5–10 rows); evaluated for correctness of entities/relations (45%), consistency of sample data (30%), clarity of diagrams (25%).
Assignment 5	Unit 5: Integrated Visual Analysis - analyze a problem, produce visual solution plan (decomposition, flowchart, model, storyboard)	CO5, CO6	TS6, TS9, TS10	5h SL	Submission: integrated visual solution pack (1-2 pages each artifact) and 3-4 min team presentation; evaluated for completeness & coherence across visuals (40%), solution quality & edge-case handling

					(30%), communication & teamwork in presentation (30%).
Video Learning Report	Video lectures on visualization or algorithm animation (min 3 hours viewing); structured report and class presentation	CO2, CO3	TS2, TS8, TS9	9h SL	Submission: structured learning report (max 1,200 words) covering learning outcomes, key concepts observed, comparisons to course techniques, and a 1-paragraph personal reflection (50%); Presentation: 8–10 min class presentation and Q&A evaluated for clarity and insight (30%); Evidence: timestamps/notes and at least two annotated screenshots from video demonstrating visualization techniques (20%).
Case Study Report	In-depth analysis of a real-world system's visualization/design (e.g., scheduler design, campus resource app, or UI flow); data-collection and comparative analysis	CO4, CO5, CO6	TS5, TS7, TS10	6h SL	Submission: technical case report (1,500–2,000 words) including system description, extracted visuals (use-cases/UML/data tables), critique of design choices, and suggested improvements (60%); Data & Evidence: collected artifacts, citations or interview notes (20%); Presentation/Defense: 6–8 min class defense with peer questions (20%).

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 - Visual Recognition and Representation Selection; TS2 - Problem Illustration and Logic Expression	**CO1, CO2**	Short-answer and illustration questions on representation choice, flowcharts, pseudocode, trace tables, and decision tables.
Section B	**15**	TS3 - Decomposition and Abstraction Application; TS4 - Visual Model Construction	**CO3, CO4**	Applied questions requiring decomposition, abstraction, UML-style visual models, and structured visual problem solving.
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 emphasis, following the sample's exam structure.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance

Section A	**15**	TS1 - Visual Recognition and Representation Selection; TS2 - Problem Illustration and Logic Expression	**CO1, CO2**	Conceptual questions on visual tools, problem illustration, and logical representation.
Section B	**25**	TS3 - Decomposition and Abstraction Application; TS4 - Visual Model Construction; TS5 - Analytical Critique of Visual Solutions	**CO3, CO4, CO5**	Applied and analytical questions on decomposition, abstraction, model construction, and critique of visual plans
Section C	**10**	TS5 - Analytical Critique of Visual Solutions; TS6 - Integrated Blueprint Design and Communication	**CO5, CO6**	Long-form analysis and design questions on integrated visual solution packs, communication clarity, ethics, and team presentation design
TOTAL	**50**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (15)	ETE (60)	TS	PO Primary
CO1	Identify visual representations for computational problems	✓	✓	—	TS1, TS2	PO1, PO2, PO11
CO2	Illustrate problems using flowcharts, pseudocode, trace tables	✓	✓	✓	TS3, TS4	PO1, PO2, PO3
CO3	Apply decomposition, pattern recognition, and abstraction	✓	✓	✓	TS5, TS6	PO2, PO3, PO4
CO4	Construct lightweight UML/ER sketches and algorithm visualizations	✓	✓	✓	TS7, TS3	PO1, PO3, PO5
CO5	Analyze entities, relationships, constraints, and logical flow visually	✓	—	✓	TS7, TS9	PO2, PO4, PO9
CO6	Design integrated visual solution blueprints and present them	✓	—	✓	TS6, TS9, TS10	PO3, PO8, PO11

CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO-PO and CO–PSO Mapping Matrix (Original Framework)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

CO1	1	2	-	-	1	-	-	-	-	-	1	-	-	1
CO2	2	2	1	-	2	-	-	-	1	-	1	1	-	2
CO3	2	3	2	1	2	-	-	1	-	-	2	2	1	2
CO4	2	2	3	1	2	-	-	1	1	-	2	2	2	2
CO5	2	3	2	2	2	1	1	2	2	-	2	3	1	2
CO6	2	3	3	2	3	1	1	3	3	1	3	3	2	2
Avg	**1.83**	**2.5**	**2.2**	**1.5**	**2.0**	**1.0**	**1.0**	**1.75**	**1.75**	**1.0**	**1.83**	**2.2**	**1.5**	**1.83**

13. CO × PO Alignment Map (H/M Indicators - All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		**M**												
CO2	**M**	**M**			**M**									**M**
CO3	**M**	**H**	**M**		**M**						**M**	**M**		**M**
CO4	**M**	**M**	**H**		**M**						**M**	**M**	**M**	**M**
CO5	**M**	**H**	**M**	**M**	**M**			**M**	**M**		**M**	**H**		**M**
CO6	**M**	**H**	**H**	**M**	**H**			**H**	**H**		**H**	**H**	**M**	**M**

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Visual worksheet and diagram practice across units, including sketches, flowcharts, trace tables, and reusable templates**	Total = 12 hrs	CO1–CO4 TS1–TS4	Correctness, clarity, completeness, and appropriateness of the chosen visual form.
2	**Visual portfolio development including annotated examples, critiques, and iterative refinements**	Video viewing: 3 hrs; Report preparation: 3 hrs; Presentation: 3 hrs Total = 9 hrs	CO2, CO4, CO5/TS2, TS4, TS5	Quality of explanation, critique depth, and improvement across iterations.
3	**Team mini-project and presentation based on a relatable first-year problem such as timetable reminder,**	Data collection/study: 8 hrs Report preparation: 2 hrs Total = 10 hrs	CO4, CO5, CO6/TS4, TS5, TS6	Technical coherence, integration of representations, communication quality, and teamwork.

	expense tracker, or attendance logger etc.			
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

------ - MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 15 marks + ETE 60 marks = Total 100 marks

COURSE PLAN

Engineering Physics (PHT1136)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	PHT1136
2	**Course Title**	**Engineering Physics (EP)**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	To make students proverbial with the fundamental concepts of Semiconductors materials and electromagnetism and their real-life applications for configuring various electronics devices.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Students will learn the fundamental concepts of mobility, conductivity, electrons and holes in an intrinsic semiconductor, Donor and Acceptor impurities (n-type and p-type semiconductor), Fermi levels etc. Students will gain knowledge about the formation of depletion region, barrier potential, Zener diode, Characteristics of Zener diode etc. CO2 (Understand – L2): Students will have a clear understanding of Coherent sources, interaction of radiation with matter (spontaneous and stimulated emission), Einstein's relation, population inversion and pumping, Ruby LASER, He-Ne Laser and semiconductor Laser. CO3 (Apply – L3): Students will show that they have learned the basics of fiber optics, Holography and its applications. CO4 (Analyze – L4): Students will be able to understand the significance and applications of Maxwell's equations. CO5 (Evaluate – L5): Students will be able to know about the short comings of classical physics and will learn various quantum mechanical principles. CO6 (Create – L6): Student will be familiar with the essential concepts of Semiconductors materials technology and their applications in industries. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Student will be able to determine the Energy Band Gap of Semiconductor materials.

		CO8 (Create – L5/L6): Student will be able to find Planck constant by light emitting diode method and determine the numerical aperture and acceptance angle of an optical fibre. CO9 (Apply – L2/L3): Student will be able to determine the Hall coefficient, carrier density and the mobility of a semiconductor material, find the variation of magnetic field along the axis of current carrying circular coil and also to find out the IV characteristics of a solar cell. CO10 (Apply – L3): Student will be able to understand laboratory experiments for Interpreting results, error analysis, writing reports and analyzing data.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 20 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. To study advanced topics like: Transistors and MOSFETs; Semiconductor lasers; LED and OLED physics; Nanomaterials; Carbon nanotubes; Graphene; Quantum dots 2. Value Added Experiment: To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula.
11	**References**	Textbook: Semiconductor physics and devices: basic principles- Donald A. Neamen. References: 1. Integrated Electronics- Millman - Halkias, Tata Mc Graw Hill 2. Laser and non-linear optics by B.B. laud, New Age Int. 3. Semiconductor Devices- Kanaan Kano, Pearson Education. 4. Electronics devices and circuit theory by R.L. Boylestad, Pearson. 5. Introduction to Electrodynamics, David J. Griffiths, Pearson Cambridge University Press 6. Fundamentals of Electricity and Magnetism, D. N. Vasudeva, S. Chand & Co. New Delhi 7. Fundamentals of Physics, Halliday, Resnick and Walker, John Wiley. 8. Concepts of Modern Physics, Beiser Arthur, McGraw-Hill Education

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Semiconductor Physics (4-0-4-6 = 14 hrs)**	
A	Classification of Solids on the basis of energy band, electrons and holes concentration in intrinsic semiconductors, Fermi levels, Mobility, conductivity	CO1, CO6
B	Donor and Acceptor impurities (n-type and p-type semiconductor), Drift and diffusion current, Hall effect	
C	p-n junction, formation of depletion region, barrier potential, Avalanche and Zener breakdown.	
Tools Used	Proper experimental setup present in the lab will be used	
Activities	**Objective: To perform the experiments related to Semiconductor Physics**	
Unit 2	**Laser Physics and optoelectronic Sources (6-0-4-6 = 16 hrs)**	
A	Coherent sources, interaction of radiation with matter (spontaneous and stimulated emission), Einstein's relation	CO2, CO6
B	Population inversion and pumping, active components of laser, optical amplification or gain	

C	Optoelectronic sources: Light emitting diode (construction, basic working principle), semiconductor laser (construction, basic working principle)	
Tools Used	Proper experimental setup present in the lab will be used	
Activities	Objective: To perform the experiments related to Laser Physics and optoelectronic Sources	
Unit 3	**Fiber Optics (8-0-4-6 = 18 hrs)**	
A	Introduction, structure of optical fiber, Light guidance through optical fiber	CO3, CO6
B	Acceptance angle and Acceptance cone, Numerical aperture, Types of optical fibers	
C	Attenuation and Dispersion in optical fiber, Applications of optical fibers	
Tools Used	Proper experimental setup present in the lab will be used	
Activities	Objective: To perform the experiments related to Fiber Optics	
Unit 4	**Electromagnetism (6-0-4-6 = 16 hrs)**	
A	Gauss's theorem, Biot-Savart law and its application to current carrying circular loop	CO4
B	Ampere's law and its applications to infinitely long straight wire, and solenoids. Electromagnetic induction; Faraday's law	
C	Maxwell's equations and speed of EM waves in free space	
Tools Used	Proper experimental setup present in the lab will be used	
Activities	Objective: To perform the experiments related to Electromagnetism	
Unit 5	**Quantum Mechanics (6-0-4-6 = 16 hrs)**	
A	Inadequacy of classical Physics, Wave particle duality, de-Broglie wavelength	CO5, CO6
B	Davisson-Germer experiment, Schrodinger wave equation	
C	Particle in a 1-dimensional box	
Tools Used	Proper experimental setup present in the lab will be used	
Activities	Objective: To perform the experiments related to Stefan's law and IV characteristics of a solar cell	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C	✓	✓				
4	2.A	✓	✓				
5	2.B	✓	✓				
6	2.C	✓	✓				
7	3.A			✓			
8	3.B			✓			
9	3.C			✓			
10	4.A			✓	✓		
11	4.B			✓	✓		
12	4.C			✓	✓		
13	5.A				✓	✓	✓
14	5.B				✓	✓	✓
15	5.C				✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓															
CO4				✓														
CO5					✓													
CO6						✓												
CO7			✓															
CO8			✓		✓													
CO9			✓		✓	✓				✓	✓	✓	✓					
CO10			✓			✓				✓	✓	✓	✓					

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Classification of Solids on the basis of energy band, electrons and holes concentration in intrinsic semiconductors, Fermi levels, Mobility, conductivity	Unit 1	4
DD/MM/YY	Donor and Acceptor impurities (n-type and p-type semiconductor), Drift and diffusion current,		
DD/MM/YY	Hall effect		
DD/MM/YY	p-n junction, formation of depletion region, barrier potential, Avalanche and Zener breakdown		
DD/MM/YY	Coherent sources, interaction of radiation with matter (spontaneous and stimulated emission),	Unit 2	6
DD/MM/YY	Einstein's relation		
DD/MM/YY	population inversion and pumping		
DD/MM/YY	active components of laser, optical amplification or gain		
DD/MM/YY	semiconductor laser (construction, basic working principle)		
DD/MM/YY	semiconductor laser (construction, basic working principle)		
DD/MM/YY	Introduction, structure of optical fiber	Unit 3	8
DD/MM/YY	Light guidance through optical fiber		
DD/MM/YY	Acceptance angle and Acceptance cone		
DD/MM/YY	Numerical aperture, Numerical		
DD/MM/YY	Types of optical fibers		
DD/MM/YY	Attenuation and Dispersion in optical fiber, Numerical		
DD/MM/YY	Applications of optical fibers		
DD/MM/YY	Practice numericals drom Units-1, 2 and 3		
DD/MM/YY	Gauss's theorem, Biot-Savart law and its application to current carrying circular loop	Unit 4	6
DD/MM/YY	Ampere's law and its applications to infinitely long straight wire, and solenoids		
DD/MM/YY	Electromagnetic induction, Faraday's law		
DD/MM/YY	Maxwell's equations and speed of EM waves in free space		
DD/MM/YY	Maxwell's equations and speed of EM waves in free space		
DD/MM/YY	Strings: Manipulation of text data, Command Line Arguments		
DD/MM/YY	Inadequacy of classical Physics	Unit 5	6
DD/MM/YY	Wave particle duality, de-Broglie wavelength		
DD/MM/YY	Davisson-Germer experiment		
DD/MM/YY	Schrodinger wave equation		
DD/MM/YY	Schrodinger wave equation		
DD/MM/YY	Particle in a 1-dimensional box		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W5: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W6–W8 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	To determine the Energy band gap of a semiconductor using Four Probe method.	CO7	3.0
	S-1.2	To determine the energy band gap by PN junction diode.	CO7	
W2	S-2.1	To determine the Planck's constant by light emitting diode.	CO7	3.0
	S-2.2	To determine the wavelength of prominent lines of mercury source by plane diffracting grating	CO7	
W3	S-3.1	To determine the numerical aperture and acceptance angle of multimode plastic optical fibre.	CO7	3.0
	S-3.2	To determine width of single slit and double slit by using Laser diffraction.	CO7	
W4	S-4.1	To study Hall effect and determine the Hall coefficient, carrier density and the mobility of a semiconductor material.	CO7	3.0
	S-4.2	To determine the specific resistance of the material of a given wire using Carey Foster's bridge	CO7	
W5	S-5.1	To study the magnetoresistance of the given semiconductor material.	CO7	3.0
	S-5.2	To determine the variation of magnetic field along the axis of current carrying circular coil.	CO7	
W6	S-6.1	To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula.	CO8	3.0
	S-6.2	To determine the Planck constant by light emitting diode method.	CO8	
W7	S-7.1	Verification of Stefan's law and determination of Stefan's constant of radiation.	CO8/CO9	3.0
	S-7.2	To find out the IV characteristics of a solar cell.	CO8/CO10	
W8	S-8.1	Self-assessment form submitted	CO8/CO9	3.0
	S-8.2	Final presentation, group reflection, Viva-voce	CO9/CO10	

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Semiconductor Physics	CO1 | L1–L2	MTE Sec A | ETE Sec A

TS2	**Conceptual Explanation & Logical Interpretation**	Laser Physics and optoelectronic Sources	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Fiber Optics	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Electromagnetism	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Quantum Mechanics	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Electromagnetism and Quantum Mechanics	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Program writing; program tracing — detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note

> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment (gcc, IDE, Linux CLI, debugger)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8

CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	1	1			
CO2	3	3	2	3	3	2	1	1	1	1	1			
CO3	3	3	2	3	3	2	1	1	1	1	1			
CO4	3	3	3	2	3	2	1	1	1	1	1			
CO5	3	3	3	2	3	2	1	1	1	1	1			
CO6	3	3	3	3	3	2	1	1	1	1	1			
CO7	1	3	1	2	1	1								
CO8	1	3	1	2	1	1								
CO9	1	3	1	2	1	1								
CO10	1	3	1	1	1	1								
Avg	**2.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**3.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification

SDG 4	**Quality Education**	**3 (High)**	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	**Decent Work & Economic Growth**	**3 (High)**	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	**Industry, Innovation & Infrastructure**	**3 (High)**	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	**Responsible Consumption & Production**	**2 (Moderate)**	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper

Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

EP INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Calculus and Abstract Algebra (MTT1113)

School of Engineering & Technology (SET) | B.Tech CSE | Semester I | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SET — School of Engineering & Technology	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I
Course Code:	MTT1113	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**MTT1113**
2	**Course Title**	**Calculus and Abstract Algebra**
3	**Credits**	4
4	**Contact Hours (L-T-P)**	3-1-0- (Theory: 40 hrs Classroom = 40 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. To develop a clear understanding of the fundamental concepts of **Calculus** and **Linear Algebra**. 2. To equip students with mathematical methods and techniques for solving engineering and scientific problems. 3. To enhance analytical, logical, and problem-solving skills through the application of mathematical concepts. 4. To provide a strong foundation for advanced studies and real-world applications in engineering and related fields.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Define the concept of differential calculus and illustrate Maxima, minima and saddle points.

		CO2 (Explore – L2/L3): Explore the basic concept of sets, relation, functions, groups, Rings and Field CO3 (Apply – L3): Apply the rank method to evaluate system of linear equation and inverse of a matrix. CO4 (Analyze – L4/L5): Integrate and Analyze the vector space. Determine linear dependence and independence of vectors. Evaluate basis and dimension of vector spaces. Understand linear transformations (maps). CO5 (Analyze – L4/L5): Analyze various memory to Evaluate inverse of a linear transformation. Determine the matrix representation of linear maps. CO6 (Analyze – L2/L4): Interpret the inner product spaces and build Gram-Schmidt orthogonalization process.
8	**Course Description**	This course is an introduction to the fundamental of Mathematics. The primary objective of the course is to develop the basic understanding of differential and integral calculus, linear Algebra and Abstract Algebra.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 30 hrs | Self Learning (SL): 30 hrs | Total: 60 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
12	**References**	1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005. 2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. 3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010. 4. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
	Unit 1: Calculus	
A	Differentiation, Successive differentiation Taylor's and Maclaurin theorems, indeterminate forms, L' Hospital's rule	**CO1**
B	Partial derivatives, Total derivative, Euler's theorem for homogeneous function, Maxima and minima for function of two variables	**CO1**
C	Evaluation of double integration, Applications of double integral	**CO1**
	Unit 2: Basic Algebra	
A	Sets, relations and functions	**CO1, CO2**
B	Basics of groups, Subgroups	**CO1, CO2**
C	Cyclic groups, basics of Rings and Field	**CO1, CO2**

	Unit 3: Matrices	
A	Matrices: Addition, subtraction and scalar multiplication, matrix multiplication, Symmetric, Skew-Symmetric and orthogonal Matrices	**CO1, CO2**
B	Determinants, rank of a matrix, Systems of linear equations, linear Independence and dependence. Cramer's Rule	**CO1, CO2, CO3, CO4**
C	Inverse of a matrix by using elementary transformation, Gauss elimination and Gauss-Jordan elimination, Eigenvalues, Eigenvectors, Diagonalization	**CO1, CO2, CO3, CO4**
	Unit 4: Vector Space and Linear Transformation	
A	Vector Space, linear dependence and Independent of vectors, basis, dimension	**CO1, CO2, CO3, CO5**
B	Introduction to linear transformations (maps)	**CO1, CO2, CO3, CO5**
C	Range and kernel space of a linear transformation, rank and nullity of L.T.	**CO1, CO2, CO3, CO5**
	Unit 5: Inverse of Linear and Gram Schmidt Orthonormalization	
A	Inverse of a linear transformation, Matrix associated with a L.T.	**CO1, CO2, CO3, CO6**
B	Basic introduction of Inner product spaces	**CO1, CO2, CO3, CO4, CO6**
C	Gram-Schmidt orthogonalization	**CO1, CO2, CO3, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓				
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓		
7	3.A	✓	✓				
8	3.B			✓	✓		
9	3.C			✓	✓	✓	
10	4.A		✓				
11	4.B			✓	✓		
12	4.C			✓	✓	✓	

13	5.A		✓	✓			
14	5.B			✓	✓		
15	5.C		✓	✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓															
CO3			✓	✓											✓			
CO4				✓	✓				✓									
CO5				✓	✓			✓										
CO6		✓	✓	✓														

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 56 Lectures / 56 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Differentiation: Basic concepts and standard rules of differentiation	UNIT-1	9
DD/MM/YY	Successive Differentiation and higher-order derivatives		
DD/MM/YY	Taylor's Theorem and its applications		
DD/MM/YY	Maclaurin's Theorem and series expansions		
DD/MM/YY	Indeterminate Forms and introduction to L'Hospital's Rule		
DD/MM/YY	Applications of L'Hospital's Rule in evaluating limits		
DD/MM/YY	Partial Derivatives and their geometrical interpretation		
DD/MM/YY	Maxima and Minima of Functions of Two Variables		

DD/MM/YY	Applications of Double Integrals (Area, Volume, and Engineering Applications		
DD/MM/YY	Introduction to Sets: Types of Sets, Set Operations	UNIT-2	8
DD/MM/YY	Relations: Definition, Types of Relations, and Properties		
DD/MM/YY	Functions: Definition, Types of Functions, and Composition of Functions		
DD/MM/YY	Algebraic Structures and Introduction to Groups		
DD/MM/YY	Groups: Definition, Examples, and Basic Properties		
DD/MM/YY	Subgroups: Definition, Tests for Subgroups, and Examples		
DD/MM/YY	Cyclic Groups: Examples and Applications		
DD/MM/YY	Basics of Rings: Definition, Examples, and Fundamental Properties		
DD/MM/YY	Introduction to Matrices: Addition, Subtraction, and Scalar Multiplication	UNIT-3	8
DD/MM/YY	Special Matrices: Symmetric, Skew-Symmetric, and Orthogonal Matrices		
DD/MM/YY	Rank of a Matrix and its Computation		
DD/MM/YY	Systems of Linear Equations; Linear Independence and Dependence		
DD/MM/YY	Cramer's Rule and Applications		
DD/MM/YY	Inverse of a Matrix using Elementary Transformations		
DD/MM/YY	Eigenvalues and Eigenvectors: Definitions, Properties, and Computation		
DD/MM/YY	Diagonalization of Matrices and Applications		
DD/MM/YY	Introduction to Vector Spaces: Definition, Examples, and Basic Properties	UNIT-4	7
DD/MM/YY	Subspaces of a Vector Space and Related Examples		
DD/MM/YY	Tests for Linear Dependence and Independence		
DD/MM/YY	Basis of a Vector Space: Definition and Properties		
DD/MM/YY	Introduction to Linear Transformations (Maps): Definition and Examples		
DD/MM/YY	Properties of Linear Transformations and Matrix Representation		
DD/MM/YY	Range Space and Kernel (Null Space) of a Linear Transformation		
DD/MM/YY	Review of Linear Transformations and Conditions for Invertibility	UNIT-5	8
DD/MM/YY	Inverse of a Linear Transformation		
DD/MM/YY	Examples of an inverse Linear Transformation		

DD/MM/YY	Finding the Inverse of a Linear Transformation with Examples		
DD/MM/YY	Matrix Associated with a Linear Transformation		
DD/MM/YY	Introduction to Inner Product Spaces: Definition and Examples		
DD/MM/YY	Properties of Inner Products, Norms, and Orthogonality		
DD/MM/YY	Gram–Schmidt Orthogonalization Process		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Calculus and Multivariable Analysis**	Ability to apply differential and integral calculus techniques to analyze functions, solve optimization problems, and evaluate double integrals in theoretical and practical contexts.	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Set Theory and Algebraic Structures**	Ability to apply concepts of sets, relations, functions, groups, subgroups, cyclic groups, rings, and fields to analyze and solve mathematical problems.	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Matrices and Linear Systems**	Ability to perform matrix operations, solve systems of linear equations, determine matrix properties, and apply eigenvalue, eigenvector, and diagonalization techniques to mathematical and engineering problems.	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Vector Spaces and Transformations**	Analyze vector spaces, determine linear dependence and independence, identify bases and dimensions, and apply concepts of linear transformations to mathematical problems.	CO4 | L4–L5	MTE Sec B | ETE Sec B

TS5	**Linear Transformation Analysis**	Analyze to determine the range, kernel, rank, and nullity of linear transformations, find inverses, and represent linear transformations using matrices	CO5 | L4–L5	ETE Sec B/C
TS6	**Inner Product Spaces and Orthogonality**	Analyze to inner product spaces and apply the Gram–Schmidt orthogonalization process to obtain orthogonal and orthonormal bases.	CO6 | L2–L4	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M		M	M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**25**	CO1, CO2, CO3, CO4, CO5, CO6	TS1, TS2, TS3, TS4, TS5, TS6
TOTAL	—	**25**		

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 concepts: Differential Calculus and Double Integration	CO1	TS1	6h	Report submission + evaluation
Assignment 2	Fundamentals of Abstract Algebra and Set Theory	CO2	TS2	6h	Numerical problems on process management
Assignment 3	Matrices and Linear Algebra	CO2, CO3	TS2, TS3	6h	Numerical computation + comparison
Assignment 4	Vector Spaces and Linear Transformations	CO3, CO4	TS3, TS4	6h	Step-by-step numerical trace required
Assignment 5	Inverse of a Linear Transformation and IPS	CO3, CO4, CO5	TS3, TS4, TS5	6h	Algorithm application + performance analysis

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Conceptual Recall & Identification TS2 — Conceptual Explanation & Process Interpretation	**CO1, CO2**	Short-answer: define differentiation, maxima and minima, Evaluate double integrals over given regions, ring, field
Section B	**15**	TS3 — Algorithmic Application TS4 — Algorithmic Analysis & Performance Evaluation	**CO2, CO3, CO4**	Numerical problems: Compute eigenvalues and eigenvectors of matrices. Diagonalize matrices and verify diagonalization
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Conceptual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions (all units): definitions, define differentiation, maxima and minima, Evaluate double integrals over given regions, ring, field
Section B	**25**	TS3 —matrix and linear system of equations TS4 — Vector space TS5 — Linear transformation Analysis	**CO3, CO4, CO5**	Medium questions: system of linear transformation and vector space
Section C	**10**	TS5 — Inverse of L.T. TS6 — Gram Schmidt orthonormalization	**CO5, CO6**	Long/evaluation questions: Construct orthonormal basis.
TOTAL	**50**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand basic concepts, differentiation and integration	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Explain the basic concept of sets, relation, functions, groups, Rings and Field	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Apply the rank method to evaluate system of linear equation and inverse of a matrix	✓	✓	✓	TS3	PO1, PO2, PO3, PO4
CO4	Analyze the vector space. Determine linear dependence and independence of vectors. Evaluate basis and dimension of vector spaces	✓	✓	✓	TS4	PO9, PO10, PO11
CO5	Evaluate inverse of a linear transformation. Determine the matrix representation of linear maps	✓	—	✓	TS5	PO1, PO2, PO8, PO9, PO10
CO6	Interpret the inner product spaces and build Gram-Schmidt orthogonalization process	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III
COMBINED MAPPINGS & REFERENCE
CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1	1	1	1	1	3	3	2
CO2	3	3	3	2	2	2	1	1	1	1	1	3	3	3
CO3	3	3	2	2	2	1	1	1	1	1	1	3	3	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	2
CO5	3	3	2	2	2	1	1	1	1	1	1	3	3	2
CO6	3	3	2	3	2	2	1	1	1	1	1	3	3	2
Avg	3.0	3.0	2.16	2.16	2.16	1.3	1.0	1.0	1.0	1.0	1.0	3.0	3.0	2.16

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	H	H				M	M	M	M	H	M	M
CO2	H	M	H	H				M	M	M	M	M	H	M
CO3	H	H	H	H				M	M	M	H	H	M	M
CO4	M	M	M	M	M			M	H	H	H	M	M	M
CO5	M	M	H					H	H	M	M	H		
CO6	H	M								M	H	M	M	

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Numerical Assignment Writing (5 assignments, problem-based, one per unit focus area)**	5 assignments × 6 hrs each Total = 30 hrs	CO1–CO6 TS1–TS6	Evaluated based on the assignment submitted; correctness, steps shown, comparison of algorithm performance
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

MTT1113 — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 15 marks + ETE 60 marks = Total 100 marks

COURSE PLAN

Professional Communication (SKT 1100)

School of Engineering & Technology (SET) | B.Tech CSE | Semester I | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SET — School of Engineering & Technology	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I
Course Code:	SKT 1100	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY - ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	SKT1100
2	**Course Title**	**Professional Communication**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	The objective of this course is to develop learners into confident, effective, and articulate communicators by strengthening their presentation skills, public speaking abilities, group discussion competence, and overall LSRW proficiency. The course aims to enhance pronunciation and clarity of voice, reduce language inaccuracies, and build strong verbal reasoning skills through structured speaking, reading, and writing activities. By the end of the course, learners will demonstrate improved clarity of expression, critical thinking, accuracy in language use, and the ability to communicate with confidence in academic, professional, and real-world settings.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** **CO1 (Remember – L1):** Communication Mastery & Presentation Excellence

		Recall and identify fundamental concepts of professional communication, presentation structure, and essential elements of effective message delivery. **CO2 (Understand – L2):** Public Speaking & Impromptu Communication Confidence Explain the principles of public speaking, including speech organization, audience analysis, and techniques for confident impromptu communication. **CO3 (Apply – L3):** Group Interaction, Debate & Discussion Skills Demonstrate effective communication by actively participating in group discussions, debates, and collaborative interactions using appropriate verbal and non-verbal strategies. **CO4 (Analyze – L4):** LSRW Skill Enhancement & Critical Reading Ability Analyze written and spoken content by applying listening, speaking, reading, and writing (LSRW) skills to interpret, evaluate, and respond critically. **CO5 (Evaluate – L5):** Pronunciation, Voice & Accent Improvement Evaluate speech delivery based on pronunciation, intonation, voice modulation, and accent to enhance clarity and effectiveness in communication. **CO6 (Create – L6):** Verbal Ability & Language Accuracy Create well-structured verbal and written responses using appropriate grammar, vocabulary, and language accuracy in professional contexts.
8	**Course Description**	This course builds strong communication skills through focused practice in presentations, public speaking, group discussions, and debates. Learners enhance LSRW abilities, strengthen pronunciation and accent clarity, and improve verbal accuracy through structured activities and language exercises. The course equips students to communicate confidently, think critically, and express ideas effectively in academic and professional settings.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 30% | MTE: 30% | ETE: 40% | Total: 100 marks**
11	**Textbook**	Business Communication Today – Bovee, Courtland L. & Thill, John V. A comprehensive guide covering professional communication, presentations, writing, and workplace skills.
12	**References**	1. Communication Skills – Sanjay Kumar & Pushp Lata *Widely used in Indian universities; covers LSRW, interpersonal communication, and soft skills.* 2. Soft Skills – Alex K. *Focuses on personality development, communication, and employability skills.* 3. English Grammar in Use – Raymond Murphy *Excellent for grammar, error correction, and verbal ability practice.* 4. Word Power Made Easy – Norman Lewis *Highly effective for vocabulary building and verbal ability.* 5. Online Resources: • British Council Learning English (grammar, listening, speaking practice) • Toastmasters International (public speaking frameworks) • Newspaper editorials (The Hindu / Indian Express) for reading practice

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
	Unit 1: The Art of Presentation Skills	
A	The 3 kings of Presentation - Content, Cosmetics, Presenter. Structuring Your Message for Maximum Clarity. How to organise ideas, build a logical flow, create engaging openings, and craft a memorable conclusion	**CO1**
B	Delivering with Confidence and Impact. Mastering voice modulation, body language, eye contact, pacing, and audience engagement techniques.	**CO1**
C	Student Group Presentations	**CO1**
	Unit 2: Introduction to Communication Readiness - Toastmasters Style	
A	Introduction to Toastmaster-Style Speaking | Speech Crafting Essentials (The Icebreaker Style), Voice Modulation & Vocal Variety	**CO2**
B	Body Language & Stage Presence - 7 C's of Communication	**CO2**
C	Impromptu speaking mastery (table topics), speech development & delivery	**CO2**
	Unit 3: Class Debates & Group Discussion Essentials	
A	Structuring Arguments & Presenting Your Point Clearly	**CO3**
B	Active Listening, Team Interaction & Turn-Taking Skills	**CO3**
C	Critical Thinking, Rebuttals & Handling Counterarguments	**CO3**
	Unit 4: LSRW (Listening, Speaking, Reading, Writing)	
A	Listening Activities, Self-introduction/Greeting/Meeting people – Self branding (Activities & Simulation Exercises) Extempore & Free Speech Activities, 1-minute (JAM) Just a Minute	**CO4**
B	Newspaper Reading, Speed Reading Exercises. Comprehension: Skimming and Scanning: Vocabulary Building: Critical thinking: Reading Fluency: Retention and Recall: Interpretation and Inference	**CO4**
C	Written Exercises: Clarity of Expression, Grammar and Language Use, Vocabulary Enrichment, Organisation and Structure, Creative and Critical Thinking, Purposeful Writing, Editing and Revising, Tone and Style Appropriateness	**CO4**

	Unit 5: Introduction to Voice & Accent Essentials	
A	Reduce MTI (Mother Tongue Interference)	**CO5**
B	Learn Neutral (Globally Accepted English)	**CO5**
C	Develop Clear, Professional-Sounding Pronunciation	**CO5**
	Unit 6: Verbal Ability	
A	Cloze Tests & Sentence Completion	**CO5**
B	Vocabulary Building & Reading Comprehension	**CO5**
C	Error Spotting & Correction	**CO5**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C			✓	✓		✓
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓		✓
7	3.A			✓	✓	✓	
8	3.B		✓	✓	✓	✓	
9	3.C			✓	✓	✓	✓
10	4.A		✓	✓	✓		
11	4.B		✓	✓	✓	✓	
12	4.C		✓	✓	✓	✓	✓
13	5.A		✓	✓	✓	✓	
14	5.B		✓	✓	✓		
15	5.C			✓	✓	✓	✓
16	6.A	✓	✓	✓			
17	6.B		✓	✓	✓		
18	6.C		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓	✓				✓	✓				✓	✓	✓				
CO2		✓	✓	✓			✓	✓	✓			✓	✓	✓	✓			
CO3			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		
CO4			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓			
CO5			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		
CO6		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓			

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	The 3 kings of Presentation - Content, Cosmetics, Presenter -- Structuring Your Message for Maximum Clarity. How to organise ideas, build a logical flow	UNIT-1	6
DD/MM/YY	The 3 kings of Presentation - Content, Cosmetics, Presenter- Create engaging openings, and craft a memorable conclusion		
DD/MM/YY	Delivering with Confidence and Impact -Mastering voice modulation, body language techniques		
DD/MM/YY	Delivering with Confidence and Impact - Eye contact, pacing, and audience engagement techniques		
DD/MM/YY	Student Group Presentations		
DD/MM/YY	Student Group Presentations		
DD/MM/YY	7 C's of Communication	UNIT-2	4
DD/MM/YY	Introduction to Toastmaster-Style Speaking/Voice Modulation & Vocal Variety, Body Language & Stage Presence		
DD/MM/YY	Impromptu speaking mastery (Table topics)		

DD/MM/YY	Impromptu speaking mastery (Table topics)		
DD/MM/YY	Structuring Arguments & Presenting Your Point Clearly	UNIT-3	7
DD/MM/YY	Active Listening, Team Interaction & Turn-Taking Skills		
DD/MM/YY	Movie Review Activity		
DD/MM/YY	Movie Review Discussion		
DD/MM/YY	Constructive Criticism		
DD/MM/YY	Critical Thinking, Rebuttals & Handling Counterarguments		
DD/MM/YY	Self-introduction/Greeting/Meeting people	UNIT-4	10
DD/MM/YY	Self branding (Activities & Simulation Exercises)		
DD/MM/YY	Listening Activities		
DD/MM/YY	Skimming / Scanning / Reading Fluency: Retention and Recall, Interpretation and Inference		
DD/MM/YY	News Paper Reading		
DD/MM/YY	Writing Essentials - Article Writing		
DD/MM/YY	Writing Essentials - Article Reviewing		
DD/MM/YY	Writing Essentials - Email Writing		
DD/MM/YY	Writing Essentials - Email Reviewing		
DD/MM/YY	Reduce MTI (Mother Tongue Interference)	UNIT-5	4
DD/MM/YY	Pronunciation - Activity		
DD/MM/YY	Critical & Creative Thinking Activity		
DD/MM/YY	Voice modulation & clarity practice		
DD/MM/YY	Grammar Rules 1 – Subject Verb Agreement (6 Rules), Active & Passive Voice, Direct & Indirect Speech		
DD/MM/YY	Grammar Rules 2 – Articles, Prepositions & Verbs		
DD/MM/YY	Tenses Rules with Examples		
DD/MM/YY	Spotting Error Questions		
DD/MM/YY	Sentence Correction Questions		
DD/MM/YY	Spotting Error & Sentence Correction (Mixed Questions)		

DD/MM/YY	Contextual Vocabulary Questions – I	UNIT-6	13
DD/MM/YY	Contextual Vocabulary Questions – II		
DD/MM/YY	Cloze Test – Overview		
DD/MM/YY	Cloze Test – Practice Questions		
DD/MM/YY	Sentence Completion Questions		
DD/MM/YY	Para Jumbles Techniques		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Communication Fundamentals & Presentation Recall**	Recall and identify fundamental concepts of professional communication, presentation structure, audience engagement principles, and essential elements of effective message delivery	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Public Speaking & Impromptu Communication Understanding**	Explain principles of public speaking including speech organization, Toastmaster-style communication, audience analysis, confidence-building techniques, and impromptu speaking strategies	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Group Discussion, Debate & Interaction Application**	Apply communication strategies during group discussions, debates, collaborative interaction, rebuttal handling, and structured argument presentation using appropriate verbal and non-verbal communication	CO3 | L3–L4	CA | MTE Sec B | ETE Sec B
TS4	**LSRW Analysis & Critical Communication Interpretation**	Analyze written and spoken communication using listening, speaking, reading, and writing (LSRW) skills; interpret meaning, evaluate arguments, infer context, and respond critically in communication scenarios	CO4 | L4–L5	CA | MTE Sec B | ETE Sec B

TS5	**Pronunciation, Voice & Accent Evaluation**	Evaluate speech clarity, pronunciation accuracy, MTI reduction, voice modulation, tone, stress, intonation, and accent neutralization for professional communication effectiveness	CO5 | L4–L5	CA | ETE Sec B/C
TS6	**Verbal Ability & Professional Language Creation**	Create grammatically accurate, well-structured verbal and written responses using vocabulary, contextual understanding, error correction, comprehension, and professional communication conventions	CO6 | L2–L6	CA | ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M		M	M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Presentation & Public Speaking Activities (Presentation Delivery, Icebreaker Speech, JAM, Extempore, Table Topics)	5 Activities	**10**	CO1, CO2, CO5	TS1, TS2, TS5
Group Discussion, Debate & Interaction Assessment	3 Activities	10	CO2, CO3, CO4	TS2, TS3, TS4
LSRW & Communication Practice Assignments	4 Assignments	**5**	CO4, CO6	TS4, TS6

(Reading, Listening, Writing, Self-branding, Email/Article Writing)				
Verbal Ability & Language Accuracy Tests (Vocabulary, Cloze Test, Error Spotting, Sentence Correction, Comprehension)	2 Tests	**5**	CO5, CO6	TS5, TS6
TOTAL	—	30	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Presentation Skills Fundamentals — Presentation structure, audience engagement, content organization, introduction-body-conclusion framework	CO1	TS1	6h SL	Presentation structure, clarity of ideas, organization, confidence, and delivery effectiveness
Assignment 2	Toastmaster-Style Speaking & Impromptu Communication — Icebreaker speech, voice modulation, stage presence, table topics	CO2	TS2	6h SL	Speech organization, spontaneity, confidence, vocal delivery, body language, and audience engagement
Assignment 3	Group Discussion & Debate Practice — Argument construction, rebuttals, active listening, collaborative interaction	CO2, CO3	TS2, TS3	6h SL	Quality of arguments, participation, listening skills, logical thinking, rebuttal handling, and communication effectiveness
Assignment 4	LSRW Activities — Listening comprehension, newspaper reading, JAM sessions, self-introduction, writing exercises	CO3, CO4	TS3, TS4	6h SL	Interpretation ability, speaking fluency, reading comprehension, writing clarity, grammar, and critical response
Assignment 5	Pronunciation & Verbal Ability — MTI reduction, pronunciation drills, vocabulary, error spotting, sentence correction, cloze tests	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Pronunciation clarity, grammatical accuracy, vocabulary usage, verbal reasoning, fluency, and correctness
Video Resume / Speech Presentation	Professional video resume or recorded speech presentation demonstrating communication, self-branding, and professional interaction	CO1, CO2, CO5	TS1, TS2, TS5	9h SL	Communication clarity, confidence, pronunciation, body language, structure, and professional presentation quality
Case Study / Communication Analysis Report	Analysis of real-world communication scenarios, debates, speeches, workplace communication, or media interaction with structured written report	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Critical analysis, interpretation, language accuracy, communication effectiveness, comparative evaluation, and report quality

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Communication Fundamentals & Presentation Recall TS2 — Public Speaking & Impromptu Communication Understanding	**CO1, CO2**	Short-answer and descriptive questions: define principles of professional communication, explain presentation structure, discuss 7 C's of Communication, describe Toastmaster-style speaking, explain voice modulation, stage presence, audience engagement, and impromptu speaking techniques
Section B	**15**	TS3 — GD, Debate & Interaction Application TS4 — LSRW & Critical Communication Analysis	**CO2, CO3, CO4**	Application and analytical questions: analyze communication scenarios, construct arguments for debate topics, interpret communication caselets, evaluate responses in group discussions, analyze listening/reading passages, writing-based interpretation, and communication effectiveness assessment
TOTAL	30	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 are assessed predominantly in ETE through pronunciation, verbal ability, writing, and language accuracy components.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — covering all 6 units and all 6 COs. The assessment evaluates the complete progression from TS1 (communication fundamentals) through TS6 (verbal ability and professional language creation). The examination measures conceptual understanding, communication application, analytical interpretation, pronunciation awareness, and professional language proficiency. Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	20	TS1 — Communication Fundamentals & Presentation Recall TS2 — Public Speaking & Impromptu Communication Understanding	**CO1, CO2**	Short-answer and conceptual questions from all units: communication principles, presentation structure, 7 C's of Communication, Toastmaster-style speaking, body language, voice modulation, audience engagement, impromptu communication, and professional interaction concepts
Section B	40	TS3 — GD, Debate & Interaction Application TS4 — LSRW & Critical Communication Analysis TS5 —	**CO3, CO4, CO5**	Medium and application-oriented questions: communication scenario analysis, debate/GD response construction, listening and reading comprehension analysis, writing-

		Pronunciation, Voice & Accent Evaluation		based interpretation, pronunciation and MTI analysis, voice modulation evaluation, communication effectiveness assessment, and case-based communication exercises
Section C	20	TS5 — Pronunciation, Voice & Accent Evaluation TS6 — Verbal Ability & Language Creation	**CO5, CO6**	Long-answer and evaluative questions: pronunciation and accent improvement strategies, verbal ability exercises, vocabulary usage, error spotting, sentence correction, cloze tests, comprehension-based writing, professional email/article writing, and language accuracy evaluation
TOTAL	**80**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand fundamentals of professional communication, presentation structure, and message delivery	✓	✓	✓	TS1	PO9, PO10, PO11, PSO1
CO2	Explore public speaking, impromptu communication, voice modulation, and audience interaction	✓	✓	✓	TS2	PO8, PO9, PO10, PO11
CO3	Apply effective communication strategies in group discussions, debates, and collaborative interactions	✓	✓	✓	TS3	PO2, PO8, PO9, PO10
CO4	Analyze spoken and written communication using LSRW skills and critical interpretation	✓	✓	✓	TS4	PO2, PO4, PO9, PO10, PSO2
CO5	Evaluate pronunciation, voice modulation, MTI reduction, and accent clarity for professional communication	✓	—	✓	TS5	PO9, PO10, PO11, PSO2
CO6	Create accurate and structured verbal/written responses using grammar, vocabulary, and verbal ability skills	✓	—	✓	TS6	PO1, PO2, PO10, PO11, PSO3

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1		–	–	–	–	1	2	3	1	2	1	–
CO2	1	2		–	–	–	–	2	2	3	2	2	2	–
CO3	1	2	1	–	–	–	–	3	3	3	2	2	2	1
CO4	1	2	2	1	–	–	–	2	2	3	2	2	3	1
CO5	1	2	2	–	–	–	–	2	2	3	2	2	3	1
CO6	1	2	2	1	1	–	–	2	2	3	3	3	3	2
Avg	1.00	1.83	1.25	1.00	1.00	-	-	2.00	2.17	3.00	2.00	2.17	2.33	1.20

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	M	M						M	H	H	M	H	M	
CO2	M	M						M	H	H	M	M	H	
CO3	M	M	M					H	H	H	M	H	M	M
CO4	M	M	M	M				M	H	H	H	M	H	M
CO5	M	M	M					M	H	H	M	M	H	M
CO6	M	M	H	M	M			M	H	H	H	H	H	M

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria

1	**Presentation Preparation & Practice – Create and record 2 structured presentations (content, delivery, visuals)**	5 presentations × 1.5h each = 7.5h	CO1, CO2, CO3, CO4 TS1, TS2, TS3, TS4	Based on structure, clarity, delivery, and improvement shown
2	**Video Resume Preparation – Students will design and record a professional video resume highlighting their introduction, skills, achievements, and career goals.**	4 versions × 1.5h each = 6h	CO2, CO3, CO5 TS2, TS3, TS5	Based on content structure, clarity of communication, confidence, body language, pronunciation, and overall presentation quality
3	**Listening Practice/LSRW (Audio/Video Based) – Attempt assessments, watch speeches/podcasts and summarize key points for practice.**	4 assessments × 1.5h each = 6h	CO4, CO5, CO6 TS4, TS5, TS6	Based on comprehension, summary quality, and interpretation
4	**Reading & Vocabulary Building – Newspaper Editorial reading, vocabulary exercises, and word usage.**	6 reading sessions × 1.5h each = 9h	CO4, CO6 TS4, TS6	Based on vocabulary usage, understanding, and consistency
5	**Writing Practice - WriteX (Email, Article, Paragraph Writing)**	5 exercises × 1.5h each = 7.5h	CO4, CO6 TS4, TS6	Based on clarity, grammar, structure, and coherence
6	**Verbal Ability Practice – Cloze tests, sentence correction, error spotting, reading comprehension**	6 Practice Tests × 1.5h each = 9h	CO5, CO6 TS5, TS6	Based on accuracy, speed, and correctness
	TOTAL Self-Learning Hours	**45 hours**	CO1–CO6 / TS1–TS6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall communication concepts, terminology, presentation elements, and language fundamentals L2 — Understand: Explain communication principles, speaking techniques, public speaking methods, and verbal concepts L3 — Apply: Apply communication strategies, verbal skills, presentation techniques, and group interaction methods in practical situations	A1 — Receiving: Awareness and willingness to listen, participate, and engage in communication activities A2 — Responding: Active participation in presentations, discussions, debates, and speaking activities A3 — Valuing: Demonstrate confidence, professionalism, communication ethics, and appreciation for effective communication	P1 — Perception: Observing verbal and non-verbal communication cues during presentations and interactions P2 — Set: Mental and physical readiness for speech delivery, public speaking, and communication performance P3 — Guided Response: Practice pronunciation, voice modulation, presentation delivery, and speaking techniques through guided activities

L4 — Analyze: Analyze written and spoken communication, arguments, reading passages, communication scenarios, and audience responses L5 — Evaluate: Evaluate pronunciation, accent, speech clarity, verbal responses, communication effectiveness, and language accuracy L6 — Create: Create structured verbal and written responses, presentations, professional communication artefacts, and original speech content	A4 — Organizing: Integrate communication values, teamwork, professionalism, and collaborative interaction into personal communication style A5 — Characterizing: Internalize professional communication behavior, confidence, and effective interpersonal interaction as consistent traits	P4 — Mechanism: Perform communication tasks, presentations, GDs, and speaking activities with improved fluency and habitual correctness P5 — Complex Overt Response: Demonstrate skilled presentation delivery, debate participation, and fluent communication performance P6 — Adaptation: Modify speaking style, tone, and communication approach according to audience and professional context P7 — Origination: Develop original communication strategies, presentation approaches, and professional expression styles

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (45 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

Professional Communication — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 30 marks + MTE 30 marks + ETE 40 marks = Total 100 marks

School: SSCSE		Batch: 2026-30
Programme: B.Tech.		Current Academic Year: 2026-27
Branch: CSE, IT		Semester: I
1	Course Code	**IKT1001**
2	Course Title	**Fundamentals of Indian Knowledge System**
3	Credits	**Audit/Non-Credit**
4	Contact Hours (L-T-P)	**2-0-0**
	Course Type	**Value Added Course**
5	Course Objective	1. To introduce students to the fundamental principles and introductory aspects of Indian Knowledge Systems (IKS). 2. To recognize the vast corpus of knowledge traditions of India and discuss its evolution through multidisciplinary framework. 3. To encourage students to develop their perspectives in domains such as Vedic Mathematics, Astronomy, Metallurgy, Ayurveda etc. **(SDG 3: Good Health and Well Being & SDG4: Quality Education)** 4. To highlight the importance of indigenous traditions in resolving contemporary issues in various fields.
6	Course Outcomes	Students will be able to: CO1: Explain the geographical, literary and philosophical foundations of India and its knowledge traditions. CO2: Explain the key contributions of Indian Mathematics and Astronomy and trace their influence on modern science and computing. CO3: Interpret the contricutions of Metallurgy and Ayurveda, and develop informed perspectives on their contemporary relevance. **SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education)** CO4: Relate the importance of Indian tradition of spirituality and ethics to modern times. CO5: Examine the significance of indigenous knowledge traditions in addressing contemporary challenges in areas such as health, education, environment, society, and sustainable development. CO6: Apply insights derived from Indian Knowledge Systems to critically reflect on contemporary issues and develop contextually relevant solutions**.**
7	Course Description	This course is an exploration of the Indian Knowledge System (IKS), encompassing its meaning, nature, and scope. Students will engage with the Vedic corpus and other classical texts, interpreting them through their perspectives while developing critical thinking skills. The

		course emphasizes the application of traditional knowledge to contemporary times	
8	**Syllabus**		**CO Mapping**
	Unit 1	**Introduction to Indian Knowledge System**	
	A	• India, that is Bharat: Understanding *Bharatavarsha* — Historical Geography of Bharat, Bharat: a land of rare natural endowments	CO1
	B	• Understanding Indian Knowledge Systems: Nature, Philosophy and Character	CO1
	C	• Understanding the Vedic Corpus: the Vedas; components of the Vedas; Vedangas	CO1
	Unit 2	**Indian Mathematics**	
	A	• Introduction to Vedic Mathematics: Numbers, fractions and geometry in the Vedas. Decimal nomenclature of numbers in the Vedas	CO2
	B	• Zero and Infinity. Constructions from Sulba Sutras. Decimal Place Value System: Simplification of arithmetic operation; Linguistic representation of Numbers	CO2
	C	• Ancient Indian Mathematicians: Baudhayana; Pingala; Aryabhatta, Varahmihira; Bhaskara I & II	CO2
	Unit 3	**Indian Astronomy**	
	A	• Early Astronomical Observations: Celestial observations in the Vedic corpus; Study of *Surya, Candra, Naksatra* and *Graha.*	CO3
	B	• Major Texts of Indian Astronomy: *Vedanga Jyotisa*; *Surya Siddhanta*; *Aryabhatiya Pañcasiddhantika*; *Brahmasphutasiddhanta*, *Tantrasangraha*	CO3
	C	• Astronomical Evidence and Instruments: Inscriptions recording solar and lunar eclipses; Astronomical instruments.	CO3
	Unit 4	***Rasashastra*: Ancient Indian Metallurgy**	
	A	• Introduction to *Rasashastra*: Objectives of *Rasashastra*, Important Substances: Metals and Minerals	CO4
	B	• Important Processes: *Shodhana, Bhavana, Marana, Bhasma*	CO4

	C	• Important Texts: *Rasaratna Samuccaya; Rasendra Mangala*; *Rasa Hridaya Tantra; Rasarnava Ayurveda Prakasha*	CO4
	Unit 5	**Health Sciences of Ancient India**	
	A	• Vedic Foundations of Ayurveda: maintenance of health and treatment of disease. Fundamental concepts: Triguna, Panchamahabhuta and Saptadhatu.	CO5; CO6
	B	• Health, Disease and Preventive Practices: Ayurvedic understanding of the causes of disease and imbalance of *Dosas*. *Dinacarya*; Ritucarya. Food, lifestyle and preventive healthcare in Ayurveda.	CO5; CO6
	C	• Major Texts and Pharmacological Knowledge: Major Ayurvedic texts: *Caraka Samhita*, *Susruta Samhita* and *Ashtangahrdaya*; Indigenous knowledge of medicinal plants and substances.	CO5; CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: 25	ETE: 75 (MCQ Type)
	Readings Text book/s*	• Kapoor, K. & Singh, A.K. (2005) *Indian Knowledge Systems* (Vols. 1–2). New Delhi: D.K. Printworld Pvt. Ltd. • Kapoor, K. (2014/2020) *Comparative Literary Theory: An Overview*. New Delhi: D.K. Printworld (P) Limited. • Kapoor, K., Sheshagiri Rao, K.L. (eds.) (2010/2025) *Encyclopedia of Hinduism* (11 vols.). New Delhi: Indian Heritage Research Foundation & Rupa & Co. • Kapoor, K. (2005) *Text and Interpretation: The Indian Tradition*. New Delhi: D.K. Printworld Pvt. Ltd. • Rajani, M.B. and Kumar, V. (2019) '*Title of article*', *Journal of the Society of Architectural Historians*, 78(4), pp. 392–408.	

		• Muhlberger, S. (1998) *Democracy in Ancient India*. World History of Democracy. Available at: https://uts.nipissingu.ca/muhlberger/histdem/indiadem.htm • Kanungo, A.K. and Dussubieux, L. (2022) 'Indigenous glass manufacture in India: an ethnographic approach', *Journal of Glass Studies*, 64, pp. 225–248. • Sjoman, N.E. (1986) 'The memory eye: an examination of memory in traditional knowledge systems', *Journal of Indian Philosophy*, 14(2), pp. 195–213. doi:10.1007/BF00194196. • Bag, A.K. (1997) *History of Technology in India*, Vol. I. New Delhi: Indian National Science Academy. • Dasgupta, S. (1975) *A History of Indian Philosophy*, Vol. I. Delhi: Motilal Banarsidass. • Dutt, M.N. (2018) *The Mahabharata*. 10 vols. Delhi: Parimal Publications. • Jha, A. (2009) *Traditional Knowledge System in India*. New Delhi: [Publisher not specified]. • Joseph, G.G. (2016) *Indian Mathematics: Engaging with the World from Ancient to Modern Times*. London: World Scientific. • Lal, B.B. (1997) *The Earliest Civilization of South Asia*. New Delhi: Aryan Books International. • Mahadevan, B., Bhat, R.V. and Nagendra Pavana, R.N. (2022) *Introduction to Indian Knowledge System*. Delhi: PHI Learning Private Limited. • Pandey, P.C. (n.d.) *Madhya Himalayi Sanskriti mein Gyan, Vigyan evam Paravigyan*. [Publication details not specified]. • Subbarayappa, B.V. and Sarma, K.V. (1985) *Indian Astronomy: A Source Book*. Mumbai: Nehru Centre.

COURSE ARTICULATION MATRIX:

	POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
	CO1	2	2	3	1	2	1	2	2	1	3	2
	CO2	1	3	2	2	2	2	1	2	1	1	2
	CO3	2	2	2	1	2	1	2	2	3	1	1
	CO4	2	1	1	1	2	3	3	1	2	1	3
	CO5	1	3	3	2	2	1	1	2	2	1	2
	CO6	1	2	2	1	1	2	3	2	2	2	1

Semester 2, Credits: 21	
COURSE CODE	**COURSE NAME**
CSCR1302	Application based Programming in Python
CSCR1504	Design and Creativity Lab
BTT1102	Introduction to Computational Biology
IKT1105	Human Values and Professional Ethics
EEE1101	Basics of Electrical and Electronics Engineering
MTT1214	Probability and Statistics
CSCR1301	Object Oriented Programming Using Java
CVT1103	Environmental Studies
VAC	Value Added Course

COURSE PLAN

Application Based Programming in Python (CSCR1302)

School of Computing Science & Engineering (SSCSE) | B.Tech. CSE | Semester II | Batch 2026–2030

Integrated Course Plan - Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	II

2. Course Details

Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.

S.No	Attribute	Details
1	**Course Code**	CSCR1302
2	**Course Title**	**Application Based Programming in Python**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	2-0-4-2
5	**Course Status**	Core
6	**Course Objective**	This course aims to develop students' problem-solving ability through Python programming and application-based development. The course provides practical exposure to control structures, data structures, functions, object-oriented programming, file handling, modules, and data analysis libraries so that students can design and implement real-world solutions using Python.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs - Assessed via MTE + ETE:** CO1 (Remember/Understand - L1/L2): Identify and classify Python programming constructs including variables, data types, operators, conditional statements, and loops and trace the execution of basic Python programs. CO2 (Apply - L3): Construct and manipulate Python built-in data structures (lists, tuples, strings, sets, and dictionaries) to store, retrieve, and process structured data for given problem scenarios. CO3 (Apply - L3): Write modular Python programs by defining user-defined and anonymous functions with appropriate argument types, and handle runtime exceptions using try-except-finally to produce fault-tolerant applications. CO4 (Apply - L3): Execute file handling operations (read, write, append, CSV, JSON) and integrate standard library modules and third-party packages to extend and modularize Python applications. CO5 (Analyze - L4): Examine and differentiate object-oriented programming constructs like classes, objects, inheritance, encapsulation, and polymorphism by tracing class hierarchies and identifying design choices in given OOP programs.

		CO6 (Create - L6): Construct end-to-end Python solutions that apply NumPy, Pandas, and Matplotlib to load, clean, analyze, and visualize datasets, and implement searching and sorting algorithms to solve real-world computational problems. **LAB COs - Assessed via Laboratory Assessment only:** CO7 (Apply - L3): Set up and operate professional Python development environments (Anaconda, Jupyter Notebook, VS Code/PyCharm, GitHub); execute, test, and document a minimum of 10 lab programs with structured lab records demonstrating correct outputs. CO8 (Apply - L3): Demonstrate adherence to professional coding standards (PEP8), ethical practices (original code, proper attribution), and self-directed learning by completing a reflective skill-assessment log documenting measurable competency growth across the semester CO9 (Create - L6): Design, develop, and demonstrate a Python mini-project that integrates at least three course concepts (data structures, OOP, file handling, or libraries) to address a real-world or socially relevant problem with clearly documented objectives, code, and evaluated outcomes. CO10 (Create – L6): Execute team-based project activities by distributing tasks, using version control (GitHub), and delivering a structured oral/demo presentation within stipulated timelines, demonstrating collaborative problem-solving and communication skills.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. Coding Problems on Replit/Programiz/Colab - Develop 5 small coding-based problems related to Python concepts - 5 problems × 3 hrs = 15 hrs. Based on code correctness, efficiency, and documentation. 2. Virtual Labs (NPTEL): implement complex algorithms for practical problems - Algorithm design & documentation 10 hrs + verification & explanation 5 hrs = 15 hrs. 3. Logical correctness, efficiency, and documentation quality.
11	**Textbooks**	**Textbook:** Reema Thareja - Python Programming: Using Problem Solving Approach (1st Ed.), Oxford University Press. **Reference:** Eric Matthes - Python Crash Course: A Hands-on, Project-based Introduction to Programming, No Starch Press. Reference: Wes McKinney - Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter (3rd Ed.), O'Reilly.
12	**References**	

3. Outline Syllabus - Theory Units with CO Mapping (CO1-CO6)

Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7-CO10).

	Topic / Activity	CO Mapping
Unit 1	**Introduction to Python (6-0-10-4 = 20 hrs)**	
A	Python Environment, Variables, Data Types, Operators	CO1
B	Conditional Statements: if, if-else, nested if-else; Looping: for, while, nested loops	
C	Control Statements: break, continue, pass, comments	
Tools Used	Linux Environment, Python 3.8+, Jupyter Notebook, VS Code/PyCharm, Anaconda Distribution, Online Python compilers (Replit, Trinket, Programiz), Competitive Coding Platforms (Replit/Programiz/Colab)	
Activities	**Objective: To familiarize students with Python programming environment and develop understanding of basic syntax, operators, and control flow structures.** • Installation and configuration of Python environment and IDEs. • Practice basic Python syntax and program structure with print statements	

	• Implementation of arithmetic, logical, relational operators with precedence demonstration. • Creating decision-making programs using if-else, nested if, and switch alternatives Implementing some programs based on mathematical expression with the consideration of associativity and precedence. • Implementing iterative programs using while, for loops, and nested loop patterns. • Writing programs for mathematical computations (factorial, Fibonacci, sum of series). • Pattern printing programs using nested loops. • Solving basic input/output problems on competitive coding platforms.	
Unit 2	**List, Tuple and Dictionaries (6-0-12-6 = 24 hrs)**	
A	Lists and nested lists: introduction, accessing list, operations, working with lists, library functions and methods	CO2
B	Strings and tuples: introduction, access, operations, methods	
C	Sets and dictionaries: introduction, operations, functions, and data access	
Tools Used	Python IDE (PyCharm/VS Code), Jupyter Notebook, Anaconda Navigator, Git/GitHub for version control, Online data structure visualizers	
Activities	**Objective:** To construct and manipulate Python data structures for efficient data storage and retrieval • List operations: creation, slicing, appending, extending, sorting, reversing. • Nested list operations and matrix representation using lists. • String manipulation: slicing, methods (split, join, replace, find), immutability. • Tuple operations: packing/unpacking, nested tuples, tuple methods. • Set operations: union, intersection, difference, symmetric difference. • Dictionary operations: key-value pairs, nested dictionaries, dictionary methods. • Data structure comparison programs (list vs tuple vs set performance). • Implementing common algorithms using appropriate data structures.	
Unit 3	**Functions and Exception Handling (6-0-12-6 = 24 hrs)**	
A	Defining and calling functions, types of functions, function arguments	CO3
B	Anonymous functions, global and local variables	
C	Exception handling using try, except, finally, and user-defined exceptions	
Tools Used	Python IDE with debugger, Jupyter Notebook, pylint code analyzer, Unit testing frameworks (unittest, pytest)	
Activities	**Objective:** To write modular and fault-tolerant Python code using functions and structured exception handling. • Function definition with different parameter types (positional, keyword, default). • Lambda functions for one-liner operations and higher-order functions. • Scope resolution: local vs global variables, nonlocal keyword. • Recursive function implementations (factorial, Fibonacci, GCD). • Exception handling: try-except-finally blocks for different exception types. • Custom exception classes and exception propagation. • Function documentation and type hints practice. • Unit testing basic functions using unittest framework.	
Unit 4	**OOP and File Handling (6-0-14-8 = 28 hrs)**	
A	OOP concepts: class, object, attributes, abstraction, encapsulation, polymorphism, inheritance	CO4, CO5
B	Static and final keyword, access modifiers and specifiers, scope of a class	CO4

C	File handling: introduction and file operations (r, w, a, rb, wb); CSV and JSON handling	CO5
Tools Used	Python IDE with refactoring tools, UML design tools (PyUML, PlantUML), pylint, mypy for static analysis, GitHub for collaboration	
Activities	**Objective:** To examine OOP design structures and execute file-based persistence operations in Python programs. • Class creation with attributes, methods, and special methods (__init__, __str__). • Inheritance hierarchies: single, multiple, multilevel inheritance. • Polymorphism demonstration using method overriding and duck typing. • Encapsulation using private attributes (_var, __var) and property decorators. • File operations: reading (r, rb), writing (w, wb), appending (a), with statement. • CSV file handling using csv module. - JSON file operations using json module. • Context managers and file object best practices.	
Unit 5	**Application Based Programming (6-0-12-6 = 24 hrs)**	
A	Modules and packages: importing module, math module, random module, creating modules	CO5, CO6
B	Introduction to NumPy, Pandas, and Matplotlib	CO6
C	Applications: linear search, binary search, bubble sort, data analysis pipeline	CO6
Tools Used	Anaconda Distribution, Jupyter Notebook, Google Colab, NumPy, Pandas, Matplotlib, Seaborn libraries, Kaggle datasets, UCI ML Repository	
Activities	**Objective:** To construct end-to-end data analysis solutions using Python scientific computing libraries. • NumPy array operations: creation, indexing, broadcasting, vectorization. • Pandas DataFrame operations: loading CSV/Excel, filtering, grouping, merging. • Data cleaning: handling missing values, outliers, data type conversion. • Statistical analysis: mean, median, correlation, group statistics. • Matplotlib basic plotting: line, bar, scatter, histogram, pie charts. • Data visualization best practices and customization. • Algorithm implementations: linear search, binary search, bubble/selection/insertion sort. • Complete data analysis pipeline: load → clean → analyze → visualize.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C	✓	✓				
4	2.A			✓			
5	2.B			✓			
6	2.C			✓			
7	3.A			✓			
8	3.B			✓			
9	3.C			✓			
10	4.A				✓		

11	4.B				✓		
12	4.C			✓			
13	5.A			✓			
14	5.B						✓
15	5.C						✓

5. CO vs Bloom's Taxonomy - All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2			✓															
CO3			✓															
CO4				✓														
CO5			✓					✓										
CO6						✓									✓	✓		
CO7			✓					✓						✓				
CO8						✓									✓	✓		
CO9			✓				✓			✓								
CO10			✓								✓				✓			

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory - 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Python environment setup; identify variables, keywords, data types	Unit 1	6
DD/MM/YY	Classify and trace operator precedence and expression evaluation		
DD/MM/YY	Trace conditional statements: if, if-else, nested if-else		
DD/MM/YY	Trace looping constructs: for, while, nested loops		
DD/MM/YY	Classify control statements: break, continue, pass; comment types		
DD/MM/YY	Revision + Trace execution: Basic Python programs and pattern printing		
DD/MM/YY	Construct and traverse lists; nested list operations	Unit 2	6
DD/MM/YY	Apply list methods and library functions		

DD/MM/YY	Construct and manipulate strings: slicing, methods, immutability		
DD/MM/YY	Construct tuples: packing, unpacking, operations		
DD/MM/YY	Apply set operations: union, intersection, difference		
DD/MM/YY	Construct dictionaries: key-value pairs, nested dicts, methods		
DD/MM/YY	Define and invoke functions: parameter types, return values	**Unit 3**	**6**
DD/MM/YY	Write lambda functions; resolve global and local variable scope		
DD/MM/YY	Write recursive functions: factorial, Fibonacci, GCD		
DD/MM/YY	Write try-except-finally blocks for multiple exception types		
DD/MM/YY	Define custom exception classes; trace exception propagation		
DD/MM/YY	Revision + Write: Functions & Exception Handling programs		
DD/MM/YY	Examine OOP concepts: class, object, attributes, encapsulation	**Unit 4**	**6**
DD/MM/YY	Trace inheritance hierarchies and polymorphism		
DD/MM/YY	Differentiate static methods, access modifiers, class scope		
DD/MM/YY	Execute file operations: read, write, append using with statement		
DD/MM/YY	Execute CSV and JSON file handling operations		
DD/MM/YY	Revision + Trace: OOP class hierarchy problems		
DD/MM/YY	Integrate modules and packages; apply math and random modules	**Unit 5**	**6**
DD/MM/YY	Create custom modules; resolve import paths		
DD/MM/YY	Construct NumPy arrays; apply indexing and mathematical operations		
DD/MM/YY	Construct Pandas DataFrames; execute filter, sort, groupby operations		
DD/MM/YY	Construct Matplotlib charts: line, bar, scatter, histogram		
DD/MM/YY	Implement linear search, binary search, bubble sort; trace execution		

7. Lab Session Plan - List of Experiments (Updated CO7- CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	**Python Environment Setup & Basic Programs:** Install Python 3.8+, configure IDE (PyCharm/VS Code/Jupyter); write “Hello World” with comments; write programs for arithmetic operations (+, −, ×, /, %); use *input()* function for user input (name, age, marks)	**CO7**	3.0
	S-1.2	**Operator Precedence & Type Conversion:** Write programs demonstrating operator precedence; execute explicit/implicit type casting examples; write programs with mixed data types (int+float=float)	**CO7**	
W2	S-2.1	**Decision Making - if-else**: Write grade calculator (marks → A/B/C/D/F); write simple calculator using conditional statements; write BMI calculator with weight categories	**CO7**	3.0
	S-2.2	**Nested Loops & Patterns:** Write programs to print pyramid, diamond, right triangle patterns; write Floyd’s triangle, number patterns; write factorial and sum-of-digits programs using loops	**CO7**	

W3	S-3.1	**List Operations - Real World Applications:** Construct student marks list management programs; write shopping cart using lists; write matrix representation using nested lists	**CO7**	3.0
	S-3.2	**String & Tuple Operations**: Write palindrome checker and anagram detection programs; execute text processing (word count, vowel count); write tuple packing/unpacking applications	**CO7**	
W4	S-4.1	**Set & Dictionary Operations:** Execute set operations: union, intersection, difference; write dictionary-based phonebook/contact management; write dictionary frequency counter	**CO7**	3.0
	S-4.2	**Data Structure Applications:** Construct Student Record Management System (CRUD); write word frequency analyzer from text file; compare data structure performance	**CO7**	
W5	S-5.1	**Functions - Modular Programming:** Write function library for mathematical operations; write programs with positional, keyword, default parameters; write recursive factorial and Fibonacci	**CO7**	3.0
	S-5.2	**Lambda Functions & Variable Scope:** Write lambda functions for sorting and filtering; execute *map()*, *filter()*, *reduce()* applications; trace global/local variable scope	**CO7**	
W6	S-6.1	**Exception Handling – Basic:** Write handlers for divide-by-zero and invalid input; execute multiple exception types with try-except-finally; write file-not-found exception handler	**CO7**	3.0
	S-6.2	**Advanced Exception Handling:** Define custom exception classes (InvalidAgeException); trace exception propagation; write comprehensive error logging system	**CO7**	
W7	S-7.1	**Classes & Objects - Real World Modeling:** Define Student class with attributes and methods; define BankAccount class (deposit, withdraw, balance); define Rectangle class (area, perimeter)	**CO7**	3.0
	S-7.2	**Inheritance & Polymorphism:** Construct Shape hierarchy: Circle, Rectangle extends Shape; trace method overriding; write multiple inheritance example	**CO7**	
W8	S-8.1	**OOP Advanced Concepts:** Write programs demonstrating encapsulation with private attributes (_var, __var); apply property decorators (@property); differentiate class methods and static methods	**CO7**	3.0
	S-8.2	**File Handling Operations:** Execute text file read/write operations; process CSV files using csv module; execute JSON file handling using json module	**CO7**	
W9	S-9.1	**Advanced File Operations:** Write student record management with file persistence; write file merging and splitting utilities; write log file analyzer	**CO7**	3.0
	S-9.2	**Modules & Packages:** Create custom module and import it; apply math module functions; write simulations using random module	**CO7**	
W10	S-10.1	**NumPy Array Operations:** Construct NumPy arrays; apply indexing, slicing, and reshaping; execute mathematical operations on arrays	**CO7**	3.0
	S-10.2	**Pandas DataFrame Basics:** Load CSV/Excel data into DataFrames; execute filtering, sorting, groupby; compute basic statistical measures	**CO7**	
W11	S-11.1	**Data Visualization with Matplotlib:** Construct line plots, bar charts, and histograms; construct scatter plots and pie charts; apply customization and labeling	**CO7**	3.0

	S-11.2	**Searching Algorithms:** Implement linear search and trace execution; implement binary search on sorted arrays; compare performance of both	**CO7**	
W12	S-12.1	**Sorting Algorithms:** Implement bubble sort, selection sort, insertion sort; compare Python's sorted() vs custom implementations; trace time complexity	**CO7**	3.0
	S-12.2	**Data Analysis Pipeline:** Construct complete data analysis workflow; execute dataset loading and cleaning; perform exploratory data analysis	**CO7**	
W13	S-13.1	**Mini Project - Problem Definition & Design:** Teams define real-world Python application (data analysis / OOP-based tool); construct system design using UML; document scope, methodology, and expected outcomes	**CO8**	3.0
	S-13.2	**Mini Project - Development Phase:** Implement and integrate core modules; combine data structures, OOP, and file handling; execute mid-project review and code feedback	**CO8**	
W14	S-14.1	**Ethics, Professionalism & Reflective Practice:** Examine open-source licensing, code plagiarism, data privacy issues; complete self-assessment rubric; write personal learning reflection log measuring competency growth	**CO9**	3.0
	S-14.2	**Skill Self-Assessment & Code Documentation:** Execute peer code review; write docstrings and type hints; apply PEP8 code formatting standards	**CO9**	
W15	S-15.1	**Team Project - Final Integration & Testing:** Integrate full system; execute unit testing and debugging as a team; manage GitHub branches and resolve conflicts	**CO10**	3.0
	S-15.2	**Team Project - Presentation & Viva:** Deliver project demonstrations; respond to individual viva-voce; execute peer evaluation; submit final project report	**CO10**	

Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) - CO1 through CO6

THEORY COs (CO1–CO6) - Assessed exclusively via MTE and ETE only

Six theory skill dimensions - one per Bloom's level L1–L6 - correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment

TS1	**Identification of syntax elements & Classification of Data Types**	Identify Python syntax elements, classify data types, keywords, and built-in constructs; trace program output for simple programs	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Construction of programs & Manipulation**	Construct Python programs using data structures (lists, tuples, sets, dictionaries); apply built-in methods for data processing.	CO2 | L3	MTE Sec A | ETE Sec A
TS3	**Modular Writing & Fault Tolerance**	Write modular programs using functions with varied argument types; write exception-handling blocks for specified error scenarios	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Examination and Differentiation**	Examine class hierarchies; differentiate OOP constructs (inheritance types, access specifiers); trace method resolution in given programs	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Execution & Integration**	Execute file I/O operations; integrate standard and third-party modules to build extended applications	CO5 | L3	ETE Sec B/C
TS6	**End-to-End Construction**	Construct complete data analysis solutions using NumPy, Pandas, and Matplotlib; implement searching and sorting algorithms with documented complexity	CO6 | L6	ETE Sec C

9. Theory Assessment Structure - MTE and ETE

9.1 Mid Term Examination (MTE) - 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1, TS2	**CO1, CO2**	Short answer: Identify and classify Python constructs, trace/predict output of basic programs
Sec B	**6**	TS3, TS4	**CO3, CO4**	Program writing: Construct programs using data structures, write functions and exception handlers
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–4 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) - 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1, TS2	**CO1, CO2**	Short questions: Identify, classify, construct across all units
Sec B	**50**	TS3, TS4, TS5	**CO3, CO4, CO5**	Descriptive/program writing: Write functions, examine OOP designs, execute file operations
Sec C	**25**	TS5, TS6	**CO5, CO6**	Long/design questions: Construct complete Python programs using libraries; implement algorithms
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme - Overview

Component	Weightage	Marks	COs Assessed

Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation - no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) - Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each - assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection - all 4 Lab COs (CO7–CO10)
TOTAL	-	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each - Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 - Problem definition: attributes, metrics, success criteria CA2 - Experimental design and tool configuration CA7 - Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 - Execution correctness; output matches expected CA4 - Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 - Output analysis and result interpretation CA6 - Documented outcome with verification CA8 - Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 - Documentation ethics, responsible practice PO7 - Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks - All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 - SDG mapping; societal relevance P2 - Problem scope and stakeholder requirements P4 - Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 - Timeline, milestones, resource planning P11 - Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 - Professional toolchain selection P6 - Complete project build and integration P7 - System commissioning and operational testing	2: Fully operational | 1-1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 - Measurable outcome vs stated goals P9 - Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 - Communication plan and testing strategy P10 - Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 - Skill growth mapping (pre/post project) P13 - Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7- CO10)		

12. CA Skill Dimensions (8 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	State the problem clearly; identify inputs, expected outputs, and constraints	CO7
CA2	**Experimental Design & Tool Setup**	Plan solution approach; sketch algorithm/flowchart before coding	CO7
CA3	**Code Implementation & Execution**	Operate JDK, IDE, debugger, and Linux CLI with accuracy	CO7
CA4	**Computational Efficiency & Optimization**	Compile, run, and verify programs against all test cases	CO7
CA5	**Output Analysis & Result Interpretation**	Assess alternate approaches; justify chosen solution on efficiency grounds	CO8
CA6	**Documented Outcome with Verification**	Annotate outputs; trace variable values; provide inferences	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Develop modular, reusable solutions addressing societal/real-world contexts	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Submit complete, formatted record; respond correctly to viva questions	CO7, CO9

13. Project Skill Dimensions (13 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Identify and document how the project addresses at least one SDG (e.g., SDG 4, SDG 8, SDG 9)	CO8 | PO6
P2	Problem Scoping & Requirements	Define problem statement, scope, objectives, and constraints in a structured document	CO8 | PO2
P3	Communication & Testing Strategy	Produce class diagrams and architecture diagrams; justify design decisions	CO10 | PO9
P4	Innovative Solution Proposal	Develop the project in clearly separated, reusable Java modules	CO8 | PO3
P5	Professional Toolchain	Use IDE, version control (Git), and build tools professionally	CO7 | PO5
P6	End-to-End Implementation	Execute structured test cases; document results and inferences	CO7, CO8 | PO3
P7	System Commissioning & Testing	Implement robust error/exception handling in all critical modules	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Maintain naming conventions, comments, and clean code standards throughout	CO8 | PO6
P9	Critical Analysis & Reporting	Acknowledge sources; avoid plagiarism; adhere to coding standards	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Complete peer and self-evaluation rubrics; identify personal skill gaps	CO10 | PO9, PO11
P11	Financial Feasibility & Planning	Demonstrate equitable task distribution and documented team coordination	CO10 | PO10
P12	Individual Skill Growth Mapping	Deliver a structured 10-min demonstration; respond to evaluator questions	CO9 | PO10
P13	Professional Attitude, Ethics & Responsibility	Maintain a project plan; meet milestones; submit deliverables on schedule	CO9 | PO11

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping - confirming strict assessment separation.

Theory COs (CO1–CO6) have NO CA alignment - confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).

Theory COs (CO1–CO6) have NO project alignment - confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2		H	M																								
CO3		M	H																								
CO4				H	M																						
CO5					H	M																					
CO6						H																					
CO7			M				H	H	H	H	H	H	M	H					M		M						
CO8					M	H	H	H	M	H	H	H	H	M	H	H	H	H	H	H	H	H					
CO9		M										M					M									H	H
CO10																M	H		M					H	H		

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO-PO and CO-PSO Mapping Matrix (All 10 COs)

Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	-	-	-	-	2	3	2	—
CO2	2	2	-	-	1	-	-	-	-	-	2	2	2	1
CO3	2	2	1	-	1	-	-	-	-	-	2	2	2	1
CO4	2	2	2	1	1	-	-	1	-	-	1	2	3	1
CO5	2	1	1	-	2	-	-	-	-	-	1	1	2	2
CO6	2	2	2	1	2	1	-	1	1	-	1	2	3	2
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	2	–	–	–	3	–	1	2

CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	2.17	1.57	1.66	1.00	1.62	1.5	2.00	1.66	2.00	1.00	1.75	2.00	2.30	1.54

PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.

16. CO × PO Alignment Map (H/M Indicators - All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H										M
CO2	M	M									M
CO3	M	M									M
CO4	M	M	M								
CO5	M				M						
CO6	M	M	M		M						
CO7	M				H						M
CO8	M	M	M		M	M		M			M
CO9						M	H		M		H
CO10								H	H	M	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Directly develops computational thinking, Python programming literacy, and measurable problem-solving skills through application-based programming (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Builds industry-relevant skills (NumPy, Pandas, data analysis, OOP) aligned with software development and data science career paths, (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables construction of data analysis pipelines, digital tools, and Python applications supporting modern IT infrastructure (CO10).
SDG 17	Partnerships for the Goals	2 (Moderate)	Supports collaborative learning through team mini-projects, peer code reviews, and open-source library usage (CO9, CO7).

18. Bloom's Taxonomy - Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain - Simpson (7 Levels)
L1 - Remember: Recall facts, definitions, basic concepts L2 - Understand: Explain ideas, concepts, principles L3 - Apply: Use knowledge to solve new problems	A1 - Receiving: Awareness, willingness to attend A2 - Responding: Active participation and reaction A3 - Valuing: Showing commitment, assigning value	P1 - Perception: Sensory cues guide motor activity P2 - Set: Mental, physical readiness to act P3 - Guided Response: Basic practice through imitation P4 - Mechanism: Habitual correct performance

L4 - Analyze: Break down information, examine patterns L5 - Evaluate: Judge, justify, assess, make decisions L6 - Create: Design, develop, produce new solutions	A4 - Organizing: Integrating values into personal system A5 - Characterizing: Internalized value system	P5 - Complex Overt Response: Skilled performance P6 - Adaptation: Modify skills for special situations P7 - Origination: Create new solution patterns

OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains - Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) - reflecting the skill-based nature of laboratory and project assessment.

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

Application based Programming in Python INTEGRATED COURSE PLAN - MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Design and Creativity Lab (CSCR1504)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester II | Batch 2026–2030
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2025–2029
Program:	B.Tech	**Current Academic Year:**	2025–26
Branch:	CSE	**Semester:**	II
Course Code:	CSCR1504	**Course Type:**	Core — Lab Only

2. Course Details

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.

1	**Course Code**	CSCR1504
2	**Course Title**	**Design and Creativity Lab**
3	**Credits**	2
4	**Contact Hours (L-T-P-SL)**	0-1-2-1 (Tutorial: 15 hrs | Lab: 30 hrs | Self Learning: 15 hrs | Total: 60 hrs)
5	**Course Status**	Core — Lab Only (No Theory Lecture Component)
6	**Course Objectives**	Students will be able: 1. To equip students with the knowledge and skills to solve complex problems through a human-centered, iterative approach. 2. To focus on fostering creativity, empathy, and collaboration while guiding students through the stages of design thinking to develop impactful solutions. 3. To ideate, prototype, and implement innovative ideas in real-world contexts.
7	**Course Outcomes (COs)**	After successful completion of this course, the students will be able to: **CO1 (Remember– L1):** Understand the design thinking process. **CO2 (Understand – L2):** Conduct user-centered research **CO3 (Apply– L3):** Develop and evaluate creative ideas. **CO4 (Analyze – L4):** Build and test prototype. **CO5 (Evaluate – L5):** Communicate and pitch innovative solutions. **CO6 (Create – L6):** Transform innovation into actionable plans.
8	**Course Description**	This course will equip students with the knowledge and skills to solve complex problems through a human-centered, iterative approach. It focuses on fostering creativity, empathy, and collaboration while guiding students through the stages of design thinking to develop impactful solutions. By the end of the course, students will be able to ideate, prototype, and implement innovative ideas in real-world contexts.

9	**Teaching & Learning Scheme**	Lab Instructions (LI): 30 hrs | Tutorial (T): 15 hrs | Self Learning (SL): 15 hrs | Total: 60 hrs | Credits: 2
10	**Mode of Examination**	Lab Only. CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
11	**Self Learning (SL: 15 hrs)**	Case Study Analysis of Innovative Products/Services (e.g., analyzing design thinking application in real-world solutions), User Research Activity (Conduct interviews/observations and prepare empathy map for a chosen problem), Ideation Exercise (Brainstorming and generating multiple solutions for a selected problem statement), Prototype Design (Create low-fidelity prototype such as sketches, storyboards, or paper models)
12	**Textbook**	1. Falk Uebernickel, Li Jiang & Walter Brenner, *Design Thinking: The Handbook.* 2. Christian Müller-Roterberg, *Design Thinking For Dummies*
13	**References**	1. Larry J. Leifer, Michael Lewrick & Patrick Link, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods 2. Alyssa Gallagher & Kami Thordarson, Design Thinking in Play: An Action Guide for Educators

3. Outline Syllabus — Lab Units with CO Mapping

ℹ All CO mappings refer to Lab COs (CO1–CO6). This is a lab-only course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit-1: Introduction to design thinking (0-4-8-4 = 16hrs)	
A	Basic Introduction, Design Thinking vs Traditional Problem Solving	**CO1**
B	Key Principles of Design Thinking, stages of design thinking	**CO1**
C	Introduction to innovation, types of innovations	**CO1**
	Unit-2: Empathizing and problem definition (0-3-6-3 = 12hrs)	
A	Research types, primary research (observe, interview, immerse), secondary research (prior art), online research, past facts and figures.	**CO2**
B	Empathy tools: beginner's mind, fly on the wall, AEIOU, Empathy map, 5W&H, 5Why	**CO3**
C	Problem articulation, how might we (HMW), Problem Definition	**CO3**
	Unit 3: Ideation (0-4-8-4 = 16hrs)	
A	Ideation, brainstorming techniques, Double diamond design process, what if	**CO3**
B	Group ideation, encouraging diverse perspective	**CO3**
C	Prioritizing and evaluating ideas	**CO3**
	Unit 4: Prototyping and testing (0-2-4-2 = 8 hrs)	
A	Why to prototype, stages of prototype, benefits of a prototype	**CO4**
B	Types of prototypes, Low fidelity prototype, high fidelity prototype,	**CO4**
C	prototype testing, gathering feedback, iteration and refinement	**CO4**
	Unit 5: Business Modeling (0-2-4-2=8hrs)	
A	Definition, types of business model,	**CO5, CO6**
B	Value proposition canvas, business model canvas	**CO5, CO6**
C	Startup pitch template, case study	**CO5, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No.	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✔	✔				
2	1.B	✔	✔	✔	✔		
3	1.C	✔	✔	✔	✔		
4	2.A		✔	✔	✔		
5	2.B		✔	✔	✔	✔	
6	2.C		✔	✔	✔	✔	✔
7	3.A		✔	✔	✔	✔	✔
8	3.B		✔	✔	✔	✔	✔
9	3.C			✔	✔	✔	✔
10	4.A	✔	✔	✔			
11	4.B		✔	✔	✔		
12	4.C		✔	✔	✔	✔	✔
13	5.A	✔	✔	✔			
14	5.B		✔	✔	✔	✔	✔
15	5.C		✔	✔	✔	✔	✔

5. CO vs Bloom's Taxonomy — All Three Domains

i Only strong/dominant alignments are mapped. Lab COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)						Psychomotor (P1–P7)					
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓						✓						✓					
CO2		✓					✓	✓					✓	✓				
CO3			✓					✓	✓					✓	✓			
CO4				✓					✓						✓	✓		
CO5					✓				✓	✓	✓				✓	✓	✓	
CO6										✓						✓	✓	✓
	Legend: ✓= Strong / Dominant mapping only.																	

6. Lab Session Plan — List of Experiments

🔬 **W1–W12: Core experiments developing CO1–CO5 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO6 design, optimisation, and integration experiments — all assessed under CA and CE.**

Week	Session	Experiment	Lab CO	Marks

W1	**S-1.1**	Introduction to Design Thinking	**CO1**	3.0
	S-1.2	Need for Design Thinking	**CO1**	
W2	**S-2.1**	Design Thinking vs Traditional Problem Solving	**CO1**	3.0
	S-2.2	Key Principles of Design Thinking	**CO1**	
W3	**S-3.1**	Human-Centered Design	**CO1**	3.0
	S-3.2	Stages of Design Thinking	**CO1**	
W4	**S-4.1**	Empathize Stage	**CO2**	3.0
	S-4.2	Define Stage	**CO2**	
W5	**S-5.1**	Ideate Stage	**CO3**	3.0
	S-5.2	Prototype Stage	**CO3**	
W6	**S-6.1**	Test Stage	**CO3**	3.0
	S-6.2	Introduction to Innovation	**CO3**	
W7	**S-7.1**	Importance of Innovation	**CO4**	3.0
	S-7.2	Types of Innovation	**CO4**	
W8	**S-8.1**	Incremental Innovation	**CO4**	3.0
	S-8.2	Disruptive Innovation	**CO4**	
W9	**S-9.1**	Research Methods Overview	**CO4**	3.0
	S-9.2	Primary Research Techniques	**CO4**	
W10	**S-10.1**	Observation Method	**CO5**	3.0
	S-10.2	Interview Method	**CO5**	
W11	**S-11.1**	Immersion Technique	**CO5**	3.0
	S-11.2	Secondary Research	**CO5**	
W12	**S-12.1**	Prior Art Study	**CO6**	3.0
	S-12.2	Stages of Prototype Development	**CO6**	
W13	**S-13.1**	Low Fidelity Prototypes	**CO6**	3.0
	S-13.2	High Fidelity Prototypes	**CO6**	
W14	**S-14.1**	Prototype Testing and Feedback	**CO6**	3.0
	S-14.2	Iteration and Refinement	**CO6**	
W15	**S-15.1**	Business Model Canvas and Startup Pitch Template	**CO6**	3.0
	S-15.2	Stages of Prototype Development	**CO6**	

i Instructions: Write programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.

PART II LAB ASSESSMENT FRAMEWORK *CA Rubric, CE Structure, ESE Pattern, Lab Skill Dimensions*

7. Lab Skill Dimensions (LS1–LS8)

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE).

Eight Lab Skill Dimensions — mapping progressively from L3 to L6 — correspond to the six COs. They define exactly what competency is measured in each component of CA, CE, and ESE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
LS1	Design Thinking Comprehension	Ability to understand the concepts, principles, stages, and importance of Design Thinking and innovation.	CO1 | L3	CA | CE Sec A
LS2	User-Centered Research & Empathy Skills	Ability to perform primary and secondary research using observation, interviews, immersion, empathy maps,	CO1–CO3 | L3	CA | CE Sec A
LS3	Problem Identification & Definition	Ability to analyze user needs, articulate problems, and frame effective “How Might We (HMW)” statements.	CO4 | L4	CA | CE Sec B
LS4	Ideation & Creative Thinking	Ability to generate innovative ideas through brainstorming, double diamond process, what-if analysis, and group ideation activities.	CO5 | L5	CA | CE Sec B| ESE Sec B
LS5	Idea Evaluation & Decision Making	Ability to prioritize, compare, evaluate, and select feasible solutions based on design and innovation requirements.	CO3–CO5 | L4	CA | ESE Sec B
LS6	Prototype Development Skills	Ability to create low-fidelity and high-fidelity prototypes demonstrating practical implementation of ideas.	CO1–CO5 | L3	CA (Lab Record)
LS7	Testing, Feedback & Iterative Refinement	Ability to test prototypes, gather user feedback, refine solutions, and improve outcomes iteratively.	CO4, CO6 | L4–L6	CA | ESE Sec B/C
LS8	Business Modeling & Innovation Communication	Ability to develop business models using Value Proposition Canvas and Business Model Canvas, and effectively communicate solutions through startup pitches and case studies.	CO6 | L6	CE Sec C | ESE Sec C

8. CO × Lab Skill Dimension Mapping (6 COs × 8 Dimensions)

Each CO maps primarily to one or two LS dimensions (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this lab course.

CO	LS1 Research & Empathy	LS2 Problem Definition	LS3 Ideation & Creativity	LS4 Idea Evaluation	LS5 Prototyping	LS6 Testing & Refinement	LS7 Communication & Pitching	LS8 Business Modeling
CO1	H	M						
CO2	H	H						
CO3	M	M	H	M				

CO4		M	M	H	H	M		
CO5			M	H	M	M	H	
CO6			M	M			H	H

H = High / Primary M = Medium / Secondary Blank = No direct alignment

9. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	**30**	All Lab COs: CO1–CO6 | LS1–LS7 | Per-experiment rubric
Course Examination (CE)	30%	**30**	CO1–CO6 | LS1–LS8 | Practical + Viva
End Semester Examination (ESE)	40%	**40**	CO1–CO6 | LS4–LS8 | Program writing + Analysis + Design
TOTAL	**100%**	**100**	All COs assessed across all three instruments

10. Continuous Assessment (CA) — 30 Marks

10.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Lab Skill Dimensions Covered	Marking Guide	Lab CO
Research & Problem Understanding	1	LS1 — Research & Empathy LS2 — Problem Definition	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO1–CO4
Ideation & Solution Development	1	LS3 — Ideation & Creativity LS4 — Idea Evaluation	1.0: Correct & runs | 0.5: Minor errors | 0: Does not compile	CO1–CO5
Prototype Development & Testing	0.75	LS5 — Prototyping LS6 — Testing & Refinement	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO3–CO5
Communication & Professional Conduct	0.25	LS7 — Communication & Pitching LS8 — Business Modeling	0.25: Consistent | 0.10: Occasional | 0: Absent	CO6
Total	**3.0**	All 8 LS dimensions covered		CO1–CO6

10.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
>10	Best 10	**30 Marks**	Best 10 of all sessions (3 marks × 10 = 30)
< 10	All attended	**≤ 30 Marks**	Each missed session = zero; cannot be compensated

11. Continuous Evaluation (CE) — 30 Marks

ℹ CE is a mid-point practical examination covering Units 1–3 (CO1–CO3). CO4, CO5, and CO6 are assessed in ESE only. CE maps to LS1–LS5.

Section	Marks	Lab Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	LS1 — Design Thinking Comprehension LS2 —	CO1, CO2	Conduct empathy analysis, identify user problems, apply research techniques, and

		Research & Empathy Skills		explain findings using suitable empathy tools.
Sec B	10	LS3 — Problem Identification LS4 — Ideation & Creative Thinking LS5 — Idea Evaluation	CO2, CO3, CO4	Generate innovative ideas using brainstorming/HMW methods, compare alternatives, prioritize solutions, and justify selected ideas.
Sec C (Viva)	10	LS6 — Prototype Development LS7 — Testing & Refinement	CO3–CO5	Prototype demonstration, testing approach, feedback interpretation, iterative improvement, and viva questions based on practical activities.
TOTAL	**30**	**LS1–LS7**	**CO1–CO5**	**Units 1–4 covered. CO6 assessed primarily in ESE/project-based activities.**

12. End Semester Examination (ESE) — 40 Marks

ℹ ESE is comprehensive — all 5 units and all 6 COs. Full progression from LS2 (implementation) through LS8 (innovation). Minimum 16/40 required to pass.

Section	Marks	Lab Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	LS1 — Design Thinking Comprehension LS2 — Research & Empathy Skills LS3 — Problem Identification	CO1, CO2, CO3	Analyze user problems, apply empathy tools, define problem statements, and demonstrate understanding of Design Thinking stages and innovation concepts.
Sec B	20	LS4 — Ideation & Creative Thinking LS5 — Idea Evaluation LS6 — Prototype Development	CO3, CO4, CO5	Generate and evaluate innovative ideas, perform brainstorming/HMW activities, design prototypes, and justify selected solutions using structured reasoning.
Sec C	10	LS7 — Testing & Refinement LS8 — Business Modeling & Innovation Communication	CO5, CO6	Prototype testing, feedback analysis, iteration strategies, business model canvas preparation, startup pitch presentation, and innovation communication.
TOTAL	**40**	LS2–LS8 (all)	CO1–CO6	Minimum 16/40 to pass. Scaled from 100-mark paper if needed.

12.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	LS Dims	PO Primary
CO1	Understand the design thinking process.	✓	✓	✓	LS1, LS2, LS6	PO1, PO2, PO5
CO2	Conduct user-centered research	✓	✓	✓	LS2, LS6	PO1, PO3
CO3	Develop and evaluate creative ideas.	✓	✓	✓	LS2, LS3, LS5, LS6	PO1, PO2, PO3
CO4	Build and test prototype.	✓	—	✓	LS3, LS4, LS5, LS7	PO1, PO2, PO3
CO5	Communicate and pitch innovative solutions.	✓	—	✓	LS4, LS5, LS7	PO1, PO2, PO8, PO9, PO10
CO6	Transform innovation into actionable plans.	✓	—	✓	LS7, LS8	PO1, PO2, PO10, PO11

⚠ CO4 and CO5 are NOT assessed in CE (only Units 1–3 are covered at the course examination). They are assessed in CA (lab sessions) and ESE.

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

13. CO–PO and CO–PSO Mapping Matrix

ℹ Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	1		1	-	-	-	2	-	-
CO2	3	3	3	3	3	-		-	2	2	2	2	-	-
CO3	3	2	2	2	3	2		-	-	2	3	2	-	-
CO4	3	3	3	3	3	2		2	2	2	3	3	-	-
CO5	2	2	2	2	2	3		2	-	3	2	2	-	-
CO6	3	2	3	2	3	3		2	3	3	2	2	-	-
Avg	**2.83**	**2.33**	**2.500**	**2.4**	**2.8**	**2.2**	**0**	**1.75**	**2.25**	**2.80**	**2.00**	**2.20**	**0**	**0**

14. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M	-	-	L		L	-	-	-	M	-	-
CO2	H	H	H	H	H	-		-	M	M	M	M	-	-
CO3	H	M	M	M	H	M		-	-	M	H	M	-	-
CO4	H	H	H	H	H	M		M	M	M	H	H	-	-
CO5	M	M	M	M	M	H		M	-	H	M	M	-	-
CO6	H	M	H	M	H	H		M	H	H	M	M	-	-

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

ℹ OBE Compliance Statement: This is a lab-only course. All 6 COs span all three domains — Cognitive (L3–L6) as the primary domain, Psychomotor (P3–P6) for implementation and design skills, and Affective (A2–A4) for professional and collaborative conduct — reflecting the skill-based, hands-on nature of laboratory assessment.

16. Attendance Policy & Pass/Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Lab / Practical Sessions	**75%**	All lab sessions	Debarred from ESE if below threshold
Self-Learning Submissions	All activities	SL activities (15 hrs — coding problems)	Incomplete SL affects CA score directly

⚠ *Lab attendance must meet 75% minimum. Missing SL activities (coding platform submissions) directly impacts CA marks and is not compensable by examination performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 16 / 40**	**MANDATORY**	40% of ESE marks required; failing ESE means failing the course regardless of CA + CE performance
Overall Total (CA + CE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 30 + CE 30 + ESE 40 = 100; 40% overall minimum required

(-------) — LAB-ONLY COURSE PLAN — MEASUREMENT ARCHITECTURE
11 Programme Outcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments → 8 Lab Skill Dimensions (LS1–LS8)
CO1–CO3: Apply/Analyse → LS1–LS3, LS6 → CA + CE + ESE
CO4–CO5: Analyse/Evaluate → LS3–LS5, LS7 → CA + ESE
CO6: Create → LS7–LS8 → CA + ESE Sec C
Marks: CA 30 + CE 30 + ESE 40 = Total 100

COURSE PLAN

Introduction to Computational Biology (BTT1102)

School of Engineering & Technology (SET) | B.Tech CSE | Semester IV | Batch 2018–2022

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SET — School of Engineering & Technology	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	II
Course Code:	BTT1102	**Course Type:**	Core — Theory Only

2. Course Details

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

S.No	Attribute	Details
1	**Course Code**	BTT1102
2	**Course Title**	Introduction to Computational Biology
3	**Credits**	2
4	**Contact Hours (L-T-P-SL)**	2-0-0-2 (Theory: 30 hrs Classroom + 30 hrs Self Learning = 60 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Introduction of fundamental biological concepts and their applications in computational sciences, bioinformatics, and artificial intelligence (AI). 2. It provides computer science students with an understanding of how biology integrates with modern technological advancements. 3. It allows to use of AI in big data analysis, and nanotechnology. 4. It provides concept of using AI for modern disease detection, diagnostics and agricultural biotechnology.

7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Understand the fundamental principles of biology and their relevance to computational sciences. CO2 (Explore – L2/L3): Analyze the molecular basis of biological systems and their computational modeling. CO3 (Apply – L3): Examine genetic principles and their applications in AI and machine learning. CO4 (Analyze – L4/L5): Explore AI-driven medical and agricultural biotechnologies. CO5 (Analyze – L4/L5): Investigate the role of bioinformatics in modern biology and healthcare. CO6 (Analyze – L2/L4): Apply computational tools for genomics, drug discovery, and disease modeling.
8	**Course Description**	This course covers essential biological principles from a computational perspective, focusing on applications in bioinformatics, AI-driven medical research, and systems biology. Topics include molecular biology, genetic algorithms, AI applications in genomics, and the role of computational modeling in disease prediction and drug discovery. The course integrates interdisciplinary approaches to solving biological problems using modern technological tools.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 30 hrs | Self Learning (SL): 30 hrs | Total: 60 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). Molecular Biology of the Cell. Garland Science, USA. 2. Lesk, A. M. (2019). Introduction to Bioinformatics. Oxford University Press, UK. 3. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, USA. 4. Baldi, P., & Brunak, S. (2001). Bioinformatics: The Machine Learning Approach. MIT Press, USA. 5. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments. Wiley, USA.
12	**References**	1. Alberts, B. et al. Essential Cell Biology, 2018 Garland Publishing, Inc. (ISBN: 081533480X) 4.

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MSE, and ESE.*

	Topic	CO Mapping
Unit 1	**Introduction to Biology and Computational Biology**	

A	Characteristics of living organisms	CO1, CO6
B	Cell theory; Structure of Prokaryotic and Eukaryotic Cells	CO1, CO6
C	Introduction to Computational Biology and its interdisciplinary applications	CO1, CO6
Unit 2	**Biomolecules and Computational Biology**	
A	Introduction to Biomolecules	CO1, CO2
B	Amino acid, Overview of protein structure: Primary, secondary, tertiary, and quaternary structures	CO1, CO2, C06
C	Bioinformatics tools and techniques for analyzing biological datasets from large-scale data,	CO1, CO2, C06
Unit 3	**Introduction to Biological databases and their applications**	
A	Nucleic acid sequence databases-GenBank, EMBL, DDBJ	CO1, CO3
B	Protein sequence databases-UniProt, TrEMBL, GenPept	CO1, CO2, CO3, CO6
C	Structural databases – PDB, NDB, PubChem, and Zinc	CO1, CO2, CO3, CO6
Unit 4	**AI in Medical Biotechnology**	
A	Genetic Diseases and Personalized Medicine	CO1, CO4
B	Applications of AI in Gene therapy	CO1, CO2, CO3, CO4, CO6
C	Cancer: Causes, Diagnostics, and Role of Computational Biology in Treatment	CO1, CO2, CO3, CO4, CO6
Unit 5	**AI in Biotechnology**	
A	Artificial Intelligence in Biotechnology: AI in Genomics and Precision Medicine	CO1, CO2, CO5, CO6
B	AI in Agriculture: Precision Farming, Crop Monitoring, and Automated Disease Detection, Robotics	CO1, CO2, CO5, CO6

C	AI in Bioinformatics: Big Data Analysis in Genomics and Proteomics	CO1, CO3, CO4, CO5, CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C	✓	✓				
4	2.A		✓	✓			
5	2.B	✓	✓	✓			
6	2.C		✓	✓			
7	3.A	✓	✓	✓			
8	3.B		✓		✓		
9	3.C		✓		✓	✓	
10	4.A	✓	✓				
11	4.B		✓	✓			
12	4.C			✓	✓	✓	
13	5.A	✓	✓		✓		
14	5.B			✓	✓		
15	5.C		✓	✓		✓	

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓															
CO3			✓	✓	✓			✓										
CO4				✓	✓	✓				✓								
CO5					✓			✓	✓							✓		
CO6	✓		✓	✓						✓								

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 30 Lectures / 30 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Characteristics of living organisms	UNIT-1	4
DD/MM/YY	Cell theory		
DD/MM/YY	Structure of Prokaryotic and Eukaryotic Cells		
DD/MM/YY	Introduction to Computational Biology and its interdisciplinary applications		
DD/MM/YY	Introduction to Biomolecules	UNIT-2	6
DD/MM/YY	Types of Amino acid, amide bonds		
DD/MM/YY	Overview of protein structure: Primary, secondary, tertiary, and quaternary structures		
DD/MM/YY	Types of Bioinformatics tools from large-scale data		
DD/MM/YY	Biological datasets		
DD/MM/YY	Techniques for analyzing biological datasets		
DD/MM/YY	Concept of Nucleic acid databases	UNIT-3	8
DD/MM/YY	Role of different types of Nucleic acid sequence databases-GenBank		
DD/MM/YY	EMBL, DDBJ		
DD/MM/YY	Concept of Protein sequence databases		
DD/MM/YY	Uses of UniProt, TrEMBL		
DD/MM/YY	GenPept Structural databases		
DD/MM/YY	Structural databases – PDB		
DD/MM/YY	Deadlock Detection & Recovery Algorithms		

DD/MM/YY	Concept of Genetic Diseases	UNIT-4	6
DD/MM/YY	Concept of gene therapy, Personalized Medicine		
DD/MM/YY	Introduction of cancer		
DD/MM/YY	Types of cancer and Diagnostics		
DD/MM/YY	Role of AI in cancer detection and treatment		
DD/MM/YY	Artificial Intelligence in Biotechnology		
DD/MM/YY	Artificial Intelligence in Biotechnology	UNIT-5	6
DD/MM/YY	AI in Genomics and Precision Medicine		
DD/MM/YY	AI in Agriculture Precision Farming, Crop Monitoring		
DD/MM/YY	AI in Automated Disease Detection, Robotics		
DD/MM/YY	AI in Bioinformatics: Big Data Analysis in Genomics		
DD/MM/YY	AI in Bioinformatics: Big Data Analysis in Proteomics		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MSE, and ESE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Conceptual Recall & OS Identification**	Recall fundamental OS terminology, types, structures, and functional components; identify	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A

		the appropriate OS type or mechanism for a given computing scenario		
TS2	**Conceptual Explanation & Process Interpretation**	Explain process management concepts including process states, IPC, synchronization mechanisms, and scheduler types; interpret and describe working of concurrency solutions	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Algorithmic Application & Implementation**	Apply CPU scheduling, deadlock handling, and memory management algorithms to compute correct outcomes for given inputs; trace algorithm execution step-by-step	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Algorithmic Analysis & Performance Evaluation**	Analyze the effectiveness and efficiency of scheduling and resource management algorithms; compare performance on given criteria; evaluate trade-offs between competing approaches	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	**Memory System Analysis & Virtual Memory Evaluation**	Analyze memory management strategies including paging, segmentation, virtual memory, and page replacement algorithms; evaluate performance metrics such as page fault rate and turnaround	CO5 | L4–L5	ETE Sec B/C
TS6	**File System & Disk Management Evaluation**	Analyze file system structures, directory organizations, I/O modes, and disk scheduling algorithms; evaluate comparative efficiency; apply techniques to case study contexts	CO6 | L2–L4	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	**H**	**M**				
CO2	**M**	**H**	**M**			
CO3		**M**	**H**	**M**		
CO4			**M**	**H**	**M**	
CO5				**M**	**H**	**M**
CO6		**M**		**M**	**M**	**H**

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 concepts: Biology system,	CO1	TS1	5h SL	Report submission + evaluation
Assignment 2	Living organisms, Cell theory	CO2	TS2	5h SL	Subjective questions on living organisms
Assignment 3	Computational Biology and its interdisciplinary applications	CO2, CO3	TS2, TS3	5h SL	Subjective + Objective
Assignment 4	Biomolecules, Data bases	CO3, CO4	TS3, TS4	5h SL	Step-by-step trace required
Assignment 5	Diseases and solution with AI	CO3, CO4, CO5	TS3, TS4, TS5	5h SL	Algorithm application + performance analysis
Video Learning Report	Technical video on Biotechnology (min 3 hrs); structured report + class presentation	CO2, CO3	TS2, TS3	9h SL	Report: learning outcomes, key concepts, self-reflection. Presentation: 10 min
Case Study Report	AI case study (in-depth analysis report)	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, data collection, fact finding, comparative analysis

10. Mid Sem Examination (MSE) — 15 Marks (Units 1–3)

ℹ *MSE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ESE only. ME maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance

Section A	**10**	TS1 — Biology system and Identification TS2 — Conceptual Explanation of biomolecules	**CO1, CO2**	Short-answer: define living organisms, explain cell theory importance of biomolecules
Section B	**15**	TS3 — Data bases TS4 — Uses of various databases	**CO2, CO3, CO4**	Various data bases: structural and functional
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Sem Examination (ESE) — 60 Marks (All Units, All COs)

ℹ *ESE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Conceptual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions (all units): definitions, living system, identification
Section B	**25**	TS3 — Subjective analysis TS4 — Disease analysis with AI TS5 — Data base Analysis	**CO3, CO4, CO5**	Units of biomolecules, amino acids, proteins, types of data bases
Section C	**10**	TS5 — AI Analysis TS6 — Precision Medicine	**CO5, CO6**	Genetic diseases, cancer, AI in medical science
TOTAL	**50**	TS1–TS6 (all)	**CO1–CO6**	AI in agricultural sciences, biotechnology

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand basic concepts, types, structures, living system	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Units of organisms — Biomolecules	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Biological databases	✓	✓	✓	TS3	PO1, PO2, PO3, PO4
CO4	Diseases and uses of AI	✓	✓	✓	TS4	PO9, PO10, PO11

CO5	AI in biotechnology	✓	—	✓	TS5	PO1, PO2, PO8, PO9, PO10
CO6	Understand biology system utilize bio data bases	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	1	-	-	-	1	3	-	-	3	3	2
CO2	3	-	-	1	-	-	-	-	3	-	-	3	3	2
CO3	3	3	3	2	3	-	-	-	2	-	-	2	2	1
CO4	3	3	3	2	3	-	-	1	-	-	-	2	2	2
CO5	3	-	3	1	-	2	2	2	3	-	-	2	-	-
CO6	3	3	3	3	3	3	1	2	3	-	-	1	2	-
Avg	**3**	**1.5**	**2.0**	**1.6**	**1.5**	**0.83**	**0.5**	**1.00**	**2.3**	**0**	**0**	**2.1**	**1.8**	**1.75**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H			M				M	H			H	H	M
CO2	H			M					H			M	H	M
CO3	H	H	H	M	H				M			M	M	M
CO4	H	H	H	M	H			M				M	M	M

CO5	H		H	M		M	M	H	H			M		
CO6	H	H	H	H	H	H	M	M	H			M	M	

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Subjective Assignment Writing (5 assignments, problem-based, one per unit focus area)**	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on the assignment submitted; correctness, steps shown, comparison of cell system
2	**Technical Video-Based Learning related to the subject (e.g., folding of proteins, data bases)**	Video viewing: 3 hrs Report preparation: 3 hrs Presentation: 3 hrs Total = 9 hrs	CO2, CO3 TS2, TS3	Report + Presentation based on video learning outcomes; must capture key concepts, personal reflections
3	**Real-World Case Studies (e.g., Cell structure, biomolecules, AI in biotechnology)**	Data collection/study: 4 hrs Report preparation: 2 hrs Total = 6 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on in-depth study, technical depth, data collected, fact finding, and analytical conclusions drawn
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 24 / 60**	**MANDATORY**	40% of ESE paper required; failing ESE means failing the course regardless of CA + MSE
Overall Total (CA + MSE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MSE 25 + ESE 50 = 100; 40% overall minimum required

CSE 254 — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

School: SSCSE		**Batch : 2025-2029**	
Program: B.Tech.		**Current Academic Year: 2025**	
Branch: CSE		**Semester: II**	
1	Course Code	IKT1105	
2	Course Title	Human Values and Professional Ethics	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	Compulsory	
5	Course Objective	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence	
6	Course Outcomes	1. Understand that the technical education without study of human values can generate more problems than solutions. 2. Define the principles and ideals, which help in making the judgement of what is more important. 3. See that 'I' and 'Body' are two realities, and most of their desires are related to 'I' and not body, while their efforts are mostly centred on the fulfilment of the needs of the body assuming that it will meet the needs of 'I' too. 4. Appreciate the importance of harmony in the self, family and the society for mutual fulfilment. 5. Understand the importance of harmony among human beings, other living beings and entire nature for universal equilibrium and mutual co-existence. 6. Know and practice the ethical approach in profession for continuous happiness and sustained prosperity.	
7	Course Description	Human values and embedded in all human beings it is important to sensitize them towards these values that they can use in their life to attain mutual happiness and mutual prosperity. Professional ethics will enlighten them about the value addition that can be done within the framework of ethical behavior.	
8	Outline syllabus		CO Mapping
	Unit 1	The Need and Process for Value Education	
	A	The need, basic guidelines, content, and process for Value Education	CO1
	B	Concept of 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration; Continuous Happiness and Prosperity- A look at basic Human Aspirations	CO1,CO2
	C	Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment aspirations of every human being with their correct priority	CO1,CO2
	Unit 2	Understanding Harmony in the Human Being - Harmony in Myself	
	A	Human being as a co-existence of the sentient 'I' and the material 'Body'	CO3

	B	The needs of Self ('I') and 'Body' ; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)	CO3
	C	The characteristics and activities of 'I' and harmony in 'I' ; Understanding the harmony of I with the Body: Correct appraisal of Physical needs, meaning of Prosperity in detail	CO3
	Unit 3	Harmony in the Family and Society	
	A	Values in human-human relationship; Trust and Respect as the foundational values of relationship	CO4
	B	Understanding the meaning of Trust; Difference between intention and competence; The meaning of Respect; Difference between respect and differentiation; the other salient values in relationship	CO4
	C	Harmony in the society (society being an extension of family; Visualizing a universal harmonious order in society - from family to world family	CO4
	Unit 4	Harmony in the Nature and Existence	
	A	The harmony in the Nature	CO5
	B	Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature	CO5
	C	Understanding Existence as Co-existence of mutually interacting units in all-pervasive space	CO5
	Unit 5	Competence in professional ethics	
	A	Ability to utilize the professional competence for augmenting universal human order	CO6
	B	Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,	CO6
	C	Ability to identify and develop appropriate technologies and management patterns for above production systems.	CO6
	Mode of examination	Theory	
	Weight age Distribution	CA (25%) / ESE (75%)	
		Assessment 1 (10) / Assessment 2 (5) / Assignment 1 (5) / Assignment 2 (5) /	
	Text book/s*	1. R.R Gaur, R Sangal, G P Bagaria, "A foundation course in Human Values and professional Ethics", Excel books, New Delhi	
	Other References	1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. 2. A.N. Tripathy, 2003, Human Values, New Age International Publishers. 3. PL Dhar, RR Gaur, Science and Humanism, Commonwealth Publishers. Starting out with Python, Tony Gaddis, Pearson	

COURSE ARTICULATION MATRIX

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	0	0	0	1	0	2	0	1	1	1	0	0
CO2	0	1	0	1	0	1	0	2	0	1	0	0	0	0
CO3	1	0	0	1	0	1	0	2	0	0	0	1	0	0
CO4	0	1	0	1	0	2	0	2	1	1	0	0	1	0
CO5	0	1	0	1	0	2	2	2	0	1	0	0	1	0
CO6	0	0	0	0	0	2	0	3	0	1	1	0	1	0

Avg. Attainment	1	1	-	1	-	1.5	2	2.17	1	1	1	1	1	-

COURSE PLAN

Basics of Electrical and Electronics Engineering (EEE1101)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	I

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	EEE1101
2	**Course Title**	**Basics of Electrical and Electronics Engineering (BEEE)**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	2-1-2-3
5	**Course Status**	Core
6	**Course Objective**	To provide the students with an introductory concept in the field of electrical and electronics engineering to facilitate better understanding of the devices, techniques and equipment used in engineering applications.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Analyze – L4): Analyze DC and AC electrical circuits using Ohm's law, KCL, KVL, nodal/mesh methods, and network theorems to compute circuit parameters. CO2 (Understand – L2): Explain the construction, working principles, losses, and efficiency of transformers and DC motors for suitable engineering applications. CO3 (Analyze – L4): Analyze the V–I characteristics of PN junction diodes and apply them in rectifier and clipper circuits with ripple factor calculation. CO4 (Understand – L2): Interpret MOSFET characteristics and explain the role of CMOS technology and IC fabrication concepts. CO5 (Analyze – L4): Simplify and design switching circuits using number systems, logic gates, Boolean algebra, and Karnaugh maps. CO6 (Analyze – L4): Analyze electrical, electronics, and digital logic concepts to design and evaluate basic arithmetic and comparator circuits for engineering applications. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Conduct experiments on DC circuits, network theorems, transformer, DC motor, PN junction diode, rectifier circuits, and MOSFET simulation using standard laboratory instruments; record observations and verify theoretical concepts through measured values. CO8 (Create – L5/L6): Design and implement CMOS inverter, logic gate circuits, adder, and subtractor circuits using simulation tools and IC components; tabulate results and validate the

		logical operation through experimental outputs. CO9 (Apply – L2/L3): Demonstrate professional, ethical, and responsible practices; perform skill self-assessment; reflect on learning to cultivate lifelong professional growth. CO10 (Apply – L3): Collaborate and communicate effectively in team-oriented lab activities; plan, implement, and present programming solutions; apply project management principles.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs +Tutorial(T1)15 hrs + Lab Instructions (LI) 15 hrs + Self Learning (SL) 60 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 60 hrs)**	1. Circuit Simulation Problems (LTspice/Multisim/Proteus) — *Minimum 15 circuit problems* covering KCL, KVL, nodal/mesh analysis, superposition, rectifier, clipper, MOSFET, CMOS inverter, logic gates, adder/subtractor, and comparator circuits. 2. Virtual Labs (IIT Virtual Labs) — *Electrical and Electronics experiments* such as KCL/KVL verification, transformer efficiency test, DC motor characteristics, PN diode V–I, rectifier, MOSFET, CMOS inverter, and logic gates. 3. MOOC Course (NPTEL/SWAYAM) — *Any one course* on Basic Electrical Circuits / Electrical Machines / Electronic Devices and Circuits / Digital Circuits for concept strengthening.
11	**References**	1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010. 2. S. K. Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson Publication. 3. Robert L Boylestad, “Electronic Devices and Circuit Theory” Pearson Education, 2009 4. "Digital Logic and Computer Design" by M. Morris Mano.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	Basics of Electrical Circuits (6-3-12-6 = 27 hrs)	
A	Introduction to electrical circuits: Voltage, Current, Resistance, and Power, Types of components- active, passive, unilateral, bilateral, Ohm’s Law, Types of sources-voltage, current, independent, dependent. Source transformation.	CO1,CO6
B	Series and Parallel circuits, Kirchhoff’s Laws (KVL and KCL), Basic circuit analysis (nodal and mesh) techniques with DC source. Superposition Theorem.	
C	Representation of AC signal, peak, average and rms values, real power, reactive power, apparent power, power factor	
Tools Used	Breadboard, Resistors, DC supply, Function generator, Multimeter, CRO/DSO, Circuit simulation tools (LTspice/Multisim), Virtual Labs.	
Activities	**Objective:** To understand and analyze basic DC/AC circuits using fundamental laws and theorems. • Verification of Ohm’s Law, KCL and KVL using measured values. • Perform nodal and mesh analysis for given DC circuits. • Demonstrate Superposition theorem through circuit setup/simulation. • Measure RMS, peak values and compute power factor for AC signals.	
Unit 2	Transformer and DC Motor (4-3-8-6 = 21 hrs)	

A	Construction, working principle and applications of transformer, Types of transformer- step-up and step-down.	CO2, CO6
B	EMF equation of transformer, Losses observed in transformer, Efficiency of transformer	
C	Construction, working principle and applications of DC motor.	
Tools Used	Transformer , DC motor setup, Ammeter, Voltmeter, Wattmeter, Tachometer, Virtual Labs.	
Activities	**Objective:** To understand working principles, losses and efficiency of electrical machines • Observe transformer operation and identify losses. • Calculate efficiency under different loading conditions. • Demonstrate DC motor operation and direction control.	
Unit 3	**PN junction Diode and its applications (8-3-16-6 = 33 hrs)**	
A	Formation of PN junction and depletion layer, Forward and reverse biasing of PN junction diode, V-I characteristics of ideal and practical diodes.	CO3, CO6
B	Half and Full Wave rectification using PN junction diodes, calculation of ripple factor.	
C	Application of diode as clipper circuit.	
Tools Used	Diodes, Breadboard, CRO/DSO, Function generator, Multimeter, Simulation tools, Virtual Labs.	
Activities	**Objective:** To analyze diode characteristics and apply them in rectifier and clipper circuits. •Plot V–I characteristics of PN junction diode. •Construct rectifier circuits and compute ripple factor. • Implement clipper circuits and observe waveform shaping.	
Unit 4	**MOS Transistors (6-3-12-6 = 27 hrs)**	
A	Introduction to MOSFET, depletion and enhancement type, drain characteristics and transfer characteristics.	CO4, CO6
B	Introduction to CMOS technology	
C	Introduction to IC technology and role of transistors as a basic building block of ICs, CMOS inverter	
Tools Used	Simulation tools (LTspice/Proteus), Virtual Labs.	
Activities	**Objective:** To interpret MOSFET characteristics and understand CMOS/IC concepts. • Plot MOSFET drain and transfer characteristics using simulation. •Demonstrate CMOS inverter operation. • Study IC building blocks using MOS technology.	
Unit 5	**Introduction to switching circuits (6-3-12-6 = 27 hrs)**	
A	Number System Concepts- Number base conversion, 1's Complement and 2's Complement, Fundamentals of Logic Gates, Universal logic gates, BCD and Gray codes.	CO5, CO6

B	SOP and POS simplification of Boolean expressions using Karnaugh map (up to four variables), concept of don't care condition.	
C	Classification of digital circuits, Arithmetic circuits design-adder and subtractor, one-bit magnitude comparator.	
Tools Used	Logic gate trainer kit, ICs (7400 series), Breadboard, LEDs, Simulation tools, Virtual Labs.	
Activities	**Objective:** To design and simplify switching circuits using Boolean algebra and K-maps • Verify logic gate operations using ICs. • Simplify Boolean expressions using K-maps. • Design and test adder, subtractor, and comparator circuits.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓	✔		
3	1.C		✓	✓			
4	2.A		✔	✓			
5	2.B			✓	✔		
6	2.C		✔	✓			
7	3.A		✔	✓	✓		
8	3.B			✓	✔		
9	3.C			✓	✓		
10	4.A		✔	✓	✓		
11	4.B	✔	✔				
12	4.C	✔	✔	✔			
13	5.A	✔	✔	✔			
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1				✔														
CO2		✔																

CO3				✔										✓	✓			
CO4		✔												✓	✓			
CO5				✔											✓	✓		
CO6				✔	✔				✔						✓	✓		
CO7			✓	✔				✔					✓	✓	✓			
CO8					✔			✔					✓	✓	✓	✓		
CO9		✔	✓				✔	✔	✔				✓	✓				
CO10			✓		✔			✓	✔				✓	✔	✓			

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Voltage, Current, Resistance, Power; Active/Passive, Unilateral/Bilateral elements; Ohm's Law.	Unit 1	6
DD/MM/YY	Types of sources: Voltage/Current, Independent/Dependent; Source transformation		
DD/MM/YY	Series and Parallel circuits		
DD/MM/YY	Kirchhoff's Laws (KCL, KVL)		
DD/MM/YY	Nodal and Mesh analysis; Superposition theorem		
DD/MM/YY	AC signals: Peak, Average, RMS; Real, Reactive, Apparent power; Power factor		
DD/MM/YY	Construction and working principle of transformer;	Unit 2	6
DD/MM/YY	Types of transformer		
DD/MM/YY	EMF equation, losses in transformer		
DD/MM/YY	efficiency calculation		
DD/MM/YY	Construction and working principle of DC motor		
DD/MM/YY	Applications of DC motor		
DD/MM/YY	Formation of PN junction and depletion layer	Unit 3	6
DD/MM/YY	Forward and reverse biasing of PN junction diode		
DD/MM/YY	V–I characteristics of ideal and practical diode		
DD/MM/YY	Half-wave Rectifier: Ripple factor		
DD/MM/YY	Full-wave rectifiers; Ripple factor		
DD/MM/YY	Diode clipper circuits and applications		
DD/MM/YY	Introduction to MOSFET, depletion type	Unit 4	6
DD/MM/YY	Enhancement type, drain characteristics and transfer characteristics		
DD/MM/YY	Introduction to CMOS technology		
DD/MM/YY	Introduction to IC technology		

DD/MM/YY	Role of transistors as a basic building block of ICs		
DD/MM/YY	CMOS inverter		
DD/MM/YY	Number System Concepts- Number base conversion	**Unit 5**	**6**
DD/MM/YY	1's Complement and 2's Complement, Fundamentals of Logic Gates		
DD/MM/YY	Universal logic gates, BCD and Gray codes		
DD/MM/YY	SOP and POS simplification of Boolean expressions using Karnaugh map (up to four variables)		
DD/MM/YY	concept of don't care condition.		
DD/MM/YY	Classification of digital circuits, Arithmetic circuits design-adder and subtractor, one-bit magnitude comparator.		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Configure DC circuit on breadboard; measure voltage & current	**CO7**	3.0
	S-1.2	Verify KCL & KVL using measured values	**CO7**	
W2	S-2.1	Verify Superposition Theorem using experimental setup	**CO7**	3.0
	S-2.2	Compare theoretical and experimental results	**CO7**	
W3	S-3.1	Determine transformer losses and calculate efficiency	**CO7**	3.0
	S-3.2	Study cut-section of transformer and observe construction	**CO7**	
W4	S-4.1	Start DC motor and observe direction control	**CO7**	3.0
	S-4.2	Study DC motor parts and working	**CO7**	
W5	S-5.1	Plot V–I characteristics of PN junction diode	**CO7**	3.0
	S-5.2	Design Half-wave rectifier and compute ripple factor	**CO7**	
W6	S-6.1	Design Full-wave rectifier and compare performance	**CO7**	3.0
	S-6.2	Record readings and validate theoretical values	**CO7**	
W7	S-7.1	MOSFET simulation: Plot drain & transfer characteristics	**CO8**	3.0
	S-7.2	Interpret simulation graphs and tabulate results	**CO8**	
W8	S-8.1	CMOS inverter simulation and verify logic levels	**CO8**	3.0
	S-8.2	Analyze voltage transfer characteristics	**CO8**	
W9	S-9.1	Implement logic gates using IC 74 series	**CO8**	3.0
	S-9.2	Verify AND, OR, NOT, NAND, NOR, XOR truth tables	**CO8**	
W10	S-10.1	Design and implement Half Adder	**CO8**	3.0
	S-10.2	Verify truth table and outputs	**CO8**	
W11	S-11.1	Design and implement Full Adder	**CO8**	3.0

	S-11.2	Verify logical operation experimentally	**CO8**	
W12	S-12.1	Design and implement Half Subtractor	**CO8**	3.0
	S-12.2	Verify outputs and compare with theory	**CO8**	
W13	S-13.1	Integrate diode, MOSFET, and logic circuit into a mini application	**CO8/CO10**	3.0
	S-13.2	Team-based circuit implementation and documentation	**CO10**	
W14	S-14.1	Lab record audit, safety compliance check, ethical handling of instruments	**CO9**	3.0
	S-14.2	Self-assessment and reflection on experimental learning	**CO8/CO10**	
W15	S-15.1	Mini project presentation: Design & demonstrate digital circuit	**CO8/CO10**	3.0
	S-15.2	Final lab assessment, viva, record verification, presePeer review, teamwork evaluation, final lab submissionntation	**CO9/CO10**	

ℹ *Instructions: Perform the experiment using standard electrical and electronics laboratory instruments and simulation tools. Record all observations, tabulations, circuit diagrams, measured readings, and calculated results in the lab record. The lab record (aim, apparatus required, circuit diagram, procedure, observation table, calculations, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Factual Recall & Electrical Fundamentals	Recall definitions of voltage, current, resistance, power, circuit elements, types of sources, AC terms (peak/avg/RMS), and basic laws	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	Conceptual Understanding of Electrical Machines	Explain construction, working principles, EMF equation, losses, efficiency, and applications of transformers and DC motors	CO2 | L2-L3	MTE Sec A | ETE Sec A
TS3	Circuit Analysis & Theorem Application	Apply Ohm's law, KCL, KVL, nodal/mesh methods, superposition theorem, AC power, and power factor to compute circuit parameters	CO1 | L3-L4	MTE Sec B | ETE Sec B
TS4	Electronic Device Characteristics & Applications	Analyze PN junction diode V–I characteristics; evaluate rectifier, clipper circuits, ripple factor; interpret MOSFET and CMOS inverter characteristics	CO3,CO4 | L3-L4	MTE Sec B | ETE Sec B
TS5	Logic Simplification & Switching Theory	Simplify Boolean expressions using K-maps; analyze number systems, logic gates, codes, and switching concepts	CO5 | L4	ETE Sec B
TS6	Digital Circuit Design &	Design and evaluate adder, subtractor, and comparator	CO6 | L4	ETE Sec C

	Evaluation **Design**	circuits using digital logic and electronics fundamentals		

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short answers: definitions, laws (Ohm's, KCL, KVL), AC terms (RMS, PF), transformer/DC motor construction, losses, efficiency
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Numerical/problem solving: nodal/mesh/superposition, AC power calculations; diode V–I analysis, ripple factor, rectifier/clipper; MOSFET/CMOS interpretation
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, laws (Ohm's, KCL, KVL), AC terms (RMS, power factor), transformer/DC motor construction, losses, efficiency, diode/MOSFET basics, logic gate concepts (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Numerical/problem solving: nodal/mesh/superposition, AC power; diode V–I, ripple factor, rectifier/clipper; MOSFET/CMOS interpretation; Boolean simplification using K-map; logic design and comparison
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design switching/logic circuits (adder, subtractor, comparator); justify design choices; integrate electrical/electronic concepts in complete solutions
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III
LABORATORY ASSESSMENT FRAMEWORK
Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4

End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	**CA1 —** Define aim with circuit/device attributes, variables, and success criteria **CA2 —** Experimental setup, instrument selection, and connections **CA7 —** Circuit diagram / procedure / observation plan	**1.0**: Clear aim + proper design | **0.5**: Partial setup/plan | **0**: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	**CA3 —** Correct execution; proper use of breadboard, meters, CRO/simulator **CA4 —** Accuracy of readings; tabulation; repeatability	**1.0**: Correct & accurate | **0.5**: Minor errors | **0**: Incorrect/failed	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	**CA5 —** Analysis of readings; verification with theory (laws/characteristics) **CA6 —** Result interpretation and conclusion **CA8 —** Complete lab record; viva understanding	**0.75**: Thorough | **0.5**: Adequate | **0.25**: Partial | **0**: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	**CO9 —** Responsible handling of instruments, neat wiring, safety **PO7 —** Professional and ethical conduct in lab	**0.25**: Consistent | **0.10**: Occasional | **0**: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define the experiment aim; identify measurable electrical/electronic parameters (V, I, R, waveforms, losses, ripple, logic states) and success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan the experiment; select and configure breadboard, meters, CRO, power supply, ICs, and simulation tools	CO7
CA3	**Code Implementation & Execution**	Correct circuit connections / simulation setup; proper instrument usage to obtain expected readings	CO7
CA4	**Computational Efficiency & Optimization**	Accuracy of observations; repeatability; minimizing wiring/measurement errors	CO7
CA5	**Output Analysis & Result Interpretation**	Analyze readings/waveforms; explain deviations; verify laws/characteristics with evidence	CO8
CA6	**Documented Outcome with Verification**	Record observations, calculations, graphs, and final result; verify with theory	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Draw circuit diagram/truth table/procedure before execution; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab record; demonstrate conceptual understanding and professional practice	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	Problem Scoping & Requirements	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	Innovative Solution Proposal	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	Professional Toolchain	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	End-to-End Implementation	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	System Commissioning & Testing	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	Individual Skill Growth Mapping	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	Professional Attitude, Ethics & Responsibility	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions	CA Skill Dimensions	Project Skill Dimensions

	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	H	H				M	H	H	H		M			M	H
CO8							M		M		H	H	H	H	M	H		H	M	H	M	H	H	M		H	M
CO9														H			H							H		H	H
CO10													H	H		M	H	H		M	H	M	H	H		H	H

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	1	–	–	–
CO2	3	2	–	–	–	–	–	–	1	–	2	–	–	–
CO3	3	3	2	–	2	1	–	–	1	–	2	–	–	–
CO4	2	3	2	2	2	–	–	–	–	–	2	–	–	–
CO5	2	3	3	2	3	–	–	–	–	–	2	–	–	–
CO6	2	2	3	2	3	2	–	2	1	1	3	–	–	–
CO7	–	–	1	–	3	1	–	–	–	–	–	–	–	–
CO8	–	1	3	1	2	3	–	–	–	–	–	–	–	–
CO9	–	–	–	–	–	–	3	–	–	–	3	–	–	–

CO10	–	–	–	–	–	1	–	3	3	3	2	–	–	–
Avg	**1.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**3.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10					M		H	H	H	M	

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	**Quality Education**	**3 (High)**	Builds strong foundation in electrical, electronics, and digital fundamentals; promotes analytical thinking and lifelong learning through theory (CO1–CO6) and reflective lab practice (CO9)
SDG 7	Affordable & Clean Energy	**3 (High)**	Covers transformers, AC power, power factor, and efficiency (CO1, CO2) that are essential for energy-efficient systems and power utilization.
SDG 8	Decent Work & Economic Growth	**3 (High)**	Develops practical skills in circuit analysis, machines, devices, and tool usage (CO7, CO8) relevant to core engineering industries.
SDG 9	Industry, Innovation & Infrastructure	**3 (High)**	Enables design of rectifiers, MOSFET/CMOS circuits, logic gates, and arithmetic circuits (CO3–CO6, CO8, CO10) supporting innovation in electronics and infrastructure.
SDG 12	**Responsible Consumption & Production**	**2 (Moderate)**	Encourages efficient circuit design, optimal component usage, and ethical lab practices (CO7, CO9) promoting responsible engineering.

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts	A1 — Receiving: Awareness, willingness to attend	P1 — Perception: Sensory cues guide motor activity

L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Probability and Statistics (MTT1214)

Sharda School of Engineering & Science (SSES) | B.Tech CSE | Semester II | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MSE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSES —Sharda School of Engineering & Science	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	II
Course Code:	MTT1214	**Course Type:**	Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MSE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**MTT1214**
2	**Course Title**	**Probability and Statistics**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-1-0 (Theory: 40hrs Classroom + 30 hrs Self Learning = 70hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Develop the ability to collect, organize, and analyze data effectively. 2. Understand the concepts of probability and uncertainty in real-world situations. 3. Interpret statistical results and draw meaningful conclusions from data. 4. Enhance problem-solving skills through the application of statistical reasoning.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Define measure of central tendency, dispersion, and moments to interpret data distributions, including skewness and kurtosis.

		CO2 (Explore – L2/L3): Explain the fundamental concepts of probability, including conditional probability, Bayes' theorem, and expectation for discrete and continuous random variables. CO3 (Apply – L3): Apply the discrete and continuous probability distributions such as Binomial, Poisson, Normal, and Exponential distributions in real-world problems. CO4 (Analyze – L4/L5): Analyze relationships between variables using correlation, rank correlation, and regression analysis techniques. CO5 (Analyze – L4/L5): Evaluate curve fitting with the help of least squares and hypothesis testing (small and large sample tests) to analyze data and draw inferences. CO6 (Analyze – L6): Interpret chi-square tests to assess goodness of fit and independence of attributes in statistical data.
8	**Course Description**	This course provides a comprehensive introduction to the fundamental concepts of probability and statistics. Topics include probability theory, random variables, probability distributions (discrete and continuous), mathematical expectation, sampling distributions, hypothesis testing, correlation, and regression analysis.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 40hrs | Self Learning (SL): 30 hrs | Total: 70 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MSE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	(i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. (ii) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
12	**References**	1. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. 2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000. 3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MSE, and ETE.*

	Topic	CO Mapping
	Unit 1: Descriptive Statistics	
A	Measure of central tendency and its measures,	**CO1**
B	Dispersion and its measures,	**CO1**
C	Moments, Skewness and Kurtosis.	**CO1**

	Unit 2: Probability theory	
A	Definition of Probability and Conditional probability, Baye's rule,	**CO2**
B	Discrete and Continuous random variables, p.m.f and p.d.f.	**CO2**
C	Expectation and Variance of Discrete and Continuous Random Variables, Chebyshev's Inequality.	**CO2**
	Unit 3: Probability distribution	
A	Discrete Probability distributions: Binomial, Poisson,	CO3
B	Geometric distribution, Continuous distribution: Uniform distribution,	CO3
C	Normal and exponential distribution, Gamma distribution.	CO3
	Unit 4: Correlation, Regression and Curve Fitting	
A	Correlation and Rank Correlation,	**CO4**
B	Regression,	CO4
C	Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Rule.	CO4
	Unit 5: Testing of Hypothesis	
A	Test of significance: small sample test, large sample test for mean, proportion and Variance,	CO5
B	Chi-square test for goodness of fit,	CO6
C	Chi-square test for independence of attributes.	CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓	✓			
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓		

7	3.A		✓	✓			
8	3.B		✓	✓			
9	3.C		✓	✓			
10	4.A			✓	✓	✓	
11	4.B			✓	✓	✓	
12	4.C			✓	✓		
13	5.A			✓	✓		
14	5.B			✓	✓		
15	5.C			✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓	✓														
CO3			✓	✓														
CO4			✓	✓	✓		✓					✓						
CO5			✓	✓														
CO6			✓	✓														

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 30 Lectures / 30 Hours)

ℹ *Total classroom contact: 40 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	OBE, Measure of central tendency	UNIT-1	6
DD/MM/YY	Mean, Mode, Median		
DD/MM/YY	Dispersion and its measure		

DD/MM/YY	Moments, Relation between moments		
DD/MM/YY	Skewness		
DD/MM/YY	Kurtosis		
DD/MM/YY	Probability definition, conditional probability	UNIT-2	11
DD/MM/YY	Bayes' rule		
DD/MM/YY	Discrete random variables		
DD/MM/YY	Independent random variables		
DD/MM/YY	Expectation of Discrete Random Variables		
DD/MM/YY	Chebyshev's Inequality		
DD/MM/YY	Continuous random variables and their properties		
DD/MM/YY	Probability mass function(p.m.f.)		
DD/MM/YY	Expectation of Continuous Random Variables		
DD/MM/YY	Probability Density Function(p.d.f.)		
DD/MM/YY	Chebyshev's Inequality		
DD/MM/YY	Discrete Probability distributions: Binomial	UNIT-3	7
DD/MM/YY	Discrete Probability distributions: Poisson		
DD/MM/YY	Geometric Distribution		
DD/MM/YY	Continuous distribution: Uniform distribution,		
DD/MM/YY	Normal distribution		
DD/MM/YY	exponential distribution,		
DD/MM/YY	Gamma distribution		
DD/MM/YY	Correlation	UNIT-4	8
DD/MM/YY	Rank Correlation		
DD/MM/YY	Tied Rank Correlation		
DD/MM/YY	Regression		
DD/MM/YY	Method of least squares		

DD/MM/YY	Fitting of straight lines		
DD/MM/YY	Fitting of second degree parabolas		
DD/MM/YY	Fitting of more general curves		
DD/MM/YY	Sampling, Test of significance	UNIT-5	8
DD/MM/YY	test for proportion (large sample)		
DD/MM/YY	test for mean (large sample)		
DD/MM/YY	test for variance (large sample)		
DD/MM/YY	test for mean (small sample)		
DD/MM/YY	test for variance (small sample)		
DD/MM/YY	Chi-square test for goodness of fit		
DD/MM/YY	Chi-square test for independence of attributes.		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MSE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MSE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Statistical Concepts & Descriptive Data Interpretation**	**Recall and interpret measures of central tendency, dispersion, moments, skewness and kurtosis for describing data distributions**	CO1 | L1–L2	CA | MSE Sec A | ETE Sec A

TS2	**Probability Reasoning & Random Variable Interpretation**	**Explain probability concepts, conditional probability, Bayes' theorem, random variables, expectation and variance**	CO2 | L2–L3	CA | MSE Sec B | ETE Sec A
TS3	**Probability Distribution Application**	**Apply Binomial, Poisson, Geometric, Uniform, Normal, Exponential and Gamma distributions to solve numerical problems**	CO3 | L3	CA | ETE Sec B
TS4	**Correlation & Regression Analysis**	**Analyze relationships among variables using correlation, rank correlation and regression techniques**	CO4 | L4–L5	CA | ETE Sec B
TS5	**Statistical Inference & Hypothesis Evaluation**	**Evaluate curve fitting models and perform hypothesis testing for decision-making using statistical evidence**	CO5 | L4–L5	CA | ETE Sec B/C
TS6	**Chi-Square Interpretation & Statistical Decision Making**	**Discuss goodness-of-fit and independence tests and draw valid conclusions from statistical data**	CO6 | L6	CA | ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	**H**	**M**				
CO2	**M**	**H**	**M**			
CO3		**M**	**H**	**M**		
CO4			**M**	**H**	**M**	
CO5				**M**	**H**	**M**
CO6		**M**		**M**	**M**	**H**

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**10**	CO1, CO2, CO3, CO4,CO5,CO6	TS1, TS2, TS3, TS4
Assessment 1-2	2 assessment	**15**	CO1,CO2, CO3,CO4,CO6	TS1,TS2,TS3, TS4, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment -wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Measures of Central Tendency, Dispersion, Moments	CO1	TS1	6h SL	Numerical calculations and interpretation
Assignment 2	Probability, Conditional Probability, Bayes' Theorem	CO2	TS2	6h SL	Problem solving and reasoning
Assignment 3	Probability Distributions	CO2, CO3	TS2, TS3	6h SL	Distribution-based numerical applications
Assignment 4	Correlation and Regression Analysis	CO3, CO4	TS3, TS4	6h SL	Computation and analytical interpretation
Assignment 5	Curve Fitting and Hypothesis Testing	CO3, CO4, CO5	TS3, TS4, TS5	6h SL	Statistical inference and evaluation

10. Mid Serm Examination (MSE) — 15 Marks (Units 1–2)

ℹ *MSE covers Units 1–2 (CO1, CO2), CO3, CO4, CO5 and CO6 are assessed in ETE only. MSE maps to TS1–TS2.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**5**	TS1 — Conceptual Recall & Probability and Statistics Identification TS2 — Conceptual Explanation & Process Interpretation	**CO1, CO2**	Short-answer questions, conceptual explanations, probability reasoning

Section B	**10**	TS3 — Probability Distribution Application TS4 — Correlation & Regression Analysis	**CO1, CO2**	Numerical problems involving distributions and applications
TOTAL	**15**	TS1–TS2	**CO1–CO2**	Units 1–2 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 24/60 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**24.0**	TS1,TS2,TS3,TS4,TS5,TS6 — Conceptual Recall & Conceptual Explanation	**CO1, CO2, CO3, CO4, CO5, CO6**	Short questions (all units): definitions, Conceptual and short-answer questions
Section B	**10.8**	TS3 — Probability Distribution Application TS4 — Performance Evaluation TS5 — Statistical Inference & Hypothesis Evaluation	**CO3, CO4, CO5**	Medium questions: Numerical and analytical questions
Section C	**18.0**	TS3,TS4,TS5 — &Hypothesis Evaluation Interpretation	**CO3, CO4, CO5**	Long/evaluation questions: virtual memory analysis, thrashing, disk scheduling comparisons
Section D	**7.2**	T6 — Chi-Square & Statistical Inference	**CO6**	Long/evaluation questions: virtual memory analysis,
TOTAL	**60**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 24/60 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MSE (15)	ETE (60)	TS	PO Primary
CO1	Define measure of central tendency, dispersion, and moments to interpret data distributions, including skewness and kurtosis	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Explain the fundamental concepts of probability, including conditional probability, Bayes' theorem, and expectation for discrete and continuous random variables.	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Apply the discrete and continuous probability distributions such as Binomial, Poisson, Normal, and Exponential distributions in real-world problems.	✓	—	✓	TS3	PO1, PO2, PO3, PO4

CO4	Analyze relationships between variables using correlation, rank correlation, and regression analysis techniques.	✓	—	✓	TS4	PO9, PO10, PO11
CO5	Evaluate curve fitting with the help of least squares and hypothesis testing (small and large sample tests) to analyze data and draw inferences.	✓	—	✓	TS5	PO1, PO2, PO8, PO9, PO10
CO6	Interpret chi-square tests to assess goodness of fit and independence of attributes in statistical data	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ *CO3, CO4, CO5 and CO6 are NOT assessed in MSE (only Units 1–2 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	1	1	1	3	3	2
CO2	3	2	3	2	2	2	1	1	1	1	1	2	3	2	3
CO3	3	2	2	2	3	1	1	1	1	2	1	1	3	2	2
CO4	3	3	2	2	2	1	1	1	1	2	1	1	3	3	2
CO5	3	2	2	2	2	1	1	1	1	1	1	2	3	2	2

CO6	3	3	2	3	2	2	1	1	1	1	1	2	3	3	2
Avg	3.00	2.50	1.60	2.16	2.16	1.33	1.00	1.00	1.00	1.33	1.00	1.50	3.00	2.50	2.16

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M
CO2	H	M	H	M	M	M	M	M	M	M	M	M	M	M	M
CO3	H	M	M	M	H	M	M	M	M	M	M	M	M	M	M
CO4	H	H	M	M	M	M	M	M	M	M	M	M	M	M	M
CO5	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M
CO6	H	H	M	H	M	M	M	M	M	M	M	M	M	M	M

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	Numerical Assignment Writing (5 assignments based on probability, distributions, correlation, regression and hypothesis testing)	5 assignments × 6 hrs each Total = 30 hrs	CO1–CO6 TS1–TS6	Evaluated based on the assignment submitted; correctness, steps shown, comparison of algorithm performance
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act

L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (Normal, and Exponential distributions in real-world problems). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of hypothesis testing, correlation, and regression analysis.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MSE
Overall Total (CA + MSE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MSE 15 + ETE 60 = 100; 40% overall minimum required

MTT1214 — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Define / Understand → TS1, TS2 → CA + MSE Sec A, Sec B + ETE Sec A
CO3–CO5: Apply / Evaluate → TS3, TS4 → CA + ETE Sec B/C
CO6: Estimate, Discuss → TS5, TS6 → CA + ETE Sec D

CA 25 marks + MSE 15 marks + ETE 60 marks = Total 100 marks

COURSE PLAN

Object Oriented Programming Using Java (CSCR1301)

School of Computing Science & Engineering (SSCSE) | B.Tech. CSE | Semester II | Batch 2026 - 2030

Integrated Course Plan - Theory COs (CO1-CO6) + Lab COs (CO7-CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	II

2. Course Details

Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.

S.No	Attribute	Details
1	**Course Code**	CSCR1301
2	**Course Title**	**Object Oriented Programming Using Java**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	2-0-2-2
5	**Course Status**	Core
6	**Course Objective**	To introduce object-oriented programming concepts in Java and develop problem-solving skills through structured lab practice, design exercises, ethical coding, and collaborative project work.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs - Assessed via MTE + ETE:** CO1 (Remember - L1): List and identify core Java programming constructs like keywords, primitive data types, operators, and JVM architecture components with higher quartile accuracy in recall assessments. CO2 (Understand - L2): Classify and differentiate the four OOP principles (encapsulation, abstraction, inheritance, polymorphism) and explain their role in Java program structure through annotated code examples. CO3 (Apply - L3): Construct executable Java programs using classes, objects, constructors, method overloading, and control structures to solve at least five distinct computational problems per unit. CO4 (Analyze - L4): Decompose and trace Java programs involving arrays, strings, wrapper classes, and inheritance hierarchies to locate design flaws and reusability gaps, producing documented debug reports. CO5 (Evaluate - L5): Assess and justify design choices for Java programs employing polymorphism, interfaces, exception handling, and file I/O against correctness, robustness, and maintainability criteria. CO6 (Create - L6): Architect and implement a concurrent Java application integrating multithreading, synchronization, and inter-thread communication that satisfies a defined problem specification within stated time and resource constraints. **LAB COs - Assessed via Laboratory Assessment only:**

		CO7 (Apply - L3): Execute Java programs using professional tools (JDK, Eclipse/NetBeans, Linux CLI, debuggers); configure experimental setups; demonstrate system operation; maintain structured lab records. CO8 (Create - L5/L6): Design and develop modular Java applications addressing real-world problems with societal awareness; propose solutions with planning justifications; evaluate outcomes against stated objectives in a written format. CO9 (Apply - L2/L3): Demonstrate professional, ethical, and responsible coding practices; perform self-assessed skill audits; document reflective learning entries across at least three lab milestones. CO10 (Apply - L3): Collaborate and communicate effectively in team-oriented lab activities; plan, implement, and present programming solutions; apply project management principles across at least one mini-project cycle.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 30 hrs = 90 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. Coding Problems on HackerRank/LeetCode - 10 OOP-focused problems minimum. 2. Virtual Labs (NPTEL): Java programming experiments. 3. MOOC course on Java/OOP (SWAYAM/Coursera/NPTEL).
11	**References**	Textbook: Schildt, H. - Java: The Complete Reference (12th Ed.), McGraw-Hill. Reference: Bloch, J. - Effective Java (3rd Ed.), Addison-Wesley. Reference: Horstmann, C.S. - Core Java Vol. I: Fundamentals (12th Ed.), Prentice Hall.

3. Outline Syllabus - Theory Units with CO Mapping (CO1–CO6)

Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).

	Topic / Activity	CO Mapping
Unit 1	**Fundamentals of Java Programming (6-0-6-4 = 16 hrs)**	
A	Introduction to Java: JVM architecture, bytecode, platform independence, basic program structure, keywords, identifiers, variables, constants, data types, type casting	CO1
B	Operators and Expressions: Arithmetic, logical, relational, bitwise, assignment operators; precedence and associativity; ternary operator; type conversion	CO2
C	Control Structures: if, if-else, nested if, switch-case; while, do-while, for, enhanced for; break, continue, return	CO3
Tools Used	Linux Environment, JDK, Eclipse/NetBeans IDE, Online Compilers, Competitive Coding Platforms (HackerRank, LeetCode)	
Activities	**Objective:** To familiarize students with the Java programming environment and develop clear understanding of basic syntax, operators, and control flow structures. Study of Linux Commands • Install JDK, configure IDE, write and execute "Hello World"; explore basic program structure • Demonstration of different data types with type-conversion examples (implicit/explicit casting) • Programs demonstrating operator precedence and associativity rules • Decision-making programs using if-else, nested if, and switch-case • Implementing iterative constructs using while, do-while, and for loops • Writing nested-loop programs for pattern printing and mathematical computations	
Unit 2	**Classes and Objects (6-0-8-6 = 20 hrs)**	
A	Classes, Objects, Constructors: Class definition, object instantiation, default/parameterised/copy constructors, constructor overloading, this keyword, garbage collection	CO2

B	Methods and Overloading: Method declaration, invocation, pass-by-value vs. reference, static members/blocks, command-line arguments, varargs, method overloading	CO3
C	Arrays and String Handling: 1D/2D arrays, String and StringBuilder, string methods/immutability, wrapper classes, autoboxing/unboxing	CO4
Tools Used	Linux Environment, Java IDE (Eclipse/NetBeans), Debugger tools, Git/GitHub, Virtual Labs	
Activities	**Objective:** To understand OOP concepts, develop real-world entities using classes, master object creation and method implementation, and apply arrays and strings for data manipulation. • Creating classes and objects to represent real-world entities (Student, Product, Employee) • Implementing various constructor types and demonstrating constructor overloading • Applying method overloading for flexible function creation • Demonstrating static variables, methods, and their use cases • Implementing 1D and 2D arrays: declaration, initialization, traversal • Array operations: linear/binary search, bubble/insertion/selection sort • String manipulation: palindrome check, anagram detection, reversal, substring operations • Using wrapper classes for type conversions and processing command-line arguments	
Unit 3	**Advanced OOP Concepts (8-0-8-8 = 24 hrs)**	
A	Inheritance and Hierarchies: Single/multi-level/hierarchical inheritance, super keyword, method overriding, final keyword, abstract classes, Object class methods (toString, equals, hashCode)	CO1, CO4
B	Polymorphism and Interfaces: Compile-time and runtime polymorphism, dynamic dispatch, interface definition and implementation, default/static interface methods, lambda expressions, functional interfaces	CO5
C	Packages, Encapsulation, and Access Control: Package creation, import statements, access modifiers (public/private/protected/package-private), getters/setters, inner and nested classes	CO6
Tools Used	IDE with refactoring tools, UML tools (Lucidchart, PlantUML), Code-review platforms, GitHub	
Activities	**Objective:** To design modular, flexible, and reusable Java programs using inheritance, polymorphism, interfaces, and packages; to understand encapsulation principles. • Creating class hierarchies demonstrating single and multi-level inheritance • Implementing method overriding and demonstrating dynamic polymorphism • Designing abstract classes for extensible application frameworks • Creating interfaces and implementing multiple inheritance of type • Organising code using packages and demonstrating code-reusability benefits • Implementing encapsulation using access modifiers and getter/setter methods • Creating nested and inner classes for specialised use cases • Comparing OOP designs and selecting the most appropriate approach	
Unit 4	**Exception Handling and File I/O (5-0-4-6 = 15 hrs)**	
A	Exception Handling: Exception hierarchy (Throwable, Exception, RuntimeException, Error), try-catch-finally, throw/throws, custom exceptions, multiple catch blocks, best practices	CO5
B	File I/O Streams: InputStream, OutputStream, Reader, Writer; byte vs. character streams; FileInputStream/FileOutputStream; FileReader/FileWriter; BufferedReader/Writer; Scanner class	CO5
C	Advanced File Operations: Sequential and random access, serialisation/deserialisation, directory operations, CSV file processing, data import/export	CO5
Tools Used	IDE with debugging capabilities, LogBack/SLF4J for logging, File management tools, Text editors	

Activities	**Objective:** To develop robust Java programs that handle runtime errors effectively and perform efficient file I/O operations for real-world data management. • Handling runtime errors using appropriate try-catch-finally blocks • Creating custom exceptions for application-specific error handling • Implementing multi-level exception handling in complex programs • Reading data from text files and processing information • Writing data to files in structured formats • Implementing file operations: merging files, sorting file contents, generating file statistics • Creating buffered I/O programs for efficient file processing	
Unit 5	**Multithreading (5-0-4-6 = 15 hrs)**	
A	Thread Fundamentals: Thread concept, benefits of multithreading, Thread class and Runnable interface, creating threads, thread naming/identification, thread priorities, JVM scheduling	CO6
B	Thread Lifecycle and Synchronisation: Thread states, control methods (start, run, sleep, join, yield), synchronized keyword, locks, mutual exclusion, deadlock prevention, thread interruption	CO6
C	Inter-thread Communication and Concurrency: wait/notify/notifyAll, producer-consumer pattern, Executor framework, volatile keyword, concurrent collections, thread-safe data structures	CO6
Tools Used	IDE with thread debugging, JProfiler for thread analysis, Thread visualisation tools, Concurrency testing frameworks	
Activities	**Objective:** To develop concurrent Java applications demonstrating advanced thread management, synchronization, and inter-thread communication for real-world multi-threaded scenarios. • Creating and managing multiple threads using Thread class and Runnable interface • Implementing thread priorities and observing JVM scheduling behavior • Demonstrating complete thread lifecycle using appropriate thread methods • Implementing synchronized methods and blocks for race-condition prevention • Solving classic concurrency problems: Producer-Consumer, Dining Philosophers • Implementing inter-thread communication using wait() and notify() • Building simple thread pools and Executor service implementations	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓		✓			
2	1.B			✓			
3	1.C			✓			
4	2.A			✓			
5	2.B			✓			
6	2.C				✓		
7	3.A		✓		✓	✓	
8	3.B		✓			✓	✓
9	3.C					✓	
10	4.A					✓	
11	4.B					✓	
12	4.C					✓	

13	5.A						✓
14	5.B						✓
15	5.C						✓

5. CO vs Bloom's Taxonomy - All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓						✓					✓						
CO2		✓						✓					✓					
CO3			✓					✓						✓				
CO4				✓					✓						✓			
CO5					✓					✓						✓		
CO6						✓				✓							✓	
CO7			✓					✓						✓				
CO8						✓				✓							✓	
CO9			✓								✓				✓			
CO10			✓						✓						✓			

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory - 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Java, JVM architecture, bytecode, platform independence, and the basic structure of a Java program.	Unit 1	6
DD/MM/YY	Keywords and identifiers, variables and constants, and primitive and non-primitive data types.		
DD/MM/YY	Implicit and explicit type casting, type conversion, and expressions in Java.		
DD/MM/YY	Arithmetic operators, relational and logical operators, assignment and bitwise operators, ternary operator, and operator precedence and associativity.		
DD/MM/YY	If statement, if-else statement, nested if, and switch-case statement.		
DD/MM/YY	While loop, do-while loop, for loop, enhanced for loop, and break, continue, and return statements.		
DD/MM/YY	OOP basics: class, object, encapsulation, abstraction (conceptual view)	Unit 2	8
DD/MM/YY	Defining classes and objects; object creation and memory model		
DD/MM/YY	Constructors: default, parameterised, overloading; this keyword		

DD/MM/YY	Methods: definition, calling, pass-by-value; static members and blocks		
DD/MM/YY	1D and 2D arrays: declaration, initialization, traversal		
DD/MM/YY	Arrays in applications: searching, sorting, matrix operations		
DD/MM/YY	Strings: String and StringBuilder, common operations and methods		
DD/MM/YY	Wrapper classes, autoboxing/unboxing, command-line arguments		
DD/MM/YY	Single, multi-level, and hierarchical inheritance, super keyword, method overriding.	**Unit 3**	**6**
DD/MM/YY	Method overriding, 'final' keyword, abstract classes/methods for framework design, Object class, its methods e.g. toString, equals, and hashCode.		
DD/MM/YY	Compile-time polymorphism through method overloading, runtime polymorphism through method overriding, and dynamic method dispatch.		
DD/MM/YY	Interface definition and implementation, multiple interface implementation, default and static methods in interfaces, and functional interfaces with lambda expressions.		
DD/MM/YY	Packages, package creation and naming conventions, import statements, and access modifiers including public, private, protected, and package-private access.		
DD/MM/YY	Getters and setters for data encapsulation, package-level organization and code reusability strategies, and applications of inner classes and nested classes.		
DD/MM/YY	Exception hierarchy, checked vs. unchecked, try-catch-finally	**Unit 4**	**4**
DD/MM/YY	Throw and throws, multiple catch blocks, custom exceptions		
DD/MM/YY	Basics of file I/O, byte vs. character streams, FileInputStream/FileOutputStream		
DD/MM/YY	Readers/Writers, buffered streams, Scanner, simple file-based applications		
DD/MM/YY	Multithreading: concept, Thread class and Runnable interface, thread lifecycle	**Unit 5**	**6**
DD/MM/YY	Thread methods (sleep, join, yield); thread priorities and scheduling		
DD/MM/YY	Synchronisation: synchronized methods/blocks, race conditions		
DD/MM/YY	Inter-thread communication: wait, notify, notifyAll; producer-consumer		
DD/MM/YY	Thread pools and Executor framework (intro); simple concurrent tasks		

7. Lab Session Plan - List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Java Environment Setup & Basic Programs • Install JDK, configure Eclipse/NetBeans • "Hello World" with comments and program structure • Arithmetic operations (+, –, *, /, %) • Scanner class for user input	**CO7**	3.0
	S-1.2	Operator Precedence & Type Conversion • Programs demonstrating operator precedence • Explicit/implicit type casting examples • Programs with mixed data types	**CO7**	
W2	S-2.1	Decision Making - if-else & switch • Grade calculator (marks → A/B/C/D/F) • ATM menu system (balance check, withdraw, deposit) • Simple calculator using switch-case	**CO7**	3.0
	S-2.2	Nested Loops & Patterns	**CO7**	

		• Pyramid, diamond, right-triangle patterns • Floyd's triangle, number patterns • Sum of digits, factorial using loops		
W3	S-3.1	Classes & Objects - Real-World Modelling • Student class (name, rollno, marks, percentage) • Rectangle class (length, breadth, area, perimeter) • BankAccount class (balance, deposit, withdraw)	**CO7, CO8**	3.0
	S-3.2	Constructors & Method Overloading • Constructor overloading in Student class • Copy constructor for Rectangle • Method overloading: add(int), add(double), add(int,int)	**CO7, CO8**	
W4	S-4.1	Arrays - 1D Operations • Declaration, initialisation, traversal • Linear search, frequency count • Largest/smallest element, sum/average	**CO7**	3.0
	S-4.2	Array Algorithms • Bubble, selection, insertion sort • Binary search (sorted array) • Reverse array, duplicate removal	**CO7**	
W5	S-5.1	2D Arrays & Matrix Operations • Matrix addition, subtraction, multiplication • Transpose of matrix • Diagonal elements sum	**CO7**	3.0
	S-5.2	String Manipulation • Palindrome check, anagram detection • Vowel/consonant count, word count • String reversal, substring operations	**CO7**	
W6	S-6.1	Inheritance - Class Hierarchy • Shape hierarchy: Circle, Rectangle extends Shape • Vehicle hierarchy: Car, Bike extends Vehicle • Employee hierarchy: Manager, Developer	**CO7, CO8**	3.0
	S-6.2	Method Overriding & Polymorphism • Override calculateArea(), display() methods • Dynamic method dispatch demonstration • final keyword usage	**CO7, CO8**	
W7	S-7.1	Abstract Classes & Interfaces • Abstract Shape class with abstract methods • Drawable interface implementation • Multiple interface implementation	**CO7, CO8**	3.0
	S-7.2	Object Class Methods • Override toString(), equals(), hashCode() • Compare objects using overridden methods • Lambda expressions and functional interfaces	**CO7, CO8**	
W8	S-8.1	Exception Handling - Basic • Divide by zero, array index out of bounds • NumberFormatException handling • try-catch-finally blocks	**CO7**	3.0
	S-8.2	Advanced Exception Handling • Custom exception: InvalidAgeException • Multiple catch blocks • throw/throws keywords	**CO7**	
W9	S-9.1	File I/O - Byte Streams • FileInputStream/FileOutputStream • Copy file content • Character count in file	**CO7**	3.0
	S-9.2	File I/O - Character Streams • FileReader/FileWriter • Line-by-line reading/writing • Word count from text file	**CO7**	
	S-10.1	Advanced File Operations	**CO7, CO8**	

W10		• Student record management (add, search, delete) • CSV file read/write • File merging and sorting file contents		3.0
	S-10.2	Multithreading - Thread Creation • Thread using Thread class vs. Runnable • Multiple threads execution • Thread naming and priority	**CO7, CO8**	
W11	S-11.1	Thread Lifecycle & Methods • Demonstrate thread states (new, runnable, terminated) • sleep(), join(), yield() methods • Thread interruption	**CO7, CO8**	3.0
	S-11.2	Thread Synchronisation • Synchronised methods/blocks • Race condition demonstration • Atomic counter example	**CO7, CO8**	
W12	S-12.1	Inter-Thread Communication • Producer-Consumer using wait()/notify() • Bounded buffer problem • Thread coordination	**CO7, CO8**	3.0
	S-12.2	Thread Pools & Executors • ExecutorService creation • Fixed thread pool execution • Callable and Future	**CO7, CO8**	
W13	S-13.1	Mini Project - Phase 1: Proposal & Design • Topic selection with SDG alignment • UML class diagram and system design • Project plan and task distribution	**CO8, CO9, CO10**	3.0
	S-13.2	Mini Project - Phase 2: Implementation • Core module coding and unit testing • Code review and refactoring • Version control (Git commits)	**CO8, CO9, CO10**	
W14	S-14.1	Mini Project - Phase 3: Integration & Testing • Full integration of modules • Test cases: edge cases, exception handling • Documentation and README	**CO8, CO9, CO10**	3.0
	S-14.2	Mini Project - Phase 4: Presentation Preparation • Slide deck (problem, design, demo, reflection) • Rehearsal and peer review • Lab record finalisation	**CO8, CO9, CO10**	
W15	S-15.1	Mini Project - Final Presentation & Viva • Team demonstration (10 min) • Individual viva questions • Rubric-based evaluation by faculty	**CO8, CO9, CO10**	3.0
	S-15.2	Lab Examination • One unseen problem (OOP concept) • Code, compile, execute, and document • Viva on submitted solution	**CO9/CO10**	

Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.

PART II
THEORY ASSESSMENT FRAMEWORK
Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) - CO1 through CO6

THEORY COs (CO1–CO6) - Assessed exclusively via MTE and ETE only

Six theory skill dimensions - one per Bloom's level L1–L6 - correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall and list Java keywords, data types, operators, JVM components, and basic syntax elements from memory.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Classify and differentiate OOP principles; explain class structure, encapsulation, and abstraction through annotated examples.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Construct executable Java programs using classes, objects, constructors, method overloading, and control structures.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Decompose and trace Java programs involving arrays, strings, wrapper classes, and inheritance to identify flaws and produce debug reports.	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Assess and justify design choices for programs employing polymorphism, interfaces, exceptions, and file I/O against correctness and maintainability criteria.	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Architect and implement a concurrent Java application integrating multithreading and synchronisation within defined constraints.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure - MTE and ETE

9.1 Mid Term Examination (MTE) - 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1, TS2	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3, TS4	**CO3, CO4**	Program writing; program tracing - detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) - 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1, TS2	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3, TS4	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5, TS6	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application

TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme - Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation - no cross-assessment

11. Laboratory Assessment (40 Marks)

LAB COs (CO7–CO10) - Assessed exclusively via Laboratory Assessment only (CA + Mini Project)

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each - assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection - all 4 Lab COs (CO7–CO10)
TOTAL	-	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each - Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 - Problem definition: attributes, metrics, success criteria CA2 - Experimental design and tool configuration CA7 - Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 - Execution correctness; output matches expected CA4 - Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 - Output analysis and result interpretation CA6 - Documented outcome with verification CA8 - Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9

Professional Attitude & Ethical Conduct	**0.25**	CO9 - Documentation ethics, responsible practice PO7 - Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks - All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 - SDG mapping; societal relevance P2 - Problem scope and stakeholder requirements P4 - Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 - Timeline, milestones, resource planning P11 - Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 - Professional toolchain selection P6 - Complete project build and integration P7 - System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 - Measurable outcome vs stated goals P9 - Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 - Communication plan and testing strategy P10 - Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 - Skill growth mapping (pre/post project) P13 - Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment (gcc, IDE, Linux CLI, debugger)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7

CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Produce class diagrams and architecture diagrams; justify design decisions	CO8 | PO3, PO5
P5	**Professional Toolchain**	Develop the project in clearly separated, reusable Java modules	CO7, CO8 | PO5
P6	**End-to-End Implementation**	Use IDE, version control (Git), and build tools professionally	CO8 | PO1, PO3
P7	**System Commissioning & Testing**	Execute ≥5 structured test cases; document results and inferences	CO8 | PO1
P8	**Measurable Impact & Outcome**	Implement robust error/exception handling in all critical modules	CO8, CO9 | PO3
P9	**Critical Analysis & Reporting**	Maintain naming conventions, comments, and clean code standards throughout	CO9 | PO8
P10	**Professional Presentation & Teamwork**	Acknowledge sources; avoid plagiarism; adhere to coding standards	CO9 | PO9, PO11
P11	**Financial Feasibility & Planning**	Complete peer and self-evaluation rubrics; identify personal skill gaps	CO10 | PO9
P12	**Individual Skill Growth Mapping**	Demonstrate equitable task distribution and documented team coordination	CO10 | PO10
P13	**Professional Attitude, Ethics & Responsibility**	Deliver a structured 10-min demonstration; respond to evaluator questions	CO10 | PO9

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping - confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment - confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment - confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H																										
CO2		H																									
CO3			H																								
CO4				H																							
CO5					H																						
CO6						H																					
CO7			M				H	H	H	H	M	H		H	M				H	M		M						
CO8					M	H	H	H	M	H	H	H	H	M	H	H	H	H	H	H	H	H						
CO9		M												H		H					M	H	H	H				
CO10													M		M	M	M	M					M	M	H	H	H

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV
COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2											3	2	
CO2	3	2										3	2	

CO3	3	3	2									3	3	
CO4	3	3	2	2								3	2	
CO5	2	3	3	2								2	3	
CO6	2	2	3	2	2							2	3	3
CO7	2		2		3							2	3	
CO8	2	2	3	2	2	2	2					2	3	2
CO9								3						
CO10									3	3	2			
Avg	**2.38**	**2.5**	**2.5**	**2.0**	**2.33**	**2.0**	**2.0**	**3.0**	**3.0**	**3.0**	**2.0**	**2.5**	**2.62**	**2.5**

PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.

16. CO × PO Alignment Map (H/M Indicators - All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	**M**										
CO2	**H**	**M**									
CO3	**H**	**H**	**M**								
CO4	**H**	**H**	**M**	**M**							
CO5	**M**	**H**	**H**	**M**							
CO6	**M**	**M**	**H**	**M**	**M**						
CO7	**M**		**M**		**H**						
CO8	**M**	**M**	**H**	**M**	**M**	**M**	**M**				
CO9								**H**			
CO10									**H**	**H**	**M**

H = High / Primary **M** = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	**Quality Education**	**3 (High)**	Course develops programming competency and computational problem-solving skills; lab record, viva, and self-assessment promote lifelong learning habits. (CO1-CO10).
SDG 8	**Decent Work & Economic Growth**	**2 (Moderate)**	OOP skills and professional tool use (IDE, Git, debuggers) prepare students for industry-grade software development roles. (CO3, CO5, CO6, CO7, CO8)
SDG 9	**Industry, Innovation & Infrastructure**	**3 (High)**	Designing concurrent and file-based Java applications addresses real-world infrastructure and software innovation challenges. (CO5, CO6, CO8)
SDG 17	**Partnerships for the Goals**	**2 (Moderate)**	Team-based mini-project promotes collaboration, shared responsibility, and communication skills aligned with partnership values. (CO10)

18. Bloom's Taxonomy - Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain - Simpson (7 Levels)
L1 - Remember: Recall facts, definitions, basic concepts L2 - Understand: Explain ideas, concepts, principles L3 - Apply: Use knowledge to solve new problems L4 - Analyze: Break down information, examine patterns L5 - Evaluate: Judge, justify, assess, make decisions L6 - Create: Design, develop, produce new solutions	A1 - Receiving: Awareness, willingness to attend A2 - Responding: Active participation and reaction A3 - Valuing: Showing commitment, assigning value A4 - Organizing: Integrating values into personal system A5 - Characterizing: Internalized value system	P1 - Perception: Sensory cues guide motor activity P2 - Set: Mental, physical readiness to act P3 - Guided Response: Basic practice through imitation P4 - Mechanism: Habitual correct performance P5 - Complex Overt Response: Skilled performance P6 - Adaptation: Modify skills for special situations P7 - Origination: Create new solution patterns

OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains - Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) - reflecting the skill-based nature of laboratory and project assessment.

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

OOP using Java INTEGRATED COURSE PLAN - MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SSCSE		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2026-27**	
1	Course Code	CVT1103	
2	Course Title	Environmental Science	
3	Credits	0	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	Compulsory	
5	Course Objective	1. Enable students to learn the concepts, principles and importance of environmental science 2. Provide students an insight of various causes of natural resource depletion and its conservation 3. Provide knowledge of layers of atmosphere with an insight of role of climatic elements in dispersion of pollutants 4. Provide detailed knowledge of causes, effects and control of different types of environmental pollution, solid waste management and its effect on climate change, global warming and ozone layer depletion 5. Provide and enrich the students about social issues such as R&R, water conservation and sustainability.	
6	Course Outcomes	CO1.Understand the scope of environmental science with knowledge about various types of natural resources and its conservation CO2. Study about the structure and composition of atmosphere and factors affecting weather and climate CO3. Study about pollution causes, effects and control and solid waste management CO4. Effect of global warming and ozone layer depletion CO5.Understand sustainable development, resettlement and rehabilitation, impact of population explosion on environment CO6.Understand overall environmental issues and its management	
7	Course Description	Environmental Science emphasises on various factors as 1. Importance and scope of environmental science 2. Natural resource conservation 3. Pollution causes, effects and control methods and solid waste management 4. Social issues associated with environment	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**General Introduction**	
	A	Definition, principles and scope of environmental science	CO1
	B	Water Resources, Land Resources, Food Resources	CO1
	C	Mineral Resources, Energy Resources, Forest Resources	CO1
	Unit 2	**Atmosphere and meteorological parameters**	

	A	Structure and composition of atmosphere	CO2
	B	Meteorological parameters: Pressure, Temperature, Precipitation, Humidity,	CO2
	C	Radiation, Wind speed and direction, Wind Rose	CO2
	Unit 3	**Environmental Pollution (Cause, effects and control measures)**	
	A	Air, water, Noise and Soil pollution	CO3
	B	Case studies on pollution	CO3
	C	Solid waste management: Causes, effects and control measures of urban and industrial wastes.	CO3, CO6
	Unit 4	**Climate Change and its impact**	
	A	Concept of Global Warming and greenhouse effect	CO4
	B	Ozone layer Depletion and its consequences	CO4
	C	Climate change and its effect on ecosystem, Kyoto protocol and IPCC concerns on changing climate	CO4
	Unit 5	**Social Issues and the Environment**	
	A	Concept of sustainable development, Water conservation	CO5, CO6
	B	Resettlement and rehabilitation of people; its problems and concerns, Case studies	CO5, CO6
	C	Population explosion and its consequences	CO5, CO6
	Mode of examination	Theory	
	Weight age Distribution	CA(25) ESE(75)	
	Text book/s*	**1.** Joseph, Benny, "Environmental Studies", Tata Mcgraw-Hill. **2.** .Howard S. Peavy, Donald R. Rowe, George Tchobanoglous. Environmental engineering Mc Graw-Hill, 1985	
	Other References		

CO-PO Mapping

CO↓ PO →	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	2	1	2			2	3	1	1	3
CO2	1	3	2	2	1	3	1	1	2		3	3	2	2
CO3		2	2	2		2	2		1		1		1	3
CO4	1		1	2	3				2	3		2		
CO5		3		1	2	3	2	1		2	2	1	3	1
CO6	2		1			1			1	1				2

Average of non-zeros entry in following table (should be auto calculated).

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**	**PSO 3**

Course Code/ Name	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative	Communication	Project Management and	Life-Long Learning	Familiarity and practical	Understand, analyze and	Apply standard Software
CVT1103	**1.25**	**2.25**	**1.40**	**1.60**	**2.00**	**2.00**	**1.75**	**1.00**	**1.50**	**2.00**	**2.25**	**1.75**	**1.75**	**2.20**

Strength of Correlation: 24.5

1. Addressed to ***Slight (Low=1) extent*** ***2.*** Addressed to***Moderate (Medium=2) extent***
3. Addressed to ***Substantial (High=3) extent***

Semester 3, Credits: 21	
COURSE CODE	**COURSE NAME**
CSCR2310	Computer Networks
CSCR2111	Discrete Structures
CSCR2312	Principles of Operating System
CSCR2113	Computer Organization and Architecture
CSCR2311	Data Structure
CSCR2600	Project Based Learning (PBL) -1 (Mini-Hackathon Based)
SKP2301	Professional Skills, Data Structures & Web Technologies

COURSE PLAN

Computer Networks (CN)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026 onwards
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	**CSCR2310**
2	**Course Title**	**Computer Networks**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-2
5	**Course Status**	Core
6	**Course Objective**	To provide students with a strong foundation in computer networking concepts, reference models, transmission techniques, routing, and network protocols, along with practical exposure to network design, simulation, and troubleshooting for real-world networking applications.

7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Understand – L2): Demonstrate networking fundamentals and differentiate the working of OSI and TCP/IP models. CO2 (Analyze – L4): Investigate error control, flow control, and MAC protocols for reliable communication. CO3 (Apply – L3): Apply IP addressing, subnetting, routing, and congestion control techniques. CO4 (Analyze – L4): Examine transport layer services, TCP/UDP protocols, and congestion control mechanisms. CO5 (Understand – L2): Describe connection management and application layer protocols. CO6 (Understand – L2): Outline the basic concepts and applications of cryptography and network security. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Configure and troubleshoot network utilities and commands. CO8 (Analyze – L4): Implement error detection, routing and congestion control algorithms. CO9 (Apply – L3): Simulate and evaluate network topologies using Packet Tracer and networking tools. CO10 (Evaluate/Create – L5/L6): Implement cryptographic algorithms or Develop secure networking applications.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	• Practice IP addressing, subnetting, routing, and protocol-based numerical problems. • Perform Computer Networks Virtual Labs (NPTEL/Virtual Labs) on routing, CRC, flow control, and network simulation. • Complete a MOOC/NPTEL/SWAYAM course on Computer Networks and network security fundamentals.
11	**References**	**Text Book** Tanenbaum, A. S. — Computer Networks (4th Edition), PHI. **Reference Books** Forouzan, B. A. — Data Communications and Networking, TMH, Latest Edition. Stallings, W. — Data and Computer Communication, Macmillan Press.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction**	
A	Introduction to Computer Networks, applications, network classification, network topologies, communication modes, and geographical distribution of networks.	CO1, CO2
B	OSI and TCP/IP reference models, functions of each layer, and networking devices: Hub, Repeater, Switch, Bridge, Router, and Gateway.	CO1, CO2
C	Transmission Media: Wired and Wireless media, bandwidth concepts, and multiplexing techniques — FDM and TDM.	CO1, CO2

Tools Used	Cisco Packet Tracer, Whiteboards, Virtual Labs, Networking Utilities (PING, IPCONFIG, TRACERT, NETSTAT)	
Activities	Objective: To understand networking fundamentals, reference models, networking devices, and transmission techniques. • Study of Computer Network Fundamentals. • Comparison of OSI and TCP/IP models. Demonstration of Networking Devices- • Hub, Switch, Bridge, Router, Gateway and Repeater • Working and applications of networking devices Practical exposure using networking tools- • Basic networking commands: PING, IPCONFIG, TRACERT, NETSTAT • Network simulation using Cisco Packet Tracer and Virtual Labs	
Unit 2	**Data Link Layer**	
A	Functions of Data Link Layer, Framing, Error Detection and Error Correction techniques: Parity Bit, CRC, and Hamming Code.	CO1, CO2
B	Flow Control Protocols: Stop-and-Wait, Sliding Window, Go-Back-N, and Selective Repeat ARQ.	CO1, CO2
C	MAC- Sub-layer Protocols: ALOHA, CSMA, CSMA/CD protocols, and IEEE Standards 802.3, 802.4,802.5	CO1, CO2
Tools Used	Cisco Packet Tracer, GCC Compiler/C Programming Environment, Wireshark, Virtual Labs, Whiteboards, Networking Utilities.	
Activities	Objective: To understand framing, error control, flow control, and MAC protocols used in reliable data communication. • Implementation of error detection and correction methods: Parity, CRC, and Hamming Code. • Demonstration of Stop-and-Wait and Sliding Window protocols. • Analysis of MAC protocols: ALOHA, CSMA, and CSMA/CD. • Simulation of flow control and MAC protocols using Cisco Packet Tracer and Virtual Labs.	
Unit 3	**Network Layer**	
A	Functions of Network Layer, Network Layer Protocols: IP, ICMP, ARP, RARP, and IGMP; Types of Routing Algorithms.	CO1, CO3
B	IPv4 Addressing, IP Header Format, CIDR, Subnet Mask, Subnetting.	CO1, CO3
C	Congestion Control Techniques: Leaky Bucket and Token Bucket Algorithms.	CO1, CO3
Tools Used	Cisco Packet Tracer, GCC Compiler/C Programming Environment, Virtual Labs, Whiteboards, Networking Utilities.	
Activities	**Objective**: To understand network layer protocols, IP addressing, subnetting, routing algorithms, and congestion control techniques. • Practice on IPv4 addressing, subnetting, CIDR, and subnet mask calculations. • Analysis of routing algorithms and routing table concepts. • Implementation of subnetting and routing-based numerical problems. • Network layer simulation using Cisco Packet Tracer and Virtual Labs.	
Unit 4	**Transport Layer**	
A	Need of transport layer & its services, Quality of Service, connection oriented and connection less communication	CO1, CO4
B	Transmission Control Protocol (TCP): Segment Structure, Header Format, Connection Management, and Flow Control.	CO4, CO5

C	TCP congestion control, Internet Congestion Control Algorithm, Overview of User Datagram Protocol (UDP)	CO5
Tools Used	Wireshark, Cisco Packet Tracer, Virtual Labs, GCC Compiler/C Programming Environment, Whiteboards, Networking Utilities.	
Activities	**Objective:** To understand transport layer services, TCP/UDP protocols, connection management, flow control, and congestion control mechanisms. • Comparison of connection-oriented and connectionless communication. • Analysis of TCP segment structure and header fields. • Demonstration of TCP connection establishment and termination. • Comparison of TCP and UDP protocols using Wireshark and Packet Tracer simulations.	
Unit 5	**Application Layer**	
A	Domain Name System (DNS), HTTP, FTP, SMTP	CO1, CO5
B	Network Security services, cryptography, Symmetric versus Asymmetric cryptographic algorithms- DES, and RSA	CO5
C	Application of Security in Networks: Digital signature	CO5, CO6
Tools Used	Wireshark, Cisco Packet Tracer, GCC Compiler/C Programming Environment, OpenSSL Tools, Virtual Labs, Web Browsers.	
Activities	**Objective**: To understand application layer protocols, cryptography concepts, and network security mechanisms. • Analysis of client-server communication using networking tools. • Demonstration of DNS lookup and HTTP request-response process. • Implementation of basic cryptographic algorithms: DES and RSA.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C		✓	✓			
7	3.A		✓	✓			
8	3.B			✓	✓		
9	3.C			✓	✓		
10	4.A		✓	✓			
11	4.B			✓	✓		
12	4.C			✓	✓		
13	5.A		✓	✓			
14	5.B				✓	✓	✓

15	5.C				✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1		✓					✓											
CO2				✓			✓	✓										
CO3			✓					✓	✓					✓	✓			
CO4				✓				✓	✓					✓	✓			
CO5		✓					✓	✓										
CO6		✓					✓	✓	✓									
CO7			✓					✓	✓				✓	✓	✓			
CO8				✓				✓	✓	✓				✓	✓	✓		
CO9			✓		✓			✓	✓				✓	✓	✓	✓		
CO10					✓	✓			✓	✓	✓			✓	✓	✓	✓	

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Computer Networks: need, components	Unit 1	9
DD/MM/YY	Applications of Computer Networks		
DD/MM/YY	Network classification: LAN, MAN, WAN; client–server vs P2P		
DD/MM/YY	Network topologies: bus, star, ring, mesh, tree		
DD/MM/YY	Communication modes: simplex, half-duplex, full-duplex; unicast/multicast/broadcast		
DD/MM/YY	Geographical distribution of networks and use-cases		
DD/MM/YY	OSI reference model: overview and layer functions		
DD/MM/YY	TCP/IP reference model: overview and comparison with OSI		
DD/MM/YY	Networking devices: Hub, Repeater, Switch, Bridge, Router, Gateway		
DD/MM/YY	Functions of Data Link Layer; framing basics	Unit 2	9
DD/MM/YY	Framing techniques: fixed/variable, character/bit stuffing		
DD/MM/YY	Error types and need for error detection/correction		
DD/MM/YY	Error Detection: Parity Bit methods		

DD/MM/YY	Error Detection: CRC – concept and simple examples		
DD/MM/YY	Error Correction: Hamming Code – idea and construction		
DD/MM/YY	Flow Control Protocols: basics and Stop-and-Wait		
DD/MM/YY	Sliding Window Protocols: concept and operation		
DD/MM/YY	ARQ Protocols: Go-Back-N and Selective Repeat		
DD/MM/YY	MAC sub-layer: role and overview	Unit 3	9
DD/MM/YY	ALOHA and Slotted ALOHA protocols		
DD/MM/YY	CSMA and CSMA/CD protocols		
DD/MM/YY	IEEE 802.3 (Ethernet) standard: frame format and basics		
DD/MM/YY	IEEE 802.4 and 802.5 standards: token-based access overview		
DD/MM/YY	Functions of Network Layer; introduction to routing		
DD/MM/YY	Network Layer Protocols: IP and ICMP		
DD/MM/YY	ARP and RARP protocols		
DD/MM/YY	IGMP and types of routing algorithms (distance vector, link state – overview)		
DD/MM/YY	IPv4 Addressing: address structure and classes	Unit 4	9
DD/MM/YY	IP Header Format: fields and their roles		
DD/MM/YY	CIDR and Subnet Mask: notation and purpose		
DD/MM/YY	Subnetting techniques: design and examples		
DD/MM/YY	Numerical problems on subnetting		
DD/MM/YY	Congestion in networks: causes and symptoms		
DD/MM/YY	Congestion Control: Leaky Bucket Algorithm		
DD/MM/YY	Congestion Control: Token Bucket Algorithm and comparison with Leaky Bucket		
DD/MM/YY	Need of Transport Layer, its services, QoS, connection-oriented vs connectionless communication		
DD/MM/YY	TCP: segment structure and header format	Unit 5	9
DD/MM/YY	TCP: connection management (three-way handshake)		
DD/MM/YY	TCP: flow control mechanisms		
DD/MM/YY	TCP congestion control and Internet congestion control algorithms		
DD/MM/YY	Overview of UDP and TCP vs UDP comparison		
DD/MM/YY	Application Layer: DNS and HTTP		
DD/MM/YY	Application Layer: FTP and SMTP		
DD/MM/YY	Network Security services and basic cryptography concepts		
DD/MM/YY	Symmetric vs Asymmetric cryptography: DES and RSA; Digital Signature and its applications		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Study of Data Communication and Networking fundamentals; identification of five components of data communication system	CO7	3.0
	S-1.2	Study of OSI reference model and TCP/IP model using networking diagrams and simulations	CO7	
W2	S-2.1	Practice of networking utilities: IPCONFIG, PING, TRACERT and NETSTAT commands	CO7	3.0
	S-2.2	Configure basic peer-to-peer network and troubleshoot connectivity issues	CO7	
W3	S-3.1	Study and simulation of computer network topologies using Cisco Packet Tracer	CO7	3.0
	S-3.2	Demonstration and configuration of networking devices: Hub, Switch, Bridge, Router and Gateway	CO7	
W4	S-4.1	Implement Character Stuffing and De-stuffing using C programming	CO7	3.0
	S-4.2	Implement Error Detection using Cyclic Redundancy Check (CRC) algorithm	CO7	
W5	S-5.1	Implement Hamming Code generation and error correction technique	CO7	3.0
	S-5.2	Simulation of framing and error detection techniques using Virtual Labs	CO7	
W6	S-6.1	Demonstration of Stop-and-Wait protocol using networking simulation tools	CO7	3.0
	S-6.2	Simulation of Sliding Window protocol and flow control mechanisms	CO7	
W7	S-7.1	Simulation and analysis of ALOHA and CSMA protocols	CO7	3.0
	S-7.2	Simulation of CSMA/CD and IEEE 802.3 LAN protocol using Packet Tracer	CO7	
W8	S-8.1	Write a C program to identify IP address classes (Class A, B, C, D and E)	CO7	3.0
	S-8.2	Write a C program to convert dotted decimal IP address into 32-bit binary format	CO7	
W9	S-9.1	Practice IPv4 addressing, subnetting and subnet mask calculations	CO7	3.0
	S-9.2	Configure routing tables and analyze routing algorithms using Packet Tracer	CO7	
W10	S-10.1	Implement congestion control using Leaky Bucket algorithm	CO7	3.0
	S-10.2	Implement Token Bucket algorithm and compare congestion control techniques	CO7	
W11	S-11.1	Analyze TCP and UDP packets using Wireshark	CO7	3.0
	S-11.2	Demonstration of TCP connection establishment, termination and flow control	CO7	
W12	S-12.1	Create and simulate network topology using Cisco Packet Tracer	CO7	3.0
	S-12.2	Configure client-server communication and DNS lookup process using networking tools	CO7	
W13	S-13.1	Implement Distance Vector Routing algorithm with real-world routing analysis	CO8	3.0
	S-13.2	Case study and performance analysis of routing and congestion control techniques in real networks	CO8	
W14	S-14.1	Implement DES encryption algorithm; analyze security applications and submit reflection report	CO8/CO9	3.0
	S-14.2	Team-based implementation of RSA algorithm with peer review and collaborative presentation	CO8/CO10	
W15	S-15.1	Develop secure client-server communication application with ethical networking practices and self-assessment	CO8/CO9	3.0
	S-15.2	Open-ended mini project using Packet Tracer/cryptographic tools; final demonstration, teamwork evaluation and presentation	CO9/CO10	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Basic Networking Concepts & Terminology	Recall basic networking concepts, OSI/TCP-IP models, networking devices, transmission media, and protocol names	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	Understanding of Data Communication & Protocols	Explain framing, error control, flow control, MAC protocols, and the working of networking layers and protocols	CO2 | L2	MTE Sec A | ETE Sec A
TS3	IP Addressing & Routing Problem Solving	Apply IPv4 addressing, subnetting, CIDR, routing concepts, and congestion control techniques to solve numerical and networking problems	CO3 | L3	MTE Sec B | ETE Sec B
TS4	Analysis of Transport Layer Mechanisms	Analyze TCP/UDP protocols, connection management, flow control, and congestion control mechanisms in computer networks	CO4 | L4	MTE Sec B | ETE Sec B
TS5	Understanding of Application Layer & Security Concepts	Explain DNS, HTTP, FTP, SMTP, cryptography concepts, and compare different security mechanisms and protocols	CO5 | L2–L5	ETE Sec B/C
TS6	Secure Networking & Protocol Design Understanding	Understand the use of cryptographic algorithms, digital signatures, and secure communication techniques in computer networks	CO6 | L2–L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO3 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**6**	TS1 — Basic Networking Concepts & Terminology TS2 — Understanding of Data Communication & Protocols	CO1, CO2	Short-answer questions: definitions, protocol functions, networking concepts, OSI/TCP-IP layers, device identification
Sec B	**4**	TS3 — IP Addressing & Routing Problem Solving	CO3	Numerical problems, subnetting, IP addressing, routing concepts, CRC/congestion control based analytical questions

TOTAL	10	TS1–TS3	CO1–CO3	Units 1–3 covered; CO4, CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	25	TS1 — Basic Networking Concepts & Terminology TS2 — Understanding of Data Communication & Protocols	CO1, CO2	Short questions: networking fundamentals, OSI vs TCP/IP models, transmission media, networking devices, framing, error control, flow control, MAC protocols and protocol-based conceptual questions
Sec B	50	TS3 — IP Addressing & Routing Problem Solving TS4 — Analysis of Transport Layer Mechanisms	CO3, CO4	Medium questions: IP addressing, subnetting, routing algorithms, congestion control numericals, TCP/UDP analysis, transport layer services, flow control and protocol analysis questions
Sec C	25	TS5 — Understanding of Application Layer & Security Concepts TS6 — Secure Networking & Protocol Design Understanding	CO5, CO6	Long-answer/design questions: connection management, DNS, HTTP, FTP, SMTP, cryptography concepts, DES/RSA comparison, digital signatures and network security applications
TOTAL	100	TS1–TS6 (all)	CO1–CO6	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	30	3.0 marks each — assesses CO7, CO8 and CO9 through implementation, simulation, troubleshooting and documentation
Mini Project	1 Project	10	Network design/simulation or secure networking application using Cisco Packet Tracer / cryptographic tools — assesses all Lab COs (CO7–CO10) through design, implementation, demonstration and presentation
TOTAL	—	**40**	Laboratory Assessment only

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Understanding & Network Configuration	1.0	CA1 — Understanding of networking problems and objectives CA2 — Network/tool configuration and setup CA7 — Planning of solution, topology, algorithm or protocol implementation	1.0: Proper understanding and correct setup | 0.5: Partial understanding/setup | 0: Incorrect or missing	CO7, CO8
Implementation, Simulation & Execution	1.0	CA3 — Correct execution of program/simulation/network configuration CA4 — Efficient implementation and troubleshooting using networking tools	1.0: Correct execution with proper results | 0.5: Partially correct execution | 0: Failed execution	CO7
Result Analysis & Lab Documentation	0.75	CA5 — Analysis and interpretation of outputs/results CA6 — Proper documentation and verification of results CA8 — Lab record completion and viva understanding	0.75: Complete analysis and documentation | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Conduct & Ethical Practices	0.25	CO9 — Responsible use of networking tools and documentation ethics PO7 — Professional behaviour and ethical laboratory practices	0.25: Consistent and professional | 0.10: Occasional compliance | 0: Absent	CO9
Total	**3.0**	**All 8 CA skill dimensions covered**		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	30 Marks	x lowest experiment scores are dropped
10	All 10	30 Marks	No score dropped
< 10	All Conducted	≤ 30 Marks	Missing experiments treated as zero (deficit = zero)

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	1.5	P1 — SDG mapping and societal relevance of networking/security application P2 — Network requirements, objectives and problem scope P4 — Suitable networking/security solution with possible alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO10 / PO3, PO6
Project Planning & Resource Utilization	1.5	P2 — Timeline, milestones and implementation planning P11 — Effective	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10

		use of networking tools, simulation software and lab resources		
End-to-End Implementation & System Testing	2.0	P5 — Appropriate networking/security tool selection P6 — Complete implementation and integration of routing, congestion control or security mechanisms P7 — Testing, troubleshooting and verification of outputs	2: Fully functional | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Result Analysis & Technical Documentation	2.0	P8 — Analysis of outputs/results against objectives P9 — Comparative analysis, screenshots/logs and technical report preparation	2: Thorough | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO4, PO6
Communication, Presentation & Teamwork	2.0	P3 — Demonstration planning and communication strategy P10 — Professional presentation, viva performance and teamwork	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Conduct	1.0	P12 — Reflection on learning and skill development P13 — Ethical practices, responsible tool usage and professional conduct	1.0: Reflective & professional | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	**All 13 Project Skill Dimensions; all 4 Lab COs (CO7–CO10)**		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	Network Problem Understanding & Configuration Planning	Understand the networking/security problem; identify required utilities, protocols, topology requirements and expected outcomes	CO7, CO8
CA2	Experimental Design & Tool Configuration	Plan experiments and configure networking/simulation tools such as Cisco Packet Tracer, Wireshark, GCC, OpenSSL and Virtual Labs	CO7, CO9
CA3	Implementation, Configuration & Execution	Correctly configure network utilities, implement algorithms/programs and execute simulations to obtain expected outputs	CO7, CO8
CA4	Troubleshooting, Testing & Performance Analysis	Troubleshoot configuration/execution errors; analyze routing, congestion and protocol performance	CO7, CO8
CA5	Output Analysis & Result Interpretation	Analyze outputs, packet flow, routing behaviour, congestion results and security implementation outcomes logically	CO8, CO10
CA6	Documentation & Result Verification	Maintain proper lab records, screenshots/logs and verify outputs against experiment objectives	CO7, CO8, CO9
CA7	Algorithm, Security & Topology Design	Develop routing logic, congestion control flow, cryptographic implementation or network topology design before execution; justify approach	CO8, CO9, CO10
CA8	Lab Record Maintenance, Viva & Professional Practice	Maintain complete lab records and demonstrate conceptual understanding, simulation knowledge and professional conduct during viva	CO7, CO9, CO10

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor

P1	SDG Alignment & Social Relevance	Relate the networking/security project to societal needs, secure communication, smart systems or digital connectivity applications	CO10 | PO6
P2	Problem Scoping & Network Requirements	Define project scope, network requirements, topology needs and measurable objectives clearly	CO8 | PO2
P3	Communication & Testing Strategy	Plan team communication, testing procedures, experiment validation and task coordination	CO10 | PO9
P4	Networking/Security Solution Design	Propose suitable routing, congestion control, topology or security solution with alternatives and justification	CO8 | PO3
P5	Professional Toolchain & Resource Usage	Select and use appropriate networking/simulation/security tools and configure project environment properly	CO7 | PO5
P6	End-to-End Implementation	Develop and integrate complete networking/security solution using multiple syllabus concepts and tools	CO7, CO8 | PO3
P7	System Testing & Troubleshooting	Execute testing, troubleshoot errors and verify correct working of routing, topology or security implementation	CO7, CO8 | PO5
P8	Result Evaluation & Performance Analysis	Evaluate outputs against objectives and analyze routing, congestion or security performance using observations/metrics	CO8 | PO6
P9	Technical Analysis & Documentation	Perform comparative analysis, maintain screenshots/logs and prepare structured technical documentation/report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver project presentation/demo professionally and demonstrate teamwork and task sharing	CO10 | PO8, PO9
P11	Project Planning & Resource Management	Plan implementation stages, manage available lab/software resources and justify tool utilization	CO10 | PO10
P12	Skill Development & Learning Reflection	Reflect on learning outcomes, networking/security skills gained and individual contribution to the project	CO9 | PO11
P13	Professional Ethics & Responsible Practice	Demonstrate ethical conduct, originality, responsible use of networking/security tools and proper documentation practices	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1	TS2	TS3	TS4	TS5	TS6	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	P1	P2	P3	P4	P5	P6	P7	P8 I	P9	P10	P11	P12	P13
CO1	H	M																									
CO2	M	H		H																							
CO3			H	M																							
CO4			M	H																							

CO5					H	M																			
CO6					M	H																			
CO7							H	H	H	H		H	M	H					H	H	H				
CO8							H		H	H	H	H	H			H		H		H	H	H	H		
CO9								H				H	H	H	H				M					H	H
CO10											H		H	H	H		H		M				H	H	H

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	1	–	–	–	–	–	1	2	1	–
CO2	3	3	1	2	1	–	–	–	–	–	1	2	2	–
CO3	3	3	2	2	2	2	–	–	–	–	1	3	3	2
CO4	2	3	2	3	2	–	–	–	–	–	1	2	3	2
CO5	2	2	1	1	1	–	–	–	–	–	1	2	2	1
CO6	2	2	2	1	2	2	1	1	–	–	2	2	2	2
CO7	–	1	2	1	3	–	–	–	–	–	–	2	3	2
CO8	–	2	3	2	2	2	–	–	–	–	–	2	3	3
CO9	–	1	2	2	3	1	3	–	1	–	3	2	3	3
CO10	–	2	3	2	2	2	2	2	2	1	2	2	3	3
Avg	**2.50**	**2.10**	**2.00**	**1.80**	**1.90**	**1.80**	**1.67**	**1.50**	**1.50**	**1.00**	**1.38**	**2.10**	**2.50**	**2.25**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M			M						M
CO2	H	H	M	M	M						M

CO3	H	H	M	M	M	M					M
CO4	M	H	M	H	M						M
CO5	M	M	M	M	M						M
CO6	M	M	H	M	H	M	M				H
CO7		M	M		H						M
CO8		H	H	M	M	M					M
CO9			M	M	H	M	H	M	M		H
CO10		M	H	M	M	M	M	H	H	M	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	**3 (High)**	Develops strong understanding of computer networking fundamentals, routing, protocols, simulation and security concepts; supports lifelong learning and technical competency development (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	**3 (High)**	Builds industry-relevant networking, troubleshooting, simulation and security skills using professional tools such as Cisco Packet Tracer and Wireshark (CO7–CO10).
SDG 9	Industry, Innovation & Infrastructure	**3 (High)**	Supports development of reliable communication networks, routing solutions, congestion control mechanisms and secure networking applications through practical implementation and simulation activities (CO3, CO8, CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Encourages efficient network design, optimized routing/configuration practices, ethical usage of networking resources and responsible handling of security tools and data (CO7, CO9, CO10).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

COMPUTER NETWORKS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO11 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Discrete Structures (CSCR2111)

Sharda School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester III | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE - Sharda School of Computing Science & Engineering	**Batch:**	2026-30
Program:	B. Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	III
Course Code:	CSCR2111	**Course Type:**	Core - Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No.	Attribute	Details
1	**Course Code**	**CSCR2111**
2	**Course Title**	**Discrete Structures**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Develop mathematical reasoning and logical thinking required in Computer Science. 2. Introduce formal structures such as sets, relations, functions, algebraic structures, lattices, and graphs. 3. Enable students to model computational problems using discrete mathematical techniques. 4. Build analytical and problem-solving skills for algorithms, data structures, cryptography, AI, and software engineering.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** Course Outcomes — Bloom's Level CO1: Explain principles of sets, relations, and functions used in computational systems. — L2 CO2: Apply propositional and predicate logic to validate mathematical arguments and proofs — L3 CO3: Analyze and apply algebraic structures including groups, rings, lattices and POSETs — L3 CO4: Analyze Boolean Algebra, Recurrence Relations, and Generating Functions in digital systems and algorithmic analysis. — L4

		CO5: Design and analyze trees, graphs, and combinatorial techniques L5-L6 CO6: Develop computational models using discrete mathematical concepts L6
8	**Course Description**	This course introduces the foundations of discrete mathematics essential for computer science applications including logic, proofs, algebraic structures, Boolean algebra, graph theory, recurrence relations, combinatorics, and trees.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1) *C. L. Liu, Elements of Discrete Mathematics, second edition 1985, McGraw-Hill Book Company. Reprinted 2000.* 2) Jean Paul Trembley, R Manohar, "Discrete Mathematical Structures with Application to Computer Science", McGraw-Hill. 3) *K. H. Rosen, Discrete Mathematics and applications, fifth edition 2003, Tata McGraw Hill Publishing Company.*
12	**References**	1) *J .L. Mott, A. Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.* 2) *W.K. Grassmann and J.P.Trembnlay, Logic and Discrete Mathematics, A Computer Science*

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

Unit	Topic	CO Mapping
Unit 1:	**Set Theory, Relations and Functions**	
A	Sets, subsets, power sets, Cartesian products, multisets, ordered pairs, set identities	**CO1**
B	Relations: properties, equivalence relations, partial ordering, composition of relations	**CO1**
C	Functions: injective, surjective, bijective, recursive functions, applications	**CO1**
Unit 2:	**Logic and Mathematical Induction**	
A	Propositional logic, truth tables, tautologies, contradiction, inference theory	**CO1, CO2**
B	Predicate logic, quantifiers, well-formed formulas, inference rules	**CO2**
C	Mathematical induction, strong induction, recursive definitions	**CO2**
Unit 3:	**Algebraic Structures**	
A	Groups, subgroups, cyclic groups, cosets, Lagrange's theorem	**CO3**
B	Rings, fields, homomorphisms, modulo arithmetic	**CO3**
C	POSET, Hasse diagrams, lattice introduction	**CO3**
Unit 4:	**Lattices and Boolean Algebra**	
A	Lattices, complemented lattices, modular lattices, distributive lattices	**CO4**
B	Boolean algebra, K-Maps, logic gates, combinational and sequential circuits	**CO4**

C	Recurrence relations, generating functions, recursive algorithms	**CO4**
Unit 5:	**Graph Theory and Combinatorics**	
A	Trees, binary trees, tree traversal, spanning trees	**CO4, CO5**
B	Graphs, graph representation, planar graphs, graph coloring, Euler and Hamiltonian graphs	**CO5**
C	Counting techniques, permutations, combinations, pigeonhole principle, inclusion–exclusion	**CO5, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓	✓			
2	1.B	✓	✓	✓			
3	1.C	✓	✓	✓			
4	2.A	✓	✓	✓	✓		
5	2.B	✓	✓	✓	✓		
6	2.C	✓	✓	✓	✓		
7	3.A	✓	✓	✓	✓		
8	3.B	✓	✓	✓	✓		
9	3.C	✓	✓	✓	✓		
10	4.A	✓	✓	✓	✓	✓	
11	4.B	✓	✓	✓	✓	✓	
12	4.C	✓	✓	✓	✓	✓	
13	5.A	✓	✓	✓	✓	✓	✓
14	5.B	✓	✓	✓	✓	✓	✓
15	5.C	✓	✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Cognitive Domain is primary for this theory-oriented mathematical course. Affective Domain appears mainly in higher-order analytical and design-oriented COs (CO4–CO6). Psychomotor Domain is limited to computational implementation, mathematical modeling, and programming-oriented activities (P3–P5).*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1		✓					✓											
CO2		✓	✓				✓	✓						✓				
CO3			✓					✓						✓	✓			
CO4				✓					✓					✓				

CO5				✓	✓				✓	✓				✓	✓			
CO6				✓	✓	✓			✓	✓				✓	✓	✓		

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

Interpretation

CO1 focuses on conceptual understanding of discrete mathematical foundations → primarily L2.
CO2–CO3 involve application and demonstration of logic/algebraic structures → L3 with limited psychomotor mapping due to proof/problem-solving practice.
CO4 emphasizes analytical reasoning → dominant L4 and affective valuation of analytical correctness.
CO5 focuses on design-oriented graph/combinatorial solutions → L4–L5 with organizational affective skills.
CO6 includes development and evaluation of mathematical/computational models → higher-order L4–L6 with stronger psychomotor engagement through implementation/programming activities.

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Set theory, multisets, set identities	UNIT-1	9
DD/MM/YY	Set theory, multisets, set identities		
DD/MM/YY	Set theory, multisets, set identities		
DD/MM/YY	Relations and properties		
DD/MM/YY	Relations and properties		
DD/MM/YY	Relations and properties		
DD/MM/YY	Functions and recursive functions		
DD/MM/YY	Functions and recursive functions		
DD/MM/YY	Functions and recursive functions		
DD/MM/YY	Propositional logic and inference	UNIT-2	9
DD/MM/YY	Propositional logic and inference		
DD/MM/YY	Propositional logic and inference		
DD/MM/YY	Propositional logic and inference		
DD/MM/YY	Predicate logic and quantifiers		
DD/MM/YY	Predicate logic and quantifiers		
DD/MM/YY	Predicate logic and quantifiers		
DD/MM/YY	Mathematical induction		
DD/MM/YY	Mathematical induction		
DD/MM/YY	Groups, subgroups, cyclic groups	UNIT-3	9
DD/MM/YY	Groups, subgroups, cyclic groups		
DD/MM/YY	Groups, subgroups, cyclic groups		
DD/MM/YY	Groups, subgroups, cyclic groups		
DD/MM/YY	Rings, fields, modulo arithmetic		
DD/MM/YY	Rings, fields, modulo arithmetic		
DD/MM/YY	Rings, fields, modulo arithmetic		
DD/MM/YY	POSET and Hasse diagrams		

DD/MM/YY	POSET and Hasse diagrams		
DD/MM/YY	Lattices and Boolean algebra	UNIT-4	9
DD/MM/YY	Lattices and Boolean algebra		
DD/MM/YY	Lattices and Boolean algebra		
DD/MM/YY	Lattices and Boolean algebra		
DD/MM/YY	K-Maps and logic circuits		
DD/MM/YY	K-Maps and logic circuits		
DD/MM/YY	K-Maps and logic circuits		
DD/MM/YY	Recurrence relations and generating functions		
DD/MM/YY	Recurrence relations and generating functions		
DD/MM/YY	Trees and binary trees	UNIT-5	9
DD/MM/YY	Trees and binary trees		
DD/MM/YY	Trees and binary trees		
DD/MM/YY	Graphs and graph algorithms		
DD/MM/YY	Graphs and graph algorithms		
DD/MM/YY	Graphs and graph algorithms		
DD/MM/YY	Graphs and graph algorithms		
DD/MM/YY	Counting techniques and combinatorics		
DD/MM/YY	Counting techniques and combinatorics		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L6) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

TS ID	Recommended Dimension	What is Measured	CO/BTL	Assessment
TS1	Set Theory & Mathematical Foundations	Understanding sets, relations, functions, mappings and formal mathematical structures	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Logical Reasoning & Proof Construction	Ability to formulate logical arguments, truth tables, quantifiers, and mathematical induction proofs	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Algebraic Structure Application	Application of groups, rings, lattices, and algebraic operations in problem solving	CO3 | L3	CA | MTE Sec B | ETE Sec B

TS4	Analytical Reasoning & Boolean Evaluation	Analysis of Boolean algebra, recurrence relations, and generating functions	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	Graph & Tree Modeling	Design and analysis of trees, graph representations, spanning trees, traversal and graph problems	CO5 | L4–L5	ETE Sec B/C
TS6	Computational Modeling & Discrete Problem Solving	Development of mathematical/computational models using combinatorics and discrete techniques	CO6 | L5–L6	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1	TS2	TS3	TS4	TS5	TS6
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6				M	M	H

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Assignment	Focus Area	CO	TS	Suggested Activity	Evaluation Criteria
Assignment 1	Set theory, relations, functions	CO1	TS1	Problem-solving worksheet	Assignment submission + evaluation
Assignment 2	Logic, truth tables, induction proofs	CO2	TS2	Proof-based exercises	Numerical problems on logic and inference rules.

Assignment 3	Groups, rings, lattices	CO3	TS3	Algebraic problem solving	Numerical computation + applications
Assignment 4	Boolean algebra, recurrence relations	CO4	TS4	K-map simplification + recurrence solving	Step-by-step numerical trace required
Assignment 5	Graph theory & combinatorics	CO5, CO6	TS5, TS6	Graph modeling and counting problems	Algorithm application + performance analysis
Video Learning Report	Graph algorithms / cryptography applications	CO4, CO5	TS4, TS5	Presentation + report	Report: learning outcomes, key concepts, self-reflection. Presentation: 10 min
Case Study Report	Real-world discrete math applications in AI/networking/security	CO5, CO6	TS5, TS6	Analytical report	Technical depth, data collection, fact finding, comparative analysis

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	5	TS1, TS2	CO1, CO2	Short-answer conceptual and proof-based questions covering sets, relations, logic, and induction
Section B	10	TS3, TS4	CO2, CO3	Numerical/problem-solving questions involving algebraic structures, modulo arithmetic, and analytical reasoning
TOTAL	15	TS1–TS4	CO1–CO3	Units 1–3 only. CO4, CO5 and CO6 assessed in ETE only

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 24/60 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1, TS2	CO1, CO2	Conceptual understanding, logic proofs, definitions, and short analytical questions
Section B	25	TS3, TS4, TS5	CO3, CO4, CO5	Long-answer analytical and numerical problems involving Boolean algebra, lattices, trees, graphs, and recurrence relations

Section C	20	TS5, TS6	CO5, CO6	Case-study/problem-design based questions involving graph modeling, combinatorics, computational modeling, and real-world applications
TOTAL	60	TS1–TS6	CO1–CO6	Comprehensive assessment covering all units and all course outcomes

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (15)	ETE (60)	TS	PO Primary
CO1	Sets, relations, functions	✓	✓	✓	TS1	PO1
CO2	Logic and mathematical proofs	✓	✓	✓	TS2	PO1, PO2
CO3	Algebraic structures	✓	✓	✓	TS3	PO1, PO2
CO4	Boolean algebra & recurrence relations	✓		✓	TS4	PO2, PO4
CO5	Trees, graphs, combinatorics	✓		✓	TS5	PO3, PO4
CO6	Computational mathematical modeling	✓		✓	TS6	PO4, PO5

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	1	2	–	–
CO2	3	3	–	1	–	–	–	–	–	–	1	2	2	–
CO3	3	3	1	2	–	–	–	–	–	1	1	3	2	–
CO4	2	3	2	3	1	–	–	–	–	2	1	2	3	–
CO5	2	3	3	3	2	–	–	–	–	1	2	3	3	1
CO6	2	2	3	3	3	–	–	–	–	2	2	3	3	2
Avg	**2.5**	**2.7**	**2.25**	**2.4**	**2**	**–**	**–**	**–**	**–**	**1.5**	**1.3**	**2.5**	**2.6**	**1.5**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M									M	H		
CO2	H	H		M							M	H	M	

CO3	H	H	M	M						M	M	H	M	
CO4	M	H	M	H	M					M	M	M	H	
CO5	M	H	H	H	M					M	M	H	H	M
CO6	M	M	H	H	H					M	M	H	H	M

14. Self-Learning Activities (SL: 45 Hours)

S. No	Activity	Hours	COs / TS	Evaluation Criteria
1	Problem-solving assignments on sets, logic, algebraic structures, and recurrence relations	15 hrs	CO1–CO4 / TS1–TS4	Accuracy of solutions, logical reasoning, timely submission
2	Graph theory and combinatorics small project / case study	15 hrs	CO5, CO6 / TS5, TS6	Modeling quality, analytical interpretation, presentation
3	Technical video learning report and computational modeling exercises using discrete mathematics tools/software	15 hrs	CO3–CO6 / TS3–TS6	Report quality, conceptual clarity, application-oriented understanding
TOTAL Self-Learning Hours	45 Hours	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the beginning of the semester.	

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (45 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 15 + ETE 60 = 100; 40% overall minimum required

---------- — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 15 marks + ETE 60 marks = Total 100 marks

COURSE PLAN

Principles of Operating System (CSCR2312)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	III

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR2312
2	**Course Title**	**Principles of Operating System (POS)**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	2-0-2-2
5	**Course Status**	Core
6	**Course Objective**	1. Introduce the challenges for designing operating systems. 2. Cover different design principles and algorithms for resource management. 3. Enable evaluation of algorithms proposed for resource allocation and scheduling. 4. Develop the ability to implement and analyze algorithms and OS utilities.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Understand – L1/L2): Identify the challenges and understand the basic concepts, types, structures, and services of an Operating System. CO2 (Explore – L2/L3): Explore process management concepts including process states, inter-process communication, CPU scheduling, synchronization, and deadlocks. CO3 (Apply – L3): Understand and implement algorithms in resource allocation and utilization, including scheduling and deadlock handling techniques. CO4 (Analyze – L4/L5): Integrate and interpret the effectiveness and efficiency of algorithms used for resource management of operating systems. CO5 (Analyze – L4/L5): Analyze various memory management techniques including paging, segmentation, virtual memory, demand paging, and page replacement algorithms. CO6 (Analyze – L2/L4): Understand file system concepts, file operations, disk scheduling algorithms, and I/O management techniques, and analyze their comparative efficiency. **LAB COs — Assessed via Laboratory Assessment only:** **CO7 (Apply – L3):** Implement Linux/Unix commands, shell utilities, process management programs, and system calls using professional development tools.

		CO8 (Create – L5/L6): Develop system-level applications using process synchronization, inter-process communication, file operations, and scheduling techniques. **CO9 (Apply – L2/L3):** Demonstrate ethical computing practices, documentation skills, responsible system usage, and reflective learning. **CO10 (Apply – L3):** Collaborate effectively in team-oriented operating system mini-projects and communicate technical solutions professionally.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 30 hrs = 90 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	Linux shell scripting exercises, scheduling simulation activities, NPTEL OS labs, system programming assignments, GitHub-based mini projects
11	**References**	Textbook: Silberschatz, A., Galvin, P.B. & Gagne, G. — Operating System Concepts (10th Ed.), Wiley. Reference: 1. Stallings, W. — Operating Systems: Internals and Design Principles, Maxwell Macmillan 2. Tanenbaum, A.S. — Operating System: Design and Implementation, Prentice Hall India 3. Milenkovic, M. — Operating Systems: Concepts and Design, McGraw Hill

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Unit 1: Introduction to Operating Systems (4-0-10-6 = 20 hrs)**	
A	Operating System Concepts and functions; Comparison of different Operating Systems	**CO1, CO2, CO3**
B	Types of Operating Systems: Batch, Multiprogramming, Multi-Tasking, Multiprocessing, Distributed, Real-Time OS	
C	Operating System Structure: Monolithic, Layered, Microkernel; Operating System Services	
Tools Used	Linux OS, Virtual Machines, Ubuntu, Shell Terminal, gcc compiler, Virtual Labs	

Activities	**Objective:** To familiarize students with Linux commands and develop a clear understanding of Shell scipts and different operating systems
	• Study of Linux Commands
	  ○ Working with Directories
	  ○ Understanding of gcc compiler, compiling and executing on Linux Environment.
	• Understanding shell commands and directory structure
	• Study of process monitoring utilities
	• Comparison of Windows and Linux operating systems
	• Demonstration of system calls and process creation	

Unit 2	**Process Synchronization (6-0-12-6 = 24 hrs)**	
A	Process Concepts: PCB, Process States, Process Operations, Inter-Process Communication	**CO2, CO3, CO4**
B	Critical Section Problem & Solutions; Introduction to Semaphores	

C	Classical Problems of Synchronization: Producer-Consumer, Readers-Writer, Dining Philosophers	
Tools Used	Linux Environment, Shell Terminal, gcc, pthread library, synchronization utilities, Virtual Labs	
Activities	• Creating parent-child processes using fork() • Process synchronization using wait(), sleep(), semaphores • Implementation of IPC mechanisms • Thread creation using pthreads • Simulation of synchronization problems	
Unit 3	**CPU Scheduling (8-0-16-6 = 30 hrs)**	
A	Concept of CPU Scheduling; Types of Schedulers (Short, Long, Middle term); Dispatcher; Performance Criteria	CO2, CO3, CO4, CO5
B	CPU Scheduling Algorithms: FCFS, SJF, Priority, Round Robin, Multilevel Queue, Multilevel Feedback Queue	
C	Deadlock Concepts & Handling Techniques: Avoidance, Prevention, Detection & Recovery	
Tools Used	Linux Environment, Scheduling simulators, Online compilers, Visualization tools	
Activities	• Scheduling algorithm simulation • Gantt chart analysis • Performance comparison of scheduling algorithms • Deadlock detection case studies • Banker's algorithm implementation	
Unit 4	**Memory Management & Virtual Memory (8-0-14-6 = 28 hrs)**	
A	Memory Hierarchy; Memory Management Unit (MMU)	CO3, CO4, CO5
B	Paging; Segmentation	
C	Virtual Memory Concept; Demand Paging; Page Replacement Algorithms: FIFO, Optimal, LRU	
Tools Used	Linux Environment, Memory allocation simulators, Visualization tools, Virtual Labs.	
Activities	• Address translation demonstration • Simulation of page replacement algorithms • Memory fragmentation analysis • Performance comparison of memory allocation techniques • Virtual memory experiments	
Unit 5	**File Systems & I/O Management (6-0-12-6 = 24 hrs)**	
A	I/O Interface; Modes of Data Transfer: Programmed, Interrupt-Driven, and DMA	CO3, CO4, CO5, CO6
B	Disk Structure; Disk Scheduling: FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK	
C	File Concept; File Operations; File Directories; Case Study of Windows Operating System	
Tools Used	Linux Environment, File utilities, Disk management tools, GitHub, Shell scripting.	

Activities	• File handling using system calls • Disk scheduling simulation • Linux file system navigation • File buffering and descriptor analysis • Team-based case study presentation	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓				
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓		
7	3.A	✓	✓				
8	3.B			✓	✓		
9	3.C			✓	✓	✓	
10	4.A		✓				
11	4.B			✓	✓		
12	4.C			✓	✓	✓	
13	5.A		✓	✓			
14	5.B			✓	✓		
15	5.C		✓	✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓															
CO3			✓	✓											✓			
CO4				✓	✓				✓									
CO5				✓	✓			✓										
CO6		✓	✓	✓														
CO7			✓					✓							✓			

CO8					✓	✓			✓						✓	✓	
CO9		✓	✓							✓				✓			
CO10			✓							✓	✓				✓		

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	OS Concepts and Functions; Comparison of different Operating Systems	Unit 1	4
DD/MM/YY	Types of Operating Systems: Batch, Multiprogramming, Multi-Tasking, Multiprocessing		
DD/MM/YY	Types (contd.): Distributed and Real-Time Operating Systems		
DD/MM/YY	OS Structure: Monolithic, Layered, Microkernel; OS Services		
DD/MM/YY	Process Concepts: PCB, Process States, Process Operations	Unit 2	6
DD/MM/YY	Inter-Process Communication (IPC) — Shared Memory and Message Passing		
DD/MM/YY	Critical Section Problem and Solutions (Peterson's Solution)		
DD/MM/YY	Introduction to Semaphores — Binary and Counting		
DD/MM/YY	Classical Problems: Producer-Consumer Problem, Readers-Writer Problem		
DD/MM/YY	Dining Philosophers Problem — Solutions and Analysis		
DD/MM/YY	CPU Scheduling Concepts; Types of Schedulers (Short, Long, Middle Term)	Unit 3	8
DD/MM/YY	Dispatcher; Performance Criteria (CPU utilisation, throughput, turnaround, wait time)		
DD/MM/YY	CPU Scheduling Algorithms: FCFS, SJF (Preemptive & Non-Preemptive)		
DD/MM/YY	Priority Scheduling; Round Robin Scheduling — analysis and examples		
DD/MM/YY	Multilevel Queue Scheduling; Multilevel Feedback Queue Scheduling		
DD/MM/YY	Deadlock Concepts: Deadlock Characterization, Resource-Allocation Graph		
DD/MM/YY	Deadlock Handling: Avoidance (Banker's Algorithm), Prevention Techniques		
DD/MM/YY	Deadlock Detection & Recovery Algorithms		
DD/MM/YY	Memory Hierarchy; Memory Management Unit (MMU)	Unit 4	6
DD/MM/YY	Paging: Concept, Hardware, Protection, Shared Pages, Page Table Structures		
DD/MM/YY	Segmentation: Concept, Hardware, Protection and Sharing		
DD/MM/YY	Virtual Memory Concept; Demand Paging; Page Fault Handling		
DD/MM/YY	Page Replacement Algorithms: FIFO, Optimal Page Replacement		
DD/MM/YY	Page Replacement Algorithms: LRU; Thrashing and its effects		
DD/MM/YY	I/O Interface; Modes of Data Transfer: Programmed I/O, Interrupt-Driven I/O	Unit 5	6
DD/MM/YY	Direct Memory Access (DMA); I/O Subsystem		
DD/MM/YY	Disk Structure; Disk Scheduling: FCFS, SSTF		
DD/MM/YY	Disk Scheduling: SCAN, LOOK, C-SCAN, C-LOOK — comparative analysis		
DD/MM/YY	File Concept; File Operations; File Directories; Access Methods		

DD/MM/YY	Case Study: Windows Operating System — File, Process and Memory Management		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W7: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W8–W12 (teal rows): CO8 (design/real-world). W13-W15: CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Linux installation, terminal usage, basic shell commands, file permissions	**CO7**	3.0
	S-1.2	Working with directories, file handling commands, command history and manual pages	**CO7**	
W2	S-2.1	Shell scripting basics: variables, input/output, conditional statements	**CO7**	3.0
	S-2.2	Shell scripting using loops and menu-driven shell programs	**CO7**	
W3	S-3.1	Process creation using fork() and getpid() system calls	**CO7**	3.0
	S-3.2	Process replacement using exec() family of functions	**CO7**	
W4	S-4.1	Parent-child process communication using wait() and exit()	**CO7**	3.0
	S-4.2	Creation and analysis of orphan and zombie processes	**CO7**	
W5	S-5.1	Process synchronization using sleep() and synchronization primitives	**CO7**	3.0
	S-5.2	Semaphore implementation for critical section handling	**CO7**	
W6	S-6.1	Creating multiple threads using pthread library	**CO7**	3.0
	S-6.2	Thread synchronization using mutex locks	**CO7**	
W7	S-7.1	Producer–Consumer problem implementation using semaphores	**CO7**	3.0
	S-7.2	Readers–Writers problem implementation and analysis	**CO7**	
W8	S-8.1	CPU Scheduling simulation: FCFS and SJF algorithms	**CO8**	3.0
	S-8.2	CPU Scheduling simulation: Round Robin and Priority scheduling	**CO8**	
W9	S-9.1	Banker's Algorithm implementation for deadlock avoidance	**CO8**	3.0
	S-9.2	Deadlock detection and recovery simulation	**CO8**	
W10	S-10.1	FIFO and Optimal Page Replacement algorithm simulation	**CO8**	3.0
	S-10.2	LRU Page Replacement algorithm and performance comparison	**CO8**	
W11	S-11.1	File handling using open(), read(), write(), close() system calls	**CO8**	3.0
	S-11.2	File sharing and inter-process communication using files	**CO8**	
W12	S-12.1	File buffering using fopen(), fread(), fwrite(), fflush()	**CO8**	3.0
	S-12.2	File descriptor table and file pointer manipulation using lseek() and ftell()	**CO8**	
W13	S-13.1	Linux process monitoring utilities: ps, top, htop and background jobs	**CO8/CO9**	3.0
	S-13.2	Shell scripting for automation tasks with ethical system usage discussion	**CO8/CO9**	
W14	S-14.1	Design and implementation of a mini Linux shell	**CO8/CO10**	3.0
	S-14.2	Process scheduler simulator with team-based role allocation and peer review	**CO8/CO10**	
W15	S-15.1	Team-based operating system mini project demonstration and documentation	**CO9/CO10**	3.0
	S-15.2	Final presentation, code review, project reflection, and viva voce	**CO9/CO10**	

ℹ *Instructions: Write Linux/Unix-based C programs, compile and execute using gcc compiler, validate outputs with suitable test cases, and analyze system behavior wherever applicable. Maintain a proper lab record including aim, algorithm, source code, execution steps, output, result, and observations. The completed lab record must be submitted before the next laboratory session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall operating system concepts, terminology, process states, scheduling terms, memory hierarchy, file system structures, and Linux/Unix commands; identify correct OS services and functions.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Explain process management, synchronization mechanisms, scheduling algorithms, memory management techniques, and file system organization; interpret process execution and resource allocation behaviour	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply operating system algorithms and Linux system programming concepts to solve scheduling, synchronization, memory allocation, and file handling problems	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Analyze process synchronization issues, deadlocks, paging behaviour, CPU utilization, and system performance; trace execution flow and identify resource conflicts	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Compare scheduling algorithms, page replacement methods, deadlock handling techniques, and disk scheduling approaches; evaluate efficiency using performance metrics and resource utilization analysis	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design and develop modular operating system solutions integrating process management, synchronization, memory management, file handling, and Linux utilities for real-world system-level problems	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type

Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer questions: operating system concepts, process states, scheduling terminology, synchronization concepts, output prediction, Linux command interpretation
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Numerical/problem-solving questions on CPU scheduling, synchronization, deadlock analysis, paging, process tracing, algorithm analysis, and system behaviour interpretation
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: operating system concepts, process states, synchronization terminology, Linux commands, memory management concepts, file system structures, output tracing, and concept-based MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium-answer questions: CPU scheduling problems, deadlock handling, synchronization analysis, page replacement calculations, disk scheduling, algorithm comparison, performance evaluation, and resource utilization analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design and justify operating system solutions, synchronization mechanisms, memory management strategies, file handling systems, Linux-based system applications, and integrated case studies
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III
LABORATORY ASSESSMENT FRAMEWORK
Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6

Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define operating system problem statements; identify measurable system parameters such as CPU utilization, turnaround time, waiting time, throughput, memory usage, and synchronization requirements	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiments; configure Linux/Unix development environment using gcc compiler, shell terminal, process monitoring tools, IDE/debugger, and synchronization libraries	CO7
CA3	**Code Implementation & Execution**	Develop correct Linux/Unix-based C programs using system calls, process management, synchronization mechanisms, and file operations; compile and execute successfully	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate scheduling efficiency, memory utilization, synchronization overhead, and system performance; identify bottlenecks and propose optimized solutions	CO7
CA5	**Output Analysis & Result Interpretation**	Analyze process execution, synchronization behaviour, scheduling outputs, paging performance, and file handling results; justify observations using evidence-based reasoning	CO8
CA6	**Documented Outcome with Verification**	Record experimental outcomes formally; validate outputs against expected operating system behaviour and problem specifications	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Design algorithms, flowcharts, pseudocode, scheduling logic, synchronization strategy, and memory management approaches before implementation; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete laboratory records including aim, algorithm, source code, execution steps, output, and conclusion; demonstrate conceptual understanding through viva voce	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	Problem Scoping & Requirements	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	Innovative Solution Proposal	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	Professional Toolchain	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	End-to-End Implementation	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	System Commissioning & Testing	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	Individual Skill Growth Mapping	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	Professional Attitude, Ethics & Responsibility	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions	CA Skill Dimensions	Project Skill Dimensions

	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6		M		M	M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	–	–	–	2	2	1	2	3	2	2
CO2	3	2	3	3	–	–	–	2	2	2	1	2	3	2
CO3	3	3	3	3	–	–	–	1	1	1	3	3	2	1
CO4	2	2	2	2	1	–	–	2	3	3	3	2	2	2
CO5	2	2	3	–	–	–	–	3	3	1	2	3	–	–
CO6	3	2	–	–	–	–	–	–	–	2	3	2	2	–
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	2.50	2.14	2.33	2.25	2.00	1.67	3.00	2.00	2.20	1.86	2.29	2.38	2.25	2.00

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									M
CO2	H	M							M		M
CO3	M	H	M		M	M			M		M
CO4	M	H	M	H	M						M
CO5	M	H	H	M	M						M
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10					M			H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in operating system concepts, Linux/Unix programming, process management, memory management, and system-level problem solving; promotes lifelong learning and technical competency development (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant system programming, Linux administration, synchronization, scheduling, and file management skills directly applicable to software engineering, cloud computing, cybersecurity, and IT infrastructure domains (CO7, CO8, CO10).
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient and optimized operating system solutions; supports innovation through process scheduling, memory optimization, synchronization mechanisms, and real-world system-level mini projects (CO5, CO6, CO8, CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Encourages efficient utilization of computational resources, optimized scheduling and memory allocation techniques, ethical system usage, responsible file handling, and sustainable computing practices (CO5, CO7, CO9).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)

L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

POS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Computer Organization and Architecture

Sharda School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV
Course Code:	CSCR2113	**Course Type:**	Core — Theory Only

2. Course Details

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

S.No	Attribute	Details
1	**Course Code**	**CSCR2113**
2	**Course Title**	**Computer Organization and Architecture**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Understand number systems, digital logic circuits and Boolean algebra. 2. Learn sequential circuits, registers, counters and memory organization. 3. Understand CPU organization, instruction cycles and control units. 4. Analyze memory hierarchy and I/O organization techniques. 5. Study advanced computer architecture concepts including pipelining and parallel processing.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Understand number systems, logic gates and combinational circuits. CO2 (Apply – L3): Apply sequential logic concepts including flip-flops, counters and registers.

		CO3 (Analyze – L4/L5): Analyze CPU organization, instruction formats and control units. CO4(Understand – L1/L2): Understand memory hierarchy, cache mapping and I/O organization. CO5 (Analyze – L4/L5): Analyze pipeline processing, parallel processing and advanced architectures. CO6 (Evaluate – L5): Evaluate RISC/CISC architectures and modern computing systems.
8	**Course Description**	This course introduces the basic structure of a digital computer and used for understanding the organization of various units such as control unit, Arithmetic and Logical unit and Memory unit and I/O unit in a digital computer.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	M. Morris Mano – Computer System Architecture, Pearson Education
12	**References**	1. William Stallings – Computer Organization and Architecture, Pearson College Div 2. Andrew S. Tanenbaum – Structured Computer Organization, Pearson Education India 3. John L. Hennessy and David A. Patterson – Computer Architecture: A Quantitative Approach, Morgan Kaufmann

3. Outline Syllabus with CO Mapping

All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.

	Topic	CO Mapping
	Unit 1: Number System and Digital Logic Fundamentals	
A	Gates and Number Systems: Logic Gates, AND, OR, NOT Gates, NAND, NOR, XOR, XNOR Gates, Universal Gates, Truth Tables, Decimal Number System, Binary Number System, Octal Number System , Hexadecimal Number System, Conversion between Number Systems, Decimal to Binary, Binary to Decimal, Binary to Octal/Hexadecimal, Hexadecimal to Binary	**CO1**
B	Binary Arithmetic: Binary Addition, Binary Subtraction, Binary Multiplication, Binary Division, 1's Complement, 2's Complement, Signed and Unsigned Numbers, Overflow and Underflow	**CO1**
C	Codes, Boolean Algebra and combinatinal circuits: BCD Code, Gray Code, ASCII and Unicode, Error Detection Codes, Boolean Algebra Laws, De Morgan's Theorem, Half Adder and Full Adder, Half Subtractor and Full Subtractor, Multiplexers and Demultiplexers, Encoders and Decoders, Comparators	**CO1**
	Unit 2: Sequential Circuits and Register Organization	
A	Sequential Logic: Latches , Flip-Flops, SR Flip-Flop, JK Flip-Flop, D Flip-Flop, T Flip-Flop, Triggering Methods	**CO2**
B	Registers: Shift Registers, Serial and Parallel Transfer, Register Transfer Language (RTL)	**CO2**
C	Counters and Memory Basics: Ripple Counters, Synchronous Counters, Ring Counter, Johnson Counter, RAM and ROM, SRAM and DRAM, Cache Memory Basics, Memory Hierarchy	**CO2**
	Unit 3: Basic Computer Organization and CPU	

A	Computer Fundamentals and CPU Organization: Functional Units of Computer, Von Neumann Architecture, Stored Program Concept, Arithmetic Logic Unit (ALU), Control Unit, Registers in CPU, Instruction Cycle	**CO3**
B	Instruction Set Architecture (ISA): Instruction Formats, Addressing Modes, Types of Instructions, Data Transfer, Arithmetic, Logical, Branch Instructions	**CO3**
C	Microoperations and Control Unit: Register Transfer Microoperations, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Hardwired Control Unit, Microprogrammed Control Unit	**CO3**
	Unit 4: Memory Organization and Input/Output Organization	
A	Memory Organization and Cache Memory: Main Memory, Auxiliary Memory, Cache Memory, Associative Memory, Virtual Memory, Cache Mapping Techniques, Direct Mapping, Associative Mapping, Set Associative Mapping, Cache Coherence	**CO4**
B	Input/Output Organization: I/O Interface, Programmed I/O, Interrupt Driven I/O, DMA (Direct Memory Access)	**CO4**
C	Interrupts: Hardware Interrupts, Software Interrupts, Interrupt Cycle, Priority Interrupts	**CO4**
	Unit 5: Advanced Computer Architecture	
A	Pipeline Processing: Introduction to Pipelining, Pipeline Hazards, Instruction Pipeline	**CO5**
B	Parallel Processing: Multiprocessors, Multicore Architecture, SIMD and MIMD	**CO5**
C	RISC and CISC Architecture with advancement: Features of RISC, Features of CISC, Comparison of RISC and CISC, Superscalar Architecture, Flynn's Classification, Distributed Systems Basics, GPU Architecture Basics	**CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C	✓	✓	✓			
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C		✓	✓			
7	3.A		✓				
8	3.B	✓	✓	✓	✓		
9	3.C		✓	✓	✓	✓	
10	4.A		✓	✓			
11	4.B		✓	✓	✓	✓	
12	4.C		✓	✓	✓	✓	
13	5.A		✓		✓	✓	
14	5.B		✓		✓	✓	

15	5.C		✓	✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains

Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓											✓				
CO3			✓	✓	✓									✓				
CO4	✓	✓							✓									
CO5				✓	✓				✓					✓				
CO6		✓		✓	✓				✓									

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs) are structured separately in Section 11.

Date	Topics to be Covered / Title	UNIT	Total Lectures
DD/MM/YY	Introduction to Digital Logic and Computer Organization	UNIT–1	9
DD/MM/YY	Logic Gates: AND, OR, NOT Gates		
DD/MM/YY	Universal Gates: NAND, NOR, XOR, XNOR Gates and Truth Tables		
DD/MM/YY	Number Systems: Decimal, Binary, Octal and Hexadecimal		
DD/MM/YY	Conversion between Number Systems		
DD/MM/YY	Binary Arithmetic: Addition, Subtraction, Multiplication and Division		
DD/MM/YY	1's Complement, 2's Complement, Signed and Unsigned Numbers		
DD/MM/YY	Codes: BCD, Gray Code, ASCII, Unicode and Error Detection Codes		
DD/MM/YY	Boolean Algebra, De Morgan's Theorem and Combinational Circuits (Adder, Subtractor, MUX, DEMUX, Encoder, Decoder, Comparator)		
DD/MM/YY	Sequential Logic: Latches and Flip-Flops	UNIT–2	9
DD/MM/YY	SR, JK, D and T Flip-Flops		
DD/MM/YY	Triggering Methods in Flip-Flops		
DD/MM/YY	Registers and Register Transfer Language (RTL)		
DD/MM/YY	Shift Registers and Data Transfer Mechanisms		
DD/MM/YY	Serial and Parallel Transfer		
DD/MM/YY	Ripple Counters and Synchronous Counters		
DD/MM/YY	Ring Counter and Johnson Counter		
DD/MM/YY	RAM, ROM, SRAM, DRAM, Cache Basics and Memory Hierarchy		
DD/MM/YY	Functional Units of Computer and Von Neumann Architecture	UNIT–3	9
DD/MM/YY	Stored Program Concept and CPU Organization		
DD/MM/YY	Arithmetic Logic Unit (ALU), Control Unit and CPU Registers		
DD/MM/YY	Instruction Cycle and CPU Operations		
DD/MM/YY	Instruction Set Architecture (ISA) and Instruction Formats		
DD/MM/YY	Addressing Modes and Types of Instructions		
DD/MM/YY	Register Transfer Microoperations		
DD/MM/YY	Arithmetic, Logic and Shift Microoperations		
DD/MM/YY	Hardwired and Microprogrammed Control Unit		
DD/MM/YY	Memory Organization: Main, Auxiliary and Cache Memory	UNIT–4	9
DD/MM/YY	Associative and Virtual Memory		

DD/MM/YY	Cache Mapping Techniques: Direct, Associative and Set Associative Mapping		
DD/MM/YY	Cache Coherence and Performance Considerations		
DD/MM/YY	Input/Output Organization and I/O Interface		
DD/MM/YY	Programmed I/O and Interrupt Driven I/O		
DD/MM/YY	DMA (Direct Memory Access)		
DD/MM/YY	Hardware and Software Interrupts		
DD/MM/YY	Interrupt Cycle and Priority Interrupts		
DD/MM/YY	Introduction to Pipeline Processing and Instruction Pipeline	**UNIT–5**	**9**
DD/MM/YY	Pipeline Hazards and Resolution Techniques		
DD/MM/YY	Parallel Processing Concepts		
DD/MM/YY	Multiprocessors and Multicore Architecture		
DD/MM/YY	SIMD and MIMD Architectures		
DD/MM/YY	Features of RISC Architecture		
DD/MM/YY	Features of CISC Architecture and RISC vs CISC Comparison		
DD/MM/YY	Superscalar Architecture and Flynn's Classification		
DD/MM/YY	Distributed Systems Basics and GPU Architecture Basics		

7. Theory Skill Dimensions (TS1–TS6)

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Digital Logic & Number System Fundamentals**	Understanding number systems, binary arithmetic, logic gates, Boolean algebra, combinational circuits, coding schemes, and logical problem solving.	**CO1 | L1–L2**	**CA | MTE Sec A | ETE Sec A**
TS2	**Sequential Logic & Register Organization**	Application of sequential logic concepts including latches, flip-flops, triggering methods, counters, shift registers, register transfer language (RTL), and memory basics.	**CO2 | L2–L3**	**CA | MTE Sec A/B | ETE Sec A/B**
TS3	**CPU Organization & Instruction Processing**	Analysis of computer organization including CPU architecture, instruction cycle, instruction formats, addressing modes, microoperations, and control units.	**CO3 | L3–L5**	**CA | MTE Sec B | ETE Sec B**
TS4	**Memory Hierarchy & I/O Organization**	Understanding memory organization, cache mapping techniques, virtual memory, interrupt mechanisms, DMA, and I/O interfacing.	**CO4 | L1–L2**	**CA | MTE Sec A/B | ETE Sec A/B**
TS5	**Pipeline & Parallel Processing Analysis**	Analysis of pipelining concepts, hazards, instruction pipeline, multiprocessors, multicore systems, SIMD/MIMD architectures, and performance trade-offs.	**CO5 | L4–L5**	**MTE Sec B | ETE Sec B/C**
TS6	**Advanced Architecture Evaluation**	Evaluation of RISC/CISC architectures, superscalar systems, Flynn's classification, distributed computing, and GPU-based computing systems.	**CO6 | L5**	**ETE Sec C**

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.

CO	TS1 Digital Logic & Number System Fundamentals	TS2 Sequential Logic & Register Organization	TS3 CPU Organization & Instruction Processing	TS4 Memory Hierarchy & I/O Organization	TS5 Pipeline & Parallel Processing Analysis	TS6 Advanced Architecture Evaluation
CO1	**H**	M				
CO2	M	**H**	M	M		
CO3		M	**H**	M	M	
CO4			M	**H**	M	
CO5			M	M	**H**	M
CO6			M		M	**H**

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Number Systems, Logic Gates, Boolean Algebra & Combinational Circuits *(Number conversions, binary arithmetic, complements, Boolean simplification, adders, subtractors, multiplexers, decoders, comparators)*	CO1	TS1	6h SL	Conceptual clarity, numerical accuracy, Boolean simplification, circuit design, truth table construction, and logical reasoning
Assignment 2	Sequential Circuits & Register Organization *(Latches, flip-flops, triggering methods, shift registers, RTL, counters, memory basics)*	CO2	TS2	6h SL	Sequential circuit analysis, timing interpretation, counter design, RTL execution, register transfer understanding, and problem-solving ability

Assignment 3	Computer Organization & CPU Architecture *(Von Neumann architecture, ALU, control unit, instruction cycle, ISA, instruction formats, addressing modes, microoperations, control unit)*	CO3	TS3	6h SL	CPU analysis, instruction tracing, microoperation sequencing, architecture understanding, analytical reasoning, and HOTS-based problem solving
Assignment 4	Memory Organization & Input/Output Systems *(Cache memory, virtual memory, cache mapping techniques, DMA, interrupts, I/O organization)*	CO4	TS4	6h SL	Cache analysis, memory hierarchy interpretation, interrupt handling, I/O mechanism comparison, and system-level reasoning
Assignment 5	Pipeline Processing, Parallel Processing & Advanced Architectures *(Pipeline hazards, multicore systems, SIMD/MIMD, RISC vs CISC, superscalar systems, Flynn's classification, GPU basics)*	CO5, CO6	TS5, TS6	6h SL	Performance analysis, architectural comparison, hazard evaluation, processor classification, design interpretation, and evaluative thinking
Video Learning Report	Technical Video Learning on Modern Computer Architecture *(Pipeline processing, GPU architecture, multicore systems, cache optimization, ARM/Intel processors) (Minimum 3 hours of technical content)*	CO3, CO5, CO6	TS3, TS5, TS6	9h SL	Report + Presentation: technical understanding, architecture interpretation, critical reflection, and comparative evaluation
Case Study Report	Real-world Computer Architecture Case Study *(Intel vs AMD Processors, ARM Architecture, GPU Computing, Supercomputers, Distributed Systems, RISC-V)*	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, architecture comparison, system analysis, fact-finding, innovation understanding, and analytical conclusions

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**5 Marks**	**TS1, TS2**	**CO1, CO2**	**Short Answer / Objective / Numerical Questions —** Covers number systems, binary arithmetic, Boolean algebra, logic gates, flip-flops, counters, registers, and memory basics. Emphasis on conceptual understanding and direct application.
Section B	**10 Marks**	**TS2, TS3**	**CO2, CO3**	**Analytical / Descriptive / Numerical Problems —** Questions on RTL, counters, CPU organization, instruction cycle, ISA, addressing modes, microoperations, and control units. Includes **HOTS-based analytical questions** and architecture interpretation.
Total	**15 Marks**	**TS1–TS3**	**CO1–CO3**	**Balanced assessment of conceptual, numerical, and analytical competencies from Units 1–3**

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1, TS2, TS4	CO1, CO2, CO4	Short Answer / Conceptual / Numerical Questions — Covers number systems, binary arithmetic, Boolean algebra, logic gates, flip-flops, counters, registers, memory hierarchy, cache basics, I/O organization, and interrupts.
Section B	25	TS2, TS3, TS4, TS5	CO2, CO3, CO4, CO5	Analytical / Problem-Solving / Descriptive Questions — Covers CPU organization, instruction cycle, ISA, addressing modes, RTL, microoperations, cache mapping, DMA, pipelining, hazard analysis, multiprocessor systems, and multicore architecture.
Section C	10	TS5, TS6	CO5, CO6	Long Descriptive / Evaluative Questions — Covers advanced architecture topics including RISC vs CISC, superscalar architecture, Flynn's classification, SIMD/MIMD, distributed systems, GPU architecture, and advanced processor design.
Total	**50 Marks**	**TS1–TS6**	**CO1–CO6**	**Comprehensive assessment of conceptual, analytical, numerical, and evaluative competencies across all units**

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand number systems, logic gates, Boolean algebra, and combinational circuits	✓	✓	✓	TS1	PO1, PO2
CO2	Apply sequential logic concepts including flip-flops, counters, registers, and RTL	✓	✓	✓	TS2	PO1, PO2, PO3
CO3	Analyze CPU organization, instruction formats, addressing modes, and control units	✓	✓	✓	TS3	PO1, PO2, PO4
CO4	Understand memory hierarchy, cache mapping, I/O organization, and interrupts	✓	✓	✓	TS4	PO1, PO2, PO5
CO5	Analyze pipeline processing, parallel processing, and advanced architectures	✓	—	✓	TS5	PO1, PO2, PO4, PO5
CO6	Evaluate RISC/CISC architectures and modern computing systems	✓	—	✓	TS6	PO1, PO2, PO5, PO11

CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	–	–	–	–	1	–	3	2	1
CO2	3	3	3	2	2	–	–	–	–	1	–	3	3	2
CO3	3	3	3	3	2	–	–	–	–	1	1	3	3	2
CO4	3	3	2	2	3	–	–	–	–	1	–	2	3	2
CO5	3	3	3	3	3	–	–	–	1	1	1	3	3	2
CO6	3	2	3	2	3	–	–	–	1	2	1	3	2	3
Avg	**3.00**	**2.83**	**2.67**	**2.33**	**2.33**	**–**	**–**	**–**	**1.00**	**1.17**	**1.00**	**2.83**	**2.67**	**2.00**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M	M	M					M		H	M	M
CO2	H	H	H	M	M					M		H	H	M
CO3	H	H	H	H	M					M	M	H	H	M
CO4	H	H	M	M	H					M		M	H	M
CO5	H	H	H	H	H				M	M	M	H	H	M
CO6	H	M	H	M	H				M	M	M	H	M	H

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	Numerical Assignment Writing *(5 assignments, problem-based, one per unit focus area covering number systems, sequential circuits, CPU organization, memory systems, and advanced computer architecture)*	30 Hours	CO1–CO6 / TS1–TS6	Accuracy in numerical problem solving, logic design, analytical reasoning, architecture interpretation, HOTS-based problem solving, and technical presentation
2	Technical Video-Based Learning related to the Subject *(e.g., CPU organization, pipelining, cache memory, multicore processors, RISC/CISC architecture, GPU computing, memory hierarchy)*	9 Hours	CO3, CO5, CO6 / TS3, TS5, TS6	Video learning report quality, concept understanding, technical interpretation, comparative analysis, self-reflection, and presentation/viva
3	Real-World Case Studies *(e.g., Intel vs AMD processor architecture, ARM processor organization, GPU architecture, multicore systems, distributed computing, cache optimization techniques)*	6 Hours	CO4, CO5, CO6 / TS4, TS5, TS6	Technical depth, system-level understanding, architecture comparison, analytical reasoning, interpretation of findings, and report quality
	TOTAL Self-Learning Hours	**45 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold

Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

Computer Organization & Architecture - MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

COURSE PLAN

Data Structures (CSCR2311)

School of Computing Science & Engineering (SSCSE) |B.Tech CSE | Semester I | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	III

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR2311
2	**Course Title**	**Data Structures**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	1. Learn the basic concepts of Data Structures and algorithms. 2. Design and Implementation of Various Basic and Advanced Data Structures. 3. Learn the concepts of various searching, Sorting and Hashing Techniques. 4. Choose the appropriate data structures and algorithm design method for a specified application.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Recall and list fundamental concepts of data structures, including types (linear vs. non-linear), static vs. dynamic memory allocation, and asymptotic notations (Big-O, Omega, Theta). CO2 (Understand – L2): Explain the working and internal representation of linear data structures (arrays, linked lists, stacks, queues) and nonlinear data structures (trees, graphs), including their traversal mechanisms. CO3 (Apply – L3): Select and use appropriate linear data structures like stacks and queues to solve real-world computational problems such as expression evaluation, job scheduling, and palindrome checking. CO4 (Analyze – L4): Analyze and compare various searching algorithms (linear, binary) and sorting algorithms (bubble, selection, insertion, merge, quick) in terms of time and space complexity. CO5 (Evaluate – L5): Evaluate different hashing techniques (division, mid-square, folding) and collision resolution methods (chaining, open addressing) to design an efficient hash function for a given application.

		CO6 (Create – L6): Design, implement, and demonstrate complete algorithmic solutions by integrating nonlinear data structures (trees, graphs) and advanced algorithms (traversal, shortest path, MST) to solve complex, real-world problems. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Implement operations like traversal, insertion, deletion, and searching on various linear and nonlinear data structures using professional tools (GCC, Linux CLI, debuggers) and maintain structured lab records. CO8 (Apply – L3): Apply linear data structures (stacks, queues, linked lists) to solve given problems and develop complete executable solutions with proper modularization. CO9 (Create – L5/L6): Design and develop applications using nonlinear data structures (trees, graphs) and hashing techniques, demonstrating optimized solutions with justification of data structure selection. CO10 (Evaluate – L5): Choose and justify the most appropriate data structure(s) for a given problem by evaluating trade-offs in time, space, and implementation complexity, while collaborating and presenting solutions effectively in a team.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. 5 assignments of 3h each. Total = 15h 2. 5 small coding-based problems of 3h each. Total = 15h 3. Self-learning on-line course Total = 15h
11	**References**	Textbook: Lipschutz, “Data Structures” Schaum’s Outline Series, TMH Reference: Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI Reference: Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publication.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction (9-0-6-9 = 24 hrs)**	
A	Data Structure – Definition, Operations and Applications, Abstract Data Types, Algorithm – Definition, Introduction to Complexity, Big OH notation, Time and Space tradeoffs.	CO1
B	Dynamic Memory Allocation(Malloc, calloc, realloc, free), Recursion – Definition, Examples- Tower of Hanoi problem, Tail Recursion	
C	Arrays: Implementation of One Dimensional Arrays, Multidimensional Arrays, Applications of Arrays, Address Calculation, Matrix Operations, Sparse martices	
Tools Used	Linux Environment, GCC compiler with memory debugging tools (Valgrind), Virtual Labs, whiteboards, sticky notes for ADT modeling, online complexity visualizers.	
Activities	**Objective:** To understand asymptotic complexity, ADT concept, and dynamic memory management by implementing array-based structures and recursive solutions. Implement programs to compute time complexity of simple algorithms using Big-O notation. Use malloc/calloc to create dynamic arrays and compare with static allocation. Implement Tower of Hanoi recursively and trace tail recursion.	

	Perform address calculation for row-major and column-major 2D arrays. Represent and manipulate sparse matrices using triplet representation. Use Valgrind to detect memory leaks in dynamic allocation.	
Unit 2	**Linked List (9-0-6-9 = 24 hrs)**	
A	Concept of Linked List, Garbage Collection, Overflow and Underflow, Array Implementation and Dynamic Implementation of Singly Linked Lists	CO2, CO3
B	Array Implementation and Dynamic Implementation of Doubly Linked List, Circularly Linked List	
C	Operations on a Linked List- Insertion, Deletion, Traversal, Polynomial Representation and Addition	
Tools Used	Linux Environment, GCC, Competitive coding platforms (Leetcode, Hackerrank), Virtual Labs, whiteboards, online linked list visualizers (VisuAlgo), GitHub for version control.	
Activities	**Objective:** To apply dynamic memory allocation to implement linear linked structures and compare array vs. linked representations. Implement singly linked list with insertion, deletion, traversal, and search. Compare array implementation vs. dynamic implementation of linked lists. Implement doubly linked list and circular linked list with menu-driven programs. Represent a polynomial using linked list and perform addition of two polynomials. Detect and handle overflow/underflow conditions. Solve real-world problems (e.g., student record management) using linked lists.	
Unit 3	**Stack and Queue (9-0-6-9 = 24 hrs)**	
A	Stacks: Definitions, Primitive operations, Application of stacks – Conversion of Infix Expression to Postfix form, Evaluation of Postfix Expressions	CO3
B	Queues: Definition, Primitive Operations, Implementation of Circular Queues, Priority Queues	
C	Deques, Application of Queues. Implementation - Linked Stacks, Linked Queues.	
Tools Used	Linux Environment, GCC, Competitive coding platforms, Virtual Labs, expression tree visualizers, online stack/queue simulators, GitHub.	
Activities	**Objective:** To design and implement linear data structures (Stack & Queue) using both array and linked representations for real-world applications. Implement stack using array and linked list with push/pop/peek operations. Convert infix expression to postfix using stack (handling operator precedence). Evaluate postfix expression using stack. Implement linear queue, circular queue, and priority queue using array. Implement queue using linked list to avoid overflow limitations. Simulate real-world problems: palindrome checking (stack), job scheduling (queue), undo-redo functionality.	
Unit 4	**Tree and Graphs (9-0-6-9 = 24 hrs)**	
A	Trees: Terminologies, Binary tree, Representation, Applications, Binary search Tree – Operations on Binary Search Trees (Traversing, Insertion, deletion etc.), Binary Search Algorithm, AVL Tree	CO4, CO6

B	Graph: Terminology, Representation, Traversals- Depth First Search, Breadth First Search.	
C	Graph Applications – Minimum Spanning Trees – Prim's and Kruskal's Algorithms	
Tools Used	Linux Environment, GCC, Graph visualization tools (Graphviz), Virtual Labs, BST visualizers, online graph traversal simulators, Leetcode, GitHub.	
Activities	**Objective:** To implement nonlinear data structures (trees and graphs) and apply traversal, search, and optimization algorithms. Implement binary tree and BST with insertion, deletion, and three traversals (inorder, preorder, postorder). Implement AVL tree with rotation operations (LL, RR, LR, RL). Represent graphs using adjacency matrix and adjacency list. Implement DFS and BFS traversals on graphs. Implement Prim's and Kruskal's algorithms for MST. Apply BST for dictionary/phonebook application. Analyze time complexity of tree/graph operations.	
Unit 5	**Searching, Sorting and Hashing (9-0-6-9 = 24 hrs)**	
A	Implementation and Analysis - Linear search, Binary Search	CO5, CO6
B	Implementation and Analysis- Bubble Sort, Insertion Sort, Selection Sort, Tree sort	
C	Hashing: Concepts and Applications, Hash Functions, Collisions, Methods of Resolving Collisions	
Tools Used	Linux Environment, GCC, Hashing visualizers, Sorting algorithm analyzers (Big-O simulators), Competitive coding platforms, Virtual Labs, GitHub.	
Activities	**Objective:** To compare searching and sorting algorithms empirically and design efficient hash functions with collision resolution. Implement linear search and binary search; compare their time complexities. Implement bubble sort, insertion sort, selection sort, and tree sort. Count and compare number of comparisons/swaps for each sorting algorithm on different input sizes. Design a hash function (e.g., division method, mid-square) for integer/string keys. Implement collision resolution using chaining (linked list) and open addressing (linear probing, quadratic probing). Create a complete dictionary application using hashing. Analyze best-case, average-case, and worst-case scenarios empirically	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			

5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B	✔	✓			✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A	✔	✓		✔	✓	
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✔																	
CO2		✔																
CO3			✔											✔				
CO4				✔										✔				
CO5					✔										✔			
CO6						✔		✔								✔	✔	
CO7			✔									✔	✔					
CO8				✔	✔									✔	✔			
CO9			✔				✔	✔										
CO10			✔						✔			✔						

Legend: ✔ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Data Structure – Definition, Operations, Applications, Abstract Data Types (ADT)	Unit 1	4
DD/MM/YY	Algorithm – Definition, Introduction to Complexity, Asymptotic Notations (Big-O, Omega, Theta)	Unit 1	
		Unit 1	

DD/MM/YY	Time and Space Tradeoffs, Analysis of Simple Algorithms	Unit 1	
DD/MM/YY	Dynamic Memory Allocation: malloc, calloc, realloc, free; Garbage Collection Concepts		
DD/MM/YY	Recursion – Definition, Examples (Factorial, Fibonacci), Tail Recursion		
DD/MM/YY	Tower of Hanoi Problem – Recursive Implementation and Complexity Analysis		
DD/MM/YY	Arrays: 1D Array – Declaration, Initialization, Memory Representation, Address Calculation		
DD/MM/YY	Multidimensional Arrays (2D, 3D) – Row-major and Column-major Address Calculation		6
DD/MM/YY	Matrix Operations (Addition, Multiplication, Transpose), Sparse Matrices – Triplet Representation	Unit 1 Unit 1 Unit 1 Unit 1	
DD/MM/YY	Concept of Linked List – Advantages over Arrays, Garbage Collection, Overflow/Underflow	Unit 1 Unit 2	
DD/MM/YY	Singly Linked List – Array Implementation vs Dynamic Implementation		
DD/MM/YY	Singly Linked List Operations: Insertion (Beginning, End, Position), Deletion, Traversal, Search		
DD/MM/YY	Doubly Linked List – Dynamic Implementation, Operations (Insert, Delete, Traverse)		
DD/MM/YY	Circularly Linked List – Dynamic Implementation, Operations, Applications	Unit 2 Unit 2	8
DD/MM/YY	Polynomial Representation Using Linked List, Polynomial Addition	Unit 2	
DD/MM/YY	Stack: Definition, Primitive Operations (Push, Pop, Peek), Array Implementation	Unit 2 Unit 2	
DD/MM/YY	Stack: Linked List Implementation, Applications – Reversal, Palindrome Checking	Unit 3 Unit 3	
DD/MM/YY	Stack Application: Infix to Postfix Conversion – Algorithm and Examples	Unit 3	
DD/MM/YY	Stack Application: Evaluation of Postfix Expression		
DD/MM/YY	Queue: Definition, Primitive Operations (Enqueue, Dequeue), Array Implementation		
DD/MM/YY	Circular Queue – Need, Implementation, Overflow/Underflow Conditions	Unit 3	6
DD/MM/YY	Priority Queue – Types (Ascending/Descending), Array Implementation	Unit 3 Unit 3	
DD/MM/YY	Deque (Double Ended Queue) – Input Restricted, Output Restricted, Applications	Unit 3 Unit 3	
DD/MM/YY	Linked Queue – Implementation Using Linked List, Comparison with Array Queue	Unit 3	
DD/MM/YY	Queue Applications – Job Scheduling, CPU Scheduling Simulation		
DD/MM/YY	Tree: Terminologies (Root, Parent, Child, Leaf, Depth, Height), Binary Tree – Properties	Unit 3	
DD/MM/YY	Binary Tree Representation – Array Representation, Linked Representation	Unit 4 Unit 4	6
DD/MM/YY	Binary Tree Traversals – Inorder, Preorder, Postorder (Recursive and Iterative)	Unit 4	
DD/MM/YY	Binary Search Tree (BST) – Definition, Operations: Insertion, Deletion, Searching	Unit 4 Unit 4	

DD/MM/YY	AVL Tree – Need, Balance Factor, Rotations (LL, RR, LR, RL), Insertion		
DD/MM/YY	Graph: Terminology (Vertex, Edge, Directed/Undirected, Weighted/Unweighted)	Unit 4	
DD/MM/YY	Graph Representation – Adjacency Matrix, Adjacency List	Unit 4	
DD/MM/YY	Graph Traversals – Depth First Search (DFS) – Algorithm and Example	Unit 4	
DD/MM/YY	Graph Traversals – Breadth First Search (BFS) – Algorithm and Example	Unit 4	
DD/MM/YY	Minimum Spanning Tree – Prim's Algorithm (Concept, Example, Complexity)	Unit 4	
DD/MM/YY	Minimum Spanning Tree – Kruskal's Algorithm (Concept, Example, Complexity)	Unit 4	
DD/MM/YY	Searching Algorithms – Linear Search (Algorithm, Complexity, Analysis)	Unit 5	
DD/MM/YY	Searching Algorithms – Binary Search (Algorithm, Complexity, Analysis, Recursive & Iterative)	Unit 5	
DD/MM/YY	Sorting Algorithms – Bubble Sort (Algorithm, Complexity, Example)	Unit 5	
DD/MM/YY	Sorting Algorithms – Insertion Sort (Algorithm, Complexity, Example)	Unit 5	
DD/MM/YY	Sorting Algorithms – Selection Sort (Algorithm, Complexity, Example)	Unit 5	
DD/MM/YY	Sorting Algorithms – Tree Sort (Using BST, Complexity, Comparison with Other Sorts)	Unit 5	
DD/MM/YY	Hashing: Concepts and Applications, Hash Functions (Division, Mid-Square, Folding)	Unit 5	
DD/MM/YY	Collision Resolution – Chaining (Separate Chaining Using Linked List)	Unit 5	
DD/MM/YY	Collision Resolution – Open Addressing (Linear Probing, Quadratic Probing, Double Hashing)	Unit 5	
DD/MM/YY	Performance Analysis of Hashing – Load Factor, Rehashing	Unit 5	
DD/MM/YY	Revision and Problem Solving – Unit 1 & 2	All Units	
DD/MM/YY	Revision and Problem Solving – Unit 3 & 4	All Units	
DD/MM/YY	Revision and Problem Solving – Unit 5 & Previous Year Questions	All Units	

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Setting up environment: Linux commands, gcc, first C program — professional tool setup	CO7	3.0

	S-1.2	Calculate average of three integers; Four-fours digit problem	CO7	
W2	S-2.1	Currency denominations (Rs. 10, 50, 100); Gross salary calculator	CO7	3.0
	S-2.2	Reverse a 5-digit number; Interchange contents of two variables	CO7	
W3	S-3.1	Calculate area of triangle; Area & circumference of circle	CO7	3.0
	S-3.2	Bitwise operations on a number: set, check, toggle, and clear a bit	CO7	
W4	S-4.1	Character classification; Find roots of quadratic equation	CO7	3.0
	S-4.2	Find youngest of three (Ram, Shyam, Ajay); Leap year check	CO7	
W5	S-5.1	Check vowel/consonant via Switch-Case; Calculator for +, –, ×, ÷	CO7	3.0
	S-5.2	Income tax calculator with personal allowance and child allowance slabs	CO7	
W6	S-6.1	Check if a number is Armstrong (e.g., 153 = $1^3+5^3+3^3$)	CO7	3.0
	S-6.2	Print star patterns up to Nth line: pyramid and diamond shapes	CO7	
W7	S-7.1	Calculate Permutation & Combination; refactor into modular functions	CO7	3.0
	S-7.2	Recursive function for sum of array; recursive exponentiation	CO7	
W8	S-8.1	Menu-driven 1D array: display, sum, average	CO7	3.0
	S-8.2	Extend W8.1: minimum, maximum, search, bubble sort — all via functions	CO7	
W9	S-9.1	Menu-driven 2D arrays: row sums, column sums, diagonal sums	CO7	3.0
	S-9.2	Extend W9.1: matrix addition and multiplication via functions	CO7	
W10	S-10.1	Dynamic 1D array; functions for insert and delete operations	CO7	3.0
	S-10.2	Extend W10.1: Linear Search vs Binary Search with performance comparison	CO7	
W11	S-11.1	Extract characters at Fibonacci index positions from string; name formatter	CO7	3.0
	S-11.2	Count character frequency; word count in a string; print frequency table	CO7	
W12	S-12.1	Dynamic array of size n1; expand by n2; print all values	CO7	3.0
	S-12.2	Dynamic array with auto-doubling at 75% occupancy — efficiency analysis	CO7	
W13	S-13.1	Structure 'product': name, price, qty, amount — real-world application with SDG context	CO8	3.0
	S-13.2	Structure 'student_record' with nested 'date'; array of structures — societal relevance discussion	CO8	
W14	S-14.1	Complex number ADT using structures: design, document, and reflect — CO9 reflection form submitted	CO8/CO9	3.0
	S-14.2	Implement simple linked list — team implementation, role assignment, peer review session	CO8/CO10	
W15	S-15.1	Merge & sort files — ethical data handling; skill self-assessment form submitted	CO8/CO9	3.0
	S-15.2	Text file to lowercase; frequency counts — team code review, final presentation, group reflection	CO9/CO10	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall basic definitions: Data Structure, ADT, Algorithm, Complexity notations (Big-O, Omega, Theta), Tree/Graph terminologies, Hash functions, Sorting algorithm names	CO1	L1–L2
TS2	**Conceptual Explanation & Logical Interpretation**	Explain working of linear structures (stack, queue, linked list), nonlinear structures (tree, graph), recursion (Tower of Hanoi), collision resolution methods, MST algorithms (Prim's, Kruskal's)	CO2	L2
TS3	**Procedural Application & Problem Solving**	Apply stacks (infix to postfix, postfix evaluation), queues (circular, priority), linked lists (insertion/deletion/polynomial addition), BST (insertion/deletion/traversal), sorting (bubble, insertion, selection)	CO3	L3
TS4	**Analytical Reasoning & Program Tracing**	Trace recursive functions (Tower of Hanoi, Fibonacci), analyze complexity of sorting/searching algorithms, detect bugs in BST/AVL operations, analyze collision resolution performance, compare DFS vs BFS traversal paths	CO4	L4
TS5	**Comparative Evaluation & Algorithmic Justification**	Compare array vs linked list implementation, linear vs binary search, various sorting algorithms (bubble/insertion/selection/merge/quick), different hash functions, Prim's vs Kruskal's for MST, AVL vs BST	CO5	L5
TS6	**Synthesis & Holistic Design**	Design complete solutions integrating multiple data structures (e.g., hash table with linked list chaining, graph with adjacency list, expression evaluation using stack + tree), optimize using appropriate DS for real-world problems (dictionary, job scheduling, shortest path)	CO6	L6

9. Theory Assessment Structure — MTE and ETE

9.1 MidTerm Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	4	TS1 — Factual Recall & Conceptual Recognition	CO1, CO2	Short-answer: definitions of ADT, Big-O, Stack, Queue, Linked List; complexity of algorithms; predict output of recursive functions (e.g., Tower of Hanoi step); identify correct linked list operation
Sec B	6	TS2 — Conceptual Explanation & Logical Interpretation	CO3	Program writing: implement stack using array, infix to postfix conversion, singly linked list insertion/deletion, circular queue operations
TOTAL	10		CO1,CO2, CO3	

9.2 EndTerm Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11

		conduct		
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define the data structure problem clearly (e.g., implement BST insertion, infix to postfix conversion, graph DFS). Identify measurable parameters: number of operations (insertions/deletions), time taken, memory usage, collision count in hashing, tree height, sorting comparisons	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan the sequence of operations for the experiment. Configure development environment: Linux CLI, GCC compiler, Valgrind (memory leak detection), GDB debugger, GitHub for version control	CO7
CA3	**Code Implementation & Execution**	Write correct C code implementing the specified data structure operation (e.g., stack push/pop, linked list traversal, AVL rotation). Compile and execute to produce expected output without errors	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time complexity (Big-O) and space complexity of the implemented data structure operation. Identify bottlenecks (e.g., $O(n^2)$ sorting, collision chain length in hashing). Propose optimizations (e.g., using balanced BST instead of linear search)	CO7
CA5	**Output Analysis & Result Interpretation**	Analyze program output critically (e.g., inorder traversal of BST must be sorted, postfix evaluation must match manual calculation). Explain deviations from expected results. Draw evidence-based inferences about data structure behavior	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally in the lab record. Verify outputs against the problem statement using test cases (e.g., empty list insertion, duplicate key handling in BST, collision resolution in hash table)	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm, flowchart, or pseudocode before coding (e.g., algorithm for DFS traversal, steps for heap insertion). Justify design choices (e.g., why linked list over array for polynomial addition, why linear probing over chaining)	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete, organized, and timely lab records with problem statements, code, outputs, and analysis. Demonstrate conceptual understanding orally during viva (e.g., explain AVL rotations, compare BFS vs DFS, justify hash function choice)	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3

P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

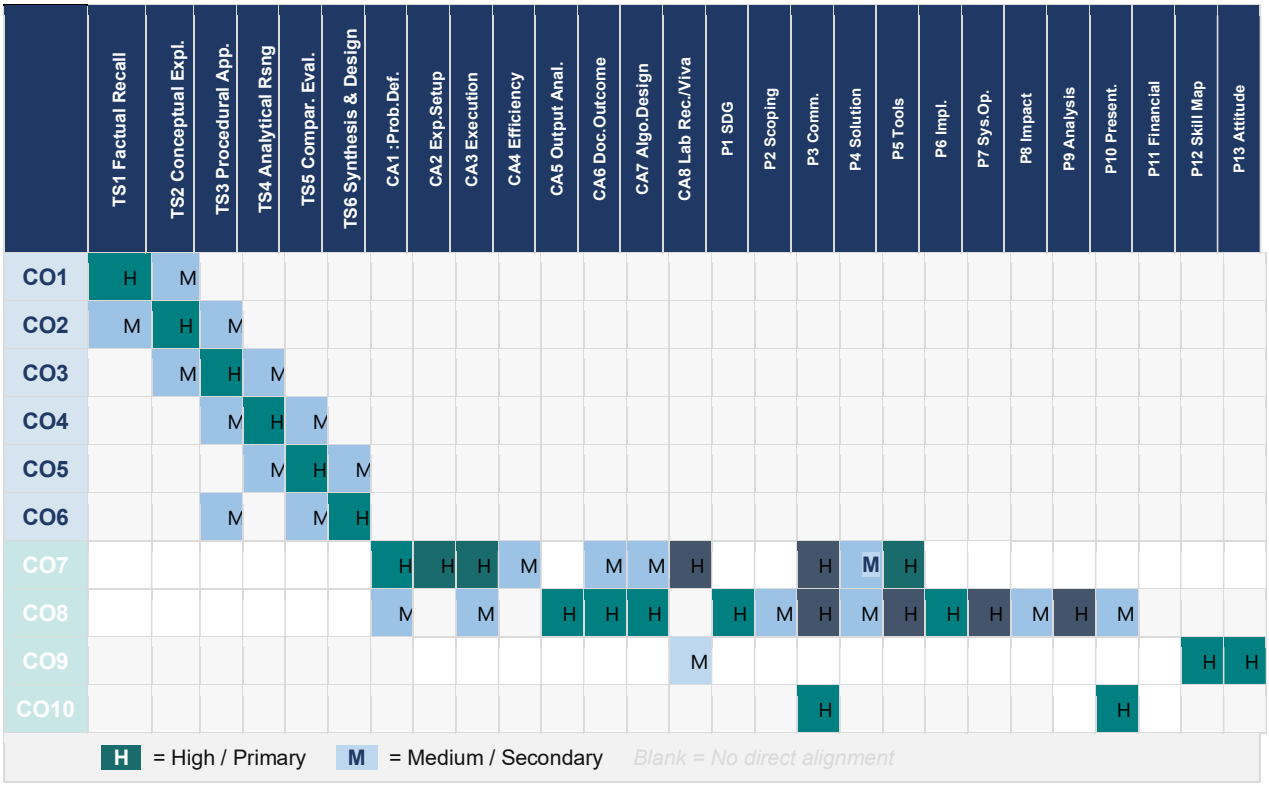
14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions	CA Skill Dimensions	Project Skill Dimensions



PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1	–
CO2	3	2	–	–	–	–	–	–	1	–	2	2	2	–

CO3	3	3	2	–	2	2	–	–	1	–	2	3	2	2
CO4	2	3	2	2	2	–	–	–	–	–	2	2	3	2
CO5	2	3	3	2	2	–	–	–	–	–	2	2	3	2
CO6	2	2	3	2	3	2	–	2	1	1	3	3	3	3
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	**2.5**	**2.14**	**2.33**	**1.75**	**2.33**	**1.8**	**3**	**2.5**	**1.5**	**2**	**2.13**	**2.22**	**2.3**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M								M	
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary **M** = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	**Quality Education**	**3 (High)**	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	**Decent Work & Economic Growth**	**3 (High)**	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	**Industry, Innovation & Infrastructure**	**3 (High)**	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	**Responsible Consumption & Production**	**2 (Moderate)**	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE ProgrammeOutcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SSCSE		**Batch: 2025-2029**			
Program: B.Tech.		**Current Academic Year: 2026-27**			
Branch: CSE		**Semester: III**			
1	Course Code	**CSCR2600**			
2	Course Title	Project Based Learning -1			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	1. To align student's skill and interests with a realistic problem or project 2. To understand the significance of problem and its scope 3. Students will make decisions within a framework			
6	Course Outcomes	Students will be able to: CO1: Identify and formulate problem statement with systematic approach. CO2: Develop teamwork and problem-solving skills, along with the ability to communicate effectively with others. CO3: Design the problem solution as per the problem statement framed. CO4: Classify and understand techniques for software verification and validation of project successfully. CO5: Fabricate and implement the solution by using different aspects of programming language. CO6: Develop a glory of the need to engage in life-long learning.			
7	Course Description	In PBL-1, the students will learn how to define the problem for developing projects, identifying the skills required for developing the project based on given a set of specifications and all subjects of that Semester.			
8	**Outline syllabus**				**CO Mapping**
	Unit 1	Problem Definition, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.			CO1, CO2
	Unit 2	Develop a work flow or block diagram for the proposed system/software.			CO2, CO3
	Unit 3	Design algorithms for the proposed problem.			CO3
	Unit 4	Implementation of work under the guidance of a faculty member and obtain the appropriate results.			CO3, CO4
	Unit 5	Demonstrate and execute Project with the team. Validate and verify the project modules.			CO4, CO5, CO6
		Report should include Abstract, Hardware / Software Requirement, Problem Statement, Design/Algorithm, Implementation Detail. Validation Reports. References if any. The presentation, report, work done during the term supported by the documentation, forms the basis of assessment.			
	Mode of examination	**Lab**			
	Weight age Distribution	**CA**	**CE**	**ETE**	
		30%	30%	40%	

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Identify and formulate problem statements with systematic approach.	PO1, PO2, PO4, PO9, PO10, PO11, PSO1, PSO2, PSO3
2.	CO2: Develop teamwork and problem-solving skills, along with the ability to communicate effectively with others.	PO1, PO2, PO4, PO7, PO9, PO10, PO11, PSO3
3.	CO3: Design the problem solution as per the problem statement framed.	PO1, PO2, PO5, PO9, PO10, PO11, PSO1, PSO2
4.	CO4: Classify and understand techniques for software verification and validation of project successfully.	PO1, PO2, PO6, PO9, PO10, PO11, PSO2
5.	CO5: Fabricate and implement the solution by using different aspects of programming language.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PSO1, PSO2, PSO3
6.	CO6: Develop a glory of the need to engage in life-long learning.	PO1, PO2, PO4, PO9, PO10, PO11, PSO3

PO and PSO mapping with level of strength for Course Name Project Based Learning -1 (Course Code CSCR2600)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3		3				3	3	2	3	2	2	1
CO2	3	2		3		2		3	3	2	3			1
CO3	3	2			2			3	3	2	3	2	2	
CO4	3	3				2		3	3	2	3		2	
CO5	3	3	2	2	2	3	3	3	3	2	3	2	2	
CO6	3	3		3				3	3	2	3			1
Avg PO attained	**3**	**2.7**	**0.34**	**1.84**	**0.67**	**0.67**	**0.84**	**0.5**	**3**	**3**	**2**	**1**	**1.4**	**0.5**

Strength of Correlation: 21.46

1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

COURSE PLAN

Professional Skills, Data Structures & Web Technologies (SKP2301)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester III | Batch 2026–2030

Lab-Only Course Plan — All 6 Lab COs (CO1–CO6) | New AICTE 11-PO Framework | Full Skill Mapping

PART I COURSE SYLLABUS *Course Identification, Details, Outcomes, BTL Mapping & Session Plan*

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2027–28
Branch:	CSE	**Semester:**	III
Course Code:	SKP 2301	**Course Type:**	Core

2. Course Details

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.

1	**Course Code**	SKP 2301
2	**Course Title**	Professional Skills, Data Structures & Web Technologies
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	0-0-6-0 (Tutorial: 0 hrs | Lab: 90 hrs | Self Learning: 0 hrs | Total: 90 hrs)
5	**Course Status**	Core
6	**Course Objectives**	The objective of this course is to develop learners into confident, professional, and industry-ready individuals by enhancing their verbal ability, workplace communication, presentation skills, leadership qualities, employability competencies, quantitative aptitude, and logical reasoning through practical activities, simulations, and collaborative learning approaches. The course further aims to build foundational computational thinking, problem-solving, and application development skills through the study of Data Structures, Data Analytics fundamentals, and modern Web Development practices, enabling students to design efficient solutions, develop responsive applications, and apply analytical and programming tools for real-world problem solving.
7	**Course Outcomes (COs)**	After successful completion of this course, the students will be able to: **CO1 (Remember – BTL1):** Professional Communication & Computational Fundamentals Recall the fundamental concepts of professional communication, workplace etiquette, data analytics, computational complexity, web technologies, and development environments required for academic and professional problem solving. **CO2 (Understand – BTL2): Business** Communication & Computational Concepts Explain the principles of business communication, presentation skills, data preprocessing techniques, semantic web structures, algorithmic approaches, and foundational computing concepts used in modern professional environments. **CO3 (Apply – BTL3):** Application Development & Professional Interaction Skills

		Apply frontend development tools, searching and sorting techniques, spreadsheet analytics, verbal communication, presentations, group discussions, leadership activities, and collaborative problem-solving skills in practical situations. **CO4 (Analyze – BTL4):** Critical Thinking, Data Structures & Workplace Problem Solving Analyze workplace scenarios, communication challenges, linked list operations, UI/UX principles, responsive layouts, reading passages, and analytical problems using critical thinking and structured reasoning approaches. **CO5 (Evaluate – BTL5):** Employability, Analytical Workflows & Solution Effectiveness Evaluate professional communication practices, resumes, networking strategies, stacks, queues, responsive design methods, and Python-based analytical workflows for improved employability and system efficiency. **CO6 (Create – BTL6):** Integrated Solution Development & Professional Content Creation Design and develop integrated projects, responsive applications, analytical solutions, and professional content using data structures, frontend technologies, quantitative aptitude, logical reasoning, and workplace communication skills for real-world applications.
8	**Course Description**	This course provides an interdisciplinary foundation in professional communication, employability skills, computational problem solving, data structures, data analytics, and frontend application development. The course focuses on enhancing verbal ability, workplace communication, leadership, quantitative aptitude, logical reasoning, and professional writing through presentations, discussions, simulations, and collaborative activities, while also developing analytical thinking, algorithmic problem solving, and responsive application development skills using modern web technologies, data handling techniques, visualization tools, and programming practices. The course emphasizes practical implementation, critical thinking, teamwork, industry-relevant workflows, and real-world problem-solving abilities aligned with modern professional and technology-driven environments.
9	**Teaching & Learning Scheme**	Tutorial (T): 90 hrs| Total: 90 hrs | Credits: 3
10	**Mode of Examination**	CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
12	**Textbook**	1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, Latest Edition. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, MIT Press, Latest Edition. 3. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications. 4. Wes McKinney, Python for Data Analysis, O'Reilly Publications. 5. Aruna Koneru, Professional Communication, Oxford University Press. 6. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publications.
13	**References**	1. Reema Thareja, Data Structures Using C, Oxford University Press. 2. E. Balagurusamy, Programming in ANSI C, McGraw Hill. 3. Herbert Schildt, Python: The Complete Reference, McGraw Hill. 4. David Flanagan, JavaScript: The Definitive Guide, O'Reilly Publications. 5. Raymond Murphy, English Grammar in Use, Cambridge University Press. 6. Norman Lewis, Word Power Made Easy, Goyal Publishers. 7. Sanjay Kumar & Pushp Lata, Communication Skills, Oxford University Press. 8. Alex K., Soft Skills, S. Chand Publications. 9. Arun Sharma & Meenakshi Upadhyay, How to Prepare for Verbal Ability and Reading Comprehension, McGraw Hill. 10. Online Resources: NPTEL, GeeksforGeeks, LeetCode, Kaggle Learn, MDN Web Docs, W3Schools, British Council Learning English, Toastmasters International, TED Talks, LinkedIn Learning, GitHub Learning Lab, Newspaper Editorials (The Hindu / Indian Express).

3. Outline Syllabus — Units with CO Mapping

i All CO mappings refer to COs (CO1–CO6). This is a practical course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit 1: Professional Communication, Web Fundamentals & Analytical Thinking	
A	Corporate Etiquette, Workplace Ethics, Professional Behaviour, Introduction to Data Analytics/Web Fundamentals, Development Environment & HTML Workflow	**CO1**
B	Communication Readiness, Networking, Recruitment Platforms, Data Analytics Lifecycle, Static vs Dynamic Websites	**CO1**
C	Complexity Analysis, Recursion Fundamentals, Negotiation & Conflict Resolution through Case Studies and Simulations	**CO1**
	Unit 2: Business Writing, Web Design & Data Processing Skills	
A	Email Writing, Business Writing, Technical & Creative Writing, Data Collection & Preprocessing, Semantic HTML & Webpage Structuring	**CO2**
B	Essay Writing, Precis Writing, SOP & LOM Drafting, Data Cleaning & Transformation, Responsive Page Design	**CO2**
C	Arrays, Strings, Sliding Window Techniques, Pattern Matching & Problem Solving	**CO2**
	Unit 3: Public Speaking, Leadership & Programming Fundamentals	
A	Presentation Skills, TED Talk Practices, Toastmasters Sessions, Introduction to Python, Variables, Data Types & Operators	**CO3**
B	Debates, JAM Sessions, Group Discussions, Responsive Design Principles, CSS Grid & UI Development	**CO3**
C	Leadership, Team Building, Video Resume Development, Multi-section Frontend Project Development	**CO3**
	Unit 4: Verbal Ability, Data Structures & Problem Solving	
A	Grammar & Error Detection, Reading Comprehension, Vocabulary Building, Stack & Queue Fundamentals	**CO4, CO6**
B	Paragraph Jumbles, Cloze Tests, Logical Interpretation, Applications of Stacks & Queues	**CO4, CO6**
C	Min Stack, Queue using Stacks, Problem Solving & Analytical Reasoning Exercises	**CO4, CO6**
	Unit 5: Quantitative Aptitude, Logical Reasoning & Employability Readiness	
A	Simplification, Approximation, Vedic Maths, Percentage, Ratio & Proportion, Profit & Loss	**CO5, CO6**
B	Coding-Decoding, Number Systems, Calendars, Alphanumeric Series, Logical Arrangement & Venn Diagrams	**CO5, CO6**
C	Resume Building, ATS Optimization, Employability Skills, Analytical & Non-Verbal Reasoning Practice	**CO5, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A – Professional communication, workplace etiquette & networking	✓	✓				
2	1.B – Web fundamentals, HTML workflow & computational thinking		✓	✓			
3	1.C – Complexity analysis, recursion & analytical problem solving		✓	✓	✓	✓	
4	2.A – Business writing, email drafting & technical documentation	✓	✓	✓			
5	2.B – Semantic HTML, responsive design & frontend structuring		✓	✓			
6	2.C – Arrays, strings, dataset preprocessing & spreadsheet analytics		✓	✓	✓	✓	
7	3.A – Presentation skills, public speaking & group discussions		✓	✓	✓		
8	3.B – Leadership, collaboration & professional interaction		✓	✓	✓	✓	
9	3.C – Python fundamentals, CSS Grid & UI development			✓	✓	✓	✓
10	4.A – Grammar fundamentals, parts of speech & sentence correction	✓	✓	✓	✓		
11	4.B – Reading comprehension, vocabulary & verbal reasoning		✓	✓	✓	✓	
12	4.C – Stacks, queues, searching, sorting & logical reasoning		✓	✓	✓	✓	✓
13	5.A – Quantitative aptitude & analytical reasoning	✓	✓	✓	✓		
14	5.B – Resume building, ATS optimization & GitHub workflow		✓	✓	✓	✓	
15	5.C – UI/UX principles, integrated projects & employability readiness			✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

i Only strong/dominant alignments are mapped. Lab COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓						✓				✓	✓					
CO2		✓	✓					✓	✓			✓	✓	✓				
CO3			✓	✓				✓	✓	✓			✓	✓	✓			
CO4			✓	✓	✓				✓	✓				✓	✓	✓		
CO5			✓	✓	✓				✓	✓	✓			✓	✓	✓	✓	

CO6			✓	✓	✓	✓				✓	✓			✓	✓	✓	✓	✓
	Legend: ✓= Strong / Dominant mapping only.																	

6. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	**30**	CO1–CO6 | Professional Communication, Verbal Ability, Aptitude, Web Development, Data Structures, Data Analytics, Leadership & Employability Skills | Activity-based evaluation, worksheets, coding exercises, presentations, assignments, communication tasks
Course Examination (CE)	30%	**30**	CO1–CO6 | Analytical Thinking, Problem Solving, Writing Skills, Frontend Development, Programming Fundamentals, Logical Reasoning | Practical assessment + Viva + Problem-solving activities
End Semester Examination (ESE)	40%	**40**	CO1–CO6 | Coding Implementation, Analytical Problem Solving, Communication Effectiveness, Responsive Webpage Development, Data Structures & Employability Readiness | Practical implementation + Viva + Project/Case-based evaluation
TOTAL	**100%**	**100**	All COs assessed through practical, analytical, communication, coding, presentation, and problem-solving based evaluation methods

7. Continuous Assessment (CA) — 30 Marks

7.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Skill Dimensions Covered	Marking Guide	CO
Communication, Problem Understanding & Planning	1.0	Professional communication, analytical thinking, problem understanding, presentation of approach, workplace interaction, algorithmic thinking	1.0: Clear understanding & structured approach | 0.5: Partial understanding | 0: Unable to explain/problem not attempted	CO1–CO4
Practical Implementation / Technical Execution	1.0	HTML/CSS implementation, Python exercises, frontend tasks, data structures, aptitude/problem-solving activities, spreadsheet/data analytics tasks	1.0: Correct implementation/execution | 0.5: Minor errors/incomplete | 0: Not executed	CO2–CO5
Output Analysis & Lab Documentation	0.75	Output analysis, webpage presentation, coding output, communication tasks, resume/document drafting, lab/activity records, project demonstration	0.75: Complete & well-presented | 0.5: Adequate | 0.25: Partial | 0: Absent	CO3–CO6

Professional & Ethical Conduct	0.25	Teamwork, leadership, workplace ethics, collaboration, communication etiquette, participation in activities/discussions	0.25: Consistent & professional | 0.10: Occasional participation | 0: Poor participation	CO1-CO6
Total	**3.0**	Communication, technical, analytical, presentation, employability, and professional skill dimensions covered		CO1–CO6

7.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
>10	Best 10	**30 Marks**	Best 10 of all sessions (3 marks × 10 = 30)
< 10	All attended	**≤ 30 Marks**	Each missed session = zero; cannot be compensated

8. Continuous Evaluation (CE) — 30 Marks

ℹ CE is a mid-point practical examination covering Units 1–3 (CO1–CO3). CO4, CO5, and CO6 are assessed in ESE only.

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	Professional communication, workplace readiness, HTML/CSS implementation, frontend fundamentals, analytical/problem-solving ability	CO1, CO2	Communication activity, webpage creation, responsive design task, professional writing task, or analytical/problem-solving exercise with practical implementation
Sec B	10	Python/programming fundamentals, arrays/strings/problem solving, data analytics/spreadsheet activities, logical reasoning and implementation skills	CO2, CO3	Coding/problem-solving activity, spreadsheet/data analysis task, frontend implementation, Python exercise, or practical analytical task with output demonstration
Sec C (Viva)	10	Presentation skills, conceptual understanding, communication clarity, leadership/team participation, output interpretation, professional behaviour	CO1–CO3	Viva, presentation, demonstration, communication-based questioning, output explanation, project/activity discussion, and conceptual interpretation
TOTAL	**30**	Communication, analytical, technical, coding, presentation, professional, and employability skill dimensions covered	CO1–CO3	Units 1–3 based practical, communication, coding, frontend, analytical, and activity-oriented evaluation

9. End Semester Examination (ESE) — 40 Marks

ℹ ESE is comprehensive — all 5 units and all 6 COs. Minimum 16/40 required to pass.

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	Communication skills, verbal ability, grammar, professional writing, frontend/web fundamentals, aptitude and logical reasoning basics	CO1, CO2, CO4	Communication activity, grammar/verbal ability task, HTML/CSS implementation, responsive webpage exercise, aptitude/reasoning problem-solving, or analytical interpretation task
Sec B	20	Data structures, programming fundamentals, analytical thinking, problem solving, Python/programming implementation, searching/sorting, arrays, stacks, queues, frontend/problem-solving activities	CO3, CO4, CO5	Coding/problem-solving tasks, implementation exercises, algorithmic analysis, frontend development activities, Python exercises, data structure implementation, logical interpretation and analytical problem-solving
Sec C	10	Leadership, employability readiness, presentation skills, project/problem-solving approach, analytical evaluation, professional communication, innovation and collaborative skills	CO5, CO6	Viva, presentation, resume/ATS evaluation, project demonstration, analytical discussion, communication-based evaluation, problem-solving explanation, leadership/teamwork assessment, and practical interpretation
TOTAL	**40**		CO1–CO6	Comprehensive practical, coding, communication, aptitude, analytical, frontend, and activity-oriented evaluation covering all Unit

9.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	Skill Dims	PO Primary
CO1	Recall professional communication, workplace etiquette, web fundamentals, data analytics basics, and computational concepts	✓	✓	✓	Communication readiness, conceptual understanding, workplace interaction, analytical thinking	PO1, PO8, PO9
CO2	Explain business communication, presentation principles, semantic web structures, data preprocessing, and computational approaches	✓	✓	✓	Professional writing, presentation skills, frontend/web structuring, analytical interpretation	PO1, PO2, PO9
CO3	Apply frontend development, programming fundamentals, presentations, group discussions,	✓	✓	✓	Coding implementation, frontend	PO1, PO3, PO5, PO8

	leadership, and collaborative problem solving				development, teamwork, communication, practical problem solving	
CO4	Analyze communication challenges, reading passages, UI/UX layouts, linked list operations, and structured reasoning problems	✓	—	✓	Critical thinking, analytical reasoning, data structures, logical interpretation, problem analysis	PO1, PO2, PO3
CO5	Evaluate employability practices, responsive designs, analytical workflows, stacks, queues, and professional strategies	✓	—	✓	Aptitude, employability skills, analytical evaluation, reasoning, responsive design analysis	PO1, PO2, PO8, PO9, PO10
CO6	Design integrated projects, responsive applications, analytical solutions, and professional content for real-world applications	✓	—	✓	Project development, innovation, frontend implementation, leadership, collaborative solution design	PO3, PO5, PO9, PO11

⚠ CO4, CO5, and CO6 are comprehensively assessed in CA and ETE components through analytical, coding, frontend, aptitude, communication, and project/problem-solving activities. MTE primarily focuses on Units 1–3 and assesses foundational communication, programming, analytical, and frontend implementation skills related to CO1–C.

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

10. CO–PO and CO–PSO Mapping Matrix

ℹ Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	-	2	2	1	-	2	1	1
CO2	2	2	2	-	2	-	-	2	2	1	-	2	2	1
CO3	2	3	2	-	3	-	-	2	3	2	-	2	3	3
CO4	3	3	2	-	2	-	-	2	2	2	-	3	2	2
CO5	3	3	2	-	2	-	-	3	3	2	2	3	2	2
CO6	2	3	3	-	3	-	-	3	3	3	3	2	3	3
Avg	2.50	2.67	2.40	–	2.17	–	–	2.33	2.50	2.00	2.50	2.33	2.17	2.00

11. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M					M	M			M		
CO2	M	M	M		M			M	M			M	M	
CO3	M	H	H		H			M	H	M		M	H	H
CO4	H	H	M		M			M	M	M		H	M	M
CO5	H	H	M		M			H	H	M	M	H	M	M
CO6	M	H	H		H			H	H	H	H	M	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

12. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — **Remember:** Recall facts, definitions, terminology, communication rules, syntax, and concepts. **L2 — Understand:** Explain communication principles, analytical concepts, coding logic, and web structures. **L3 — Apply:** Use programming, analytical reasoning, frontend development, and communication skills in practical tasks **L4 — Analyze:** Examine logical patterns, communication challenges, algorithms, UI structures, and analytical **L5 — Evaluate:** Assess solutions, frontend designs, employability strategies, and analytical outcomes **L6 — Create:** Design projects, responsive interfaces, analytical solutions, and integrated applications	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Demonstrating professionalism, teamwork, and ethical conduct A4 — Organizing: Integrating professional values, collaboration, and leadership qualities A5 — Internalized professional behavior and ethical responsibility	P1 — Perception: Observing cues and identifying processes P2 — Set: Readiness for practical execution and participation P3 — Guided coding, implementation, and practical exercises P4 — Independent and confident practical execution P5 — Skilled implementation and problem-solving performance P6 — Adaptation: Modifying and improving solutions for specific requirements P7 — Origination: Creating innovative technical and communication-based solutions

ℹ OBE Compliance Statement: This is a practical, activity-oriented, and skill-integrated course. All 6 COs span Cognitive (L2–L6) as the primary domain, Psychomotor (P2–P7) for implementation and technical execution, and Affective (A2–A5) for teamwork, professionalism, communication, leadership, and collaborative learning.

13. Attendance Policy & Pass/Fail Criteria

13.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Lab / Practical Sessions	**75%**	Coding labs, communication activities, presentations, group discussions, frontend tasks, analytical exercises, practical implementations	Debarred from ETE if attendance falls below prescribed limit

⚠ Minimum 75% attendance is mandatory in practical/activity sessions. Non-submission of self-learning tasks, coding activities, analytical exercises, or communication assignments directly impacts internal assessment and is not compensable through external examination performance.

13.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 16 / 40**	**MANDATORY**	40% of ESE marks required; failing ESE means failing the course regardless of CA + CE performance
Overall Total (CA + CE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 30 + CE 30 + ESE 40 = 100; 40% overall minimum required

_____—COURSE PLAN — MEASUREMENT ARCHITECTURE

11 Programme Outcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments → Skill Dimensions

CO1–CO3: Apply/Analyse → CA + CE + ESE

CO4–CO5: Analyse/Evaluate → CA + ESE

CO6: Create → CA + ESE Sec C

Marks: CA 30 + CE 30 + ESE 40 = Total 100

Semester 4, Credits: 23	
COURSE CODE	**COURSE NAME**
CSCR2314	Data Base Management System
CSCR2115	Theory of Computation
CSCR2117	Introduction to Cloud Computing
CSCR2315	Software Engineering and Testing Methodologies
CSCR2601	Project Based Learning (PBL) -2 (Research Methodology Based)
	Program Elective-1
CSCR2200	Data Analytics using Visualization Tools
CSCF2302	Machine Learning for Cyber Security
CSAI2200	Human Computer Interaction
CSCF2303	Open Source Tools for Cybersecurity & Forensics
SKP2401	Integrated Professional Communication and Intelligent Computing

COURSE PLAN

Data Base Management System (CSCR2314)

School of Computing Science & Engineering (SSCSE) | B.Tech. CSE | Semester IV | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR2314
2	**Course Title**	**Data Base Management System**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	The course aims to develop students' ability to design, implement, and manipulate databases, provide foundational knowledge for constructing database management systems, and foster the application of DBMS concepts across diverse examples and real-world scenarios.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Explain the basics concepts of data base. CO2 (Understand – L2): Demonstrate the knowledge of databases to E-R modelling. CO3 (Apply – L3): Ability to design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respective data. CO4 (Analyze – L4): Apply normalization techniques to reduce redundancy from the database. CO5 (Evaluate – L5): To appraise the basic issues of Transaction processing, Serializability& concurrency control. CO6 (Create – L6): Design & develop database for real life problems. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Understand – L2): Understand and apply SQL commands for database creation, retrieval, and manipulation. CO8 (Apply – L3): Create and execute SQL queries using SELECT statements, filtering, grouping, and reporting functions. CO9 (Apply – L3): Perform database operations using DML commands such as INSERT, UPDATE, and DELETE to manage data effectively. CO10 (Create – L6): Develop database-driven applications/projects by applying various SQL concepts and commands in real-world scenarios.

8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self-Learning (SL: 30 hrs)**	1. Advanced SQL Queries, Joins, Subqueries, and Reporting Functions. 2. Database Security, Transactions, Backup, and Recovery Mechanisms. 3. Mini Project on Database Application Development using DBMS.
11	**References**	Textbook: Korth, Silberschatz & Sudarshan, Data base Concepts, Tata McGraw-Hill, Latest Edition. Reference: Elmasri, Navathe, Fundamentals of Database Systems, Pearson Education Inc. Reference: Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to design, Implementation and Management, Pearson Education, Third Edition.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction to Databases: (4-0-10-6 = 20 hrs)**	
A	Introduction of DBMS, Characteristic of DBMS, Data Models, Database languages, Database Administrator, Database Users.	CO1, CO2, CO6
B	Three Schema architecture of DBMS, Data Models, Hierarchical, Network, Data independence and database language, DDL, DML, Data Modeling using Entity Relationship Model.	
C	Strong Entity, Weak entity, Specialization and generalization, converting ER Model to relational tables.	
Tools Used	MySQL Workbench, Oracle Database, XAMPP, phpMyAdmin, Microsoft Visio, Draw.io, SQLite, PostgreSQL	
Activities	• **Objective:** To understand the fundamentals of DBMS, data models, database languages, schema architecture, and ER modeling concepts for designing relational databases. • Design an Entity Relationship (ER) diagram for a Library/Student Management System, identify strong and weak entities, apply specialization/generalization, convert the ER model into relational tables, and perform basic DDL and DML operations using SQL.	
Unit 2	**Relational Database Language and Interfaces: (6-0-12-6 = 24 hrs)**	
A	Relational data model concepts, Concept of keys, Mapping Constraints.	CO2, CO3
B	Null Values, Domain Constraints, Referential Integrity Constraints.	
C	Unary Relational Operations: SELECT and PROJECT Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, SQL.	
Tools Used	MySQL Workbench, Oracle Database, PostgreSQL, SQLite, Online GDB, Virtual Labs, Draw.io	

Activities	• **Objective:** To understand relational data model concepts, relational algebra operations, integrity constraints, and SQL queries for effective database design and data manipulation. • Create relational tables with primary and foreign keys, apply domain and referential integrity constraints, perform SELECT, PROJECT, JOIN, and DIVISION operations using SQL queries, and practice query execution using MySQL/PostgreSQL in a Linux environment or online compiler.	
Unit 3	**Normalization in Design of Databases: (8-0-16-6 = 30 hrs)**	
A	Functional Dependency, Different anomalies in designing a Database, loss less join decompositions.	CO1, CO3, CO4, CO6
B	Normalization: first second and third normal forms, Boyce-Codd normal form, dependency preservation.	
C	Multi-valued dependencies, fourth normal forms, Inclusion dependencies.	
Tools Used	MySQL Workbench, Oracle Database, PostgreSQL, SQLite, phpMyAdmin, Draw.io, Microsoft Visio, Lucidchart, DB Fiddle, Online GDB	
Activities	• **Objective:** To understand functional dependencies, normalization techniques, decomposition methods, and dependency preservation for designing efficient and anomaly-free relational databases. • Identify functional dependencies and different anomalies (insertion, deletion, updation) in given database tables. • Perform decomposition of relations and verify lossless join and dependency preservation properties. • Normalize database relations from 1NF to BCNF and 4NF using suitable examples. • Analyze multivalued dependencies and inclusion dependencies in relational schemas. • Implement normalized relational tables using SQL in MySQL/PostgreSQL.	
Unit 4	**Transaction Management: (6-0-12-6 = 24 hrs)**	
A	Transaction processing system, schedule and recoverability, Testing of serializability.	CO5
B	Serializability of schedules, conflict & view serializable schedule.	
C	Recovery from transaction failures, deadlock handling.	
Tools Used	MySQL Workbench, Oracle Database, PostgreSQL, SQLite, DB Fiddle, XAMPP, Linux, Virtual Lab, Online GDB, GitHub.	
Activities	**Objective:** To understand transaction processing concepts, serializability, recoverability, concurrency control, and deadlock handling mechanisms in DBMS. • Simulate transaction schedules and test for serializability using conflict and view serializability methods. • Analyze recoverable and non-recoverable schedules with suitable examples. • Perform concurrency control experiments using simultaneous transactions in SQL. • Implement transaction control commands such as COMMIT, ROLLBACK, and SAVEPOINT.	

	• Demonstrate deadlock situations and apply deadlock prevention and recovery techniques. • Study transaction failure scenarios and perform database recovery operations using logs/checkpoints.	
Unit 5	**Concurrency Control: (6-0-10-6 = 22 hrs)**	
A	Two-Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering.	CO5, CO6
B	Multi-version Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques.	
C	Granularity of Data Items and Multiple Granularity Locking.	
Tools Used	MySQL Workbench, Oracle Database, PostgreSQL, SQLite, DB Fiddle, Linux, Virtual Labs, GitHub, Online GDB, Draw.io	
Activities	• **Objective:** To understand various concurrency control techniques, locking protocols, timestamp ordering, multi-version concurrency control, and multiple granularity locking mechanisms in DBMS. • Simulate Two-Phase Locking (2PL) protocols for concurrent transactions. • Implement timestamp ordering protocols and analyze transaction execution order. • Perform experiments on optimistic concurrency control and validation techniques. • Demonstrate Multi-version Concurrency Control (MVCC) using database transactions. • Analyze lock granularity levels such as row-level, page-level, and table-level locking.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C			✓	✓		
4	2.A		✓	✓			
5	2.B			✓	✓		
6	2.C			✓	✓		
7	3.A			✓	✓		
8	3.B				✓	✓	
9	3.C				✓	✓	
10	4.A			✓	✓		
11	4.B				✓	✓	
12	4.C			✓		✓	
13	5.A			✓	✓		

14	5.B				✓	✓	
15	5.C				✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓					✓	✓					✓					
CO3			✓	✓				✓	✓						✓			
CO4			✓	✓					✓						✓			
CO5					✓				✓	✓								
CO6						✓				✓	✓						✓	
CO7		✓	✓					✓					✓	✓				
CO8			✓						✓	✓				✓	✓			
CO9			✓						✓					✓	✓			
CO10					✓	✓				✓	✓					✓	✓	

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to DBMS, Characteristics of DBMS, Advantages of DBMS	Unit 1	4
DD/MM/YY	Data Models, Database Languages, DBA and Database Users		
DD/MM/YY	Three Schema Architecture, Data Independence, Hierarchical & Network Models		
DD/MM/YY	ER Model, Strong & Weak Entity, Specialization, Generalization, ER to Relational Tables		
DD/MM/YY	Relational Data Model Concepts, Relational Schema and Instances	Unit 2	6
DD/MM/YY	Concept of Keys and Mapping Constraints		
DD/MM/YY	Null Values, Domain Constraints, Referential Integrity Constraints		
DD/MM/YY	Relational Algebra: SELECT and PROJECT Operations		
DD/MM/YY	Set Operations, JOIN and DIVISION Operations		
DD/MM/YY	Introduction to SQL and Basic SQL Queries		

DD/MM/YY	Functional Dependency and Types of Dependencies	**Unit 3**	**8**
DD/MM/YY	Database Anomalies and Lossless Join Decomposition		
DD/MM/YY	First Normal Form (1NF)		
DD/MM/YY	Second Normal Form (2NF)		
DD/MM/YY	Third Normal Form (3NF)		
DD/MM/YY	Boyce-Codd Normal Form (BCNF) and Dependency Preservation		
DD/MM/YY	Multivalued Dependencies and Fourth Normal Form (4NF)		
DD/MM/YY	Inclusion Dependencies and Normalization Case Studies		
DD/MM/YY	Transaction Processing System and Transaction States	**Unit 4**	**6**
DD/MM/YY	Schedules and Recoverability		
DD/MM/YY	Testing of Serializability		
DD/MM/YY	Conflict and View Serializable Schedules		
DD/MM/YY	Recovery from Transaction Failures		
DD/MM/YY	Deadlock Handling Techniques		
DD/MM/YY	Introduction to Concurrency Control and Two-Phase Locking	**Unit 5**	**6**
DD/MM/YY	Timestamp Ordering Concurrency Control		
DD/MM/YY	Multi-version Concurrency Control Techniques		
DD/MM/YY	Validation (Optimistic) Concurrency Control		
DD/MM/YY	Granularity of Data Items		
DD/MM/YY	Multiple Granularity Locking and Case Studies		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (Understand and apply SQL commands). W13–W15 (teal rows): CO8 (Create and execute SQL queries), CO9 (Perform database operations), CO10 (Develop database-driven applications/projects). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Study and classification of SQL commands	**CO7**	3.0
	S-1.2	Identify and use different SQL data types	**CO7**	
W2	S-2.1	Create tables using different data types	**CO7**	3.0
	S-2.2	Demonstrate constraints with SQL data types	**CO7**	
W3	S-3.1	Write SQL statements using character and numeric data types	**CO8**	3.0
	S-3.2	Mini exercise on SQL syntax and database creation	**CO10**	
W4	S-4.1	Create tables using DDL commands	**CO7**	3.0
	S-4.2	Modify table structure using ALTER TABLE	**CO7**	
W5	S-5.1	Remove tables using DROP TABLE	**CO7**	3.0
	S-5.2	Apply PRIMARY KEY and FOREIGN KEY constraints	**CO8**	

W6	S-6.1	Create databases for Student/Employee Management System	**CO10**	3.0
	S-6.2	Implement NOT NULL, UNIQUE, and CHECK constraints	**CO8**	
W7	S-7.1	Insert records into tables using INSERT command	**CO8**	3.0
	S-7.2	Retrieve records using SELECT statement	**CO9**	
W8	S-8.1	Update records using UPDATE command	**CO9**	3.0
	S-8.2	Delete records using DELETE command	**CO9**	
W9	S-9.1	Use aggregate functions SUM, AVG, COUNT, MAX, MIN	**CO8**	3.0
	S-9.2	Develop queries for real-world database applications	**CO10**	
W10	S-10.1	Perform sorting using ORDER BY clause	**CO8**	3.0
	S-10.2	Group records using GROUP BY clause	**CO8**	
W11	S-11.1	Filter grouped records using HAVING clause	**CO8**	3.0
	S-11.2	Apply aggregate functions with grouping clauses	**CO8**	
W12	S-12.1	Generate summary reports using SQL queries	**CO10**	3.0
	S-12.2	Create SQL queries for data analysis and reporting	**CO10**	
W13	S-13.1	Execute simple and nested subqueries	**CO8**	3.0
	S-13.2	Implement INNER JOIN and OUTER JOIN queries	**CO8**	
W14	S-14.1	Perform SELF JOIN and CROSS JOIN operations	**CO8**	3.0
	S-14.2	Create and use SQL Views	**CO9**	
W15	S-15.1	Create database triggers for INSERT/UPDATE operations	**CO10**	3.0
	S-15.2	Mini project using Joins, Views, Subqueries, and Triggers	**CO10**	

ℹ *Instructions: Write and execute SQL queries using appropriate DBMS software. Perform database creation, table manipulation, data retrieval, and reporting operations with suitable examples and test cases. Lab record (aim, query/procedure, output, and result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Ability to remember and identify fundamental DBMS concepts, terminology, architectures, data models, and SQL commands.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Ability to explain database concepts, relational models, constraints, normalization, and transaction management logically.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Ability to apply SQL queries, normalization techniques, relational algebra, and database operations to solve problems.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Ability to analyze dependencies, transaction schedules, concurrency issues, and trace SQL/query execution logically.	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Ability to compare normalization forms, concurrency control methods, locking techniques, and justify suitable approaches.	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Ability to design complete database systems, ER models, relational schemas, and real-world database applications.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Program writing; program tracing — detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9

Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Ability to identify database problems, define objectives, requirements, constraints, and expected outcomes for SQL-based tasks.	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Ability to configure DBMS tools/software, create databases, tables, and prepare the environment for executing SQL operations.	CO7

CA3	**Code Implementation & Execution**	Ability to write, execute, and debug SQL queries, DDL, DML commands, joins, subqueries, views, and triggers correctly.	CO7
CA4	**Computational Efficiency & Optimization**	Ability to optimize SQL queries, reduce redundancy through normalization, and improve database performance and consistency.	CO7
CA5	**Output Analysis & Result Interpretation**	Ability to analyze query outputs, validate results, and interpret database reports and transaction outcomes logically.	CO8
CA6	**Documented Outcome with Verification**	Ability to document aim, procedure, SQL queries, outputs, results, and verify correctness using suitable test cases.	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Ability to design ER models, relational schemas, normalization strategies, and structured database solutions for applications.	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Ability to maintain systematic lab records and effectively explain SQL queries, concepts, and implementation during viva-voce.	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									M
CO2	M	H	M				M	M					M	M			M		M							M	M
CO3		M	H	M		M	H	M	H	M	H	M	H	M		M	M	H	H	H	M		M	M		H	M
CO4		M	H	H	M		M		H	H	H	M	M	M				M	M	M	M		H			H	M
CO5		M	M	H	H		M		M	M	H	M		M			M	M	M	M	H	M	H	M		M	H
CO6				M	M	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H	H	M	H	M
CO7		H	H				M	H	H		M	M	M	H			M		H	H	M					M	M
CO8		M	H	M			M	M	H	M	H	M	M	H				M	H	H	M		M			M	M
CO9			H	M			M	M	H	M	H	M		H				M	H	H	M		M			M	M
CO10			M	M	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H	H	M	H	H

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV
COMBINED MAPPINGS & REFERENCE
CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	–	–	–	–	2	–	–	–	–	–	3	3	–
CO2	2	–	–	–	3	2	–	–	2	–	–	3	3	–
CO3	3	3	3	–	3	2	–	–	–	–	–	2	3	–
CO4	3	3	3	3	–	2	–	2	3	–	–	–	–	3
CO5	2	3	2	–	2	2	–	2	–	–	–	–	3	–
CO6	3	3	3	3	3	3	–	3	3	–	–	–	–	3
CO7	3	–	–	–	2	–	–	–	–	–	2	3	3	2
CO8	–	3	3	3	2	–	–	–	3	–	2	2	3	3
CO9	–	2	2	2	2	–	–	–	3	–	2	2	2	3
CO10	–	2	2	2	3	–	–	–	3	–	3	3	2	3
Avg	2.7	2.7	2.5	2.6	2.5	2.1	-	2.3	2.8	-	2.2	2.5	2.7	2.8

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									M
CO2	H	M	M		M				M		M
CO3	H	H	H	M	H			M	M		M
CO4	H	H	M	H	M						M
CO5	H	H	M	H	M	M	M		M		M
CO6	H	H	H	H	H	M	M	H	H	H	H
CO7	M	M			H						M
CO8	M	H	M	M	H				M		M
CO9	M	H	M	M	H						M
CO10	H	H	H	H	H	M	M	H	H	H	H

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Theory of Computation (CSCR2115)

School of Engineering & Technology (SET) | B.Tech. CSE | Semester IV | Batch 2026-30

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE	**Batch:**	2026-30
Program:	B.Tech.	**Current Academic Year:**	2026-27
Branch:	CSE	**Semester:**	IV
Course Code:	CSCR2115	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	CSCR2115
2	**Course Title**	**Theory of Computation**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-1-0-4 (Theory: 30 hrs Classroom + 30 hrs Self Learning = 60 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. To develop a strong foundation in the principles of automata theory, formal languages, and computational models. 2. To enable students to design and analyze finite automata, pushdown automata, and Turing machines for computational problem solving. 3. To provide understanding of regular expressions, grammars, language representation, and their applications in computation. 4. To familiarize students with the concepts of computability, decidability, and complexity in the Theory of Computation.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Understand the fundamental concepts of automata theory, formal languages, and related computational models.

		CO2 (Apply – L2/L3): Design and construct DFA, NDFA, and perform conversion from NDFA to DFA for language recognition problems. CO3 (Apply – L3): Construct finite automata with and without output, and analyze their applications in computational systems. CO4 (Analyze – L3/L4): Implement regular expressions and grammars corresponding to finite automata and analyze their equivalence. CO5 (Apply – L3/L4): Design Pushdown Automata (PDA) from Context Free Languages (CFL) and grammars, and perform interconversion between them. CO6 (Analyze – L4/L5): Design Turing Machines for computational problems and develop an understanding of computability, decidability, and undecidability concepts.
8	**Course Description**	The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 30 hrs | Self Learning (SL): 30 hrs | Total: 60 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science(Automata, Languages and Computation)", PHI
12	**References**	1.Peter Linz, "Formal Languages and Auomata", Narosa Publishing House 2.Hopcroft, Ullman, "Introduction to Automata Theory, Language and Computation", Narosa Publishing House

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
Unit 1	**Finite Automata**	
A	Introduction to languages, Kleene closures, Finite Automata (FA), Transition graph, Nondeterministic finite Automata (NFA), Deterministic finite Automata (DFA).	CO1, CO2
B	Equivalence of NDFA and DFA, Construction of DFA from NFA and optimization of Finite Automata.	CO1, CO2
C	Applications and Limitation of FA. (FAT tool).	CO1, CO2
Unit 2	**Regular Expression and Finite Automata**	
A	Regular Expression, Finite Automata with null move, Regular Expression to Finite Automata.	CO1, CO2,CO4

B	Arden Theorem, Pumping Lemma for regular expressions.	CO1, CO2,CO4
C	FA with output: Moore machine, Mealy machine and Equivalence.	CO1, CO2,CO3
Unit 3	**REGULAR & CONTEXT FREE LANGUAGE**	
A	Defining grammar, Chomsky hierarchy of Languages and Grammar. Ambiguous to Unambiguous CFG.	CO3, CO4
B	Simplification of CFGs.	CO3, CO4
C	Normal forms for CFGs, Pumping lemma for CFLs.	CO3, CO4
Unit 4	**PUSH DOWN AUTOMATA**	
A	Description and definition of PDA and Non-Deterministic PDA, Working of PDA.	CO1, CO3, CO5
B	Acceptance of a string by PDA with final state and with Null store. Two stack PDA.	CO1, CO3, CO5
C	Conversion of PDA into CFG, Conversion of CFG into PDA.	CO1, CO3, CO5
Unit 5	**TURING MACHINE**	
A	Turing machines (TM): Basic model, definition and representation, Language acceptance by TM.	CO6, CO1
B	Turing machine as a computational machine, Halting problem of TM, Universal TM (Visual Turing machine).	CO6, CO1
C	Modifications in TM, Undecidability of Post correspondence problem, Church's Thesis, Godel Numbering.	CO6, CO1

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓				
4	2.A		✓	✓			✓
5	2.B		✓	✓		✓	
6	2.C			✓	✓		
7	3.A	✓	✓				
8	3.B			✓	✓		
9	3.C			✓	✓	✓	
10	4.A		✓				
11	4.B			✓	✓		
12	4.C			✓	✓	✓	✓

13	5.A		✓	✓			
14	5.B			✓	✓		
15	5.C		✓	✓	✓		✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for Output based FA and Regular Expressions in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓		✓														
CO2		✓	✓	✓														
CO3			✓	✓											✓			
CO4			✓	✓	✓				✓	✓					✓			
CO5				✓	✓			✓										
CO6		✓	✓	✓	✓				✓									

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 and CO4 (regular Expressions). Affective (A3) for CO4,CO5 and CO6 (valuing efficiency).

6. Lecture Plan Outline (Theory — 30 Lectures / 30 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Symbol, Alphabets, Strings	UNIT-1	4
DD/MM/YY	Introduction to languages, Kleene closures		
DD/MM/YY	Finite Automata (FA), Transition graph		
DD/MM/YY	Deterministic finite Automata (DFA)		
DD/MM/YY	Minimisation Of DFA		
DD/MM/YY	Nondeterministic finite Automata (NFA)		
DD/MM/YY	Equivalence of NDFA and DFA		
DD/MM/YY	Construction of DFA from NFA and optimization of Finite Automata		
DD/MM/YY	Regular Expression	UNIT-2	6
DD/MM/YY	Finite Automata with null move		

DD/MM/YY	Finite Automata		
DD/MM/YY	Regular Expression to Finite Automata.		
DD/MM/YY	Arden Theorem		
DD/MM/YY	Pumping Lemma for regular expressions.		
DD/MM/YY	FA with output: Moore machine		
DD/MM/YY	Mealy machine and Equivalence		
DD/MM/YY	Defining grammar	UNIT-3	8
DD/MM/YY	Chomsky hierarchy of Languages and Grammar.		
DD/MM/YY	Chomsky hierarchy		
DD/MM/YY	Ambiguous to Unambiguous CFG.		
DD/MM/YY	Simplification of CFGs.		
DD/MM/YY	Simplification		
DD/MM/YY	Normal forms for CFGs		
DD/MM/YY	Pumping lemma for CFLs.		
DD/MM/YY	Definition of PDA, Working of PDA.	UNIT-4	6
DD/MM/YY	Description of Non-Deterministic PDA		
DD/MM/YY	Acceptance of a string by PDA with final state and with Null store		
DD/MM/YY	Two stack PDA.		
DD/MM/YY	Conversion of PDA into CFG		
DD/MM/YY	Conversion of CFG into PDA.		
DD/MM/YY	Language acceptance by TM.	UNIT-5	6
DD/MM/YY	Turing machine as a computational machine		
DD/MM/YY	Halting problem of TM		
DD/MM/YY	Universal TM (Visual Turing machine).		
DD/MM/YY	Undecidability of Post correspondence problem		
DD/MM/YY	Church's Thesis		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
ID	**Dimension**	**What is Measured**	**CO / BTL**	**Assessment**
TS1	Conceptual Understanding of Automata & Formal Languages	Understand fundamental concepts of automata theory, formal languages, symbols, strings, alphabets, and language classifications; identify computational models for given problems	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Finite Automata Design & Interpretation	Design and analyze DFA and NDFA models; perform conversion from NDFA to DFA; interpret state transitions and language acceptance	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Automata Construction & Applications	Construct finite automata with and without outputs; apply automata concepts to pattern matching and computational applications	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	Regular Expressions & Grammar Analysis	Analyze and implement regular expressions and grammars corresponding to finite automata; evaluate equivalence among representations	CO4 | L3–L4	MTE Sec B | ETE Sec B
TS5	Pushdown Automata & Context Free Language Evaluation	Design Pushdown Automata (PDA) from Context Free Grammars (CFG) and CFLs; analyze parsing and stack-based computation mechanisms	CO5 | L3–L4	ETE Sec B/C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	**H**	**M**				
CO2	**M**	**H**	**M**			
CO3		**M**	**H**	**M**		
CO4			**M**	**H**	**M**	

CO5				**M**	**H**	**M**
CO6		**M**		**M**	**M**	**H**

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Introduction to automata, alphabets, strings, languages, and finite automata concepts	CO1	TS1	5h SL	Conceptual understanding + problem solving
Assignment 2	DFA and NDFA design, state transition diagrams, and NDFA to DFA conversion	CO2	TS2	5h SL	Automata construction + conversion accuracy
Assignment 3	Finite automata with output (Moore and Mealy Machines) and applications	CO2, CO3	TS2, TS3	5h SL	State machine implementation + analysis
Assignment 4	Regular expressions, regular grammars, and equivalence with finite automata	CO3, CO4	TS3, TS4	5h SL	Expression design + grammar conversion
Assignment 5	Context Free Grammar (CFG), Pushdown Automata (PDA), and CFL applications	CO4, CO5	TS4, TS5	5h SL	PDA design + grammar analysis
Assignment 6	Turing Machines, decidability, computability, and undecidable problems	CO5, CO6	TS5, TS6	5h SL	Computational analysis + TM design

Video Learning Report	Technical video on automata theory, CFG/PDA, or Turing Machines (minimum 3 hours); structured report + presentation	CO2, CO4	TS2, TS4	9h SL	Concept clarity, report quality, presentation
Case Study Report	Real-world applications of Theory of Computation such as compiler design, lexical analysis, pattern matching, NLP, and AI parsing	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, comparative analysis, application understanding

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	10	TS1 — Conceptual Understanding of Automata & Formal Languages TS2 — Finite Automata Design & Interpretation	CO1, CO2	Short-answer questions: define automata concepts, explain formal languages, identify DFA/NDFA properties, perform simple state transitions and conversions
Section B	15	TS3 — Automata Construction & Applications TS4 — Regular Expressions & Grammar Analysis	CO2, CO3, CO4	Problem-solving and analytical questions: construct automata, convert regular expressions and grammars, analyze automata equivalence, implement Moore/Mealy machines
TOTAL	25	TS1–TS4	CO1–CO4	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Conceptual Recall TS2 — Regular Expressions	**CO1, CO2**	Short questions (all units): definitions, regular expressions, PDA, TM
Section B	**25**	TS3 — Algorithmic Application TS4 — Performance Evaluation TS5 —Analysis	**CO3, CO4, CO5**	Medium questions: Converting reular expressions to PDA, Constructing PDA, Constructing Turing machines
Section C	**10**	TS5 —Psuhdown Automata TS6 — Turing Machine	**CO5, CO6**	Long/evaluation questions: Modifications of TM, Languages accepted by PDA and TM, Applications
TOTAL	**50**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Formulate the concept of Automata and related terminology.	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Design DFA and NDFA and conversion from NDFA to DFA.	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Construct finite automata without output and with output.	✓	✓	✓	TS3	PO1, PO2, PO3, PO4
CO4	Implement regular expression and grammar corresponding to DFA and vice-versa	✓	✓	✓	TS4	PO9, PO10, PO11
CO5	Design Push down Automata from Context Free Language or Grammar and vice-versa .	✓	—	✓	TS5	PO1, PO2, PO8, PO9, PO10
CO6	Design Turing Machine for computational problems,Develop a clear understanding of un-decidability.	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III
COMBINED MAPPINGS & REFERENCE
CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	–	–	–	2	3	2	2	2	2	2	2
CO2	3	2	3	3	–	–	–	2	2	2	2	2	2	2	3
CO3	3	3	3	3	–	–	–	3	2	2	3	2	3	2	2
CO4	2	3	2	2	2	–	–	2	3	3	2	2	3	2	2
CO5	2	2	3	–	–	–	–	3	3	2	2	–	3	–	–
CO6	3	2	-	–	-	–	–	–	–	2	3	–	3	3	–
Avg	**2.67**	**2.50**	**2.80**	**2.75**	**1.00**	**–**	**–**	**2.40**	**2.60**	**2.14**	**2.33**	**2.00**	**2.66**	**2.20**	**2.25**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H				M	H	M	M	M	M	M	M
CO2	H	M	H	H				M	M	M	M	M	M	M	H
CO3	H	H	H	H				H	M	M	H	M	H	M	M
CO4	M	H	M	M	M			M	H	H	M	M	H	M	M
CO5	M	M	H					H	H	M	M		H		
CO6	H	M								M	H		H	H	

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Numerical Assignment Writing (5 assignments,**	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on the assignment submitted; correctness, steps shown, comparison of algorithm performance

	problem-based, one per unit focus area)			
2	**Technical Video-Based Learning related to the subject (e.g., PDA, TM)**	Video viewing: 3 hrs Report preparation: 3 hrs Presentation: 3 hrs Total = 9 hrs	CO2, CO3 TS2, TS3	Report + Presentation based on video learning outcomes; must capture key concepts, algorithms, and personal reflections
3	**Real-World Case Studies (e.g., Regular Expressions and PDA)**	Data collection/study: 4 hrs Report preparation: 2 hrs Total = 6 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on in-depth study, technical depth, data collected, fact finding, and analytical conclusions drawn
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

------- — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

COURSE PLAN

Introduction to Cloud Computing (CSCR2117)

Sharda School of Computing Science and Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026–2029

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE — Sharda School of Computing Science and Engineering	**Batch:**	2026–2029
Program:	B. Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV
Course Code:	CSCR2117	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCR2117**
2	**Course Title**	**Introduction to Cloud Computing**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. To provide fundamental knowledge of cloud computing concepts, architectures, deployment models, and service models used in modern computing environments. 2. To develop understanding of virtualization, cloud infrastructure, storage, networking, and resource management techniques used in cloud platforms. 3. To enable students to explore and use major cloud services and platforms for deploying, managing, and securing cloud-based applications and data. 4. To familiarize students with real-world cloud computing applications, security challenges, emerging trends, and industry practices in distributed and scalable computing systems.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:**

		CO1 (Understand – L1/L2): Understand the fundamental concepts of cloud computing, including cloud architecture, characteristics, deployment models, and service models. **CO2 (Explore – L2/L3):** Explore virtualization technologies, cloud infrastructure components, storage systems, networking concepts, and resource provisioning mechanisms in cloud environments. **CO3 (Apply – L3):** Apply cloud computing platforms and services for deploying, managing, and accessing cloud-based applications and resources. **CO4 (Analyze – L4):** Analyze cloud security, privacy, reliability, and performance issues along with mechanisms used for securing cloud environments. **CO5 (Analyze – L4/L5):** Evaluate different cloud service providers, cloud platforms, and distributed computing solutions based on scalability, cost, efficiency, and usability. **CO6 (Create/Analyze – L5/L6):** Design and propose cloud-based solutions for real-world applications using modern cloud technologies, tools, and emerging trends.
8	**Course Description**	The course Introduction to Cloud Computing introduces students to the fundamentals of cloud computing, including cloud architecture, deployment and service models, virtualization, storage, networking, and cloud platforms. It also covers cloud security, resource management, and emerging cloud technologies to help students understand and apply cloud-based solutions for real-world applications.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Mastering Cloud Computing: Foundations and Applications Programming - 2nd Edition by Rajkumar Buyya Ph.D. (Author), Christian Vecchiola Ph.D. (Author), S.Thamarai Selvi Ph.D. (Author), Shivananda Poojara MSc (Author), Satish Narayana Srirama Ph.D. (Author) Publisher : Morgan Kaufmann, Publication date : March 27, 2026, Edition : 2nd, ISBN-10 : 0443404356, ISBN-13 : 978-0443404351
12	**References**	1. Introduction to Cloud Computing, by Michael Wufka (Author), Massimo Canonico (Author), Publisher : Springer, Publication date : January 31, 2026, ISBN-10 : 303207150X 2. Cloud Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing Book 81) 1st Edition by Rajkumar Buyya (Editor), James Broberg (Editor), Andrzej M. Goscinski (Editor), ASIN : B0052O7CR8, Publisher : Wiley, Edition : 1st, ISBN-13 : 978-1118124536 3. Cloud Computing, A Practical Approach 1st Edition, by Toby Velte (Author), Anthony Velte (Author), Robert C. Elsenpeter (Author) Publisher : McGraw Hill, Publication date : October 13, 2009, Edition : 1st, , ISBN-10 : 0071626948, ISBN-13 : 978-0071626941 4. Mastering AWS Cloud: Cloud adoption using the AWS cloud computing ecosystem (English Edition) by Paulo H. Leocadio (Author) Publisher : BPB Publications, Publication date : October 28, 2025, ISBN-10 : 9365890616

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
	Unit 1: Foundations of Cloud Computing	
A	**Introduction to Computing and Cloud Fundamentals —**	**CO1**

	Evolution of Computing, Types of Computing, Client-Server Computing, Distributed and Grid Computing, Utility Computing, Three-Tier Architecture, Characteristics and Benefits of Cloud Computing, Roots and Evolution of Cloud Computing.	
B	**Cloud Architecture and Service Models —** Cloud Computing Architecture, Layers of Cloud Computing, Deployment Models (Public, Private, Hybrid, Community), Service Models (IaaS, PaaS, SaaS), Web Services, Web Sockets, Message Queues and Message Brokers, Desired Features of Cloud Computing.	**CO1. CO2**
C	**Cloud Applications, Migration and Challenges —** Applications of Cloud Computing, Cloud Infrastructure Management, Approaches to Cloud Migration, Seven-Step Migration Model, Cloud Integration Concepts, SaaS Evolution and Challenges, Risks, Limitations, and Overview of Leading Cloud Service Providers.	**CO1, CO5**
	Unit 2: Virtualization and Cloud Infrastructure	
A	**Virtualization and Virtual Machines —** Virtualization Concepts, Hypervisors, Virtual Machines, Anatomy of Cloud Infrastructure, VM Provisioning and Deployment, Virtual Machine Migration Services, Containerization Basics.	**CO2**
B	**Cloud Infrastructure Components and Resource Management —** Cloud Infrastructure Components: Compute, Storage, Networking, Resource Pooling, Distributed Virtual Infrastructure Management, Scheduling Techniques, Resource Allocation, Provisioning and Scalability.	**CO2, CO3**
C	**Data Centers, Storage and Cluster Services —** Data Centers and Distributed Computing, Load Balancing Techniques, Cluster as a Service (CaaS), Cloud Storage Architecture, Distributed Data Storage, Data Availability and Replication, Secure Data Storage Technologies.	**CO3, CO5**
	Unit 3: Cloud Platforms and Services	
A	**Cloud Platforms and Technologies —** Introduction to AWS, Microsoft Azure, and Google Cloud Platform, Technologies and Tools for Cloud Computing, Aneka Cloud Platform, Comet Cloud Architecture and Applications.	**CO3**
B	**Cloud Services and Workflow Management —** Cloud Storage Services, Database Services, Networking and Content Delivery Services, Cloud-Based Enterprise Solutions, Workflow Management Systems, Cloud Service Orchestration and Dynamic ICT Services.	**CO3, CO5**
C	**Deployment and Scientific Applications in Cloud —** Deployment and Management of Cloud-Based Applications and Services, Scientific Applications in Cloud Environments, MapReduce Programming Model, Big Data Processing Concepts, Research Challenges and Emerging Trends in Cloud Applications.	**CO3, CO6**
	Unit 4: Cloud Security, Monitoring and Governance	
A	**Cloud Security and Identity Management —** Cloud Security Concepts, Threats and Vulnerabilities, Identity and Access Management, Security in Federated Clouds, Organizational Readiness and Risk Management in Cloud Adoption.	**CO4**
B	**Data Protection and SLA Management —** Data Security and Privacy Protection, Backup and Disaster Recovery Techniques, Service Level Agreements (SLAs), SLA Lifecycle and Types, Policy-Based Cloud Service Management, Legal and Compliance Issues in Cloud Computing.	**CO4, CO5**
C	**Performance Monitoring and Resource Optimization —**	**CO4, CO5**

	Performance Monitoring Techniques, Resource Scheduling and Optimization, Cost Management in Cloud, High Performance Computing (HPC) in Clouds, Content Delivery Networks (CDN), Resource Utilization and Performance Prediction.	
	Unit 5: Emerging Trends and Real-World Cloud Applications	
A	**Modern Cloud Computing Paradigms — (CO5)** Edge Computing, Fog Computing, Serverless Computing, Microservices, Container-Based Services, Cloud-Native Applications.	**CO5**
B	**Intelligent and Data-Driven Cloud Services —** Internet of Things (IoT), Big Data Analytics, Artificial Intelligence and Machine Learning Services in Cloud, Cloud-Based Data Processing and Smart Applications.	**CO5, CO6**
C	**Industry Applications and Future Directions — (CO6)** Case Studies of Real-World Cloud Applications, Enterprise Cloud Solutions, Cloud Governance Practices, Future Trends in Cloud Computing, Sustainable and Green Cloud Computing.	**CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓	✓			
4	2.A		✓	✓			
5	2.B		✓	✓	✓		
6	2.C			✓	✓	✓	
7	3.A	✓	✓	✓			
8	3.B			✓	✓	✓	
9	3.C			✓	✓	✓	✓
10	4.A		✓	✓			
11	4.B			✓	✓	✓	
12	4.C			✓	✓	✓	✓
13	5.A		✓	✓			
14	5.B			✓	✓	✓	
15	5.C		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓										✓	✓				
CO3			✓	✓										✓	✓			
CO4			✓	✓	✓				✓									
CO5				✓	✓				✓	✓								
CO6		✓	✓	✓	✓	✓			✓	✓				✓	✓			

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 30 Lectures / 30 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Evolution of Computing, Types of Computing, Client-Server and Distributed Computing	Unit 1	9
DD/MM/YY	Grid Computing, Utility Computing and Three-Tier Architecture		
DD/MM/YY	Introduction to Cloud Computing, Characteristics and Benefits of Cloud		
DD/MM/YY	Roots and Evolution of Cloud Computing		
DD/MM/YY	Cloud Architecture and Layers of Cloud Computing		
DD/MM/YY	Deployment Models: Public, Private, Hybrid and Community Clouds		
DD/MM/YY	Service Models: IaaS, PaaS and SaaS		
DD/MM/YY	Web Services, Web Sockets, Message Queues and Brokers		
DD/MM/YY	Cloud Applications, Migration Approaches, Challenges and Risks		
DD/MM/YY	Introduction to Virtualization and Hypervisors	Unit 2	9
DD/MM/YY	Virtual Machines and Anatomy of Cloud Infrastructure		
DD/MM/YY	VM Provisioning and Virtual Machine Migration Services		
DD/MM/YY	Containerization Concepts and Basics of Docker		
DD/MM/YY	Cloud Infrastructure Components: Compute and Storage		
DD/MM/YY	Networking, Resource Pooling and Resource Provisioning		
DD/MM/YY	Scheduling Techniques and Scalability in Cloud		
DD/MM/YY	Data Centers, Distributed Computing and Load Balancing		
DD/MM/YY	Cloud Storage Architecture and Secure Distributed Storage		
DD/MM/YY	Introduction to AWS, Azure and Google Cloud Platform		
DD/MM/YY	AWS Services: EC2, IAM, S3, EBS and CloudWatch		

DD/MM/YY	AWS Lambda, VPC and CloudFront CDN	**Unit 3**	**9**
DD/MM/YY	Microsoft Azure: Azure VM, Azure SQL Database and Azure AD		
DD/MM/YY	Azure Backup, Storage and Monitoring Services		
DD/MM/YY	Google Cloud: Compute Engine and Cloud Storage		
DD/MM/YY	Google Cloud Functions, Load Balancing and Migration Services		
DD/MM/YY	Cloud-Based Enterprise Solutions and Workflow Management Systems		
DD/MM/YY	Deployment and Management of Cloud-Based Applications		
DD/MM/YY	Cloud Security Concepts, Threats and Vulnerabilities	**Unit 4**	**9**
DD/MM/YY	Identity and Access Management in Cloud		
DD/MM/YY	Data Security and Privacy Protection Techniques		
DD/MM/YY	Backup, Disaster Recovery and Business Continuity		
DD/MM/YY	Service Level Agreements (SLAs) and SLA Lifecycle		
DD/MM/YY	Federated Cloud Security and Policy-Based Management		
DD/MM/YY	Performance Monitoring and Resource Optimization		
DD/MM/YY	High Performance Computing (HPC) and Content Delivery Networks		
DD/MM/YY	Legal, Compliance and Governance Issues in Cloud Computing		
DD/MM/YY	Edge Computing and Fog Computing	**Unit 5**	**9**
DD/MM/YY	Serverless Computing and Microservices Architecture		
DD/MM/YY	Container-Based and Cloud-Native Applications		
DD/MM/YY	Internet of Things (IoT) in Cloud Environments		
DD/MM/YY	Big Data Analytics in Cloud Computing		
DD/MM/YY	Artificial Intelligence and Machine Learning Services in Cloud		
DD/MM/YY	Scientific and Data-Intensive Applications in Cloud		
DD/MM/YY	Case Studies of Enterprise Cloud Solutions		
DD/MM/YY	Future Trends in Cloud Computing and Green Cloud Computing		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Conceptual Understanding of Cloud Computing Foundations	Recall and understand fundamental cloud computing concepts, computing paradigms, cloud characteristics, deployment models, service models, and cloud architecture components	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Virtualization and Infrastructure Interpretation	Explain virtualization concepts, VM provisioning, cloud infrastructure components, resource pooling, scalability, and distributed cloud environments; interpret infrastructure-related operations and cloud resource management	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Cloud Platform Usage and Service Application	Apply cloud platforms and services including AWS, Azure, and GCP for storage, deployment, networking, monitoring, and application hosting scenarios; analyze workflow and cloud service utilization	CO3 | L3-L4	CA | MTE Sec B | ETE Sec B
TS4	Cloud Security and Governance Analysis	Analyze cloud security threats, identity management, privacy protection, SLA management, governance frameworks, and disaster recovery techniques; evaluate cloud security practices and policies	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	Performance, Scalability and Resource Evaluation	Evaluate cloud performance metrics, resource scheduling, scalability, load balancing, HPC environments, and cost optimization techniques; compare alternative cloud management strategies	CO5 | L4–L5	ETE Sec B/C
TS6	Emerging Cloud Technologies and Solution Design	Analyze and propose cloud-based solutions using emerging technologies such as edge computing, serverless computing, IoT, AI/ML cloud services, and cloud-native applications for real-world case studies	CO6 | L3–L6	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Understanding of Cloud Foundations	TS2 Virtualization & Infrastructure Interpretation	TS3 Cloud Platform Usage & Service Application	TS4 Cloud Security & Governance Analysis	TS5 Performance, Scalability & Resource Evaluation	TS6 Emerging Technologies & Solution Design

CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5			M	M	H	
CO6			M		M	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 concepts: Computing paradigms, cloud fundamentals, cloud architecture, deployment and service models	CO1	TS1	5h SL	Conceptual understanding, report submission, comparative analysis of cloud models
Assignment 2	Virtualization concepts, VM provisioning, cloud infrastructure components, resource pooling and scalability	CO2	TS2	5h SL	Concept explanation, architecture diagrams, infrastructure interpretation
Assignment 3	Cloud platforms and services: AWS, Azure, GCP services, storage, deployment and monitoring	CO2, CO3	TS2, TS3	5h SL	Service identification, deployment workflow analysis, platform comparison
Assignment 4	Cloud security, IAM, SLA management, backup and disaster recovery techniques	CO3, CO4	TS3, TS4	5h SL	Security analysis, SLA interpretation, case-based evaluation
Assignment 5	Performance optimization, load balancing, scalability, edge computing, serverless and cloud-native applications	CO4, CO5, CO6	TS4, TS5, TS6	5h SL	Analytical comparison, performance evaluation, emerging technology analysis

Video Learning Report	Technical video learning on AWS/Azure/GCP, virtualization, cloud security or serverless computing (minimum 3 hrs) with structured report and presentation	CO2, CO3, CO5	TS2, TS3, TS5	9h SL	Learning outcomes, concept interpretation, presentation quality, self-reflection
Case Study Report	Real-world cloud case study (e.g., Netflix on AWS, Google Cloud AI services, Microsoft Azure enterprise solutions, cloud migration strategies) with detailed analysis report	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, fact finding, comparative evaluation, innovation and analytical discussion

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Conceptual Understanding of Cloud Foundations TS2 — Virtualization & Infrastructure Interpretation	**CO1, CO2**	Short-answer questions: define cloud computing concepts, explain deployment and service models, describe virtualization and VM concepts, identify cloud infrastructure components, explain migration approaches and cloud characteristics
Section B	**15**	TS3 — Cloud Platform Usage & Service Application TS4 — Cloud Security & Governance Analysis	**CO2, CO3, CO4**	Application and analytical questions: compare cloud platforms and services, analyze virtualization and provisioning scenarios, evaluate security threats and SLA models, interpret cloud deployment cases and resource management strategies
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 are assessed primarily in ETE.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Conceptual Understanding of Cloud Foundations TS2 — Virtualization & Infrastructure Interpretation	CO1, CO2	Short-answer questions from all units: definitions of cloud concepts, deployment and service models, virtualization concepts, cloud architecture, infrastructure components, migration approaches, and emerging cloud paradigms
Section B	**25**	TS3 — Cloud Platform Usage & Service Application TS4 — Cloud Security & Governance	CO3, CO4, CO5	Medium-answer analytical and application-based questions: cloud platform comparisons, SLA and security analysis, virtualization and

		Analysis TS5 — Performance, Scalability & Resource Evaluation		provisioning scenarios, performance optimization, load balancing, scalability evaluation, cloud resource management and governance
Section C	**10**	TS5 — Performance, Scalability & Resource Evaluation TS6 — Emerging Technologies & Solution Design	CO5, CO6	Long-answer and case-study questions: edge/fog/serverless computing analysis, IoT and AI/ML cloud applications, enterprise cloud case studies, cloud-native solution design, future trends, and comparative evaluation of modern cloud technologies
TOTAL	**50**	TS1–TS6 (All)	CO1–CO6	Comprehensive assessment covering all units and all course outcomes.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand cloud computing fundamentals, architectures, deployment and service models	✓	✓	✓	TS1	PO1, PO2
CO2	Explore virtualization, cloud infrastructure, resource provisioning and scalability concepts	✓	✓	✓	TS2	PO1, PO2, PO3
CO3	Apply cloud platforms and services for deployment, storage, networking and application management	✓	✓	✓	TS3	PO1, PO3, PO5
CO4	Analyze cloud security, governance, SLA management and data protection mechanisms	✓	✓	✓	TS4	PO2, PO8, PO9
CO5	Evaluate cloud performance, scalability, resource optimization and emerging cloud paradigms	✓	—	✓	TS5	PO2, PO4, PO9, PO10
CO6	Design and analyze cloud-based solutions using modern and emerging cloud technologies	✓	—	✓	TS6	PO3, PO4, PO5, PO11

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	–	–	1	1	1	1	2	3	2	1
CO2	3	3	3	2	2	–	–	1	1	1	1	2	3	3	2
CO3	3	3	3	3	3	–	–	1	1	2	2	2	3	3	2
CO4	2	3	2	3	2	–	–	3	3	2	2	1	2	2	2
CO5	2	3	2	3	2	–	1	3	3	2	2	2	2	2	3
CO6	3	3	3	3	3	–	1	2	2	3	3	2	3	3	3
Avg	2.67	3	2.5	2.67	2.17	–	1	1.83	1.83	1.83	1.83	1.83	2.67	2.5	2.17

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H				M	M	M	M	M	H	M	M
CO2	H	H	M	M				M	M	M	M	M	H	M	M
CO3	H	H	H	M	M			M	M	M	M	M	H	H	M
CO4	H	H	H	H	H			M	M	M	H	M	H	H	M
CO5	M	H	M	H	M			H	H	M	M	M	M	M	M
CO6	M	H	M	H	M		M	H	H	M	M	M	M	M	H

H = High / Primary alignment | M = Medium / Secondary alignment | Blank = No direct alignment

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Assignment Writing and Cloud Platform Exploration (5 assignments covering cloud fundamentals, virtualization, cloud services, security, scalability, and emerging technologies)**	5 Assignments × 5 hrs each Total = 25 hrs	CO1–CO5 TS1–TS5	Evaluated based on conceptual understanding, analytical interpretation, comparison of cloud services/technologies, architecture diagrams, case analysis, and report quality
2	**Technical Video-Based Learning related to Cloud**	Video Learning: 3 hrs Report Preparation: 3	CO2, CO3, CO5 TS2, TS3, TS5	Evaluation based on learning outcomes, cloud concepts understood, technical

	Computing (AWS/Azure/GCP services, virtualization, cloud security, serverless computing, cloud-native applications)	hrs Presentation: 3 hrs Total = 9 hrs		explanation, platform interpretation, presentation quality, and reflective analysis
3	**Real-World Cloud Case Study (e.g., Netflix on AWS, Microsoft Azure enterprise solutions, Google Cloud AI services, cloud migration strategies, IoT cloud applications)**	Data Collection / Study: 4 hrs Report Preparation: 2 hrs Total = 6 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, case analysis, data collection, comparative evaluation, innovation, findings, and analytical conclusions
	TOTAL Self-Learning Hours	**45 Hours**	**CO1–CO6**	**All activities are compulsory. Submission timelines and presentation schedules will be communicated at the beginning of the semester.**

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (45 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

------- — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

COURSE PLAN

Software Engineering and Testing Methodologies (CSCR2315)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester V | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR2315
2	**Course Title**	**Software Engineering and Testing Methodologies (SE&TM)**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-2
5	**Course Status**	Core
6	**Course Objective**	The objective of this course is 1. To provide fundamental knowledge of software engineering 2. To create awareness among the students about the best practices in software engineering 3. Inculcate ability in students to work as an effective member or leader of software development teams 4. To help students to develop skills that will enable them to develop reliable, high-quality software
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Recall the fundamental concepts of software engineering process, Illustrate and compare popular development lifecycle model CO2 (Understand – L2): Understand the significance of requirement analysis in the software engineering process and develop SRS for a project. CO3 (Apply – L3): Apply design concepts and strategies to construct design documents with the help of software design tools CO4 (Analyze – L4): Analyze different testing strategies suitable for software systems CO5 (Evaluate – L5): Evaluate different strategies to develop and deliver reliable and good quality software as an individual or as part of a multidisciplinary team. CO6 (Create – L6): Create software systems by adapting modern techniques and tools necessary for developing and maintaining quality software.

		LAB COs — Assessed via Laboratory Assessment only: CO7 (Apply – L3): Apply Unified Modeling Language (UML) diagrams for developing real-world software systems. CO8 (Create – L5/L6): Create design documents for representing the static and dynamic behavior of software systems. CO9 (Apply – L2/L3): Apply different software testing strategies and demonstrate software testing on real-word problems. CO10 (Apply – L3): Apply and illustrate different software testing methodologies using modern software testing tools.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self-Learning (SL: 30 hrs)**	1. Case studies on at least three real-world software design problems in Bespoke, Commercial Off-The-Shelf (COTS), and Software as a Service (SaaS)categories and preparation of SRS and appropriate UML diagrams for each of these projects. 2. Case studies on software testing using test case preparation, usage of modern testing tools and IDEs.
11	**References**	Textbook: 1. Pressman R S, Software Engineering: A Practitioners Approach, McGraw Hill. Reference: 1. Datta S, Software Engineering: Concepts and Applications, Oxford University Press, 2010. 2. K.K. Aggrawal and Yogesh Singh, "Software Engineering", New Age International Publication 3. Sommerville, Ian. "Software Engineering", Pearson (Latest Ed). 4. Jalote, Pankaj. 1991. An Integrated Approach to Software Engineering. New Delhi: Narosa Publishing House.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction to Software Engineering and Process Models (6-0-6-6 = 18 hrs)**	
A	Significance challenges and myths in software engineering, Software characteristics	CO1, CO2, CO3
B	Software Development Life Cycle (SDLC) Models: Waterfall model, Prototyping model, Incremental model, Spiral model, V model	
C	Agility, Agile Process Models: Extreme Programming (XP), Adaptive Software Development (ASD), Scrum	
Tools Used	Lucidchart: A highly collaborative, web-based tool with drag-and-drop shapes, real-time editing, and automatic sequence diagram markup. Visual Paradigm: A comprehensive, professional suite ideal for enterprise systems and rigorous UML 2.x modeling.	

Activities	**Objective:** To familiarize students with basics of software engineering, usage of tools for visual representation of software systems
	• Study of different software lifecycle models, comparison, advantages and disadvantages, selection of appropriate models for software development
	  ○ Working with different utilities in Lucidchart
	  ○ Preparation of block diagrams, flowcharts etc.
	  ○ Understanding functionalities and familiarization of Visual paradigm tool.
	• Familiarization of software project management tools such as JIRA for creating flexible workflows
	• Familiarization of version control and code review tools such as GitHut	

Unit 2	**Software Requirement Engineering (8-0-10-6 = 24 hrs)**	
A	Requirement Engineering process, Requirement Elicitation techniques	CO3, CO4
B	Types of Requirements, Feasibility study	
C	Requirement Documentation: Characteristics of SRS, Document SRS according to IEEE standards	
Tools Used	Tools like Google Forms, Typeform, or SurveyMonkey enable the creation of online surveys and forms. Document management tools (e.g., Confluence, SharePoint) help organize and store project documentation.	
Activities	**Objective:** To understand the significance of requirement analysis in software system design. • Prepare a detailed software requirement specification (SRS) document for the development of a software system. • Demonstrate the effectiveness of a good SRS in developing a high-quality software system	
Unit 3	**Software Design (8-0-10-6 = 24 hrs)**	
A	Design Concepts, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design strategies, Software cost estimation	CO2, CO3, CO4, CO5, CO6
B	Effective modular design concepts: Cohesion, Coupling	
C	UML Diagrams and Tools: Introduction to UML Diagrams, Use Case, Sequence, State chart, Object, Class, and deployment diagrams	
Tools Used	Visual Paradigm: A comprehensive, professional suite ideal for enterprise systems and rigorous UML 2.x modeling. Diagrams.net: A completely free, open-source diagramming tool that saves directly to cloud storage like Google Drive.	
Activities	**Objective:** To apply design concepts and strategies to construct design documents and blueprints for effective visualization of the static and dynamic behaviors of the proposed software system. • Draw use case diagram for a proposed software system using an appropriate UML tool such as Visual Paradigm. Identify the use cases, actors involved in the system. • Draw sequence diagrams for different scenarios in your system that reflects the functionality of the proposed system. • Draw activity (state chart) diagrams for different scenarios to describe the dynamic behavior of the proposed system • Draw Class diagrams to represent the static behavior of the proposed software system. • Draw object diagram that provides a "snapshot" of a system at a specific moment in time. • Draw deployment diagrams that model the physical deployment of the proposed software system.	
Unit 4	**Software Implementation and Testing (8-0-6-6 = 20 hrs)**	
A	Fundamentals of testing: Objectives, principles, myths and facts, limitations of testing	CO3, CO4, CO5
B	Levels of testing, Acceptance Testing and its types, Integration techniques	
C	White Box Testing, Black Box Testing, Verification and Validation, Test case designing, Debugging	
Tools Used	Unit testing tools such as Junit with Eclipse IDE/ Apache Maven dependency management tool	

	Integration testing tools such as Selenium/Katalon Studio/ Testsigma	
Activities	**Objective:** To apply different software testing strategies and demonstrate software testing on real-word problems. • Perform unit testing with suitable illustrative examples (such as calculator program, string matching etc.) using Junit testing framework. • Perform integration testing with suitable illustrative examples (such as calculator program) using Junit testing framework. • Perform boundary value analysis with illustrative examples such as finding roots of quadratic equations. • Design test cases for inventory management system based on system specifications. • Design test cases for login module of ecommerce web site such as Flipkart/Amazon	
Unit 5	**Maintenance & Quality Management (8-0-10-6 = 24 hrs)**	
A	Introduction to Maintenance, Need for Maintenance, Categories of Maintenance, Cost of Maintenance, Software Configuration Management	CO2, CO3, CO4, CO5, CO6
B	Quality Concepts: Quality, Quality Control, Cost of Quality, Software Quality Assurance, SQA Plan	
C	Statistical Software Quality Assurance: Six Sigma, The ISO 9000 Quality Standards, Capability Maturity Model	
Tools Used	Eclipse IDE/ Apache Maven dependency management tool Integration testing tools such as Selenium/Katalon Studio/ Testsigma	
Activities	**Objective:** to apply different software testing strategies and demonstrate software testing on real-word problems and illustrate different software testing methodologies using modern software testing tools. • Implement quality assurance validation for an online ecommerce web site such as Amazon • Implement quality assurance validation for login module of an email client such as Gmail. • Implement test cases for validating user feedback for a website using an open-source test automation platform such as Testsigma **Value Added Experiments:** • Case study using project tracking tool JIRA for quality assurance • Case study using software test automation tool selenium. Implementation of binding heterogeneous/composite information for a single entity using structure.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	

9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	
CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory - 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Software Engineering	Unit 1	
DD/MM/YY	Significance, Challenges and Myths in Software Engineering	Unit 1	
DD/MM/YY	Characteristics of Software	Unit 1	12
DD/MM/YY	SDLC Overview and Waterfall Model	Unit 1	
DD/MM/YY	Prototyping Model	Unit 1	

DD/MM/YY	Incremental Model	Unit 1	
DD/MM/YY	Spiral Model	Unit 1	
DD/MM/YY	V-Model and Comparative Analysis of SDLC Models	Unit 1	
DD/MM/YY	Introduction to Agility and Agile Manifesto	Unit 1	
DD/MM/YY	Extreme Programming (XP)	Unit 1	
DD/MM/YY	Adaptive Software Development (ASD)	Unit 1	
DD/MM/YY	Scrum Framework and Agile Practices	Unit 1	
DD/MM/YY	Requirement Engineering Process	Unit 2	
DD/MM/YY	Requirement Gathering and Elicitation Techniques	Unit 2	
DD/MM/YY	Functional and Non-Functional Requirements	Unit 2	
DD/MM/YY	Feasibility Study and Analysis	Unit 2	7
DD/MM/YY	Requirement Documentation Techniques	Unit 2	
DD/MM/YY	Characteristics of Good SRS	Unit 2	
DD/MM/YY	IEEE Standards for SRS Documentation	Unit 2	
DD/MM/YY	Introduction to Software Design Concepts	Unit 3	
DD/MM/YY	Function-Oriented Design Strategy	Unit 3	
DD/MM/YY	Object-Oriented Design Strategy	Unit 3	
DD/MM/YY	Top-Down and Bottom-Up Design Approaches	Unit 3	
DD/MM/YY	Software Cost Estimation Techniques	Unit 3	
DD/MM/YY	Cohesion in Modular Design	Unit 3	
DD/MM/YY	Coupling in Modular Design	Unit 3	13
DD/MM/YY	Introduction to UML Diagrams	Unit 3	
DD/MM/YY	Use Case Diagram	Unit 3	
DD/MM/YY	Sequence Diagram	Unit 3	
DD/MM/YY	State Chart and Activity Diagrams	Unit 3	
DD/MM/YY	Class Diagram	Unit 3	
DD/MM/YY	Object Diagram and Deployment Diagram	Unit 3	

DD/MM/YY	Fundamentals of Software Testing	Unit 4	9
DD/MM/YY	Objectives and Principles of Testing	Unit 4	
DD/MM/YY	Myths, Facts and Limitations of Testing	Unit 4	
DD/MM/YY	Levels of Testing	Unit 4	
DD/MM/YY	Acceptance Testing and Integration Techniques	Unit 4	
DD/MM/YY	White Box Testing Techniques	Unit 4	
DD/MM/YY	Black Box Testing Techniques	Unit 4	
DD/MM/YY	Verification and Validation	Unit 4	
DD/MM/YY	Test Case Design and Debugging	Unit 4	
DD/MM/YY	Introduction to Software Maintenance	Unit 5	4
DD/MM/YY	Categories and Cost of Maintenance	Unit 5	
DD/MM/YY	Software Quality Assurance and SQA Plan	Unit 5	
DD/MM/YY	Six Sigma, ISO 9000 and Capability Maturity Model (CMM)	Unit 5	

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Introduction to Lucidchart and Visual Paradigm	**CO7**	3.0
	S-1.2	Flowcharts and Block Diagram Preparation	**CO7**	
W2	S-2.1	SDLC Model Comparison and Case Study Analysis	**CO7**	3.0
	S-2.2	Introduction to JIRA and Workflow Management	**CO7**	
W3	S-3.1	Requirement Collection using Google Forms/Survey Tools	**CO7**	3.0
	S-3.2	Preparation of Software Requirement Specification (SRS)	**CO7**	
W4	S-4.1	Documentation using IEEE SRS Standards	**CO7**	3.0
	S-4.2	UML Use Case Diagram using Visual Paradigm	**CO7**	
W5	S-5.1	Sequence Diagram and Activity Diagram Design	**CO7**	3.0
	S-5.2	Class Diagram and Object Diagram Design	**CO8**	
W6	S-6.1	Deployment Diagram and Software Blueprint Preparation	**CO8**	3.0
	S-6.2	Unit Testing using JUnit Framework	**CO8**	
	S-7.1	Integration Testing using JUnit/Selenium	**CO9**	

W7	S-7.2	Boundary Value Analysis and Test Case Design	**CO9**	3.0
W8	S-8.1	Quality Assurance Case Study using Selenium/Testsigma/JIRA	**CO9**	3.0
	S-8.2	Introduction to Lucidchart and Visual Paradigm	**CO9**	
W9	S-9.1	Flowcharts and Block Diagram Preparation	**CO9**	3.0
	S-9.2	SDLC Model Comparison and Case Study Analysis	**CO9**	
W10	S-10.1	Introduction to JIRA and Workflow Management	**CO9**	3.0
	S-10.2	Requirement Collection using Google Forms/Survey Tools	**CO9/CO10**	
W11	S-11.1	Preparation of Software Requirement Specification (SRS)	**CO9/CO10**	3.0
	S-11.2	Documentation using IEEE SRS Standards	**CO9/CO10**	
W12	S-12.1	UML Use Case Diagram using Visual Paradigm	**CO9/CO10**	3.0
	S-12.2	Sequence Diagram and Activity Diagram Design	**CO9/CO10**	
W13	S-13.1	Class Diagram and Object Diagram Design	**CO9/CO10**	3.0
W14	S-14.1	Deployment Diagram and Software Blueprint Preparation	**CO9/CO10**	3.0
	S-14.2	Unit Testing using JUnit Framework	**CO9/CO10**	
W15	S-15.1	Integration Testing using JUnit/Selenium	**CO9/CO10**	3.0
	S-15.2	Boundary Value Analysis and Test Case Design	**CO9/CO10**	

ℹ *Instructions: SRS documents, UML diagrams, Tools used, Test cases, Testing procedure, Test results should be clearly documented. Lab record (aim, procedure, tools used, brief description on experimental set up, pseudo code, output/diagrams generated, results) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall the fundamental concepts of software engineering process, key terminologies and illustrate and compare popular SDLCs	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Understand and explain the significance of requirement analysis in the software engineering process, and develop SRS document for a project	CO2 | L2	MTE Sec A | ETE Sec A

TS3	**Procedural Application & Problem Solving**	Apply design concepts and strategies to construct design documents with the help of UML based software design tools	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Analyze different testing strategies such as unit testing, integration testing, and (Boundary Value Analysis) BVA suitable for software systems	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Evaluate different strategies to develop and deliver reliable and good quality software. Justify the need for QA and standards.	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Create software systems by adapting modern techniques and tools necessary for developing and maintaining quality software. Synthesis the systems for further refinement.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Program writing; program tracing — detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III
LABORATORY ASSESSMENT FRAMEWORK
Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project/Viva)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project/Viva	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note

> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project / Viva Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define the problem; identify measurable attributes, parameters, success criteria CO7 (Apply – L3): CO8 (Create – L5/L6): CO9 (Apply – L2/L3): Apply different software testing strategies and demonstrate software testing on real-word problems. CO10 (Apply – L3):	CO7, CO8
CA2	**Experimental Design & Tool Setup for modeling the static behavior of the system**	Design the proposed system using Unified Modeling Language (UML) tools and prepare UML diagrams that reflects the static behavior of the system.	CO7, CO8
CA3	**Modeling the dynamic behavior of the system**	Design the proposed system using Unified Modeling Language (UML) tools and prepare UML diagrams that reflects the dynamic behavior of the system.	CO7, CO8
CA4	**Software testing & Optimization**	Apply unit testing strategies and demonstrate software testing on real-word problems.	CO8, CO9

CA5	**Boundary Value Analysis & Result Interpretation**	Apply boundary value analysis method of soft Apply and illustrate different software testing methodologies using modern software testing tools.	CO8, CO9
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement. Prepare quality documents.	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce quality design diagrams, interpret the design, and refinement; justify design choices	CO8, CO10
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO9, CO10

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1	–
CO2	3	2	–	–	–	–	–	–	1	–	2	2	2	–
CO3	3	3	2	–	2	2	–	–	1	–	2	3	2	2
CO4	2	3	2	2	2	–	–	–	–	–	2	2	3	2

CO5	2	3	3	2	2	–	–	–	–	–	2	2	3	2
CO6	2	2	3	2	3	2	–	2	1	1	3	3	3	3
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	**2.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**3.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	**Quality Education**	**3 (High)**	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	**Decent Work & Economic Growth**	**3 (High)**	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	**Industry, Innovation & Infrastructure**	**3 (High)**	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	**Responsible Consumption & Production**	**2 (Moderate)**	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SSCSE		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2027-2028**	
Branch: CSE / IT		**Semester: IV**	
1	Course Code	**CSCR2601**	
2	Course Title	Project Based Learning (PBL) -2 (Research Methodology Based)	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Elective	
5	Course Objective	1.To align student's skill and interests with a realistic problem or project 2.To understand the significance of problem and its scope 3.Students will make decisions within a framework	
6	Course Outcomes	Students will be able to: CO1: Identify and formulate problem statements with systematic approach. CO2: Develop teamwork and problem-solving skills, along with the ability to communicate effectively with others. CO3: Design the problem solution as per the problem statement framed. CO4: Explain the characteristics, architecture of database approach, describe the components of the project. CO5: Fabricate and implement the solution by using different object oriented concepts like encapsulation, polymorphism etc. CO6: Develop the glory of the need to engage in life-long learning.	
7	Course Description	In PBL-1, the students will learn how to define the problem for developing projects, identifying the skills required for developing the project based on given a set of specifications and all subjects of that Semester.	
8	Outline syllabus		CO Mapping
	Unit 1	Problem Definition, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.	CO1, CO2
	Unit 2	Develop a work flow or block diagram for the proposed system / software.	CO2,CO3
	Unit 3	Design algorithms for the proposed problem.	CO3
	Unit 4	Implementation of work under the guidance of a faculty member and obtain the appropriate results.	CO3, CO4
	Unit 5	Demonstrate and execute projects with the team. Validate and verify the project modules.	CO4, CO5, CO6
		The report should include Abstract, Hardware / Software Requirement, Problem Statement, Design/Algorithm, Implementation Detail. Validation Reports. References if any.	

		The presentation, report, work done during the term supported by the documentation, forms the basis of assessment.			
	Mode of examination	Practical /Viva			
	Weight age Distribution	CA	CE(Viva)	ETE	
		30	30	40	

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Identify and formulate problem statements with systematic approach.	PO1, PO2, PO4, PO9, PO10, PO11, PSO1,PSO2,PSO3
2.	CO2: Develop teamwork and problem-solving skills, along with the ability to communicate effectively with others.	PO1, PO2, PO4, PO7, PO9, PO10, PO11, PSO3
3.	CO3: Design the problem solution as per the problem statement framed.	PO1, PO2, PO5, PO9, PO10, PO11, PSO1,PSO2
4.	CO4: Explain the characteristics, architecture of database approach, describe the components of the project.	PO1, PO2, PO6, PO9, PO10, PO11, PSO2
5.	CO5: Fabricate and implement the solution by using different object oriented concepts like encapsulation, polymorphism etc.	PO1, PO2, PO3, PO4,PO5, PO6, PO7, PO8, PO9, PO10, PO11, PSO1,PSO2, PSO3
6.	CO6: Develop the glory of the need to engage in life-long learning.	PO1, PO2, PO4, PO9, PO10, PO11, PSO3

PO and PSO mapping with level of strength for Course Name Project Based Learning -1 (Course Code CSP297)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	3	-	3	-	-	-	-	3	3	2	2	2	1
CO2	3	2	-	3	-	-	2	-	3	3	2			1
CO3	3	2	-	-	2	-	-	-	3	3	2	2	2	
CO4	3	3	-	-	-	2	-	-	3	3	2		2	
CO5	3	3	2	2	2	2	3	3	3	3	2	2	2	
CO6	3	3	-	3	-	-	-	-	3	3	2			1
Avg PO attaint ed	3	2.7	0.3	1.8	0.7	0.7	0.8	0.5	3	3	2	1	1.3	0.5

School: SSCSE		**Batch: 2026-2030**			
Program: B.Tech.		**Current Academic Year: 2027-28**			
Branch: CSE		**Semester: IV**			
1	Course Code	**CSCR2200**			
2	Course Title	**Data Analytics** Using Visualization Tools			
3	Credits	3			
4	Contact Hours (L-T-P)	0	1	4	
	Course Status	Program Elective			
5	Course Objective	To introduce the fundamentals of data analytics using spreadsheet tools with emphasis on data quality, cleaning, analysis, and basic reporting through functions and pivot tables.			
6	Course Outcomes	After the completion of this course students will be able to: CO1: Describe spreadsheet fundamentals, interface elements, and basic operations relevant to data analysis. CO2: Apply spreadsheet features to enter, format, reference, and manage data for analytical tasks. CO3: Explain types of data, file formats, and the role of data quality, privacy, and the data analyst ecosystem. CO4: Perform data cleaning operations including removal of duplicates, handling missing or inconsistent values, and using built-in cleaning features. CO5: Analyze datasets using filtering, sorting, and essential analytical functions such as conditional functions and lookup formulas. CO6: Construct pivot tables and summary reports to derive insights from real-world datasets and present findings.			
7	Course Description	This course covers the use of spreadsheet software as a practical tool for data analytics, focusing on data entry, cleaning, quality, privacy, basic analysis, lookup operations, and pivot-table-based reporting, with a final mini-project.			
8	Outline syllabus				CO Mapping
	1	Open/create workbooks, navigate sheets, use ribbon; enter simple data; save in different formats (XLSX, CSV).			CO1, CO2, CO3

	2	Enter a student-marks dataset; apply number/date formats, conditional formatting, and basic data validation rules.	CO2, CO3
	3	Use formulas and functions (SUM, AVERAGE, MIN, MAX, COUNT, COUNTA, ROUND) on sales/marks data; interpret results.	CO2, CO5
	4	Import data from CSV/TXT into Excel; compare behaviour of text, numeric, date/time fields; save and reopen in multiple formats.	CO2, CO3, CO5
	5	Given a small HR/health dataset, identify sensitive attributes, discuss anonymization; flag quality issues (missing, inconsistent, out-of-range values) using filters and conditional formatting. (Note: Use reliable sources for the dataset)	CO3, CO4
	6	On a deliberately "dirty" dataset, remove duplicates, handle blanks, standardize categories with find/replace and text functions; use Text-to-Columns where appropriate. (Note: Use reliable sources for the dataset; sample 'dirty' datasets are available)	CO4, CO5
	7	Use sort, multi-level sort, AutoFilter, and custom filters; apply IF, COUNTIF, AVERAGEIF to answer business questions (e.g., "How many high-value customers?").	CO5
	8	Maintain separate master and transaction sheets; use VLOOKUP/HLOOKUP (or XLOOKUP if available) to fetch attributes; handle errors with IFERROR.	CO5, CO6
	9	Create pivot tables for a sales/attendance dataset; perform grouping, filtering, use slicers; compute subtotals and simple calculated fields.	CO5, CO6
	10	Combine cleaned data, pivot tables, charts, and key metrics into a one-sheet report/dashboard; add basic interactivity (slicers, timelines).	CO5, CO6
	VALUE ADDED Experiments		
	11	Extension of Experiment 5: Data quality and privacy mini-case study (ethics-oriented, beyond basics)	CO3, CO4
	12	Extension of Exp 8: Lookup operations using VLOOKUP/HLOOKUP (industry-relevant skill).	CO5, CO6
	13	Extension of Exp 10: Mini analytics report with dashboard elements (integrated, near-industry use case).	CO5, CO6
	Mode of examination	Lab/Tutorial	
	Weightage Distribution	CA: 30% / CE: 30% / ESE: 40%	
	Online Resource Material	• Decision Making with Spreadsheet (NPTEL/SWAYAM) https://onlinecourses.nptel.ac.in/noc25_mg113/preview	

	Text book/s*	• "Microsoft Excel Data Analysis and Business Modeling", Wayne Winston, latest edition. • "Data Analysis Using Microsoft Excel", Michael R. Middleton, latest edition.	
	Other References	• Online Excel/Spreadsheet documentation and tutorials from Microsoft and similar platforms. • Open courseware on basic data analytics using spreadsheets.	

PO and PSO mapping with level of strength for Course: CSCR2200, Data Analytics

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	2	-	-	-	-	1	-	1	1	-
CO2	2	2	1	1	3	-	-	-	1	1	1	2	3	1
CO3	1	1	-	-	1	2	1	2	-	1	-	1	1	1
CO4	1	2	1	2	3	-	-	-	1	1	1	2	3	1
CO5	2	3	2	2	3	-	-	-	1	2	1	3	3	2
CO6	1	2	2	1	3	-	-	-	2	3	2	3	3	2

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CSCR 2200/ Data Analyti cs Lab	1.5	1.83	1.5	1.5	2.5	2	1	2	1.25	1.5	1.25	2	2.3	1.4

Strength of Correlation: 23.56
1. Addressed to Slight (Low=1) extent
2. Addressed to Moderate (Medium=2) extent
3. Addressed to Substantial (High=3) extent

COURSE PLAN

Open-source Tools for Cyber Security & Forensics (CSCF2303)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	**CSCF2303**
2	**Course Title**	Open-source Tools for Cyber Security & Forensics
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	1. To develop foundational knowledge and practical skills in using open-source tools for penetration testing, vulnerability assessment, and host reconnaissance in cyber security environments. 2. To build an understanding of legal, ethical, and professional considerations in cyber security and digital forensics while applying responsible security practices. 3.To explain and apply methodologies, tools, and techniques for identifying, analyzing, and mitigating social engineering and network-based security attacks. 4. To develop proficiency in threat prevention and defense strategies for securing real-time systems and mitigating targeted cyber attacks using open-source security tools..
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** **LAB COs — Assessed via Laboratory Assessment only:** CO1(Understand – L1/L2): Acquire knowledge of open-source tools for penetration testing and vulnerability assessment. CO2 (Explore – L2/L3): Develop an understanding of legal and ethical considerations in cyber security and digital forensics. CO3(Apply – L3): Explain the methodologies and tools used in identifying and mitigating social engineering attacks. CO4(Analyze – L4/L5): Explain and apply techniques for performing host reconnaissance using open-source tools. CO5 (Analyze – L4/L5): Analyze and execute network attack techniques to understand network security vulnerabilities.

		CO6 (Analyze – L2/L4): Gain proficiency in threat prevention strategies to secure real-time systems and mitigate targeted attacks using open source tool. CO7 (L4 – Analyze): Analyze network vulnerabilities and cyber threats using open-source security tools. CO8 (L5/L6 – Create): Prepare and present security assessment and forensic report CO9 (L3 – Apply): Apply open-source tools for security testing, monitoring, and forensic analysis. CO10 (L3 – Apply): Demonstrate ethical and professional practices while using cybersecurity tools.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 45 hrs)**	1. Perform Network Scanning and Vulnerability Mapping using Nmap 2. Open Source Intelligence (OSINT) and Footprinting Analysis using Maltego 3. Packet Inspection and Traffic Analysis using Wireshark
11	**References**	Textbook: 1. Open Source Security Tools: A Practical Guide to Security Applications, Tony Howlett, Prentice Hall, Pearson Education, Inc 2. Implementing Enterprise Cyber Security with Open-Source Software and Standard Architecture: Volume II, Anand Handa, Rohit Negi, S. Venkatesan, Sandeep K. Shukla

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Fundamentals of Cyber Security and Open-Source Tools (8-0-0-6 = 14hrs)**	
A	Understanding threats, vulnerabilities, and attacks Overview of the Cyber Security landscape and the importance of open-source tools	CO1, CO2, CO3
B	Ethical and legal implications of using open-source tools in cybersecurity	
C	Using Open-Source tools	
Tools Used	namp	
Activities	**Objective:** • Understand cyber threats, vulnerabilities, and common attacks. • Explore the cybersecurity landscape and use of open-source security tools. • Apply ethical and legal practices while using open-source cybersecurity tool	
Unit 2	**Network Security and Penetration Testing Tools (10-0-0-9= 19 hrs)**	

A	Network Scanning and Enumeration, Scanning and analyzing open ports, services, and vulnerabilities	CO3, CO4
B	Introduction to penetration testing stages and methodologies	
C	Using Open-Source tools for Penetration Testing	
Tools Used	nikto	
Activities	**Objective:** • Perform network scanning and host enumeration using open-source tools. • Analyze open ports, services, and system vulnerabilities. • Apply penetration testing methodologies using open-source security tools.	
Unit 3	**Social Engineering and Web Application Security (9-0-0-10 = 19 hrs)**	
A	Types of social engineering attacks: phishing, pretexting, and baiting	CO2, CO3, CO4
B	Introduction to OWASP Top 10 vulnerabilities	
C	Using Open Source tools for Social Engineering and Web Application Security	
Tools Used	burpsute	
Activities	**Objective:** • Identify common social engineering attacks and their techniques. • Understand the OWASP Top 10 web application vulnerabilities. • Use open-source tools to assess social engineering and web application security.	
Unit 4	**Digital Forensics and Evidence Collection (9-0-0-10 = 19 hrs)**	
A	Stages of digital forensics: identification, preservation, collection, analysis, and reporting	CO3, CO4, CO6
B	Evidence Handling and Reporting, Chain of custody and preserving digital evidence integrity	
C	Open source tools for Digital Forensics	
Tools Used	FTK, Autopsy	
Activities	**Objective:** • Understand the stages of digital forensic investigation. • Apply proper evidence handling and chain of custody procedures. • Use open-source digital forensic tools for evidence collection and analysis	
Unit 5	**Advanced Threat Detection and Mitigation Techniques (9-0-0-10 = 19 hrs)**	
A	Host and Network Intrusion Detection Systems (IDS)	C01, C03, CO5, CO6

B	Log Analysis and Threat Hunting, Analyzing logs for indicators of compromise (IoCs)	
C	Open Source tools for log analysis and threat monitoring	
Tools Used	CLi	
Activities	**Objective:** • Understand host and network intrusion detection systems (IDS). • Analyze logs to identify Indicators of Compromise (IoCs) and cyber threats. • Use open-source tools for log analysis and threat monitoring.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7

CO1	✓																
CO2		✓															
CO3			✓											✓			
CO4				✓											✓		
CO5					✓											✓	
CO6						✓			✓							✓	✓
CO7			✓		✓			✓					✓	✓	✓		
CO8					✓	✓			✓						✓	✓	✓
CO9			✓							✓	✓						
CO10			✓					✓			✓			✓			✓

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Fundamentals of Cyber Security and Open-Source Tools	**UNIT-1**	**8**
DD/MM/YY	Understanding threats		
DD/MM/YY	vulnerabilities,		
DD/MM/YY	Attacks		
DD/MM/YY	Risk		
DD/MM/YY	Overview of the Cyber Security landscape		
DD/MM/YY	Software/Tools		
DD/MM/YY	Contributor		
DD/MM/YY	Ethical and legal implications of using open-source tools in cybersecurity	**UNIT-2**	**10**
DD/MM/YY	the importance of open-source tools		
DD/MM/YY	Using Open-Source tools		
DD/MM/YY	Network Security and Penetration Testing Tools		
DD/MM/YY	Network Scanning and Enumeration		
DD/MM/YY	Scanning and analyzing open ports		
DD/MM/YY	services, and vulnerabilities		
DD/MM/YY	Introduction to penetration testing stages		
DD/MM/YY	Using Open-Source tools for Penetration Testing		
DD/MM/YY	WiresharK		
DD/MM/YY	nmap		

DD/MM/YY	Social Engineering and Web Application Security	**UNIT-3**	**9**
DD/MM/YY	Types of social engineering attacks		
DD/MM/YY	phishing, pretexting, and baiting		
DD/MM/YY	Whaling		
DD/MM/YY	Baiting		
DD/MM/YY	Introduction to OWASP Top 10 vulnerabilities		
DD/MM/YY	Introduction to OWASP Top 10 vulnerabilities		
DD/MM/YY	Introduction to OWASP Top 10 vulnerabilities		
DD/MM/YY	Introduction to OWASP Top 10 vulnerabilities		
DD/MM/YY	Using Open Source tools for Social Engineering and Web Application Security	**UNIT-4**	**9**
DD/MM/YY	Brupsuit		
DD/MM/YY	Metasploit		
DD/MM/YY	Digital Forensics and Evidence Collection		
DD/MM/YY	Stages of digital forensics		
DD/MM/YY	identification, preservation		
DD/MM/YY	collection		
DD/MM/YY	analysis, and reporting		
DD/MM/YY	Evidence Handling and Reporting	**UNIT-5**	**9**
DD/MM/YY	Chain of custody		
DD/MM/YY	preserving digital evidence integrity		
DD/MM/YY	Autopsy		
DD/MM/YY	Advanced Threat Detection and Mitigation Techniques		
DD/MM/YY	Host and Network Intrusion Detection Systems		
DD/MM/YY	Log Analysis		
DD/MM/YY	Threat Hunting		
DD/MM/YY	Analyzing logs for indicators of compromise (IoCs),		
DD/MM/YY	Open Source tools for log analysis and threat monitoring		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
	S-1	Installation and Familiarization with Cyber Security Tools	**CO7**	

W1				3.0
W2	S-2	Basic Network Discovery Using Nmap	**CO7**	3.0
W3	S-3	Packet Capture and Analysis Using Wireshark	**CO7**	3.0
W4	S-4	Network Enumeration Using Nmap	**CO7**	3.0
W5	S-5	Vulnerability Assessment Using OpenVAS (Greenbone)	**CO7**	3.0
W6	S-6	Web Server Security Assessment Using Nikto	**CO7**	3.0
W7	S-7.	HTTP Request Analysis Using Burp Suite Community Edition	**CO7**	3.0
W8	S-8	Web Application Security Testing Using OWASP ZAP	**CO8/CO9**	3.0
W9	S-9	Network using tcpdump	**CO8/CO10**	3.0
W10	S-10	Disk Image Analysis Using Autopsy	**CO9/CO10**	3.0
W11	S-11	Deleted File Recovery Using TestDisk and PhotoRec	**CO7**	3.0
W12	S-12	Basic System Log Analysis	**CO7**	3.0
W13	S-13	Basic Intrusion Detection Using open source tools	**CO8**	3.0
W14	S-14	Use python script for port scanning	**CO8/CO9**	3.0
W15	S-15	Use FTK for imaging and analysis	**CO8/CO9**	3.0

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Fundamentals of Cyber Security and Open-Source Tools**	Acquire knowledge of open-source tools for penetration testing and vulnerability assessment.	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Network Security and Penetration Testing Tools**	Develop an understanding of legal and ethical considerations in cyber security and digital forensics	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Social Engineering and Web Application Security**	Explain the methodologies and tools used in identifying and mitigating social engineering attacks.	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Digital Forensics and Evidence Collection**	Explain and apply techniques for performing host reconnaissance using open-source tools	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	**Advanced Threat Detection and Mitigation Techniques**	Analyze and execute network attack techniques to understand network security vulnerabilities.	CO5 | L4–L5	ETE Sec B/C
TS6	**Advanced Threat Detection and Mitigation Techniques**	Gain proficiency in threat prevention strategies to secure real-time systems and mitigate targeted attacks using open source tool.	CO6 | L2–L4	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions.
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Long and descriptive answers
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions.
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: Comparison, Tools and Techniques, Algorithms
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: Applications, working principles/
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CA experiments
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project/Case Study	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	**CA1** —Identification of cybersecurity problem, objectives, and scope. **CA2** —Experiment planning, tool selection, and environment configuration. **CA7** — Security methodology, attack simulation, threat analysis, and mitigation approach.	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	**CA3** - Correct execution of network scanning, vulnerability assessment, penetration testing, and forensic tasks. **CA4** -Effective use of open-source cybersecurity tools and techniques.	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	**CA5** —Analysis and interpretation of scan results, logs, vulnerabilities, and forensic evidence. **CA6** — Preparation of structured reports with observations, screenshots, evidence, and conclusions.	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CA6 —Preparation of structured reports with observations, screenshots, evidence, and conclusions. CA8 —PO7/CO9 — Ethical and responsible cybersecurity practices	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6

		P4 — Innovative solution proposal with alternatives		
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define cryptographic problem, objectives, scope, and success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Configure cryptographic tools, environments, and security utilities	CO7
CA3	**Code Implementation & Execution**	Execute encryption, hashing, authentication, and security experiments	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate performance and optimize cryptographic implementations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyze ciphertexts, logs, packets, and security outputs	CO8
CA6	**Documented Outcome with Verification**	Record observations, screenshots, outputs, and validate results	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Design secure workflows and cryptographic methodologies	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain lab records and demonstrate conceptual understanding	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6

P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

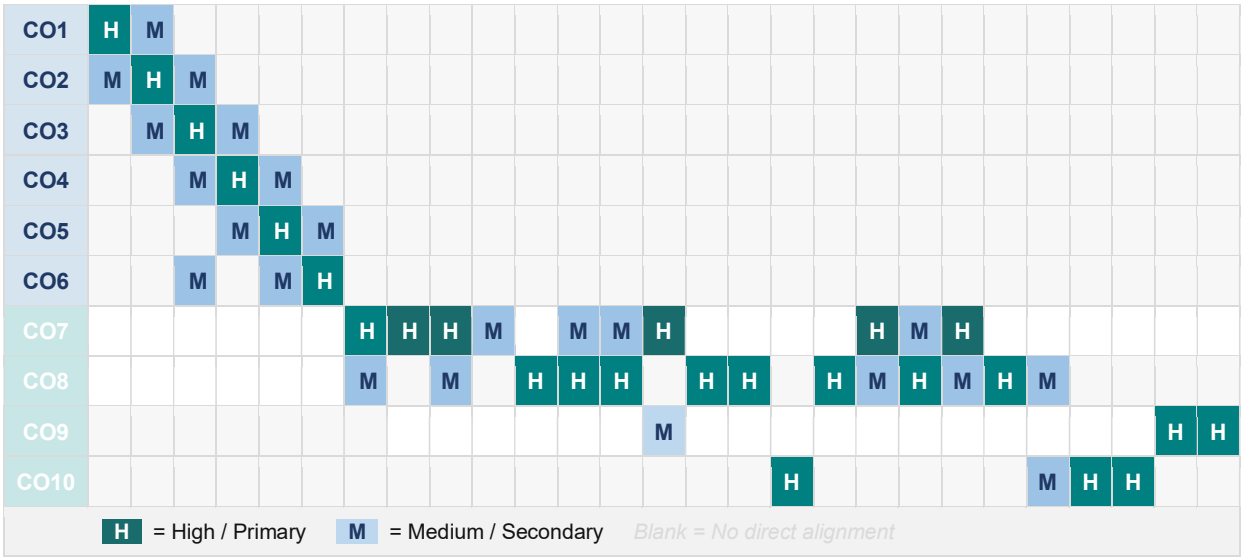
14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1: Prob. Def.	CA2 Exp. Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc. Outcome	CA7 Algo. Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude


CO1 H M
CO2 M H M
CO3 M H M
CO4 M H M
CO5 M H M
CO6 M M H
CO7 H H H M M M H H M H
CO8 M M H H H H H H M H M H M
CO9 M H H
CO10 H M H H
H = High / Primary
M = Medium / Secondary
Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	2	-	-	3	-	-	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	2	2	3	-	-	2	-	3	2	3
CO4	3	3	3	-	3	2	3	-	2	-	2	3	-	-
CO5	3	3	2	3	2	-	2	-	3	3	3	2	2	2
CO6	2	3	3	2	3	3	3	3	-	-	3	3	2	3
CO7	–	2	1	–	3	2	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	2	–	–	2	3	–	–	1	3	–	1	2
CO10	2	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	2.71	2.63	2.56	2.00	2.38	2.13	2.80	3.00	2.75	2.25	2.60	2.43	2.25	2.57

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	H	H	-	M	M	-	-	H	-	-
CO2	H	H	H	M	M	-	-	-	-	-	-
CO3	H	H	H	M	M	M	H	-	-	M	-
CO4	H	H	H	-	H	M	H	-	M	-	M
CO5	H	H	M	H	M	-	M	-	H	H	H
CO6	M	H	H	M	H	H	H	H	-	-	H

CO7	–	M		–	H	M	–	–	–	–	–
CO8	–		H		M	H	–	–	–	–	–
CO9	–	–	M	–	–	M	H	–	–		H
CO10	M	–	–	–	–		–	H	H	H	M

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)
Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SSCSE		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2027-28**	
Branch: CSE (AI/ML)		**Semester: IV**	
1	Course Code	CSAI2200 | Course Name: Human Computer Interaction	
2	Course Title	Human Computer Interaction	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. Understand fundamental design and evaluation methodologies of human computer interaction. 2. Demonstrate knowledge of human computer interaction design concepts and related methodologies. 3. Apply theories and concepts associated with effective work design to real-world applications.	
6	Course Outcomes	After the completion of this course students will be able to: CO1: Define the capabilities of both humans and computers from the viewpoint of human information processing. CO2: Explain typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms. CO3: Apply HCI design principles, standards, and guidelines. CO4: Analyse and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems. CO5: Analyse the tasks of HCI systems. CO6: Adopt a variety of simple methods for evaluating the quality of a user interface.	
7	Course Description	Students will learn the fundamental concepts of human-computer interaction and user centred design thinking, through working in teams on an interaction design project, supported by lectures, readings, and discussions. They will learn to evaluate and design usable and appropriate software based on psychological, social, and technical analysis. They will become familiar with the variety of design and evaluation methods used in interaction design.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	What is HCI? Why Human–Computer Interaction? Who is Involved in HCI? Models of Interaction Theory and HCI, Human Introduction, Input–Output Channels (Vision, Hearing, Touch, Movement), Human Memory (Sensory Memory, Long-Term Memory), Psychology and the design of interactive systems	CO1
	B	Input devices for interactive use, allowing text entry, drawing and selection from the screen: text entry, pointing, 3d interaction devices, Output display devices for interactive use, virtual reality systems and 3D visualization, various devices in the physical world, paper output and input, processing (effects, limitations, and impact on system performance)	CO1

	C	Interaction introduction, models of interaction (execution–evaluation cycle, interaction framework), frameworks, ergonomics, interaction styles, elements of the WIMP interface, interactivity, context of the interaction, experience, engagement, and fun	CO1
	Unit 2	**Design Process**	
	A	Interaction Design Basics: Introduction, The Process of Design, User Focus, Scenarios, Navigation Design (Local Structure, Global Structure), Screen Design And Layout (Tools For Layout, User Action And Control, Appropriate Appearance), Iteration And Prototyping	CO2
	B	HCI in The Software Process: Introduction, The Software Life Cycle (Activities, Validation and Verification, Management and Contractual Issues, Interactive Systems for Software Lifecycle), Usability Engineering, Iterative Design and Prototyping, Techniques For Prototyping, Design Rationale (Process-Oriented Design Rationale, Design Space Analysis, Psychological Design Rationale)	CO2
	C	Design Rules: Introduction, Principles to Support Usability (Learnability, Flexibility, Robustness), Standards, Guidelines, Golden Rules and Heuristics (Shneiderman's Eight Golden Rules 0f Interface Design, Norman's Seven Principles for Transforming Difficult Tasks into Simple Ones), HCI Patterns	CO2
	Unit 3	**Implementation Support**	
	A	Introduction of Implementation Support, Elements of Windowing Systems: Examples of Imaging Models, Architectures of Windowing Systems, Programming The Application, Using Toolkits, Usability Principles, User Interface Management Systems: UIMS As A Conceptual Architecture, Implementation Considerations)	CO3
	B	Evaluation Techniques, what is Evaluation? Goals of Evaluation, Evaluation Through Expert Analysis: Cognitive Walkthrough, Heuristic Evaluation, Model-Based Evaluation, Evaluation Through User Participation, Empirical Methods: Experimental Evaluation, Observational Techniques, Query Techniques, Evaluation Through Monitoring Physiological Responses, Choosing an Evaluation Method, A Classification Of Evaluation Techniques	CO3
	C	Universal Design: Introduction, Universal Design Principles, Multi-Modal Interaction, Sound in The Interface, Touch In The Interface, Handwriting Recognition, Gesture Recognition, Designing For Diversity: Designing For Users With Disabilities, Designing For Different Age Groups, Designing For Cultural Differences	CO3
	Unit 4	**Models and Theories**	
	A	Cognitive models, goal and task hierarchies	CO4

		GOMS, cognitive complexity theory, problems, and extensions of goal hierarchies Linguistic models (BNF, Task–Action Grammar), the challenge of display-based systems, physical and device models (keystroke-level model, three-state model) Cognitive architectures, the problem space model, interacting cognitive subsystems		
	B	Socio-organizational issues and stakeholder requirements Organizational issues: cooperation or conflict? invisible worker, automating processes – workflow and BPR, capturing requirements (stakeholders, socio-technical models, soft systems methodology, participatory design, ethnographic methods)		CO4
	C	Communication and collaboration models, face-to-face communication (transfer effects and personal space, eye contact and gaze, gestures and body language, back channels, confirmation and interruption, turn-taking), conversation, speech act theory, text-based communication (back channels and affective state, grounding constraints, turn-taking, context and deixis, pace and granularity, linear text vs. hypertext), group working.		CO4
	Unit 5	**Task Analysis**		
	A	Introduction of Task, Differences Between Task Analysis and Other Techniques, Task Decomposition, Knowledge-Based Analysis, Entity–Relationship-Based Techniques, Sources of Information and Data Collection (Documentation, Observation, Interviews, Initial Analysis, Sorting and Classification), Uses Of Task Analysis		CO5
	B	Dialog Notations and Design Introduction, Dialog: Structured Human Dialogs, Dialog Design Notations, Diagrammatic Notations (State Transition Networks, Hierarchical State Transition Nets, Concurrent Dialogs and Combinatorial Explosion of States, Escapes, Petri Nets, State Charts, Flow Charts, JSD Diagrams), Textual Dialog Notations, Dialog Semantics, Dialog Analysis and Design		CO5, CO6
	C	Standard Formalisms, Formal Notations, Model-Oriented Notations and Issues, Algebraic Notations, Temporal Logics, Interaction Models (Pie Model, Predictability, Observability, Reachability), Continuous Behavior, Modeling Rich Interaction, Status–Event Analysis, Rich Contexts (Collaboration, Information, Triggers, Artifacts, Placeholders), Low Intention and Sensor-Based Interaction		CO5, CO6
	Mode of examination	Theory		
	Weightage Distribution	CA	ESE	
		25%	75%	

	Text book/s*	1. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "human–Human-Computer Interaction," Third Edition, Pearson Education Limited	
	Other References	1. Rajendra Kumar, " Human Computer Interaction" Second Edition, Firewall Media, New Delhi. 2. Ben Schneiderman, "Design the User Interface: Strategies for Effective Human-Computer Interaction," Pearson Education.	

PO and PSO mapping with level of strength for Course Name Human Computer Interaction **(Course Code** CSAI-2200**)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	3	-	-	-	-	1	-	-	-	1	1	1	1
CO2	3	3	2	1	-	1	1	1	1	-	1	1	1	1
CO3	3	3	3	3	1	-	-	1	1	-	2	2	2	2
CO4	2	3	2	2	-	-	-	-	1	-	2	2	2	2
CO5	3	3	3	3	-	2	1	-	1	1	2	1	1	1
CO6	2	2	2	2	1	-	-	-	1	-	2	1	1	1

Average of non-zeros entry in following table (should be auto calculated).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

Course Code/ Name	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSAI2200 / Human Computer Interaction	2.67	2.83	2.40	2.20	1.00	1.50	1.00	1.00	1.00	1.00	1.67	1.33	1.33	1.33

Strength of Correlation

1. Addressed to **Slight (Low=1) extent** **2.** Addressed to **Moderate (Medium=2) extent**

3. Addressed to **Substantial (High=3) extent**

COURSE PLAN

Machine Learning for Cyber Security (CSCF 2302)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	IV

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCF2302
2	**Course Title**	Machine Learning for Cyber Security / Machine Learning for Cyber Security Lab
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Program Elective
6	**Course Objective**	1. To introduce the ideas of learning rule and implement them based on human experience. 2. To conceptualize the working of human brain using SVM, RF and ANN. 3. To become familiar with decision boundaries that can learn from available examples and generalize to form appropriate learning rules for inference systems. To provide the mathematical background for SVM, RF and Neural Network based classification techniques
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Understand – L1/L2): Identify Machine Learning and stochastic concept.. CO2 (Explore – L2/L3): Interpretation of existing models to understand the solution environment. CO3 (Apply – L3): Application of existing mathematical solutions to test problems. CO4 (Analyze – L4/L5): Analyse the logical ability to apply feature engineering to extract hierarchical patterns existing in real life problems. CO5 (Analyze – L4/L5): Build the understanding of learning theory to glance the upcoming world through it. CO6 (Analyze – L2/L4): Appraise recent trends in machine learning and applications **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Apply ML to detect cyber threats and anomalies. CO8 (Create – L5/L6: Develop and present ML-based cybersecurity solutions. CO9 (Apply – L2/L3): Collaborate to solve cybersecurity problems using ML. CO10 (Apply – L3): Apply ethical and legal practices in ML for cybersecurity.

8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 45 hrs)**	1. Explore and implement machine learning models for cyber attack detection usig public cybersecurity datasets. 2. Perform feature engineering, model evaluation, and comparison of ML algorithms for malware or intrusion detection. 3. Develop a mini-project on a cybersecurity application (e.g., phishing detection, malware classification, or network intrusion detection) and prepare a technical report with presentation.
11	**References**	1.Foundations of Machine Learning, Second Edition By MehryarMohri, Afshin Rostamizadeh and Ameet Talwalkar, MIT Press, Second Edition, 2018. 2. Introduction to Machine Learning, Third Edition, By Ethem 3. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* — Aurélien Géron — **3rd Edition** 4. *Introduction to Machine Learning with Python* — Andreas C. Müller & Sarah Guido — **1st Edition**

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction (8-0-0-6 = 14hrs)**	
A	Introduction to Machine Learning, Role of Machine Learning in Cyber Security, The ML Mindset, ML Problem Framing, Common Cyber Security Problems, ML Use Cases in Cyber Security, Identifying Security Problems for ML, Challenges in Cyber Security ML, Applications of ML Standard learning tasks(Machine Learning Pipeline, Classification, Regression, Ranking, Clustering, Dimensionality reduction or Manifold learning)	CO1, CO2, CO3
B	Learning Stages (Security Features, Security Labels, Hyperparameters, Training, Validation and Test Datasets, Loss Function, Model Evaluation), Learning Scenarios (Supervised Learning for Malware and Phishing Detection, Unsupervised Learning for Anomaly and Intrusion Detection, Semi-Supervised Learning for Threat Detection, Online Learning for Real-Time Cyber Defense, Reinforcement Learning for Adaptive Security, Active Learning for Threat Intelligence), Generalization, Supervised Learning, Unsupervised Learning, Reinforcement Learning in Cyber Security.	
C	Cyber Security Data Sources, Security Logs, Network Traffic Data, Malware Datasets, Data Types, Data Preprocessing, Data Cleaning, Missing Values, Noise Removal, Data Integration, Feature Engineering, Feature Selection, Feature Scaling, Normalization, Encoding, PCA, Sampling, Handling Imbalanced Datasets.	
Tools Used	NA	
Activities	**Objective:**	

	• Understand the fundamentals of Machine Learning and its applications in Cyber Security, including learning paradigms and security use cases. • Apply data preprocessing, feature engineering, and dimensionality reduction techniques to prepare cybersecurity datasets for machine learning models. • Analyze cybersecurity problems and select appropriate machine learning approaches for threat detection, classification, and anomaly detection.	
Unit 2	**Supervised Learning Algorithms (10-0-0-9= 19 hrs)**	
A	Regression Models Linear Regression, Cost Function, Gradient Descent, Feature Scaling, Regularization, Ridge Regression, Lasso Regression, Logistic Regression, Logistic Function, Odds and Logit, Decision Boundary, Model Training and Testing.	CO2,CO3,CO4
B	Classification Algorithms Decision Trees, Information Gain, Entropy, Gini Index, Naïve Bayes, Bayesian Classification, K-Nearest Neighbors (KNN), Support Vector Machines (SVM), Linear Discriminant Analysis (LDA), Random Forest.	
C	Model Evaluation and Optimization Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC Curve, AUC, Cross Validation, Hyperparameter Tuning, Grid Search, Random Search, Feature Importance, Model Comparison.	
Tools Used	NA	
Activities	Objective: • Understand the principles of regression and classification algorithms used in machine learning. • Apply machine learning models for classification and prediction using appropriate training and testing techniques. • Evaluate and optimize machine learning models using performance metrics, cross-validation, and hyperparameter tuning.	
Unit 3	**Unsupervised Learning Algorithms (9-0-0-10 = 19 hrs)**	
A	Unsupervised Learning Clustering Fundamentals, K-Means Clustering, Hierarchical Clustering, DBSCAN, Density-Based Clustering, Cluster Evaluation, Outlier Detection, Dimensionality Reduction, Principal Component Analysis (PCA)	CO3, CO4, CO5, CO6
B	Neural Networks and Deep Learning Artificial Neural Networks, Perceptron, Activation Functions, Feed Forward Networks, Backpropagation, Deep Neural Networks, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Autoencoders.	
C	Deep Learning Fundamentals Network Architecture, Training Deep Models, Batch Processing, Optimizers, Learning Rate Scheduling, Dropout, Batch Normalization, Transfer Learning, Model Evaluation, Hyperparameter Optimization.	
Tools Used	NA	
Activities	**Objective:**	

	• Understand the fundamentals of unsupervised learning, clustering techniques, and dimensionality reduction methods. • Apply neural networks and deep learning models for solving machine learning problems. • Evaluate deep learning models using appropriate training, optimization, and performance evaluation techniques.	
Unit 4	**Advanced Machine Learning Techniques (9-0-0-10 = 19 hrs)**	
A	Ensemble Learning Bagging, Boosting, Random Forest, AdaBoost, Gradient Boosting, XGBoost, Voting Classifiers, Stacking, Ensemble Model Evaluation	CO3, CO4, CO5
B	Explainable and Secure Machine Learning Explainable AI (XAI), Feature Importance, SHAP, LIME, Model Interpretability, Fairness in AI, Bias in Machine Learning, Privacy-Preserving Machine Learning.	
C	Adversarial Machine Learning: Adversarial Examples, Data Poisoning Attacks, Evasion Attacks, Model Extraction Attacks	
Tools Used	NA	
Activities	**Objective:** • Understand ensemble learning techniques and explainable AI concepts for improving machine learning models. • Apply ensemble methods and model interpretation techniques to develop reliable and secure machine learning solutions. • Analyze adversarial attacks and secure machine learning techniques to enhance the robustness of ML models in cybersecurity.	
Unit 5	Machine Learning Frameworks and Emerging Trends (9-0-0-10 = 19 hrs)	
A	Scikit-learn, TensorFlow, Keras, PyTorch	CO2, CO3, CO4, CO5, CO6
B	Generative AI, Large Language Models (LLMs), Federated Learning, Future Trends in AI for Cyber Security	
C	Case studies : Malware Detection, Phishing Detection, Intrusion Detection Systems, Spam Filtering, Network Traffic Analysis, Security Log Analysis, Insider Threat Detection, Threat Intelligence.	
Tools Used	NA	
Activities	**Objective:** • Understand machine learning frameworks and emerging AI technologies used in cyber security. • Apply machine learning frameworks to develop AI-based solutions for cybersecurity problems. • Analyze real-world cybersecurity case studies using machine learning and AI techniques.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	
CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	

CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Machine Learning, Role of Machine Learning in Cyber Security, The ML Mindset, ML Problem Framing, Common Cyber Security Problems, ML)	**UNIT-1**	**8**
DD/MM/YY	Use Cases in Cyber Security, Identifying Security Problems for ML, Challenges in Cyber Security ML,		
DD/MM/YY	Applications of ML Standard learning tasks(Machine Learning Pipeline, Classification, Regression, Ranking, Clustering, Dimensionality reduction or Manifold learning		
DD/MM/YY	Learning Stages (Security Features, Security Labels, Hyperparameters, Training, Validation and Test Datasets, Loss Function, Model Evaluation), Learning Scenarios (Supervised Learning for Malware and Phishing Detection, Unsupervised Learning for Anomaly and Intrusion Detection		
DD/MM/YY	Semi-Supervised Learning for Threat Detection, Online Learning for Real-Time Cyber Defense, Reinforcement Learning for Adaptive Security, Active Learning for Threat Intelligence), Generalization, Supervised Learning, Unsupervised Learning, Reinforcement Learning in Cyber Security.		
DD/MM/YY	Cyber Security Data Sources, Security Logs, Network Traffic Data, Malware Datasets, Data Types, Data Preprocessing, Data Cleaning, Missing Values, Noise Removal,.		
DD/MM/YY	Data Integration, Feature Engineering, Feature Selection, Feature Scaling, Normalization, Encoding,		
DD/MM/YY	PCA, Sampling, Handling Imbalanced Datasets		
DD/MM/YY	Regression Models Linear Regression, Cost Function, Gradient Descent, Feature Scaling, Regularization,	**UNIT-2**	**10**
DD/MM/YY	Ridge Regression, Lasso Regression, Logistic Regression, Logistic Function		
DD/MM/YY	Odds and Logit, Decision Boundary		
DD/MM/YY	Model Training and Testing		
DD/MM/YY	Classification Algorithms Decision Trees, Information Gain, Entropy, Gini Index,.		
DD/MM/YY	Naïve Bayes, Bayesian Classification, K-Nearest Neighbors (KNN), Support Vector Machines (SVM),		
DD/MM/YY	Linear Discriminant Analysis (LDA),		
DD/MM/YY	Random Forest		
DD/MM/YY	Model Evaluation and Optimization Confusion Matrix, Accuracy, Precision, Recall		
DD/MM/YY	F1-Score, ROC Curve, AUC, Cross Validation, Hyperparameter Tuning, Grid Search, Random Search		

DD/MM/YY	Feature Importance, Model Comparison.		
DD/MM/YY	Clustering Fundamentals, K-Means Clustering, Hierarchical Clustering, DBSCAN, Density-Based Clustering, Cluster Evaluation	**UNIT-3**	**9**
DD/MM/YY	Outlier Detection, Dimensionality Reduction, Principal Component Analysis (PCA)		
DD/MM/YY	Artificial Neural Networks, Perceptron, Activation Functions		
DD/MM/YY	Feed Forward Networks, Backpropagation, Deep Neural Networks, Convolutional Neural Networks (CNN),.		
DD/MM/YY	Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Autoencoders		
DD/MM/YY	Network Architecture, Training Deep Models, Batch Processing, Optimizers,.		
DD/MM/YY	Learning Rate Scheduling, Dropout, Batch Normalization		
DD/MM/YY	Transfer Learning, Model Evaluation		
DD/MM/YY	Hyperparameter Optimization		
DD/MM/YY	Bagging, Boosting, Random Forest,	**UNIT-4**	**9**
DD/MM/YY	AdaBoost, Gradient Boosting, XGBoost		
DD/MM/YY	Voting Classifiers, Stacking, Ensemble Model Evaluation		
DD/MM/YY	Explainable AI (XAI), Feature Importance		
DD/MM/YY	SHAP, LIME, Model Interpretability, Fairness in AI, Bias in Machine Learning,		
DD/MM/YY	Privacy-Preserving Machine Learning.		
DD/MM/YY	Adversarial Machine Learning: Adversarial Examples,		
DD/MM/YY	Data Poisoning Attacks, Evasion Attacks, Model Extraction Attacks		
DD/MM/YY	Machine Learning frameworks	**UNIT-5**	**9**
DD/MM/YY	Scikit-learn, TensorFlow,		
DD/MM/YY	Keras, PyTorch		
DD/MM/YY	Generative AI,		
DD/MM/YY	Large Language Models (LLMs),		
DD/MM/YY	Federated Learning,		
DD/MM/YY	Future Trends in AI for Cyber Security		
DD/MM/YY	Case studies : Malware Detection, Phishing Detection		
DD/MM/YY	Intrusion Detection Systems, Spam Filtering, Network Traffic Analysis, Security Log Analysis		
DD/MM/YY	Insider Threat Detection, Threat Intelligence.		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1	Install and configure Python, Jupyter Notebook, Scikit-learn, TensorFlow, and cybersecurity datasets.	CO7	3.0
W2	S-2	Load, visualize, and preprocess a cybersecurity dataset (NSL-KDD, CICIDS2017, or Phishing Dataset)	CO7	3.0
W3	S-3	Detect phishing websites using Logistic Regression.	CO7	3.0
W4	S-4	Classify spam emails using Naïve Bayes.	CO7	3.0
W5	S-5	Detect malicious URLs using Decision Tree Classification.	CO7	3.0
W6	S-6	Detect network intrusions using K-Nearest Neighbors (KNN).	CO7	3.0
W7	S-7	Detect anomalous network traffic using K-Means Clustering	CO7	3.0
W8	S-8	Perform anomaly detection using DBSCAN clustering.	CO8/CO9	3.0
W9	S-9	Detect brute-force attacks from authentication logs	CO8/CO10	3.0
W10	S-10	Implement Principal Component Analysis (PCA) and compare model accuracy before and after PCA.	CO9/CO10	3.0
W11	S-11	Perform k-fold cross-validation on a malware detection dataset,	CO7	3.0
W12	S-12	Implement ensemble learning using Voting Classifier for cyber attack classification.	CO7	3.0
W13	S-13	Build a simple cyber attack prediction model and visualize the prediction results.	CO8	3.0
W14	S-14	Develop a basic dashboard to display ML model performance using Python (Accuracy, Precision, Recall, F1-Score).	CO8/CO9	3.0
W15	S-15	Mini Project: Develop a simple cyber threat detection system using any ML algorithm.	CO8/CO9	3.0

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall machine learning terminology, AI concepts, learning paradigms, cybersecurity datasets, data preprocessing techniques, feature engineering methods, and evaluation metrics.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Explain supervised, unsupervised, and deep learning algorithms, regression and classification models, clustering techniques, neural networks, and their role in cybersecurity.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply data preprocessing, feature engineering, machine learning algorithms, model training, testing, and evaluation techniques to solve cybersecurity problems such as malware, phishing, spam, and intrusion detection.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Model Evaluation**	Analyze machine learning model performance using confusion matrix, accuracy, precision, recall, F1-score, ROC-AUC, cross-validation, and compare different algorithms for cybersecurity applications.	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Optimization**	Compare machine learning algorithms, optimize models using feature selection, hyperparameter tuning, ensemble learning, and explain model predictions using Explainable AI techniques.	CO5 | L5	ETE Sec B/C
TS6	**Design, Integration & Professional Practice**	Design end-to-end machine learning solutions for cybersecurity, integrate ML frameworks with security datasets, develop intelligent threat detection systems, and demonstrate ethical and responsible AI practices.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions.

Sec B	**6**	TS3 — Procedural Application & Problem Solving TS4 — Analytical Reasoning & Model Evaluation	**CO3, CO4**	Long and descriptive answers
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions.
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: Comparison, Tools and Techniques
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Design, Integration & Professional Practice	**CO5, CO6**	Long/design questions: Applications, working principles/
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CA experiments
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project/Case Study	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 – Problem identification and ML objective, CA2 – Dataset selection and preprocessing strategy, CA7 – ML workflow, feature engineering, and model selection	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Model Implementation & Computational Efficiency	**1.0**	CA3 – Correct implementation of ML algorithms, CA4 – Efficient coding, model training, parameter tuning, and use of ML frameworks	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Model Evaluation, Result Analysis & Documentation	**0.75**	CA5 – Performance evaluation using Accuracy, Precision, Recall, F1-score, ROC, Confusion Matrix, CA6 – Interpretation of results, comparison of models, report preparation	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CA6 – Structured documentation and presentation, CA8 – Viva-voce and technical communication, PO7/CO10 – Ethical AI, data privacy, and responsible use of ML in Cyber Security	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10

		P11 — Financial feasibility and cost estimation		
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	Problem Definition & Dataset Understanding	Define the machine learning problem, identify cybersecurity objectives, select appropriate datasets, define features, labels, and success criteria.	CO7, CO8
CA2	Experimental Design & Environment Setup	Plan the ML experiment, configure Python, Jupyter Notebook, Scikit-learn, TensorFlow/Keras, prepare datasets, and select suitable ML algorithms.	CO7
CA3	Model Implementation & Execution	Implement machine learning algorithms, perform data preprocessing, feature engineering, model training, testing, and prediction correctly.	CO7
CA4	Model Optimization & Computational Efficiency	Optimize model performance using feature selection, hyperparameter tuning, cross-validation, and efficient utilization of ML frameworks.	CO7
CA5	Model Evaluation & Result Interpretation	Evaluate models using Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC-AUC, compare models, and interpret results.	CO8
CA6	Documentation & Outcome Verification	Prepare structured lab reports with code, outputs, graphs, screenshots, observations, and validate results against objectives.	CO7, CO8
CA7	ML Workflow & Solution Design	Design complete machine learning workflows including data preparation, model selection, training, testing, evaluation, and cybersecurity solution planning.	CO7, CO8
CA8	Lab Record, Presentation & Professional Ethics	Maintain laboratory records, demonstrate conceptual understanding during viva, communicate results effectively, and follow ethical AI and cybersecurity practices.	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	Problem Scoping & Requirements	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	Innovative Solution Proposal	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	Professional Toolchain	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	End-to-End Implementation	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	System Commissioning & Testing	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	Individual Skill Growth Mapping	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	Professional Attitude, Ethics & Responsibility	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions	CA Skill Dimensions	Project Skill Dimensions

	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1: Prob. Def.	CA2 Exp. Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc. Outcome	CA7 Algo. Design	CA8 Lab Rec./ Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	2	3	1	1	1	2	3	2	2
CO2	3	3	2	2	3	-	2	2	-	1	2	3	3	2
CO3	2	3	3	3	3	-	2	-	-	1	2	3	3	3
CO4	3	2	2	3	3	-	2	-	1	-	2	3	3	2
CO5	2	3	-	2	2	2	2	-	1	2	3	2	3	2
CO6	2	2	-	-	-	1	-	-	3	2	2	2	2	2
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	2.50	2.29	2.20	2.17	2.57	1.67	2.33	2.00	1.80	1.67	2.25	2.44	2.50	2.30

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M	-	M	M	M	H				M
CO2	H	H	M	M	H	-	M	M	-		M
CO3	M	H	H	H	H	-	M	-	-		M
CO4	H	M	M	H	H	-	M	-		-	M
CO5	M	H	-	M	M	M	M	-		M	H
CO6	M	M	-	-	-		-	-	H	M	M
CO7	–	–		–	H		–	–	–	–	–
CO8	–		H		M	H	–	–	–	–	–
CO9	–	–	–	–	–	–	H	–	–	–	H

CO10	–	–	–	–	–		–	H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Develops strong foundations in Machine Learning, Artificial Intelligence, and Cyber Security through hands-on learning, problem-solving, and lifelong learning skills (CO1–CO6).
SDG 8	Decent Work & Economic Growth	3 (High)	Equips students with industry-relevant skills in machine learning, data analytics, cybersecurity, and AI frameworks, enhancing employability in emerging technology domains (CO3–CO6).
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Promotes the design of intelligent cyber defense systems, secure AI solutions, and innovative machine learning models for cybersecurity applications (CO4–CO6).
SDG 12	Peace, Justice & Strong Institutions	2 (Moderate)	Supports secure digital infrastructure through AI-based threat detection, intrusion detection, malware analysis, and ethical cybersecurity practices (CO2–CO6).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)
Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Integrated Professional Communication and Intelligent Computing

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester IV | Batch 2026–2030

Lab-Only Course Plan — All 6 Lab COs (CO1–CO6) | New AICTE 11-PO Framework | Full Skill Mapping

PART I COURSE SYLLABUS *Course Identification, Details, Outcomes, BTL Mapping & Lab Session Plan*

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2027–28
Branch:	CSE	**Semester:**	IV
Course Code:	SKP2401	**Course Type:**	Core

2. Course Details

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.

1	**Course Code**	SKP2401
2	**Course Title**	Integrated Professional Communication and Intelligent Computing
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	0-0-6-0 (Tutorial: 90 hrs)
5	**Course Status**	Core
6	**Course Objectives**	The objective of this course is to develop learners into confident, industry-ready professionals by strengthening their professional communication, presentation, public speaking, interview, and LSRW skills along with computational thinking, machine learning fundamentals, advanced data structures, and modern frontend development capabilities. The course aims to enhance verbal ability, critical thinking, quantitative aptitude, logical reasoning, problem-solving skills, and workplace readiness through structured activities, practical exercises, experiential learning, and industry-oriented software development practices. By the end of the course, learners will demonstrate improved communication competence, analytical ability, professional etiquette, and the capability to design scalable and effective technological solutions for academic, corporate, and real-world environments.
7	**Course Outcomes (COs)**	After successful completion of this course, the students will be able to: **CO1 (Remember – BTL1): Communication & Computing Fundamentals** Recall the fundamental concepts of professional communication, workplace readiness, machine learning, advanced data structures, and modern frontend development technologies. **CO2 (Understand – BTL2): Business Communication & Technical Workflows** Explain the principles of business communication, interpersonal effectiveness, machine learning workflows, data structure operations, JavaScript programming, and asynchronous processing techniques. **CO3 (Apply – BTL3): Professional Interaction & Computational Problem Solving** Apply communication strategies, interview and presentation skills, quantitative aptitude, logical reasoning, data structure techniques, API integration, and frontend development

		practices to solve real-world problems. **CO4 (Analyze – BTL4): Critical Thinking, LSRW & System Analysis** Analyze workplace scenarios, verbal communication, machine learning models, graph algorithms, and advanced computational structures using critical thinking and structured analytical approaches. **CO5 (Evaluate – BTL5): Decision Making & Technology Evaluation** Evaluate communication strategies, logical reasoning methods, machine learning algorithms, data structures, and frontend development approaches for effective and scalable solutions. **CO6 (Create – BTL6): Industry-Oriented Communication & Application Development** Design professional communication solutions and develop interactive, industry-oriented applications integrating modern frontend technologies, APIs, machine learning concepts, and problem-solving strategies.
8	**Course Description**	This course provides an interdisciplinary learning framework integrating professional communication, workplace readiness, machine learning fundamentals, advanced data structures, and modern JavaScript-based frontend development. The course focuses on enhancing business communication, presentation skills, interview readiness, LSRW proficiency, critical thinking, quantitative aptitude, logical reasoning, and professional etiquette alongside computational thinking, algorithmic problem-solving, machine learning workflows, API integration, and interactive web application development. Through practical activities, simulations, experiential learning, and project-based implementation using modern industry tools and technologies, students develop communication competence, analytical ability, technical proficiency, and industry-oriented problem-solving skills required for academic, corporate, and real-world environments.
9	**Teaching & Learning Scheme**	Lab Instructions (LI): 90 hrs | Total: 90 hrs | Credits: 3
10	**Mode of Examination**	Lab Only. CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
11	**Self Learning (SL: 0 hrs)**	-
12	**Textbook**	Lipschutz — Data Structures, Schaum's Outline Series, TMH 1. Business Communication Today – Bovee, Courtland L. & Thill, John V.A comprehensive resource covering professional communication, business interaction, presentations, workplace communication, and interpersonal effectiveness. 2. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow – Aurélien Géron Covers machine learning fundamentals, regression, classification, and practical implementation using modern ML frameworks. 3. Data Structures and Algorithms Made Easy – Narasimha Karumanchi Provides strong conceptual and practical understanding of trees, heaps, hashing, graphs, and algorithmic problem solving. 4.JavaScript and JQuery: Interactive Front-End Web Development – Jon Duckett Focuses on JavaScript fundamentals, DOM manipulation, asynchronous programming, API integration, and interactive frontend development. 5.Quantitative Aptitude for Competitive Examinations & A Modern Approach to Verbal & Non-Verbal Reasoning – R.S. Aggarwal Covers quantitative aptitude, logical reasoning, analytical thinking, verbal ability, and placement-oriented problem-solving techniques.
13	**References**	1. *Communication Skills* – Sanjay Kumar & Pushp Lata Widely used in Indian universities; covers LSRW skills, interpersonal communication, presentation techniques, and professional communication. 2. *Soft Skills* – Alex K. Focuses on personality development, leadership communication, employability skills, workplace etiquette, and professional behavior. 3. *English Grammar in Use* – Raymond Murphy Useful for grammar improvement, sentence correction, language accuracy, and verbal ability enhancement. 4. *Word Power Made Easy* – Norman Lewis Highly effective for vocabulary building, speaking fluency, and verbal communication development. 5. *Cracking the Coding Interview & Placement Aptitude* – Various Authors Useful for company-specific aptitude preparation, logical reasoning, and placement-oriented analytical thinking. 6. Online Resources: • British Council Learning English – Grammar, listening, speaking, and

		workplace communication practice • Toastmasters International – Public speaking and leadership communication frameworks • EFSET & Speak and Improve Tools – LSRW assessment and speaking practice • Overleaf Resume Tools – ATS-based resume building and formatting • Newspaper editorials (*The Hindu* / *Indian Express*) for reading comprehension, vocabulary, and critical thinking practice 7. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning. 8. Kyle Simpson, You Don't Know JS Series. 9. Reema Thareja, Data Structures Using C. 10. David Flanagan, JavaScript: The Definitive Guide. 11. Ian Goodfellow, Deep Learning. 12. NPTEL – Machine Learning and Data Structures Courses. 13. MDN Web Docs – JavaScript and DOM. 14. LeetCode – Trees, BST, Heap, Graph and Hashing Problems. 15. Kaggle Learn – Machine Learning. 16. GeeksforGeeks – DSA and JavaScript. 17. JavaScript.info. 18. GitHub Learning Lab.

3. Outline Syllabus — Lab Units with CO Mapping

i All CO mappings refer to Lab COs (CO1–CO6). This is a lab-only course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit 1: Professional Communication, Computational Thinking & Programming Fundamentals ***(0-0-18-0 = 18 hrs)***	
A	Introduction to PRIDE Model of Communication, Models of Communication, Professional & Business Communication	**CO1**
B	Introduction to STAR Model of Communication, Understanding KRA, KPI, CTP & CTQ, Workplace Communication Readiness	**CO1**
C	Professional Grooming, Styling, Dressing, Etiquette & Workplace Behaviour	**CO1**
D	Introduction to Machine Learning, Importance and Applications of Machine Learning, Types of Machine Learning including Supervised, Unsupervised and Reinforcement Learning OR Introduction to JavaScript, Role of JavaScript in Web Applications, Linking JavaScript Files, Browser Console and Debugging.	**CO1**
E	Machine Learning Workflow including Data Collection, Training, Testing and Prediction OR Variables, Data Types, Operators, Template Literals, Input/Output Operations and Conditional Statements.	**CO1**
F	Tree Terminology, Binary Tree Properties, Perfect, Complete and Full Binary Trees	**CO2**
G	Tree Traversals including Inorder, Preorder, Postorder, Level Order Traversal and Iterative Traversals.	**CO2**
H	Height, Diameter, Lowest Common Ancestor, Path Sum Problems and Zigzag Traversals.	**CO2**
I	Serialization and Deserialization of Trees, Flatten Binary Tree and Binary Tree Camera Problems.	**CO2**

	Unit 2: Career Readiness, Machine Learning Applications & Advanced Programming Structures. ***(0-0-18-0 = 18 hrs)***	
A	Interview Skills & PI Practice – Pre-Interview Preparation, Grooming & Stress Interviews	**CO2**
B	AI Driven Interview Tools (REMASTO Tools), Understanding Job Descriptions (JD), Understanding Job Offers, Compensation & Benefits	**CO2**
C	Hands-on Resume Building using Overleaf, ATS Optimization, Keywords, Mass Hiring, Head Hunting & Poaching	**CO3**
D	Introduction to Regression Problems and Prediction Techniques, Linear Regression Concepts, Working and Applications **OR** JavaScript Loops, Nested Loops, Break and Continue Statements.	**CO3**
E	Building Simple Prediction Models using Linear Regression **OR** Functions, Parameters, Arrow Functions, Closures, Scope and Execution Context.	**CO3**
F	Arrays and Array Methods including map(), filter(), reduce(), splice(), slice() and Spread Operator.	**CO4**
G	Binary Search Tree Properties, Insertion, Deletion and Search Operations. BST Validation, Successor, Predecessor, Floor and Ceiling Operations.	**CO4**
H	AVL Tree Concepts, Rotation Operations and Height Balance Factor. BST to Sorted DLL Conversion, Recover BST and Kth Smallest Element Problems.	**CO4**
	Unit 3: Leadership Communication, Intelligent Systems & Interactive Programming Concepts. ***(0-0-18-0 = 18 hrs)***	
A	The Strategic Debate Matrix, Executive Panel Discussion, Corporate Crisis Communication Simulation	**CO3**
B	Situation-Based Speaking, Vocabulary Speaking Challenge, Thematic Appreciation Test (TAT)	**CO3**
C	Leadership Narration, Feedback Techniques using Sandwich Model, MBTI Personality Assessment	**CO3**
D	Introduction to Classification Problems and Binary Classification, Logistic Regression Algorithm, Sigmoid Function and Applications **OR** JavaScript Objects, Nested Objects, Object Methods and JSON Parsing.	**CO4**
E	Building Classification Models using Logistic Regression **OR** ES6 Features including Destructuring, Optional Chaining, Nullish Coalescing and Template Literals.	**CO4**
F	DOM Manipulation, Selecting Elements, Content Modification, Class Manipulation and Browser Inspection Tools.	**CO4**
G	Heap Properties, Min Heap and Max Heap, Array Representation and Parent–Child Relationships. Heapify Operations, Insert and Extract Operations, Build Heap Complexity.	**CO5**
H	Heap Sort, K-Way Merge and Top-K Problems.	**CO5**
I	Priority Queue Applications, Fibonacci Heap Concepts and Median of Data Stream.	**CO5**

	Unit 4: Advanced Communication, Intelligent Computing & Asynchronous Problem Solving. ***(0-0-18-0 = 18 hrs)***	
A	Advanced LSRW Practices, EFSET & Speak and Improve Tools, Reading Comprehension (Short & Long Passages)	**CO3**
B	Sentence Correction & Improvement, Paragraph Completion, Paragraph Jumbles, WriteX Activities	**CO3**
C	Vocabulary Development, Critical Thinking & Problem Solving, Workplace Writing & Communication Exercises	**CO4**
D	Decision Tree Algorithm, Working and Applications, K-Nearest Neighbors Algorithm and Distance Measurement Techniques OR DOM Traversal, Form Handling, Validation and Local Storage.	**CO4**
E	Building Classification Models using Decision Tree and KNN Algorithms OR Events, Event Listeners, Bubbling, Delegation and Timers.	**CO4**
F	Asynchronous JavaScript including Callbacks, Promises, Async/Await and Error Handling.	**CO5**
G	Hash Function Design, Collision Handling Techniques and Open Addressing. Load Factor, Rehashing, HashMap vs HashSet and Amortized Analysis.	**CO5**
H	Frequency Counting, Two Sum Pattern and Subarray Sum Problems. Rolling Hash, Bloom Filter and Consistent Hashing Concepts.	**CO5**
	Unit 5: Analytical Reasoning, Intelligent Applications & Graph-Based Problem Solving. ***(0-0-18-0 = 18 hrs)***	
A	Number System – Remainder, Average & Weighted Average, AP & GP, Quadratic Equations	**CO4**
B	Direction & Sense, Coded Direction, Blood Relations, Coded Blood Relations, Order & Ranking	**CO4**
C	Number Puzzles, Mathematical Operations, Cubes & Dice, Syllogism (Either-Or, Possibility, Some & Not)	**CO5**
D	Probability-Based Machine Learning Algorithms, Naive Bayes Algorithm, Working and Applications OR Fetch API, HTTP Requests, JSON Handling and Error Management	**CO5**
E	Building Text and Category Classification Models using Naive Bayes OR JavaScript Modules, import/export, Classes, Constructors and Inheritance.	**CO5**
F	Interactive API-Based Project Development, Dynamic UI Interaction and Deployment Workflow.	**CO6**
G	Graph Types including Directed, Undirected and Weighted Graphs. Adjacency Matrix, Adjacency List, Degree, Path and Cycle Concepts. Breadth First Search, Multi-source BFS and Shortest Path Problems.	**CO6**
H	Depth First Search, Topological Sorting, Connected Components, Bipartite Graphs and Flood Fill Algorithms	**CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1A - Introduction to PRIDE Model of Communication, Models of Communication, Professional & Business Communication	✔	✔				
1	1B - Introduction to STAR Model of Communication, Understanding KRA, KPI, CTP & CTQ, Workplace Communication Readiness		✔	✔			
1	1C - Professional Grooming, Styling, Dressing, Etiquette & Workplace Behaviour		✔	✔	✔		
1	1D - Introduction to Machine Learning, Importance and Applications of Machine Learning, Types of Machine Learning including Supervised, Unsupervised and Reinforcement Learning OR Introduction to JavaScript, Role of JavaScript in Web Applications, Linking JavaScript Files, Browser Console and Debugging.	✔	✔	✔			
1	1E - Machine Learning Workflow including Data Collection, Training, Testing and Prediction OR Variables, Data Types, Operators, Template Literals, Input/Output Operations and Conditional Statements.		✔	✔	✔		
1	1F - Tree Terminology, Binary Tree Properties, Perfect, Complete and Full Binary Trees	✔	✔	✔	✔		
1	1G - Tree Traversals including Inorder, Preorder, Postorder, Level Order Traversal and Iterative Traversals.		✔	✔	✔		
1	1H - Height, Diameter, Lowest Common Ancestor, Path Sum Problems and Zigzag Traversals.		✔	✔	✔	✔	
1	1I - Serialization and Deserialization of Trees, Flatten Binary Tree and Binary Tree Camera Problems.		✔	✔	✔	✔	✔
2	2A - Interview Skills & PI Practice – Pre-Interview Preparation, Grooming & Stress Interviews		✔	✔	✔		
2	2B - AI Driven Interview Tools (REMASTO Tools), Understanding Job Descriptions (JD), Understanding Job Offers, Compensation & Benefits		✔	✔	✔		
2	2C - Hands-on Resume Building using Overleaf, ATS Optimization, Keywords, Mass Hiring, Head Hunting & Poaching		✔	✔	✔	✔	
2	2D - Introduction to Regression Problems and Prediction Techniques, Linear Regression Concepts, Working and Applications OR JavaScript Loops, Nested Loops, Break and Continue Statements.	✔	✔	✔			
2	2E - Building Simple Prediction Models using Linear Regression OR Functions, Parameters, Arrow Functions, Closures, Scope and Execution Context.		✔	✔	✔		
2	2F - Arrays and Array Methods including map(), filter(), reduce(), splice(), slice() and Spread Operator.		✔	✔	✔		
2	2G - Binary Search Tree Properties, Insertion, Deletion and Search Operations.	✔	✔	✔	✔	✔	
2	2H - BST Validation, Successor, Predecessor, Floor and Ceiling Operations.		✔	✔	✔	✔	✔
3	3A - The Strategic Debate Matrix, Executive Panel Discussion, Corporate Crisis Communication Simulation		✔	✔	✔	✔	
3	3B - Situation-Based Speaking, Vocabulary Speaking Challenge, Thematic Appreciation Test (TAT)		✔	✔	✔		

3	3C - Leadership Narration, Feedback Techniques using Sandwich Model, MBTI Personality Assessment		✔	✔	✔	✔	
3	3D - Introduction to Classification Problems and Binary Classification, Logistic Regression Algorithm, Sigmoid Function and Applications OR JavaScript Objects, Nested Objects, Object Methods and JSON Parsing.	✔	✔	✔	✔		
3	3E - Building Classification Models using Logistic Regression OR ES6 Features including Destructuring, Optional Chaining, Nullish Coalescing and Template Literals.		✔	✔	✔		
3	3F - DOM Manipulation, Selecting Elements, Content Modification, Class Manipulation and Browser Inspection Tools.		✔	✔	✔	✔	
3	3G - Heap Properties, Min Heap and Max Heap, Array Representation and Parent–Child Relationships.	✔	✔	✔	✔		
3	3H - Heapify Operations, Insert and Extract Operations, Build Heap Complexity.		✔	✔	✔	✔	
3	3I - Priority Queue Applications, Fibonacci Heap Concepts and Median of Data Stream.		✔	✔	✔	✔	✔
4	4A - Advanced LSRW Practices, EFSET & Speak and Improve Tools, Reading Comprehension (Short & Long Passages)		✔	✔	✔	✔	
4	4B - Sentence Correction & Improvement, Paragraph Completion, Paragraph Jumbles, WriteX Activities		✔	✔	✔	✔	
4	4C - Vocabulary Development, Critical Thinking & Problem Solving, Workplace Writing & Communication Exercises		✔	✔	✔	✔	✔
4	4D - Decision Tree Algorithm, Working and Applications, K-Nearest Neighbors Algorithm and Distance Measurement Techniques OR DOM Traversal, Form Handling, Validation and Local Storage.	✔	✔	✔	✔		
4	4E - Building Classification Models using Decision Tree and KNN Algorithms OR Events, Event Listeners, Bubbling, Delegation and Timers.		✔	✔	✔		
4	4F - Asynchronous JavaScript including Callbacks, Promises, Async/Await and Error Handling.		✔	✔	✔	✔	
4	4G - Hash Function Design, Collision Handling Techniques and Open Addressing.	✔	✔	✔	✔		
4	4H - Load Factor, Rehashing, HashMap vs HashSet and Amortized Analysis.		✔	✔	✔	✔	✔
5	5A - Number System – Remainder, Average & Weighted Average, AP & GP, Quadratic Equations		✔	✔	✔	✔	
5	5B - Direction & Sense, Coded Direction, Blood Relations, Coded Blood Relations, Order & Ranking		✔	✔	✔	✔	
5	5C - Number Puzzles, Mathematical Operations, Cubes & Dice, Syllogism (Either-Or, Possibility, Some & Not)		✔	✔	✔	✔	✔
5	5D - Probability-Based Machine Learning Algorithms, Naive Bayes Algorithm, Working and Applications OR Fetch API, HTTP Requests, JSON Handling and Error Management	✔	✔	✔	✔		
5	5E - Building Text and Category Classification Models using Naive Bayes OR JavaScript Modules, import/export, Classes, Constructors and Inheritance.		✔	✔	✔	✔	
5	5F - Interactive API-Based Project Development, Dynamic UI Interaction and Deployment Workflow.		✔	✔	✔	✔	✔
5	5G - Graph Types including Directed, Undirected and Weighted Graphs.	✔	✔	✔	✔		

5	5H - Adjacency Matrix, Adjacency List, Degree, Path and Cycle Concepts.		✔	✔	✔	✔	✔

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ Only strong/dominant alignments are mapped. Lab COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**A1**	**A2**	**A3**	**A4**	**A5**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
CO1	✔	✔					✔	✔				✔	✔					
CO2		✔	✔					✔	✔			✔	✔	✔				
CO3			✔	✔				✔	✔	✔			✔	✔	✔			
CO4			✔	✔	✔			✔	✔	✔				✔	✔	✔		
CO5				✔	✔			✔	✔	✔	✔				✔	✔	✔	
CO6			✔	✔	✔	✔		✔	✔	✔	✔				✔	✔	✔	✔

Legend: ✔ = Strong / Dominant mapping only.

6. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	**30**	CO1–CO6 through assignments, presentations, coding activities, quizzes, aptitude practice, communication tasks, lab exercises, project work, and classroom participation
Course Examination (CE)	30%	**30**	CO1–CO4 through written examination, analytical problem solving, communication assessment, ML/DSA concepts, and programming-based questions
End Semester Examination (ESE)	40%	**40**	CO1–CO6 through comprehensive theory, application-based problem solving, case studies, programming logic, communication analysis, and project-oriented questions
TOTAL	**100%**	**100**	All COs assessed across CA, MTE, and ETE components

7. Continuous Assessment (CA) — 30 Marks

7.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Skill Dimensions Covered	Marking Guide	Lab CO
Problem Understanding, Communication & Experimental Design	0.75	Problem understanding, communication clarity, workflow design, algorithm/flowchart	0.75: Clearly defined with proper design & communication | 0.50: Partial understanding/design |	CO1–CO4

		preparation, tool/platform setup	0.25: Limited clarity | 0: Missing	
Implementation, Programming & Technical Execution	1.0	Code correctness, ML/DSA/JavaScript implementation, logical execution, debugging, tool usage	1.00: Correct and successfully executed | 0.50: Minor logical/syntax issues | 0: Not working/Incomplete	CO1–CO5
Output Analysis, Problem Solving & Documentation	0.75	Result interpretation, analytical thinking, output validation, lab record maintenance, screenshots/output presentation	0.75: Thorough analysis & documentation | 0.50: Adequate analysis | 0.25: Partial documentation | 0: Absent	CO3–CO5
Professional Behaviour, Teamwork & Ethical Practices	0.50	Professional conduct, communication etiquette, responsible coding practices, collaboration, originality, record integrity	0.50: Consistent professionalism & ethics | 0.25: Occasional compliance | 0: Absent	CO5-CO6
Total	**3.0**	Integrated communication, technical, analytical and professional skill development		CO1–CO6

7.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
More than 12	Best 10	30 Marks	Best 10 performance scores from practicals, coding tasks, communication activities, presentations, aptitude sessions, ML/DSA/JavaScript exercises, and project-based activities will be considered (3 Marks × 10 = 30).
10–12	Best 8–10 Evaluated Proportionally	Up to 30 Marks	Evaluation will be based on the number of activities conducted, maintaining proportional weightage and continuous assessment standards.
Less than 10	All Conducted Activities Counted	Up to 30 Marks	Missed activities/practicals/presentations will be treated as zero unless officially approved. No compensatory activity shall normally be provided.

8. Continuous Evaluation (CE) — 30 Marks

ℹ CE is a mid-point practical examination covering Units 1–3 (CO1–CO3). CO4, CO5, and CO6 are assessed in ESE only. CE maps to LS1–LS5.

Section	Marks	Skill Dimensions Covered	COs Assessed	Assessment Type & Guidelines
Sec A	10	Communication Skills, Tool Usage, Programming Fundamentals, Practical Execution	CO1, CO2	Practical task involving communication activity, JavaScript/ML/DSA implementation, or aptitude/problem-solving exercise. Students must demonstrate proper tool/platform usage and successful execution/output.
Sec B	10	Analytical Thinking, Data Structures/ML Logic, Problem Solving, Output Interpretation	CO2, CO3,CO4	Implementation-based task such as Trees, BST, Heap, Hashing, Graphs, ML workflow, API handling, or frontend interaction. Students must analyze logic, explain outputs, and justify solution approach.

Sec C (Viva)	10	Documentation, Presentation Skills, Professional Communication, Algorithmic Understanding	CO1–CO4	Viva voce, resume/presentation review, lab/activity record verification, communication assessment, algorithm explanation, debugging discussion, output interpretation, and professional interaction evaluation.
TOTAL	**30**	Communication, Technical, Analytical & Professional Skills	CO1–CO4	Units 1–3 based continuous practical evaluation through activities, coding exercises, presentations, discussions, and implementation tasks.

9. End Semester Examination (ESE) — 40 Marks

i ESE is comprehensive — all 5 units and all 6 COs. Full progression from LS2 (implementation) through LS8 (innovation). Minimum 16/40 required to pass.

Section	Marks	Skill Dimensions	COs Assessed	Assessment Type & Guidance
Sec A	10	Technical Implementation, Tool Usage, Communication & Practical Execution	CO1, CO2, CO3	Practical implementation task involving Data Structures, Machine Learning workflow, JavaScript programming, frontend interaction, or communication-based activity. Students must execute correctly and demonstrate proper tool/platform usage with expected output/results.
Sec B	20	Algorithmic Thinking, Analytical Ability, Problem Solving, Output Interpretation	CO3, CO4, CO5	Advanced implementation and analysis-based tasks such as Trees, BST, Heap, Hashing, Graph algorithms, ML classification/regression tasks, asynchronous JavaScript, API handling, or aptitude/problem-solving activities. Students must explain logic, analyze performance, interpret outputs, and justify solution/design approach.
Sec C	10	Professional Communication, Innovation, Documentation & Presentation Skills	CO5, CO6	Viva voce, presentation, mini-project demonstration, resume/interview evaluation, debugging discussion, algorithm design, UI/project explanation, professional communication assessment, and innovation-oriented problem-solving tasks.
TOTAL	**40**	Communication, Technical, Analytical, Professional & Innovation Skills	CO1–CO6	Comprehensive evaluation covering Units 1–5 through practical implementation, activities, viva, presentations, project demonstration, and analytical assessment. Minimum 16/40 required to pass.

9.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	LS Dims	PO Primary
CO1	Recall communication, ML, DSA and frontend fundamentals	✓	✓	✓	Communication Fundamentals, Tool Usage, Technical Understanding	PO1, PO5, PO9

CO2	Explain business communication, ML workflows and programming concepts	✓	✓	✓	Communication Skills, Programming Logic, Analytical Understanding	PO1, PO2,PO9
CO3	Apply communication strategies, DSA techniques, APIs and frontend practices	✓	✓	✓	Practical Implementation, Problem Solving, Technical Execution	PO1, PO2, PO3,PO5
CO4	Analyze workplace scenarios, ML models and graph/data structure problems	✓	✔	✓	Analytical Thinking, Algorithmic Analysis, Critical Reasoning	PO1, PO2, PO4
CO5	Evaluate communication methods, algorithms and development approaches	✓	—	✓	Evaluation Skills, Performance Analysis, Decision Making	PO1, PO2, PO8, PO10
CO6	Design professional solutions and interactive industry-oriented applications	✓	—	✓	Innovation, Application Development, Professional Competency	PO3, PO5, PO10, PO11

⚠ *CO4 and CO5 are NOT assessed in CE (only Units 1–3 are covered at the course examination). They are assessed in CA (lab sessions) and ESE.*

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

10. CO–PO and CO–PSO Mapping Matrix

i Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**2**	1	1	-	-	-	-		3	2	2	**2**	**1**	**1**
CO2	2	**2**	1	-	1	-	1	2	3	2	2	2	2	**1**
CO3	**2**	**3**	2	1	1	-	1	3	3	2	2	3	**2**	2
CO4	**2**	**3**	2	2	1	1	1	**2**	3	2	3	**2**	3	**2**
CO5	2	3	2	2	2	1	1	2	**2**	3	3	2	3	**2**
CO6	**2**	**3**	3	2	3	1	1	3	3	3	**3**	3	**3**	**3**
Avg	**2.00**	**2.50**	**1.83**	**1.75**	**1.60**	**1.0**	**1**	**2.17**	**2.83**	**2.33**	**2.50**	**2.35**	**2.35**	**1.83**

11. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M					M	H	M	M	M	M	M
CO2	M	M	M		M		M	M	H	M	M	M	M	
CO3	H	H	H	M	M		M	H	H	M	M	H	M	M
CO4	H	H	H	M	M	M	M	M	H	M	H	M	H	M
CO5	H	H	H	H	M	M	M	M	M	H	H	M	H	M
CO6	M	H	H	H	H	M	M	H	H	H	H	H	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

12. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall professional communication concepts, workplace terminology, ML fundamentals, DSA terminology, JavaScript syntax, aptitude concepts and frontend development basics. **L2 — Understand:** Explain communication models, ML workflows, DSA operations, frontend interaction concepts, API handling principles and analytical reasoning methods. **L3 — Apply:** Use communication strategies, coding techniques, ML methods, APIs, JavaScript concepts and problem-solving approaches in practical and workplace situations. **L4 — Analyze:** Analyze workplace scenarios, algorithms, graph problems, ML models, reasoning patterns, frontend behavior and communication effectiveness. **L5 — Evaluate:** Assess communication methods, algorithms, technical solutions, project implementations, reasoning approaches and professional practices. **L6 — Create:** Design professional communication solutions, interactive frontend applications, intelligent systems, ML-based projects and industry-oriented technical solutions.	**A1 — Receiving:** Awareness of workplace communication, professional etiquette, technical learning tools and collaborative activities. **A2 — Responding:** Active participation in discussions, coding exercises, presentations, mock interviews, aptitude activities and teamwork tasks. **A3 — Valuing:** Demonstrating responsibility, collaboration, ethical coding practices, professional communication and workplace discipline **A4 — Organizing:** Integrating communication skills, leadership qualities, teamwork, technical practices and problem-solving approaches into structured workflows. **A5 — Characterizing:** Consistent display of professionalism, communication confidence, ethical conduct, technical competency and industry readiness.	**P1 — Perception:** Identify communication tools, IDEs, APIs, browser tools, ML platforms, coding environments and technical resources. **P2 — Set:** Readiness for interviews, presentations, coding tasks, ML implementation, aptitude practice and frontend development activities. **P3 — Guided Response:** Perform communication activities, DSA implementation, ML exercises, JavaScript tasks and analytical problem-solving through guided practice. **P4 — Mechanism:** Independently execute coding, debugging, DOM manipulation, ML workflows, reasoning tasks and communication activities with accuracy. **P5 — Complex Overt Response:** Efficiently perform integrated technical activities including API integration, frontend interaction, ML model execution and project implementation. **P6 — Adaptation:** Modify communication styles, optimize algorithms, improve frontend behavior, adapt ML workflows and refine technical solutions for different scenarios. **P7 — Origination:** Create innovative applications, intelligent systems, professional communication solutions and industry-oriented software projects.

ℹ OBE Compliance Statement: This is a lab-only course. All 6 COs span all three domains — Cognitive (L3–L6) as the primary domain, Psychomotor (P3–P6) for implementation and design skills, and Affective (A2–A4) for professional and collaborative conduct — reflecting the skill-based, hands-on nature of laboratory assessment.

13. Attendance Policy & Pass/Fail Criteria

13.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Practical / Activity Sessions	75% Attendance	Communication activities, ML/DSA practicals, JavaScript/frontend sessions, aptitude activities, presentations and industry-oriented lab sessions	Students below the minimum attendance requirement may be debarred from Continuous Evaluation (CE) and End Semester Examination (ESE) as per institute norms
Continuous Assessment Activities	Completion of Assigned Activities	Coding exercises, communication tasks, presentations, mock interviews, ML/DSA assignments, frontend/API activities and aptitude practice	Incomplete or missing activities directly affect Continuous Assessment (CA) marks
Lab Record / Documentation	Regular Submission & Verification	Practical records, coding documentation, presentation reports and project/activity submissions	Incomplete documentation may reduce CA/CE evaluation marks
Professional Participation	Active Involvement	Team discussions, viva voce, collaborative activities, communication exercises and project demonstrations	Lack of participation may affect professionalism, communication and activity-based evaluation components

⚠ *Lab attendance must meet 75% minimum. Missing SL activities (coding platform submissions) directly impacts CA marks and is not compensable by examination performance.*

13.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	≥ 16 / 40	**MANDATORY**	Minimum 40% marks in ESE are required. Failure to secure the minimum ESE marks may result in failure in the course irrespective of performance in CA and CE components.
Overall Total (CA + CE + ESE)	≥ 40 / 100	**Must pass overall**	Continuous Assessment (30) + Continuous Evaluation (30) + End Semester Examination (40) together constitute the total course assessment. Students must secure minimum overall passing marks as prescribed by institutional regulations.
Practical / Activity Participation	Satisfactory Completion	Mandatory for Course Completion	Students are expected to complete communication activities, coding exercises, ML/DSA practicals, JavaScript/frontend tasks, presentations and documentation requirements.
Professional & Academic Compliance	Mandatory	Required	Ethical practices, originality in submissions, professional conduct and timely completion of activities are compulsory as per institutional and course guidelines.

CSCR1505 — LAB-ONLY COURSE PLAN — MEASUREMENT ARCHITECTURE
11 Programme Outcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments → 8 Lab Skill Dimensions (LS1–LS8)
CO1–CO3: Apply/Analyse → LS1–LS3, LS6 → CA + CE + ESE
CO4–CO5: Analyse/Evaluate → LS3–LS5, LS7 → CA + ESE
CO6: Create → LS7–LS8 → CA + ESE Sec C
Marks: CA 30 + CE 30 + ESE 40 = Total 100

Semester 5, Credits: 23	
COURSE CODE	**COURSE NAME**
CSCR3310	AI & Machine Learning
CSCR3311	Design and Analysis of Algorithm
CSCR3600	Project Based Learning (PBL) -3 (Hackathon Based)
CSCR3110	Data Mining & Warehousing
CSCR3700	Summer Internship-I
	Program Elective-2
CSCR3203	Intro to LLMs
CSAD3510	Web & Text Analysis
CSOT3200/CSOT3201	Raspberry Pi and its Programming /Raspberry Pi and its Programming Lab
CSCF3200	Disaster Recovery Management
CCP3001	Community Connect
SKP3501	Integrated Professional Communication and Intelligent Computing

COURSE PLAN

AI & Machine Learning (CSCR3310)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester V | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE — School of Computing Science & Engineering	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	V

2. Course Details

Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.

S.No	Attribute	Details
1	**Course Code**	CSCR3310
2	**Course Title**	AI & Machine Learning
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	This course aims to introduce students to the core concepts of Artificial Intelligence and Machine Learning, including intelligent systems, knowledge representation, and learning algorithms. It focuses on building practical skills in supervised and unsupervised learning, neural networks, and model evaluation, while encouraging ethical, explainable, and real-world AI/ML applications using modern tools and techniques.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Recall and explain the core concepts and approaches in Artificial Intelligence and Machine Learning. CO2 (Understand – L2): Demonstrate appropriate search algorithms and logic-based techniques to solve AI problems. CO3 (Apply – L3): Make use of supervised learning models for classification and regression tasks. CO4 (Analyze – L4): Analyze and interpret results from unsupervised learning models and neural networks. CO5 (Evaluate – L5): Evaluate ML models using suitable performance metrics. CO6 (Create – L6): Develop AI/ML applications addressing real-world problems with ethical and social considerations. **LAB COs — Assessed via Laboratory Assessment only:**

		CO7 (Apply – L3): Implement and demonstrate fundamental AI search algorithms and rule-based systems to solve structured problems. CO8 (Create – L5/L6): Preprocess and explore real-world datasets for effective model development using appropriate data handling and visualization techniques. CO9 (Apply – L2/L3): Develop and evaluate machine learning models using supervised learning algorithms such as regression, decision trees, and SVM. CO10 (Apply – L3): Compare unsupervised learning techniques and neural networks for pattern recognition and feature extraction from data.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self-Learning (SL: 45 hrs.)**	1. Activity: Dataset Analysis and Visualization (Python/Excel/R); No. of hours: Data study=5 h; Analysis= 5 h; Visualization/report= 5 h, Total =15h; Evaluation Criteria: Correctness of analysis, interpretation of results, and visualization clarity. 2. Activity: Application / Software Development (AI/ML Model); No. of hours:15h; Evaluation Criteria: Depending on the complexity of the Application/software based on model performance, code quality, and innovation. 3.MOOC Courses - Coursera Machine Learning (Andrew Ng), NPTEL – Machine Learning
11	**Textbook**	1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021. 2. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1997. 3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly, 2022.
12	**References**	1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016. 2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012. 3. Elaine Rich and Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw-Hill, 2009.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).

	Topic / Activity	CO Mapping
Unit 1	**Foundations of Artificial Intelligence (5-0-5-5 = 15 hrs)**	
A	Definition and evolution of AI; Characteristics and classification of agents; PEAS framework, rationality and environment types.	CO1, CO2, CO3
B	Problem formulation and state-space representation; Uninformed Search: BFS, DFS, Depth-limited, Iterative deepening; Heuristic Search: Greedy Best-First, A*, Hill Climbing.	
C	Minimax algorithm, Alpha-beta pruning; Games as search problems, evaluation functions; Constraint Satisfaction Problems (CSPs): Backtracking, MRV, Forward checking.	
Tools Used	Python, Jupyter Notebook, AI simulators	
Activities	**Objective:** To understand intelligent agents and implement search strategies for problem solving.	

	• Implement BFS and DFS using Python • Solve 8-puzzle using A* algorithm • Design PEAS description for real-world problems • Demonstrate CSP using Sudoku problem	
Unit 2	**Knowledge Representation and Reasoning (10-0-7-8) = 25 hrs)**	
A	Propositional logic: syntax, semantics, inference; First-Order Logic (FOL): quantifiers, unification, resolution; Conversion to CNF and inference rules.	CO1,CO2,CO4
B	Semantic networks and frame-based systems; Production rules and inference mechanisms (forward/backward chaining);' Expert Systems architecture.	
C	Bayesian Networks: structure, joint probability, conditional independence; Inference in Bayesian networks; Introduction to Markov models and HMMs.	
Tools Used	Python, Jupyter Notebook ,Bayesian Network libraries	
Activities	**Objective:** To represent knowledge and perform logical/probabilistic reasoning. • Convert statements into CNF • Implement forward and backward chaining • Build a simple expert system • Perform inference using Bayesian networks	
Unit 3	**Supervised Learning Fundamentals (10-0-8-10) = 30 hrs)**	
A	Overview: supervised vs unsupervised vs reinforcement learning; Linear regression: cost function, gradient descent; Logistic regression for classification.	CO3, CO5
B	Decision Trees: entropy, information gain, pruning; k-NN classifier and distance metrics; Support Vector Machines (SVMs) with kernel tricks.	
C	Train-test split, k-fold cross-validation; Evaluation metrics: accuracy, precision, recall, F1, ROC, AUC; Hyperparameter tuning, grid search, bias-variance trade-off.	
Tools Used	Python, Scikit-learn, Pandas, NumPy, Matplotlib	
Activities	**Objective:** To build and evaluate supervised learning models. • Implement Linear Regression using Python • Train Decision Tree and k-NN models • Perform classification using SVM • Evaluate models using confusion matrix and ROC curve	
Unit 4	**Unsupervised Learning and Neural Networks (10-0-8-10) = 30 hrs)**	
A	Clustering: K-means, Hierarchical, DBSCAN; Silhouette score, Elbow method; PCA and t-SNE: feature extraction and visualization.	CO4, CO5,CO6
B	Perceptron model, MLP structure; Activation functions, backpropagation, loss functions; Training neural networks using gradient descent variants.	
C	CNNs: architecture, convolution and pooling; Introduction to RNNs and sequence modeling; Frameworks: TensorFlow, PyTorch overview.	

Tools Used	Python, TensorFlow, PyTorch, Scikit-learn	
Activities	**Objective:** To analyze data using unsupervised learning and implement neural networks. • Perform clustering using K-means • Apply PCA for dimensionality reduction • Implement a simple neural network • Demonstrate CNN on image dataset	
Unit 5	**Applications, Ethics, and Emerging Trends (10-0-7-12) = 29 hrs)**	
A	Use cases: Healthcare diagnostics, NLP (chatbots), Computer Vision, Finance; Smart systems and autonomous agents; Open-source projects and datasets (Kaggle, ImageNet, etc.)	CO6
B	Bias and fairness in algorithms; LIME, SHAP for explainability; Responsible AI and societal impact.	
C	Reinforcement Learning basics; Transfer learning and foundation models (e.g., GPT, BERT); AI safety, regulation, and responsible deployment.	
Tools Used	TensorFlow, PyTorch, Hugging Face, Kaggle, OpenAI tools	
Activities	**Objective:** To design AI solutions and understand ethical implications. • Case study on AI applications • Implement NLP task using pre-trained models • Perform model explainability using SHAP • Mini project on real-world AI problem	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B	✓	✓	✓			
3	1.C	✓	✓	✓	✓		
4	2.A		✓	✓	✓		
5	2.B		✓	✓	✓		
6	2.C		✓	✓	✓	✓	
7	3.A		✓	✓			
8	3.B		✓	✓	✓		
9	3.C		✓	✓	✓	✓	
10	4.A		✓	✓	✓		
11	4.B		✓	✓	✓		
12	4.C		✓	✓	✓	✓	
13	5.A		✓	✓	✓	✓	✓

14	5.B		✓	✓	✓	✓	✓
15	5.C		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓						✓					✓				
CO4				✓						✓				✓	✓			
CO5					✓						✓				✓	✓		
CO6						✓		✓		✓					✓	✓	✓	
CO7			✓					✓					✓	✓				
CO8				✓	✓	✓		✓					✓	✓	✓	✓		
CO9		✓	✓						✓	✓			✓	✓				
CO10			✓					✓		✓			✓		✓			

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Definition and evolution of AI; Characteristics and classification of agents; PEAS framework, rationality and environment types.	Unit 1	5
DD/MM/YY	Problem formulation and state-space representation; Uninformed Search: BFS, DFS, Depth-limited, Iterative deepening.		
DD/MM/YY	Heuristic Search: Greedy Best-First, A*, Hill Climbing. Minimax algorithm, Alpha-beta pruning; Games as search problems, evaluation functions;		
DD/MM/YY	Activation Functions, ReLU, Softmax, Sigmoid, Error Functions.		
DD/MM/YY	Constraint Satisfaction Problems (CSPs): Backtracking, MRV, Forward checking.		
DD/MM/YY	Propositional logic: syntax, semantics, inference.	Unit 2	10
DD/MM/YY	First-Order Logic (FOL): quantifiers, unification, resolution		
DD/MM/YY	Conversion to CNF and inference rules.		
DD/MM/YY	Semantic networks and frame-based systems		

DD/MM/YY	Production rules and inference mechanisms (forward/backward chaining)		
DD/MM/YY	Expert Systems architecture.		
DD/MM/YY	Bayesian Networks: structure, joint probability, conditional independence.		
DD/MM/YY	Inference in Bayesian networks.		
DD/MM/YY	Introduction to Markov models and HMMs.		
DD/MM/YY	Introduction to HMMs.		
DD/MM/YY	Overview: supervised vs unsupervised vs reinforcement learning	**Unit 3**	10
DD/MM/YY	Linear regression: cost function, gradient descent.		
DD/MM/YY	Logistic regression for classification.		
DD/MM/YY	Decision Trees: entropy, information gain, pruning.		
DD/MM/YY	k-NN classifier and distance metrics.		
DD/MM/YY	Support Vector Machines (SVMs) with kernel tricks.		
DD/MM/YY	Train-test split, k-fold cross-validation.		
DD/MM/YY	Evaluation metrics: accuracy, precision, recall.		
DD/MM/YY	Evaluation metrics: F1, ROC, AUC.		
DD/MM/YY	Hyperparameter tuning, grid search, bias-variance trade-off.		
DD/MM/YY	Clustering: K-means, Hierarchical, DBSCAN.	**Unit 4**	10
DD/MM/YY	Silhouette score, Elbow method; PCA and t-SNE.		
DD/MM/YY	Feature extraction and visualization.		
DD/MM/YY	Perceptron model, MLP structure; Activation functions.		
DD/MM/YY	Backpropagation, and loss functions.		
DD/MM/YY	Training neural networks using gradient descent variants.		
DD/MM/YY	CNNs: architecture, convolution and pooling		
DD/MM/YY	Introduction to sequence modeling.		
DD/MM/YY	Introduction to RNNs.		
DD/MM/YY	Frameworks: TensorFlow, PyTorch overview.		
DD/MM/YY	Use cases: Healthcare diagnostics, NLP (chatbots), Computer Vision, Finance.	**Unit 5**	10
DD/MM/YY	Smart systems and autonomous agents.		
DD/MM/YY	Open-source projects and datasets (Kaggle, ImageNet, etc.)		
DD/MM/YY	Bias and fairness in algorithms.		
DD/MM/YY	LIME, SHAP for explainability.		
DD/MM/YY	Responsible AI and societal impact.		
DD/MM/YY	Reinforcement Learning basics.		
DD/MM/YY	Transfer learning		
DD/MM/YY	Foundation models (e.g., GPT, BERT).		
DD/MM/YY	AI safety, regulation, and responsible deployment.		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Implement uninformed search algorithms: Breadth First Search (BFS) and Depth First Search (DFS) for problem solving.	CO7	3.0
	S-1.2	Implement informed search algorithms: A* and Greedy Best-First Search for optimal path finding.	CO7	
W2	S-2.1	Implement rule-based system using forward and backward chaining for logical inference.	CO7	3.0
	S-2.2	Perform Exploratory Data Analysis (EDA) using histograms, scatter plots, and boxplots to identify patterns in data using Python libraries (Matplotlib/Seaborn).	CO8	
W3	S-3.1	Implement categorical data encoding using Label Encoding and One-Hot Encoding and analyze their impact on the dataset.	CO8	3.0
	S-3.2	Generate a correlation heatmap and identify highly correlated features for feature selection.	CO8	
W4	S-4.1	Analyze class imbalance in a dataset and apply balancing techniques such as undersampling or SMOTE.	CO8	3.0
	S-4.2	Perform feature selection using filter methods such as correlation and chi-square test.	CO8	
W5	S-5.1	Perform feature engineering by creating new features from existing attributes and evaluate their usefulness.	CO8	3.0
W6	S-6.1	Perform train-test split on **House Price Prediction dataset (Kaggle)** and evaluate regression/classification results.	CO9	3.0
	S-6.2	Apply pruning techniques on Decision Tree using **Heart Disease dataset (Kaggle)** and compare performance.	CO9	
W7	S-7.1	Apply k-fold cross-validation on **Wine Quality dataset (Kaggle)** and compare with train-test split accuracy.	CO9	3.0
W8	S-8.1	Implement Decision Tree classifier using entropy and information gain on **Titanic dataset (Kaggle)** and evaluate performance using accuracy, precision, recall, and F1-score.	CO9	3.0
	S-8.2	Implement k-NN and Support Vector Machine (SVM) and perform hyperparameter tuning using Grid Search on **Breast Cancer dataset (Kaggle)**.	CO9	
W9	S-9.1	Implement K-Means clustering and visualize clusters using real datasets.	CO10	3.0
	S-9.2	Apply Principal Component Analysis (PCA) for dimensionality reduction and visualization.	CO10	
W10	S-10.1	Implement Artificial Neural Network (ANN) using TensorFlow/Keras or PyTorch.	CO10	3.0
	S-10.2	Develop and train a simple Convolutional Neural Network (CNN) for image classification.	CO10	
W11	S-11.1	Evaluate ML models using Cross-validation, Confusion Matrix, plot ROC Curve and compute AUC score using **Credit Card Fraud Detection dataset (Kaggle)**.	CO9	3.0

W12	S-12.1	Perform Model Explainability using SHAP/LIME and analyze bias and fairness in predictions.	**CO9**	3.0
W13	S-13.1	Mini Project: Develop an end-to-end ML pipeline (data preprocessing → model → evaluation → deployment concept).	**CO8,CO10**	3.0
W14	S-14.1	Project Presentation and Report Submission including ethical considerations and real-world impact analysis.	**CO9,CO10**	3.0

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only

Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Fundamentals of AI & Intelligent Agents**	Recall AI concepts, types of agents, PEAS framework, search problem formulation, basic terminology	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Search Algorithms & Knowledge Representation**	Explain uninformed/informed search, logic (FOL, propositional), inference, Bayesian reasoning	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Supervised Learning Models**	Apply regression, classification (Decision Tree, k-NN, SVM) and implement ML workflows.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Unsupervised Learning & Neural Networks**	Analyze clustering (K-means), PCA, neural networks, CNN/RNN fundamentals and interpret results	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Model Evaluation & Optimization**	Evaluate models using metrics (Accuracy, Precision, Recall, ROC), cross-validation, bias-variance, and tuning.	CO5 | L5	ETE Sec B/C
TS6	**AI System Design & Ethical Applications**	Design AI/ML solutions for real-world problems with ethical considerations and explainability	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type

Sec A	**4**	TS1 — AI Fundamentals TS2 — Search & Knowledge Representation	**CO1, CO2**	Short-answer: definitions, agent types, search strategies, logic-based reasoning.
Sec B	**6**	TS3 — Supervised Learning TS4 — Unsupervised Learning & NN	**CO3, CO4**	Problem-solving: model selection, algorithm steps, result interpretation
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — AI Fundamentals TS2 — Search & Knowledge Representation	**CO1, CO2**	Short questions: MCQs, definitions, logic inference, and search concepts.
Sec B	**50**	TS3 — Supervised Learning TS4 — Unsupervised Learning TS5 — Model Evaluation	**CO3, CO4, CO5**	Medium questions: algorithm implementation steps, comparisons, evaluation metrics, and tuning.
Sec C	**25**	TS5 — Model Evaluation TS6 — AI System Design & Ethics	**CO5, CO6**	Long/design questions: real-world problem solving, system design, and ethical justification.
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: dataset selection, features, target variable, success metrics (accuracy, loss, etc.) CA2 — Experimental design: model selection, preprocessing pipeline, tool/framework setup (Python, TensorFlow, Scikit-learn) CA7 — Algorithm/flowchart/model pipeline design (ML workflow)	1.0: Well-defined ML problem and proper model design | 0.5: Partial definition/design | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Correct implementation of ML algorithms; successful execution with expected outputs CA4 — Efficiency: appropriate model choice, hyperparameter tuning, optimized training time, resource usage	1.0: Correct & efficient model execution | 0.5: Correct but not optimized | 0: Execution fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Interpretation of results (accuracy, confusion matrix, ROC, loss curves) CA6 — Proper documentation of results and validation against objectives CA8 — Complete lab record; ability to explain model behavior (viva)	0.75: Thorough analysis & documentation | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Ethical use of datasets, proper citation, avoidance of plagiarism PO7 — Responsible AI practices (bias awareness, fairness, data privacy)	0.25: Consistent ethical practice | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; AI application relevance (healthcare, finance, NLP, etc.) P2 — Problem definition: dataset, features, stakeholders, objectives P4 — Innovative ML/DL solution with alternative models (e.g., regression vs NN)	1.5: Clearly mapped real-world AI problem with innovation | 1.0: Adequate scope | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Project planning: dataset acquisition, preprocessing steps, milestones	1.5: Detailed planning with feasibility |	CO10 / PO10

		P11 — Cost/resource estimation: compute cost (GPU/Cloud), tools, deployment feasibility	1.0: Adequate | 0.5: Basic | 0: Absent	
End-to-End Implementation & System Operation	**2.0**	P5 — Toolchain: Python, Scikit-learn, TensorFlow, PyTorch, APIs P6 — Full ML pipeline: preprocessing → model → evaluation → deployment (optional) P7 — System testing: validation, tuning, real-time or batch testing	2.0: Fully functional ML system | 1–1.5: Partially implemented | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Performance evaluation using metrics (Accuracy, Precision, Recall, F1, ROC, etc.) P9 — Comparative analysis (multiple models, hyperparameters); structured technical report	2.0: Rigorous analysis with justification | 1.5: Good | 1.0: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Clear communication of ML pipeline and results; testing strategy explanation P10 — Professional presentation (slides, demo, visualization dashboards) and teamwork	2.0: Excellent presentation & collaboration | 1.5: Good | 1.0: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Reflection on learning: tools, algorithms, challenges P13 — Ethical AI practices: bias handling, fairness, data privacy, responsible use	1.0: Deep reflection & ethical awareness | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define ML problem (classification/regression/clustering); identify dataset, features, target variable, and performance metrics (accuracy, precision, recall, F1, ROC).	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan ML workflow: data preprocessing, model selection, pipeline design; configure tools (Python, Jupyter, Scikit-learn, TensorFlow, PyTorch).	CO7
CA3	**Code Implementation & Execution**	Implement ML algorithms correctly; execute models and obtain expected outputs using appropriate libraries.	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate model efficiency; optimize using hyperparameter tuning, regularization, feature selection, and resource-aware training.	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse model outputs using metrics (confusion matrix, ROC, loss curves); interpret results and identify model strengths/limitations.	CO8
CA6	**Documented Outcome with Verification**	Document ML pipeline and results; validate outcomes against objectives and dataset characteristics.	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Design ML pipeline/algorithm (data flow, model selection, evaluation strategy); justify choice of algorithms and techniques.	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain structured lab records (code, outputs, graphs); demonstrate conceptual clarity and explain model behavior during viva.	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map AI/ML project to relevant SDGs (healthcare, finance, environment, smart systems); articulate societal impact and ethical implications.	CO8 | PO6

P2	**Problem Scoping & Requirements**	Define ML problem (classification/regression/clustering); dataset selection, feature identification, measurable objectives.	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; define testing/validation strategy (train-test split, cross-validation); coordinate team tasks.	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose AI/ML solution with alternative models (e.g., DT vs SVM vs NN); justify using performance and constraints.	CO8 | PO3
P5	**Professional Toolchain**	Select and justify tools (Python, Scikit-learn, TensorFlow, PyTorch, APIs, cloud platforms); environment setup.	CO7 | PO5
P6	**End-to-End Implementation**	Build full ML pipeline: data preprocessing → feature engineering → model training → evaluation → deployment (optional).	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy/test model; perform validation, edge-case testing, hyperparameter tuning, robustness checks.	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate performance using metrics (Accuracy, Precision, Recall, F1, ROC, AUC); compare outcomes with objectives.	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative analysis across models; statistical evaluation; structured technical report with visualizations.	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation (slides/demo/dashboard); demonstrate teamwork and role distribution.	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate cost (compute, cloud, data acquisition); justify resource utilization and scalability.	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Reflect on learning (algorithms, tools, challenges); map individual contribution to project components.	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Ensure ethical AI practices: bias mitigation, fairness, data privacy, responsible model usage and reporting.	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.

Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).

Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 -Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					

CO6			M		M	H																				
CO7							H	H	H	M		M	M	H					H	H	H					M
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M			
CO9											M			H											H	H
CO10														H		M	H			M	H	M	H	H	H	

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	–	–	–	–	–	–	–	–	1	2	1	–
CO2	3	3	2	2	–	–	–	–	1	–	2	2	2	2
CO3	3	3	3	2	2	2	–	–	1	1	2	3	3	2
CO4	2	3	2	3	2	–	–	–	–	–	2	2	3	2
CO5	2	3	3	3	3	–	–	–	–	–	2	2	3	2
CO6	2	2	3	3	3	3	2	2	2	3	3	3	3	3
CO7	–	–	2	–	3	1	–	–	–	–	–	2	3	3
CO8	–	2	3	2	–	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	2	–	3	3	3	2	2	2	2
Avg	**2.5**	**2.43**	**2.57**	**2.5**	**2.6**	**2.2**	**2.5**	**2.5**	**1.75**	**2.33**	**2.15**	**2.22**	**2.4**	**2.33**

PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									M
CO2	H	H	M	M			M				M
CO3	M	H	H	M	M	M			M		M
CO4	M	H	M	H	M		M	M	M		M
CO5	M	H	H	H	H		M	M	M		M
CO6	M	M	H	H	H	H	M	M	M	M	H
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H		M		H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Provides strong foundation in AI/ML concepts, computational thinking, and problem-solving skills; supports lifelong learning and adaptability in emerging technologies (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant AI/ML skills such as model building, evaluation, and tool usage; enhances employability in data science, AI, and analytics domains (CO3, CO5, CO7, CO9).
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Encourages innovation through development of intelligent systems and real-world AI applications; supports infrastructure through data-driven decision-making and scalable solutions (CO6, CO8, CO10).
SDG 10	Reduced Inequalities	2 (Moderate)	Promotes fair and unbiased AI systems through understanding of bias, fairness, and inclusive model design (CO6, CO9).
SDG 11	Sustainable Cities & Communities	2 (Moderate)	AI applications in smart systems, urban analytics, and automation contribute to efficient and sustainable community solutions (CO6, CO8).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Encourages efficient model design, optimized resource usage, and responsible AI practices including explainability and ethical considerations (CO5, CO9).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)

L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

(----------) INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Design and Analysis of Algorithms (CSCR3311)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester V | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	V

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR3311
2	**Course Title**	**Design and Analysis of Algorithms**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2
5	**Course Status**	Major Course
6	**Course Objective**	Objective of this course is to 1. Reinforce basic design concepts (e.g., pseudocode, specifications, top-down design) 2. Knowledge of algorithm design strategies 3. Familiarity with an assortment of important algorithms. Enable students to analyze time and space complexity
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** **CO1** (**Analyze-L1):** The asymptotic performance of algorithms **CO2** (Understand – L2): The dynamic-programming and Greedy paradigm and explain when an algorithmic design situation calls for it. **CO3** (Apply – L3): A familiarity with major algorithms and data structures **CO4** (Analyze – L4): Important algorithmic design paradigms and methods of analysis **CO5** (Evaluate – L5): NP-complete problems and develop algorithms to solve the problems. **CO6** (Create – L6): Appropriate algorithm design techniques for solving problems. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Implement C programs using professional tools (gcc, Linux CLI, debuggers); configure experimental setups; demonstrate system operation; maintain structured lab records. CO8 (Create – L5/L6): Design and develop modular C applications addressing real-world problems with societal awareness; propose solutions with planning considerations; evaluate outcomes analytically.

		CO9 (Apply – L2/L3): Demonstrate professional, ethical, and responsible practices; perform skill self-assessment; reflect on learning to cultivate lifelong professional growth. CO10 (Apply – L3): Collaborate and communicate effectively in team-oriented lab activities; plan, implement, and present programming solutions; apply project management principles.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. Reading topics yourself from books/notes 2. Practicing algorithm problems 3. Understanding proofs and complexity analysis 4. Coding algorithms 5. Solving numerical/examples 6. Watching lectures/tutorials
11	**References**	1.Cormen et al., "Introduction of Computer Algorithms", Prentice Hall India 2.Sahni et al., "Fundamentals of Computer Algorithms", Galgotia Publications. 3.Hopcroft A, The Design And Analysis Computer Algorithms, Addison Wesley

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction (4-0-10-6 = 20 hrs)**	
A	Introduction : Algorithms, Analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements	CO1, CO2, CO3
B	Asymptotic Notations and their properties – Mathematical analysis for Recursive and Non-recursive algorithms, Recurrences relations, Master Method	
C	Divide-and-conquer: Analysis and Structure of divide-and-conquer algorithms, Divide-and-conquer examples-Quick sort, Merge sort, Sorting in Linear Time counting sort, Heap Sort	
Tools Used	Turbo C Environment, Whiteboards, sticky notes, gcc compiler, Virtual Labs	
Activities	Objective: Practical based on Searching and sorting 1. WAP to demonstrate the concept of Linear and Binary Search 2. WAP to implement Merge sort 3 WAP to implement Quick Sort	
Unit 2	**Greedy Method (6-0-12-6 = 24 hrs)**	
A	Overview of the Greedy paradigm, Analysis and example: task scheduling,	CO3, CO4
B	Fractional Knapsack problem, Single source shortest paths problem: Dijkastra's Algorithm, Bellman-ford Algorithm,	
C	Overview and analysis of Backtracking & Branch and Bound: N-Queens problem and Sum of subsets	

Tools Used	Turbo C Environment, Whiteboards, sticky notes, gcc compiler, Virtual Labs	
Activities	Objective: To apply Practical based on Dynamic Programming 1. WAP to implement Matrix Chain Multiplication problem 2. WAP to demonstrate the concept of Longest Common Subsequence(LCS) 3. WAP to demonstrate concept of 0 – 1 Knapsack Problem	
Unit 3	**Dynamic Programming (8-0-16-6 = 30 hrs)**	
A	Overview, Difference between dynamic programming and divide and conquer, All pair shortest path problems: Floyd-Warshall Algorithm	CO2, CO3, CO4, CO5, CO6
B	Applications and analysis: Matrix Chain Multiplication,	
C	Applications and analysis: Longest Common sub-sequence, 0/1 Knapsack Problem	
Tools Used	Turbo C Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To understand the concept of Practical based on Greedy Programming 1. WAP to demonstrate concept of Minimum Spanning Tree(Prim's Algorithm) 2. WAP to demonstrate concept of Fractional Knapsack Problem 3. WAP to implement single source shortest problem using Dijkstra's Algorithm	
Unit 4	**Advanced Data Structures (6-0-12-6 = 24 hrs)**	
A	Red-Black Trees - Definition, Applications, Insertion and deletion of elements in RB-Tree	CO3, CO4, CO5
B	B-Trees - Definitions, Applications, Insertion and Deletion in B-Trees	
C	Data Structure for Disjoint Sets – Definition, Binomial Heaps, Fibonacci Heaps.	
Tools Used	C Environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To understand **Practical based on Advance concepts** WAP to demonstrate concept of Red Black Tree insertion and Deletion	
Unit 5	**Selected Topics (6-0-10-6 = 22 hrs)**	
A	Introduction to NP Complete and NP Hard Problems, Examples, Amortized Analysis	CO2, CO3, CO4, CO5, CO6
B	Approximation Algorithms – Travelling Sales Person Problem and Vertex Cover Problem, Randomized Algorithms, Randomized Quick Sort Algorithm	
C	String Matching Algorithms – Naive String Matching Algorithm, Rabin Karp Algorithm.	

Tools Used	C environment, Competitive coding platforms (Leetcode, Hackerrank, etc.), Virtual Labs, whiteboards, online compilers, GitHub.	
Activities	**Objective:** To understand Practical based on String Matching 1. WAP to demonstrate the concept of Naïve String matching algorithm. 2. WAP to demonstrate the concept of Robin Karp Algorithm.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	

CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 40 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction : Algorithms, Analyzing algorithms,	Unit 1	9
DD/MM/YY	Complexity of algorithms, Growth of functions, Performance measurements		
DD/MM/YY	Properties of Asymptotic Notations		
DD/MM/YY	Mathematical analysis for Recursive algorithms		
DD/MM/YY	Recurrences relations, Master Method		
DD/MM/YY	Divide-and-conquer: Analysis and Structure of divide-and-conquer algorithms		
DD/MM/YY	Divide-and-conquer examples-Quick sort, Merge sort,		
DD/MM/YY	Sorting in Linear Time counting sort, Heap Sort		
DD/MM/YY	Revision Unit 1		
DD/MM/YY	Overview of the Greedy paradigm, Analysis and example: task scheduling,	Unit 2	6
	Fractional Knapsack problem		
DD/MM/YY	Single source shortest paths problem: Dijkastra's Algorithm		
DD/MM/YY	Bellman-ford Algorithm		
DD/MM/YY	Overview and analysis of Backtracking & Branch and Bound: N-Queens problem and Sum of subsets		
DD/MM/YY	Revision Unit 2		
DD/MM/YY	Overview of dynamic programming and divide and conquer	Unit 3	8

DD/MM/YY	Difference between dynamic programming and divide and conquer		
DD/MM/YY	All pair shortest path problems: Floyd-Warshall Algorithm		
DD/MM/YY	Applications and analysis of dynamic programming		
DD/MM/YY	Matrix Chain Multiplication		
DD/MM/YY	Longest Common sub-sequence		
DD/MM/YY	0/1 Knapsack Problem		
DD/MM/YY	Revision Unit 3		
DD/MM/YY	Red-Black Trees - Definition	Unit 4	8
DD/MM/YY	Red-Black Trees -Applications		
DD/MM/YY	B-Trees - Definitions, Applications		
DD/MM/YY	Insertion and Deletion in B-Trees		
DD/MM/YY	Data Structure for Disjoint Sets – Definition		
DD/MM/YY	Binomial Heaps		
DD/MM/YY	Fibonacci Heaps		
DD/MM/YY	Revision Unit 4		
DD/MM/YY	Introduction to NP Complete Problems, Examples	Unit 5	9
DD/MM/YY	Amortized Analysis		
DD/MM/YY	Approximation Algorithms – Travelling Sales Person Problem		
DD/MM/YY	Vertex Cover Problem, Randomized Algorithms		
DD/MM/YY	Randomized Quick Sort Algorithm		
DD/MM/YY	String Matching Algorithms		
DD/MM/YY	Naive String Matching Algorithm		
DD/MM/YY	Rabin Karp Algorithm		

DD/MM/YY	Revision Unit 5		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Write a program to search an element in the array using Binary search determine the time required to search the element	CO7	3.0
	S-1.2	Write a program to search an element in the array using Binary search determine the time required to search the element	CO7	
W2	S-2.1	Write a program to sort given set of numbers in ascending/descending order using Quick Sort.	CO7	3.0
	S-2.2	Write a program to sort given set of numbers in ascending/descending order using Merge Sort and determine the time required to sort the elements.	CO7	
W3	S-3.1	Write a program to sort given set of numbers in ascending/descending order using Counting Sort	CO7	3.0
	S-3.2	Write a program to sort given set of numbers in ascending/descending order using Bucket Sort.	CO7	
W4	S-4.1	Write a program to sort given set of numbers in ascending/descending order using Radix Sort.	CO7	3.0
	S-4.2	Write a program to sort given set of numbers in ascending/descending order using Radix Sort.	CO7	
W5	S-5.1	Write a program to implement Longest Common Subsequences (LCS).	CO7	3.0
	S-5.2	Write a program to implement Longest Common Subsequences (LCS).	CO7	
W6	S-6.1	Write a program to implement Matrix chain multiplication	CO7	3.0
	S-6.2	Write a program to implement Matrix chain multiplication	CO7	
W7	S-7.1	Write a program to implement 0/1 Knapsack problem Using greedy approach.	CO7	3.0

	S-7.2	Write a program to implement 0/1 Knapsack problem Using greedy approach.	CO7	
W8	S-8.1	Write a program to implement fractional Knapsack problem Using greedy approach.	CO7	3.0
	S-8.2	Write a program to implement fractional Knapsack problem Using greedy approach.	CO7	
W9	S-9.1	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.	CO7	3.0
	S-9.2	Write a program to implement Sum of Subset problem.	CO7	
W10	S-10.1	WAP to demonstrate concept of Red Black Tree insertion and Deletion.	CO7	3.0
	S-10.2	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.	CO7	
W11	S-11.1	Write a program to implement Naïve string matching problem.	CO7	3.0
	S-11.2	Write a program to implement Naïve string matching problem.	CO7	
W12	S-12.1	Write a program to implement RabinKarp Algorithm problem.	CO7	3.0
	S-12.2	Write a program to implement RabinKarp Algorithm problem.	CO7	
W13	S-13.1	Present and analyse 5 different implementations of greedy dominating set algorithm.	CO8	3.0
	S-13.2	Design a novel algorithm that can schedule 2 salesmen in a network. Hint: The two-server problem is concerned with the movement of two servers to request points in a metric space. Consider an offline version of the problem in a graph in which the requests may be served in any order. A family of approximations algorithms can be developed for this NP complete problem.	CO8	
W14	S-14.1	Given the input n>=2,Design and write an algorithmto implement n-ary search.	CO8/CO9	3.0
	S-14.2	Implement the N-queen Problem using graphical view.	CO8/CO10	
W15	S-15.1	Merge & sort files — ethical data handling; skill self-assessment form submitted	CO8/CO9	3.0
	S-15.2	Create and implement a complete graphical environment for performing Matrix Chain Multiplication.	CO9/CO10	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall of definitions, algorithm terminology, asymptotic notation concepts, and basic recognition of algorithmic structures	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Ability to explain algorithm paradigms, interpret concepts, and justify appropriate algorithm selection	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Application of algorithms and data structures to solve computational problems step-by-step	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Analysis of algorithm behavior, tracing execution flow, recurrence solving, and complexity analysis	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Evaluation and comparison of algorithms based on efficiency, correctness, and suitability for NP and optimization problems	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design and development of complete algorithmic solutions using appropriate paradigms and optimization strategies	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-Answer Questions, Definitions, Algorithm Terminology, Output Prediction, Conceptual Explanation
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Algorithm Writing, Program Tracing, Dry Run, Complexity Analysis, Debugging, Numerical Problem Solving
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Definitions, Conceptual Questions, Short Notes, Algorithm Identification, Theoretical Explanation
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Algorithm Design, Program Tracing, Complexity Analysis, Comparative Analysis, Numerical Problems, Case-Based Questions
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long Descriptive Questions, Design-Based Problems, Optimization Problems, NP-Complete Problem Solving, Algorithm Development
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project)	1.0: Reflective & honest | 0.5: Partial |	CO9 / PO7, PO11

		P13 — Professional attitudes and ethical conduct	0: Absent	
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment (gcc, IDE, Linux CLI, debugger)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4

P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	2	-	--	--	-	2	-	-	3	2	2
CO2	2	2	2	2	-	--	--	-	3	-	-	2	3	2
CO3	2	1	2	-	-	--	--	-	1	-	-	3	2	-
CO4	1	2	2	3	-	--	--	-	2	-	-	2	2	2
CO5	3	3	1	3	-	-	-	-	3	-	-	2	1	3
CO6	2	2	3	2	2	-	-	--	2	-	-	3	2	-
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	3	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	**2.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**3.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						

CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SET		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2028-29**	
Branch:		**Semester: V**	
1	Course Code	**CSCR3600**	
2	Course Title	Project Based Learning (PBL) -3 (Hackathon Based)	
3	Credits	2	
4	Contact Hours (L-T-P-SL)	0-0-4-3	
5	Course Status	Compulsory	
6	Course Objective	1. To align student's skill and interests with a realistic problem or project. 2. To understand the significance of problem and its scope. 3. Students will make decisions within a framework.	
7	Course Outcomes	Students will be able to: CO1: Identify and formulate problem statement. CO2: Design relational database schema. CO3: Develop the solution by using different aspects of programming language. CO4: Classify and understand various test techniques for verification and validation of project. CO5: Analyze and make use of modern for solving real word problems. CO6: Develop teamwork and need to engage in life-long learning, along with the ability to communicate effectively with others.	
8	Course Description	In PBL-3, the students will learn how to define the problem for developing projects, and Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.	
9	**Outline syllabus**		**CO Mapping**
	Unit 1	Problem Definition and identification, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.	CO1, CO4
	Unit 2	Use of the relational algebra operations from mathematical set theory (union, intersection, difference, and Cartesian product) and the relational algebra operations developed specifically for relational databases (select (restrict), project, join, and division)..	CO2, CO6
	Unit 3	Design; implement project work in any programming language.	CO3
	Unit 4	Use of various test tools and techniques for software verification and validation of project	CO4, CO5
	Unit 5	Demonstrate and execute Project with the team.	CO6
		Report should include Abstract, Hardware / Software Requirement, Problem Statement, Design/Algorithm, ER diagrams, Use Case Diagrams, State Diagrams, Sequence	

		Diagrams, Communication Diagrams, and Activity Diagrams, Implementation Detail. Validation Reports. References, Test cases if any. The presentation, report, work done during the term supported by the documentation, forms the basis of assessment.		
	Mode of examination	Practical /Viva		
	Weight age Distribution	CA	CE (Viva)	ESE
		30%	30%	40%

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Identify and formulate problem statement.	PO1, PO2, PSO1
2.	CO2: Design relational database schema.	PO1, PO2, PO3, PO5, PSO1, PSO2
3.	CO3: Develop the solution by using different aspects of programming language.	PO1, PO2, PO3, PO5, PSO1, PSO2
4.	CO4: Classify and understand various test techniques for verification and validation of project.	PO2, PO3, PO4, PO5, PSO1, PSO2
5.	CO5: Analyze and make use of modern for solving real word problems.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2
6.	CO6: Develop teamwork and need to engage in life-long learning, along with the ability to communicate effectively with others.	PO9, PO10, PO11

PO and PSO mapping with level of strength for Course Name Project Based Learning -3 (Course Code CSP391)

COs \ POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	3	1	1	–	–	–	–	–	1	1	2	–	–
CO2	2	2	3	1	2	–	–	–	–	–	1	3	2	–
CO3	2	2	3	1	3	–	–	–	1	1	1	3	2	1
CO4	1	3	2	3	2	–	–	–	–	1	1	2	2	–
CO5	2	3	2	2	3	1	–	–	–	1	2	3	2	1
CO6	–	1	–	–	–	1	–	1	3	3	3	–	1	1

Avg PO attained	1.8	2.3	2.2	1.6	2.5	1	0	1	2	1.4	1.5	2.6	1.8	1

Strength of Correlation: 22.7
1. Addressed to **Slight (Low=1)** **extent**
2. Addressed to **Moderate (Medium=2)** **extent**
3. Addressed to **Substantial (High=3)** **extent**

COURSE PLAN

Data Mining and Warehousing

Sharda School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester V | Batch 2026–2030
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	V
Course Code:	CSCR3110	**Course Type:**	Core

2. Course Details

THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

S.No	Attribute	Details
1	**Course Code**	CSCR3110
2	**Course Title**	**Data Mining & Warehousing**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3
5	**Course Status**	Core
6	**Course Objective**	To introduce the fundamental concepts of data warehousing and data mining, and develop analytical and problem-solving skills through data preprocessing, visualization, mining techniques, ethical data handling, practical laboratory exercises, and collaborative project-based learning.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Remember – L1): Recall and explain the fundamental concepts of data warehousing, multidimensional data models, OLTP, OLAP, and data mining terminology. CO2 (Understand – L2): Explain data warehouse architectures, warehousing processes, distributed storage concepts, and data preprocessing techniques used in data mining applications. CO3 (Apply – L3): Apply data preprocessing, transformation, dimensionality reduction, and visualization techniques for preparing and analyzing datasets. CO4 (Analyze – L4): Analyze and implement suitable data mining algorithms such as classification, clustering, frequent pattern mining, and OLAP operations for complex datasets.

		CO5 (Evaluate – L5): Evaluate different data warehousing architectures, mining techniques, visualization tools, and analytical approaches for enterprise and real-world applications. CO6 (Create – L6): Design and develop data-driven solutions using data warehousing, mining algorithms, visualization techniques, and modern analytical tools to address societal, scientific, and industrial challenges.
8	**Course Description**	This course provides a comprehensive understanding of data warehousing and data mining concepts, including OLTP/OLAP systems, multidimensional data models, preprocessing techniques, data visualization, classification, clustering, and pattern mining. It enables students to analyze large datasets, evaluate analytical approaches and warehousing architectures, and design intelligent data-driven solutions for real-world industrial, scientific, and societal applications using modern data analytics tools.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Han, J., Kamber, M., & Pei, J. (2011). *Data mining: Concepts and techniques* (3rd ed.). Morgan Kaufmann.
12	**References**	Han, J., Kamber, M., & Pei, J. (2011). *Data mining: Concepts and techniques* (3rd ed.). Morgan Kaufmann. Dunham, M. H. (2006). *Data mining: Introductory and advanced topics*. Pearson Education. Pudi, V., & Radhakrishnan, P. (2009). *Data mining*. Oxford University Press.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.

	Topic / Activity	CO Mapping
Unit 1	**Introduction to Data Warehousing**	
A	Data Warehousing: Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database	CO1, CO2, CO3
B	Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse	
C	Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept	
Unit 2	**Data Warehouse Process and Technology**	
A	Data Warehouse Process, Extraction–Transformation–Loading (ETL), Data Cleaning, Data Integration, Metadata Management	CO2, CO3, CO4, CO5
B	Data Warehouse Architecture, Distributed Data Warehousing, Virtual Warehouse, Data Mart Concepts	
C	OLAP Technology, MOLAP vs ROLAP, OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot)	
Unit 3	**Data Preprocessing and Data Visualization**	
A	Data Preprocessing: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Data Discretization, Normalization Techniques	CO3, CO4, CO5

B	Data Visualization and Analytical Reporting: Visualization Techniques, Statistical Summarization, Correlation Analysis, Dashboards, Graphical Representation of Data	
C	Data Reduction and Feature Engineering: Dimensionality Reduction, Attribute Selection, Sampling Techniques, Feature Extraction, Principal Component Analysis (PCA)	
Unit 4	**Data Mining Techniques and Algorithms**	
A	Classification and Prediction Techniques: Decision Trees, Bayesian Classification, Rule-Based Classification, Prediction Methods, Model Evaluation Techniques	CO4, CO5, CO6
B	Clustering and Association Rule Mining: K-Means Clustering, Hierarchical Clustering, Frequent Pattern Mining, Apriori Algorithm, Association Rule Generation	
C	Advanced Data Mining Applications and Web Mining: Text Mining, Web Mining, Spatial and Temporal Data Mining, Mining Applications in Business Intelligence and Healthcare	
Unit 5	**Advanced Data Warehouse Design and Modelling**	
A	Advanced Dimensional Modeling: Slowly Changing Dimensions (Type 1, Type 2, Type 3), Junk Dimensions, Large Dimensions	CO4, CO5, CO6
B	Hierarchy and Schema Modeling: Descriptive Attributes, Cross-Dimensional Attributes, Shared Hierarchies, Incomplete Hierarchies, Recursive Hierarchies	
C	Aggregation and Warehouse Optimization: Additive, Semi-Additive and Non-Additive Measures, Aggregation Techniques, Convergence, Query Optimization in Data Warehousing	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓	✓		
4	2.A		✓	✓	✓		
5	2.B		✓	✓	✓		
6	2.C			✓	✓	✓	
7	3.A		✓	✓	✓		
8	3.B		✓	✓	✓	✓	
9	3.C			✓	✓	✓	
10	4.A			✓	✓	✓	
11	4.B			✓	✓	✓	✓
12	4.C		✓	✓	✓	✓	
13	5.A		✓	✓	✓	✓	
14	5.B		✓	✓	✓	✓	
15	5.C			✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓															
CO4				✓														
CO5					✓				✓									
CO6						✓			✓									

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Affective (A3) for CO5 and CO6 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Data Warehousing: Overview, Definition,	Unit 1	9
DD/MM/YY	Need and Characteristics		
DD/MM/YY	Data Warehousing Components and Building a Data Warehouse		
DD/MM/YY	Warehouse Database		
DD/MM/YY	Metadata Concepts Mapping the Data Warehouse to a Multiprocessor Architecture		
DD/MM/YY	Difference between Database System and Data Warehouse		
DD/MM/YY	Multi-Dimensional Data Model		
DD/MM/YY	Data Cubes, Star, Snowflake		
DD/MM/YY	Fact Constellation Schemas		
DD/MM/YY	Data Warehouse Process and ETL Concepts		

DD/MM/YY	Data Extraction and Data Cleaning Techniques	**Unit 2**	**9**
DD/MM/YY	Data Integration and Data Transformation		
DD/MM/YY	Metadata Management and Warehouse Administration		
DD/MM/YY	Data Warehouse Architecture and Distributed Data Warehousing		
DD/MM/YY	Virtual Warehouse and Data Mart Concepts		
DD/MM/YY	OLAP Technology: MOLAP, ROLAP and HOLAP		
DD/MM/YY	OLAP Operations: Roll-up, Drill-down, Slice, Dice		
DD/MM/YY	Pivoting and Multidimensional Analytical Processing		
DD/MM/YY	Data Preprocessing: Data Cleaning and Integration	**Unit 3**	**10**
DD/MM/YY	Data Transformation and Data Reduction Techniques		
DD/MM/YY	Data Discretization and Normalization Methods		
DD/MM/YY	Data Visualization Techniques		
DD/MM/YY	Statistical Summarization and Correlation Analysis		
DD/MM/YY	Dashboards and Graphical Representation of Data		
DD/MM/YY	Feature Engineering and Attribute Selection		
DD/MM/YY	Sampling Techniques and Feature Extraction		
DD/MM/YY	Principal Component Analysis (PCA)		
DD/MM/YY	Dimensionality Reduction and Visualization Tools		
DD/MM/YY	Classification Techniques: Decision Trees	**Unit 4**	**10**
DD/MM/YY	Bayesian Classification Techniques		
DD/MM/YY	Rule-Based Classification and Prediction Methods		
DD/MM/YY	Model Evaluation Techniques		
DD/MM/YY	Clustering Techniques: K-Means Clustering		
DD/MM/YY	Hierarchical Clustering Techniques		
DD/MM/YY	Frequent Pattern Mining Concepts		
DD/MM/YY	Apriori Algorithm and Association Rule Generation		
DD/MM/YY	Text Mining and Web Mining		
DD/MM/YY	Spatial and Temporal Data Mining Applications		
DD/MM/YY	Slowly Changing Dimensions: Type 1, Type 2 and Type 3	**Unit 5**	**7**
DD/MM/YY	Junk Dimensions and Large Dimensions, Advanced Dimensional Modeling Concepts		
DD/MM/YY	Descriptive Attributes and Cross-Dimensional Attributes		
DD/MM/YY	Shared Hierarchies and Incomplete Hierarchies		
DD/MM/YY	Recursive Hierarchies and Schema Modeling		
DD/MM/YY	Aggregation Techniques: Additive Measures, Semi-Additive and Non-Additive Measures		

DD/MM/YY	Convergence and Query Optimization in Data Warehousing, Warehouse Performance Optimization and Enterprise Case Studies		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L6) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall definitions, terminology, architectures, OLTP/OLAP concepts, multidimensional models, ETL concepts, and data mining terminology	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Analytical Understanding**	Explain data warehouse processes, OLAP operations, preprocessing methods, warehouse architectures, and mining workflows; interpret analytical models and visualization outputs	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Dataset Handling**	Apply preprocessing, ETL, dimensionality reduction, visualization, and mining techniques on datasets using appropriate analytical tools	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Mining Analysis**	Analyze classification, clustering, OLAP operations, association rules, and warehouse schema behavior; evaluate mining results and analytical outputs	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Decision Support**	Compare data warehouse architectures, mining algorithms, preprocessing techniques, and visualization methods based on performance, scalability, accuracy, and interpretability	CO5 | L5	ETE Sec B/C
TS6	**Design, Integration & Solution Development**	Design and develop integrated data warehousing and data mining solutions using preprocessing, analytical modeling, visualization, and optimization techniques for real-world applications	CO6 | L6	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Factual Recall & Conceptual Recognition	TS2 Conceptual Explanation & Analytical Understanding	TS3 Procedural Application & Dataset Handling	TS4 Analytical Reasoning & Mining Analysis	TS5 Comparative Evaluation & Decision Support	TS6 Design, Integration & Solution Development
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M		M	M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–2 (Theory / Application-based)	2 assignments	**10**	CO1, CO2, CO3, CO4, CO5, CO6	TS1, TS2, TS3, TS4, TS5,TS6
Assessments 1–2 (Theory / Application-based)	**2 Assessments (Assessment 1 (10 Marks) + Assessment 2 (5 Marks))**	**15**	CO1, CO2, CO3, CO4, CO5, CO6	TS1, TS2, TS3, TS4, TS5,TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 and Unit 2 concepts: Introduction to Data Warehousing , Data Warehouse Process and Technology	CO1, CO2,CO3, CO4,CO5	TS1,TS2,TS3,TS4,TS5	5h SL	Report submission + conceptual evaluation

Assignment 2	Unit 3, 4 and Unit 5 : Data Preprocessing and Data Visualization, Data Mining Techniques and Algorithms, Advanced Data Warehouse Design and Modelling	CO1,CO2,CO3, CO4, CO5,CO6	TS1,TS2,TS3,TS4,TS5 ,TS6	5h SL	Comparative analysis + conceptual explanation

9.3 Assessment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assessment 1	Unit 1 and Unit 2 concepts: Introduction to Data Warehousing , Data Warehouse Process and Technology	CO1, CO2,CO3, CO4,CO5	TS1,TS2,TS3,TS4,TS5	5h SL	Report submission + conceptual evaluation
Assessment 2	Unit 3 AND Unit 4 : Data Preprocessing and Data Visualization, Data Mining Techniques and Algorithms	CO1,CO2,CO3, CO4, CO5,CO6	TS1,TS2,TS3,TS4,TS5,TS6	5h SL	Comparative analysis + conceptual explanation

10. Mid Term Examination (MTE) — 15 Marks (Units 1–2)

ℹ *MTE covers Units 1–2 (CO1, CO2, CO3,CO4,CO5) and CO1-CO6 are assessed in ETE only. MTE maps to TS1–TS5.*

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	10	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer questions: definitions, conceptual understanding, architecture identification, OLAP/ETL concepts, terminology, analytical interpretation
Sec B	15	TS3 — Procedural Application TS4 — Analytical Reasoning TS5- Comparative Evaluation & Decision Support	**CO3, CO4,CO5**	Problem-solving and analytical questions based on preprocessing, OLAP operations, dimensional modeling, classification, clustering, association analysis, and data interpretation
TOTAL	25	TS1–TS4	**CO1–CO5**	Units 1–2 primarily covered; higher-order evaluation and design-oriented . CO1-CO6 assessed mainly in ETE

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	20	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer and conceptual questions: definitions, terminology, OLTP vs OLAP, ETL concepts, multidimensional models, OLAP operations, preprocessing concepts, architecture-based MCQs and analytical interpretation
Sec B	25	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium-answer analytical questions based on ETL workflows, preprocessing techniques, dimensional modeling, OLAP operations, classification, clustering, association rule mining, visualization, mining performance evaluation, and comparative analysis of algorithms and warehouse architectures
Sec C	15	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long-answer/design-oriented questions involving warehouse schema design, mining workflow development, analytical solution design, enterprise case studies, optimization strategies, algorithm selection with justification, and integrated real-world applications
TOTAL	60	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 24/60 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Recall and explain the fundamental concepts of data warehousing, multidimensional data models, OLTP, OLAP, and data mining terminology.	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Explain data warehouse architectures, warehousing processes, distributed storage concepts, and data preprocessing techniques used in data mining applications.	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Apply data preprocessing, transformation, dimensionality reduction, and visualization techniques for preparing and analyzing datasets.	✓	✓	✓	TS3	PO1, PO2, PO3, PO4
CO4	Analyze and implement suitable data mining algorithms such as classification, clustering, frequent pattern mining, and OLAP operations for complex datasets.	✓	✓	✓	TS4	PO9, PO10, PO11
CO5	Evaluate different data warehousing architectures, mining techniques, visualization tools, and analytical approaches for enterprise and real-world applications.	✓	✓	✓	TS5	PO1, PO2, PO8, PO9, PO10

CO6	Design and develop data-driven solutions using data warehousing, mining algorithms, visualization techniques, and modern analytical tools to address societal, scientific, and industrial challenges.	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ *CO6 is NOT assessed in MTE (only Units 1-2 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	–	–	–	–	–	–	–	–	-	2	1	–
CO2	3	2	–	1	–	–	–	–	-	–	1	2	2	–
CO3	2	3	2	2	3	-	–	–	1	–	1	2	3	2
CO4	2	3	2	3	2	–	–	–	–	–	1	2	3	2
CO5	2	3	2	3	2	1	–	–	–	–	2	2	3	2
CO6	2	2	3	2	3	3	1	1	1	1	2	2	3	3
Avg	**2.33**	**2.33**	**2.25**	2.2	**2.5**	2	**1**	**1**	**1**	**1**	**1.40**	2.0	**2.50**	**2.25**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	**H**										
CO2	**H**	**M**									

CO3	M	H	M	M	H						
CO4	M	H	M	H	M						
CO5	M	H	M	H	M						M
CO6	M	M	H	M	H	H				M	M
CO7			M		H						
CO8		M	H	M	H	M					
CO9						M	H				H
CO10					M			H	H	M	

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Numerical / Analytical Assignment Writing based on Data Warehousing and Data Mining concepts (5 assignments covering ETL, OLAP operations, preprocessing, dimensional modeling, classification, clustering, and association rule mining)**	5 assignments × 4 hrs each **Total = 20 hrs**	CO1–CO4 TS1–TS4	Evaluated based on correctness of analytical solutions, preprocessing steps, algorithm implementation logic, OLAP analysis, comparative performance evaluation, and interpretation of results
2	**Technical Video-Based Learning related to Data Warehousing and Data Mining (e.g., ETL workflows, OLAP cube operations, Decision Trees, Clustering, Data Visualization, PCA, Apriori Algorithm)**	Video viewing: 4 hrs Report preparation: 4 hrs Presentation: 4 hrs **Total = 12 hrs**	CO2, CO3 TS2, TS3	Evaluation based on report quality, conceptual understanding, analytical interpretation, explanation of mining techniques, workflow understanding, and presentation effectiveness
3	**Real-World Case Studies on Enterprise Data Warehousing and Data Mining Applications (e.g., Healthcare Analytics, Business Intelligence Systems, Recommendation Systems, Fraud Detection, Web Mining, Smart City Analytics)**	Data collection / study: 5 hrs Report preparation: 7hrs **Total = 13 hrs**	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, analytical reasoning, architecture/algorithm comparison, real-world applicability, data-driven conclusions, and solution design approach
	TOTAL Self-Learning Hours	**45 hours**	CO1–CO6	All activities are compulsory. Submission deadlines shall be communicated at the beginning of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5).*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

Data Mining and warehousing

MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 15 marks + ETE 60 marks = Total 100 marks

School: SSCSE		**Batch: 2025-2029**	
Program: B Tech		**Current Academic Year: 2025-26**	
Branch: CSE		**Semester: V**	
1	Course Code	CSCR3700	Course Name: **Summer Internship-I**
2	Course Title	**Summer Internship-I**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-0	
	Course Status	UG	
5	Course Objective	1. Experience the activities and functions of business professionals. 2. Develop and refine oral and written communication skills. 3. Identify areas for future knowledge and skill development.	
6	Course Outcomes	Students will be able to: • CO1. Integrate the concepts and strategies of academic study in a real time environment. • CO2. Identify, formulate and model problems and find engineering solution based on a systems approach. • CO3. Develop teamwork and apply prior acquired knowledge in problem solving. • CO4. Develop communication, interpersonal and other critical skills required for career growth. • CO5. Practice engineer's responsibilities, self-understanding, self-discipline and ethical standards. • CO6. Explore career alternatives prior to graduation.	
7	Course Description	An internship experience provides the student with an opportunity to explore career interests while applying knowledge and skills learned in the classroom in a work setting. The experience also helps students gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks.	
8	Outline syllabus		CO Mapping
	Unit 1	Define objectives and conditions for the internship, ensuring students that it is related to the study path carried out at the University	**CO1, CO2**
	Unit 2	Problem Definition and identification, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.	**CO2**
	Unit 3	The internship work plan is drawn up by developing team work and applies prior acquired knowledge in problem solving.	**CO3**
	Unit 4	Demonstrate and execute Project with the team. Submission of evaluation form and final report completed by the intern.	**CO4**
	Unit 5	Final evaluation form completed by the supervisor at the Host Organization and final presentation before departmental committee.	**CO5,CO6**
	Mode of examination	Practical	

	Weightage Distribution	CA	CE (Viva)	ETE	
		30%	30%	40%	
	Text book/s*	NA			
	Other References	NA			

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1. Integrate the concepts and strategies of academic study in a real time environment.	PO1, PO2, PO4, PO5, PO7, PO8, PO9, PSO1, PSO2, PSO3
2.	CO2. Identify, formulate and model problems and find engineering solution based on a systems approach.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PSO1, PSO2
3.	CO3. Develop teamwork and apply prior acquired knowledge in problem solving.	PO1, PO3, PO4, PO5, PO8, PO9, PO11, PSO1, PSO2, PSO3
4.	CO4. Develop communication, interpersonal and other critical skills required for career growth.	PO8, PO10
5.	CO5. Practice engineer's responsibilities, self-understanding, self-discipline and ethical standards.	PO6, PO8
6.	CO6. Explore career alternatives prior to graduation.	PSO1, PSO2

PO and PSO mapping with level of strength for Course Name Summer Internship-I (CSCR3700)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	2	-	3	2	1	1	1	-	-	-	1	2	2
CO2	1	2	1	2	2	1	1	1	-	-	-	1	2	-
CO3	2	-	2	2	2	-	1	3	-	1	1	1	2	2
CO4	-	-	-	-	-	-	1	-	3	-	-	-	-	-
CO5	-	-	-	-	-	2	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	2	2	2	-
Avg PO attained	1	0.7	0.5	1.2	1	0.3	1.2	1	1	0	1	1	1.3	0.7

Strength of Correlation

1. Addressed to ***Slight (Low=1) extent*** ***2.*** Addressed to ***Moderate (Medium=2) extent***
3. Addressed to ***Substantial (High=3) extent***

School: SSCSE		**Batch: 2026-2030**	
Program: B. Tech		**Current Academic Year: 2028-29**	
Branch: CSE		**Semester: V**	
1	Course Code	CSCR3203	Course Name: Intro to LLMs
2	Course Title	Intro to LLMs and Gen AI	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-2	
	Course Status	Core	
5	Course Objective	1. Understand the evolution, architecture, and working principles of LLMs and generative models. 2. Explore transformer-based architectures and their role in sequence modeling and natural language understanding. 3. Apply LLMs to generate text, code, and images using industry-standard tools. 4. Analyze ethical and societal implications of deploying generative models. 5. Develop and evaluate domain-specific applications of generative AI.	
6	Course Outcomes	After the completion of this course students will be able to: CO1: Describe the architecture, evolution, and key components of LLMs and Generative AI. CO2: Illustrate the working of transformer-based models like BERT, GPT, and T5. CO3: Implement basic applications using pretrained LLMs and prompt engineering. CO4: Analyze the capabilities, limitations, and biases in LLM-generated outputs. CO5: Evaluate ethical concerns and safety guidelines in generative model deployment. CO6: Design and present a mini-project using LLMs for a real-world application.	
7	Course Description	This course introduces the foundational concepts and recent advances in Large Language Models (LLMs) and Generative AI, emphasizing transformer architectures, prompt engineering, ethical implications, and real-world applications in creative and cognitive domains. The course blends theoretical understanding with hands-on experiments using modern frameworks such as OpenAI, Hugging Face, and LangChain.	

8	Outline syllabus		CO Mapping
	Unit 1	**Foundations of Generative AI and Language Mode**	
	A	Introduction to Generative AI: Definition, key concepts, comparison with traditional AI; Use-cases (text, image, music, code).	CO1
	B	Language Modeling Fundamentals: Statistical vs Neural Language Models; N-grams; Perplexity; Training objectives (causal vs masked).	CO1
	C	Emergence of LLMs: History and evolution: From Word2Vec to GPT; Transfer learning in NLP; Pretraining vs fine-tuning.	CO1
	Unit 2	**Transformer Architectures and LLMs**	
	A	Attention Mechanism: Scaled dot-product attention, self-attention, positional encodings.	CO2
	B	Transformer Architecture: Encoder-decoder framework, comparison of models: BERT, GPT, T5, LLaMA.	CO2
	C	Parameter Scaling and Capabilities: Model scaling laws, in-context learning, zero-shot vs few-shot capabilities.	CO2
	Unit 3	**Prompt Engineering and Toolkits**	
	A	Prompt Engineering Basics: Prompt types: zero-shot, one-shot, few-shot; Prompt formatting; Instruction tuning.	CO3
	B	Using APIs and Libraries: Hands-on with OpenAI API, Hugging Face Transformers, Google PaLM; Input-output control.	CO3
	C	LangChain and Workflow Integration: Agents, Chains, Memory in LangChain; Connecting LLMs to tools and data.	CO3
	Unit 4	**Evaluation, Bias, and Ethics**	
	A	Output Evaluation Metrics: BLEU, ROUGE, perplexity, truthfulness, helpfulness, human vs automated evaluation.	CO4, CO5
	B	Bias and Hallucination: Common failure cases: hallucination, toxicity, social bias; Red-teaming models.	CO4, CO5
	C	Ethical & Regulatory Frameworks: Responsible AI principles; Guidelines by OpenAI, EU AI Act, AI ethics frameworks.	CO4, CO5
	Unit 5	**Capstone Project and Applications**	

	A	Domain-Specific Applications: Chatbots, educational tutors, creative writing, legal assistants, code completion.			CO6
	B	End-to-End LLM Project Design: Problem formulation, data pipelines, prompt & API design, interface integration.			CO6
	C	Project Presentation and Review: Final presentations, peer reviews, ethical assessment, future scope discussion.			CO6
	Mode of examination	Monitoring and Continuous Evaluation			
	Weightage Distribution	CA	CE (Viva)	ESE	
		25%	25%	50%	
	Textbook/s*	1. 'You Look Like a Thing and I Love You: How AI Works and Why It's Making the World a Weirder Place', Janelle Shane, Publisher: Voracious (Little, Brown), 2019			
	Other References	2. Deep Learning with Python, François Chollet, Manning Publications, Edition: 2nd Edition (2021) 3. Transformers for Natural Language Processing: Build and Train State-of-the-Art Natural Language Processing Models Using the Transformer Architecture, Denis Rothman, Packt Publishing, 2nd Edition (2022).			

PO and PSO mapping with level of strength for Course: CSCR3203, Intro to LLMs and Gen AI

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	2	-	-	2	-	1	1	-	1	-	2	-	-
CO2	3	2	-	-	2	-	-	-	-	1	-	2	-	-
CO3	2	2	3	2	3	-	-	-	2	1	2	2	3	-
CO4	2	3	-	2	2	2	2	2	-	2	-	3	-	2
CO5	2	-	-	2	1	3	3	3	2	2	-	2	-	3
CO6	2	2	3	2	3	-	-	1	3	3	3	2	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSCR3203, Intro to LLMs and Gen AI	2.33	2.20	3.00	2.00	2.17	2.50	2.00	1.75	2.33	1.67	2.50	2.17	3.00	2.67

Strength of Correlation: 32.28

1. Addressed to ***Slight (Low=1) extent***

2. Addressed to ***Moderate (Medium=2) extent***

3. Addressed to ***Substantial (High=3) extent***

COURSE PLAN

Web and Text Analysis (CSAD3510)

School of Computing Science & Engineering (SSCSE) | B.Tech. CSE | Semester V | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE — School of Computing Science & Engineering	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2028–29
Branch:	CSE (AIDS)	**Semester:**	V
Course Code:	CSAD3510	**Course Type:**	**Specialization** Elective — Integrated

2. Course Details

Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.

S.No	Attribute	Details
1	**Course Code**	CSAD3510
2	**Course Title**	Web & Text Analysis
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	2-0-2-2
5	**Course Status**	Specialization Elective
6	**Course Objective**	To understand the text and web data and used it for the information retrieval.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** **CO1 (Remember – L1):** Recall the basics of www and textual data in web. **CO2 (Understand – L2):** Explain the processing of textual data on/off web for prediction of intent. **CO3 (Apply – L3):** Apply relevant models for contextual information retrieval from texts towards socio-economic betterment. **CO4 (Analyze – L4):** Analyze individual and combination of a variety of web search methods **CO5 (**Evaluate **– L5):** Explain the processes involved in information extraction from web based social networks. **CO6 (Create – L6):** Design process based on prior information for web usage analysis. **LAB COs — Assessed via Laboratory Assessment only:** **CO7** (Apply – L3): Apply text pre-processing techniques for corpus preparation.

		CO8 (Create – L5/L6): Apply and analyse text representation models such as Term-Document Matrix (TDM) and vector space models for information retrieval and similarity analysis. **CO9** (Apply – L2/L3): Analyse textual data using clustering, classification, and sentiment analysis **CO10** (Apply – L3): Evaluate and design predictive and recommender models
8	**Teaching & Learning**	Classroom Instructions (CI) + Lab Instructions (LI) + Self Learning (SL) L: 30 hrs | T: 0 hrs | P: 30 hrs | SL: 30 hrs | Total: 90 hrs | Credits: 3
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self-Learning (SL: 30 hrs)**	1. Dataset Analysis and Visualization (Python/Excel/R) — Evaluation: Correctness of analysis, interpretation of results, visualization clarity. Data study=5 h; Analysis= 5 h; Visualization/report= 5 h, Total =15h. 2. Application / Software Development: Evaluation: Depending on the complexity of the Application/software. Duration = 15 h 3. Problem Solving / Coding. Evaluation: Based on the coding solution submitted.
11	**Textbook**	Handbook of Research on Text and Web Mining Technologies edited by Song, Min, Brook Wu, Yi-Fang
12	**References**	1. Michael W. Berry, Jacob Kogan - Text Mining: Applications and Theory 2. Bing Liu - Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data 3. Eiron, N., & McCurley, K. S. (2003, July). Analysis of anchor text for web search. In Proceedings of the 26th annual international ACM SIGIR conference on Research and development in informaion retrieval (pp. 459-460).

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).

	Topic / Activity	CO Mapping
Unit 1	**Introduction (4-0-4-4 = 12hrs)**	
A	WWW, History of Web and Internet, Web Analysis.	**CO1**
B	Text Analysis, Types of Problems (Classification, Information Retrieval).	
C	Clustering & Organizing Documents, Information Extraction, Prediction & Evaluation.	
Tools Used	Python, NLTK, Jupyter Notebook, Kaggle datasets, Web browsers	
Activities	**Objective:** To understand the fundamentals of web and text data, including document organization, classification, and extraction techniques. • Think-Pair-Share on WWW evolution and web mining • Identify real-world text/web datasets • Demonstration of document classification concepts • Discussion on clustering and information extraction	
Unit 2	**NLP-based Prediction (6-0-6-6 = 18hrs)**	
A	Tokenization, Lemmatization, Vector Generation, Phrase Recognition, Parsing, Feature Generation	CO2
B	Term-Document Matrix (TDM), Corpus Creation, Pattern Discovery	
C	Similarity Measures, Nearest Neighbour, Keyword Search, Document Matching	

Tools Used	Python (NLTK, Scikit-learn), Pandas, NumPy	
Activities	**Objective:** To process textual data using NLP techniques and generate feature representations for prediction and similarity analysis. • Perform tokenization and lemmatization • Create TDM from sample corpus • Compute cosine similarity between documents • Implement nearest neighbor-based document matching	
Unit 3	**Text Information Retrieval (6-0-6-6 = 18hrs)**	
A	Clustering Methods, Cluster Label Mean, Pattern and Entity Extraction	CO3, CO4
B	Co-reference Resolution, Relationship Extraction, Template Filling.	
C	Applications: Information Retrieval Systems, Commercial Systems, Criminal Justice, Intelligence	
Tools Used	Python (Scikit-learn, SpaCy), RapidMiner, Kaggle datasets	
Activities	**Objective:** To apply clustering and extraction techniques for retrieving relevant information from text data and real-world applications. • Perform clustering on document datasets • Extract entities and relationships • Compare different clustering techniques • Case study on real-world IR systems	
Unit 4	**Web Search (5-0-5-5 = 15hrs)**	
A	Meta Search, Rank Combination Methods.	CO4, CO5
B	Web Spamming: Types, Detection and Prevention.	
C	Social Network Analysis, PageRank, HITS, Community Detection.	
Tools Used	Python, NetworkX, Gephi, Web datasets	
Activities	**Objective:** To analyse web search mechanisms, ranking algorithms, and social network structures for efficient information retrieval. • Demonstration of PageRank algorithm • Analyze web spam examples • Perform basic network analysis • Study ranking methods comparison	
Unit 5	**Web Usage Analysis (9-0-9-9 = 27hrs)**	
A	Data Collection, Preprocessing, Web Usage Data Modeling	CO5, CO6
B	Pattern Discovery and Analysis in Web Usage	
C	Recommender Systems, Collaborative Filtering, Query Log Mining	
Tools Used	Python, Pandas, Scikit-learn, Kaggle, GitHub	
Activities	**Objective:** To analyze web usage data and design recommendation systems for personalized user experience.	

	• Analyze web log datasets • Perform session identification • Implement collaborative filtering • Case study on recommendation systems	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓	✓		
4	2.A		✓	✓	✓		
5	2.B		✓	✓	✓		
6	2.C		✓	✓	✓	✓	
7	3.A		✓	✓	✓		
8	3.B		✓	✓	✓	✓	
9	3.C		✓	✓	✓		
10	4.A		✓	✓	✓	✓	
11	4.B		✓	✓	✓	✓	✓
12	4.C		✓	✓	✓	✓	
13	5.A		✓	✓	✓	✓	✓
14	5.B		✓	✓	✓	✓	
15	5.C		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)							
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7	
CO1	✓																		
CO2		✓																	
CO3			✓																
CO4				✓									✓						
CO5					✓														
CO6						✓		✓								✓			
CO7			✓				✓						✓						
CO8				✓	✓	✓	✓					✓		✓					

CO9			✓					✓	✓									
CO10			✓				✓		✓			✓		✓				

Legend: ✓= Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	WWW, History of Web and Internet, Web analysis	**UNIT-1**	**4**
DD/MM/YY	Text analysis, Types of problems solved using text analysis, Document classification and information retrieval		
DD/MM/YY	Clustering and organizing documents, Information extraction		
DD/MM/YY	Prediction and Evaluation		
DD/MM/YY	Document Tokenization, Lemmatization, Vector Generation and Prediction, Boundary determination, Phrase Recognition, Parsing	**UNIT-2**	**6**
DD/MM/YY	Feature generation		
DD/MM/YY	Term-Document Matrices (TDMs) from the Corpus		
DD/MM/YY	Problem specific novel patterns finding		
DD/MM/YY	Keyword search, Nearest Neighbour Methods, Similarity measures,		
DD/MM/YY	Web based document search, and Document matching		
DD/MM/YY	Clustering methods for similarity, Cluster Label Mean.	**UNIT-3**	**6**
DD/MM/YY	Patterns and Entities		
DD/MM/YY	Co-reference and relationship extraction		
DD/MM/YY	Template Filling		
DD/MM/YY	Applications: Information retrieval, commercial extraction systems		
DD/MM/YY	Applications: criminal justice, Intelligence		
DD/MM/YY	Meta search: combining multiple ranking, combination using similarity scores, Combination using rank position	**UNIT-4**	**5**
DD/MM/YY	Web Spamming: content spamming, and Link spamming		
DD/MM/YY	Web Spamming: Hiding techniques, and Combating spam.		
DD/MM/YY	Social network analysis, co-citations and bibliographic coupling		
DD/MM/YY	Page rank, HITS, and Community Discovery		
DD/MM/YY	Data collection	**UNIT-5**	**9**
DD/MM/YY	Data pre-processing.		
DD/MM/YY	Data modelling for web usage		
DD/MM/YY	Data modelling for web usage		
DD/MM/YY	Discovery for web usage methods		
DD/MM/YY	Analysis for web usage methods		
DD/MM/YY	Recommended system		
DD/MM/YY	Collaborative filtering,		
DD/MM/YY	Query Log Mining		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Perform web-based textual data acquisition from a social media platform and analyse the collected dataset.	CO7	3.0
W2	S-2.1	Demonstrate the usage of text mining tools/packages (e.g., yTextMiner or equivalent) for extracting insights from textual data.	CO7	3.0
W3	S-3.1	Implement text pre-processing techniques including tokenization, normalization, stop-word removal, and lemmatization.	CO7	3.0
W4	S-4.1	Generate feature vectors from textual data and perform basic prediction tasks using vector representations.	CO8	3.0
W5	S-5.1	Apply boundary detection and phrase recognition techniques on a given textual dataset.	CO8	3.0
W6	S-6.1	Perform keyword-based search and document retrieval using similarity measures.	CO8	3.0
W7	S-7.1	Implement document similarity and matching using nearest neighbour methods.	CO8	3.0
W8	S-8.1	Apply clustering techniques to group similar textual documents and identify patterns.	CO9	3.0
W9	S-9.1	Collect and organize domain-specific unstructured textual data to build a corpus.	CO7	3.0
W10	S-10.1	Construct a Term-Document Matrix (TDM) from the prepared corpus.	CO8	3.0
W11	S-11.1	Perform dimensionality reduction on TDM using appropriate techniques.	CO9	3.0
W12	S-12.1	Conduct sentiment (polarity) analysis on textual data using predefined corpora or lexicons.	CO9	3.0
W13	S-13.1	Implement text classification models for prediction based on web user transaction data.	CO9	3.0
W14	S-14.1	Develop a recommender system using K-NN and Association Rule Mining techniques.	CO10	3.0
W15	S-15.1	Implement matrix factorization-based recommendation model and evaluate its performance.	CO10	3.0

Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.

PART II
THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8.Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only

Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall fundamental concepts of WWW, web structure, and textual data, including basic terminology in text and web analytics.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Explain text processing techniques such as tokenization, lemmatization, TDM creation, and similarity measures for textual data analysis.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply clustering, classification, and information retrieval techniques to extract meaningful patterns from textual datasets.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Analyse web search methods, ranking algorithms (PageRank, HITS), and web spam detection techniques.	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Evaluate different approaches for information extraction and social network analysis in web-based systems.	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design web usage analysis models and recommender systems using prior knowledge of user behaviour and query logs.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Percentage	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, concept explanation, terminology, basic concepts
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Problem-solving, algorithm steps, short case-based questions, analytical reasoning
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Percentage	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, concepts of WWW, NLP basics, TDM, similarity measures, MCQs, short explanations (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: application of clustering, classification, information retrieval, PageRank/HITS analysis, web spam detection, comparison of algorithms and methods

Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design recommender systems, web usage models, query log mining solutions, justify approaches, case-based problem solving
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (Data collection & pre-processing), CO8 (Text representation & similarity), CO9 (Analysis & modelling), CO10 (Recommender systems & advanced applications)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7 (data collection & pre-processing), CO8 (text representation & similarity), CO9 (analysis & modelling)
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — assesses all Lab COs (CO7–CO10) including recommender systems and web usage analysis
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: dataset selection, attributes, objectives, success criteria CA2 — Experimental design: pre-processing steps, tool selection (Python, NLP libraries) CA7 — Algorithm/flowchart/solution plan for text processing or analysis	1.0: Clearly defined problem with structured design | 0.5: Partial definition/design | 0: Missing/unclear	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Correct execution of pre-processing, TDM, similarity, clustering/classification	1.0: Correct output with efficient implementation | 0.5: Correct but inefficient/partial |	CO7,CO8

		CA4 — Efficiency: proper use of libraries, optimized implementation, logical flow	0: Incorrect/no execution	
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Interpretation of outputs (e.g., similarity scores, clusters, sentiment results) CA6 — Validation of results with expected outcomes CA8 — Lab record completeness, clarity, and viva understanding	0.75: Thorough analysis with proper documentation | 0.5: Adequate explanation | 0.25: Limited/partial 0: Missing	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CA5 — Responsible handling of datasets (no plagiarism, proper citation) CA8 — Lab discipline, participation, and ethical practices	0.25: Consistent professionalism | 0.10: Occasional lapses | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst experiment scores are dropped
10	All 10	**30 Marks**	No score is dropped
< 10	All	**≤ 30 Marks**	Missing experiments treated as zero (deficit applied) Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping (e.g., social media analytics, misinformation detection) P2 — Problem definition: text/web analytics use-case, stakeholders P4 — Innovative solution using NLP/web mining techniques	1.5: Comprehensive and relevant |1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Well-planned with resources | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Toolchain (Python, NLP libraries, datasets) P6 — Implementation (pre-processing, TDM, modelling, recommendation) P7 — Functional system testing (correct outputs, working pipeline)	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Outcome evaluation (accuracy, similarity, recommendations) P9 — Comparative/analytical reporting (models, results, observations)	2: Strong analysis with metrics | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Clear explanation of approach and workflow P10 — Professional presentation (PPT/demo/report) and teamwork	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Reflection on learning (NLP, web analytics skills gained) P13 — Ethical use of data (no plagiarism, proper citation, responsible AI use)	1.0: Clear reflection & ethics | 0.5: Partial | 0: Absent |	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)	-	-

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	Problem Definition & Metrics	Define the text/web analytics problem; identify dataset, features (tokens, terms), evaluation metrics (accuracy, similarity, precision/recall).	CO7, CO8
CA2	Experimental Design & Tool Setup	Plan experiment workflow (data collection → pre-processing → modelling); configure tools (Python, NLP libraries, datasets, APIs)	CO7
CA3	Code Implementation & Execution	Implement pre-processing (tokenization, lemmatization), TDM creation, similarity, clustering/classification models and execute correctly	CO7, CO8
CA4	Computational Efficiency & Optimization	Analyse performance of algorithms (e.g., search, clustering); optimize using efficient data structures or libraries	CO7
CA5	Output Analysis & Result Interpretation	Interpret outputs such as similarity scores, clusters, sentiment polarity, classification results; draw meaningful conclusions	CO8, CO9
CA6	Documented Outcome with Verification	Document experiment results clearly; validate outputs against expected results or benchmarks	CO7, CO8
CA7	Algorithmic Design & Solution Planning	Design algorithm/flowchart for tasks like text pre-processing, recommendation, clustering; justify chosen approach	CO8, CO10
CA8	Lab Record Maintenance & Viva-Voce	Maintain complete lab records; explain concepts such as NLP techniques, web mining, and models during viva	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs (e.g., misinformation detection, sentiment analysis for public opinion); define societal impact.	CO8 | PO6
P2	Problem Scoping & Requirements	Define scope of text/web analytics problem; prepare formal problem statement with measurable goals (accuracy, relevance, recommendation quality).	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; define testing strategy for models (train-test split, validation); coordinate team roles.	CO10 | PO9
P4	Innovative Solution Proposal	Propose NLP/web mining solution (e.g., recommender system, clustering, classification); compare alternatives and justify selection	CO8 | PO3
P5	Professional Toolchain	Select and configure tools (Python, NLP libraries, APIs, datasets, GitHub); justify tool usage	CO7 | PO5
P6	End-to-End Implementation	Develop complete pipeline: data collection → pre-processing → TDM/vectorization → modelling → evaluation	CO7, CO8 | PO3
P7	System Commissioning & Testing	Execute and validate system; perform edge-case testing (noisy text, missing data, large corpus)	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate results using metrics (accuracy, precision, recall, similarity, recommendation quality); compare with baseline	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative analysis of models (e.g., clustering vs classification); prepare structured technical report with insights	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional demo and presentation; show teamwork, role distribution, and collaboration	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate cost/resources (tools, APIs, computation); discuss feasibility and optimization	CO10 | PO10
P12	Individual Skill Growth Mapping	Reflect on learning (NLP, web analytics, tools); map individual contribution and skill improvement	CO9 | PO11

P13	Professional Attitude, Ethics & Responsibility	Ensure ethical data usage (privacy, plagiarism-free work, responsible AI); maintain integrity throughout project	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.

Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).

Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H		H	M	H	H	H	M						
CO8							M	M	M		H	H	H	M	H	H	M	H	M	H	M	H	M	H	M		
CO9												M										H				H	H
CO10								H						H		M	H	H	H	H	H	M	H	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV
COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

CO1	3	1	–	–	–	–	–	–	–	–	1	2	1	–
CO2	3	2	–	–	–	–	–	–	1	–	2	2	2	–
CO3	3	3	2	–	2	2	–	–	1	–	2	3	2	2
CO4	2	3	2	2	2	–	–	–	–	–	2	2	3	2
CO5	2	3	3	2	2	–	–	–	–	–	2	2	3	2
CO6	2	2	3	2	3	2	–	2	1	1	3	3	3	3
CO7	–	–	1	–	3	1	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	–	–	–	–	1	–	–	–	3	–	1	2
CO10	–	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	**2.50**	**2.14**	**2.33**	**1.75**	**2.33**	**1.80**	**1.00**	**2.50**	**1.50**	**2.00**	**2.13**	**2.22**	**2.30**	**2.38**

PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	**H**	**M**									
CO2	**H**	**M**							**M**		
CO3	**M**	**H**	**M**		**M**	**M**			**M**		
CO4	**M**	**H**	**M**	**H**	**M**						
CO5	**M**	**H**	**H**	**M**	**M**						
CO6	**M**	**M**	**H**	**M**	**H**	**M**		**M**	**M**	**M**	**M**
CO7			**M**		**H**	**M**					
CO8		**M**	**H**	**M**	**M**	**H**					
CO9							**L**				**H**
CO10					**M**	**M**		**H**	**H**	**H**	**M**

H = High / Primary **M** = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	**Quality Education**	**3 (High)**	Develops strong foundation in text analytics, NLP, and web mining concepts; promotes analytical thinking, data literacy, and lifelong learning (CO1–CO6, CO9).
SDG 8	**Decent Work & Economic Growth**	**3 (High)**	Builds industry-relevant skills such as data pre-processing, information retrieval, and analytics using modern tools, enhancing employability in data-driven domains (CO7, CO8, CO10).

SDG 9	**Industry, Innovation & Infrastructure**	**3 (High)**	Enables development of intelligent systems like recommender systems, search engines, and web analytics platforms, fostering innovation and infrastructure in digital ecosystems (CO6, CO8, CO10).
SDG 10	**Reduced Inequalities**	**2 (Moderate)**	Supports analysis of social media and web data to identify disparities, sentiment trends, and inclusive decision-making (CO3, CO5).
SDG 11	**Sustainable Cities & Communities**	**2 (Moderate)**	Facilitates analysis of urban/social data (e.g., public opinion, traffic, services) through text and web mining for improved governance (CO3, CO6).
SDG 12	**Responsible Consumption & Production**	**2 (Moderate)**	Encourages ethical data usage, efficient processing of large datasets, and responsible AI practices in web analytics (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

WTA INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

<table>
<tr><td colspan="2">School: SSCSE</td><td colspan="2">Batch: 2026-2030</td></tr>
<tr><td colspan="2">Program: B.Tech.</td><td colspan="2">Current Academic Year: 202-27</td></tr>
<tr><td colspan="2">Branch: CSE with specialization in AIOT</td><td colspan="2">Semester: V</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="2">CSOT 3200</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="2">Raspberry Pi and its Programming</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="2">2</td></tr>
<tr><td>4</td><td>Contact Hours (L-T-P-SL)</td><td colspan="2">2-0-0-2</td></tr>
<tr><td></td><td>Course Status</td><td colspan="2">Elective</td></tr>
<tr><td>5</td><td>Course Objective</td><td colspan="2">The primary objective of this course to provide a platform to get started with the Internet of Things with Raspberry Pi along with the basic knowledge of programming and interfacing of the input/output devices</td></tr>
<tr><td>6</td><td>Course Outcomes</td><td colspan="2">CO1: List the hardware components of Raspberry Pi
CO2: Demonstrate the programming concepts using Raspberry Pi
CO3: Build Relay, DC Motor and LCD interfaces using Raspberry Pi
CO4: Construct interfaces for DHT11, ultrasonic sensor and camera using Raspberry Pi
CO5: Implementation of various analog and digital sensors using Raspberry Pi
CO6: Design and develop various applications using Raspberry Pi</td></tr>
<tr><td>7</td><td>Course Description</td><td colspan="2">This course provides a gradual pace of basic concepts to advanced interfacing and programming of Raspberry Pi for IoT based projects.</td></tr>
<tr><td>8</td><td>Teaching and Learning Scheme
(in Hours per Semester)</td><td colspan="2">
<table>
<tr><td colspan="2">Classroom Instructions (CI)</td><td>Lab Instructions (LI)</td><td>Team Work (TW) and Self Learning (SL) (TW+SL)</td><td>Total number of Hours</td><td>Total Credits TH/30</td><td></td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SL</td><td>TH</td><td></td><td></td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>30</td><td>60</td><td>2</td><td></td></tr>
</table>
</td></tr>
<tr><td>9</td><td colspan="2">Outline syllabus</td><td>CO Mapping</td></tr>
<tr><td></td><td>Unit 1</td><td colspan="2">Basics of Raspberry Pi</td></tr>
<tr><td></td><td>A</td><td colspan="2">Introduction to Raspberry Pi, Raspberry Pi Components</td><td>CO1, CO6</td></tr>
</table>

	B	Installation of NOOBS on SD Card and Raspbian on SD Card, Terminal Commands, Installation of Libraries on Raspberry Pi	CO1, CO6
	C	Getting the Static IP Address of Raspberry Pi, Run a Program on Raspberry Pi, Installing the Remote Desktop Server	CO1, CO6
	Unit 2	**Programming with Raspberry Pi**	
	A	Installation of I2C Driver on Raspberry Pi, Serial Peripheral Interface with Raspberry Pi	CO2, CO6
	B	Implementation of LED and Raspberry Pi, LED Blink Using Function, Reading the Digital Input	CO2, CO6
	C	Reading an Edge-Triggered Input: Reading Switch in Pull-Down Configuration, Reading Switch in Pull-Up Configuration	CO2
	Unit 3	**Interfacing with Raspberry Pi - I**	
	A	Interfacing of Relay with Raspberry Pi	CO3
	B	Interfacing of DC Motor with Raspberry Pi	CO3
	C	Interfacing of LCD with Raspberry Pi	CO3
	Unit 4	**Interfacing with Raspberry Pi - II**	
	A	Interfacing of DHT11 Sensor with Raspberry Pi	CO4
	B	Interfacing of Ultrasonic Sensor with Raspberry Pi	CO4
	C	Interfacing of Camera with Raspberry Pi	CO4
	Unit 5	**Interfacing with Raspberry Pi and Arduino**	
	A	Install Arduino IDE on Raspberry Pi	CO5, CO6
	B	Implementation of Digital and Analog Sensor	CO5, CO6
	C	Implementation of Actuators	CO5, CO6

<table>
<tr><td>10</td><td>List of activities for Self Learning
(SL: 30h)</td><td colspan="4"><table>
<tr><th>S. No.</th><th>Name of the Activity</th><th>No of Hours</th><th>Evaluation Criteria</th></tr>
<tr><td>1</td><td>Problem Solving / Programming using Raspberry Pi Implement Python-based Raspberry Pi programs for GPIO interfacing, sensor integration, LED control, camera interfacing, and basic IoT applications</td><td>5 programming exercises × 2h each Total = 10h</td><td>Based on correctness of program execu hardware interfacing, debugging skills, quality, and documentation of results.</td></tr>
<tr><td>2</td><td>Technical Video-Based Learning NPTEL/YouTube technical sessions on Raspberry Pi architecture, Linux environment, GPIO programming, and Raspberry Pi-based IoT applications</td><td>Video viewing = 2h Report preparation & Presentation = 3h Total = 5h</td><td>Report/presentation based on learning outcomes. Marks for concept clarity, circuit explanation, diagrams, and viva-voce performance.</td></tr>
<tr><td>3</td><td>Assignment Writing (Programming & System Configuration) Prepare assignments on Raspberry Pi architecture, Linux commands, GPIO pin configuration, Python scripting, and interfacing techniques</td><td>5 assignments × 1h each Total = 5h</td><td>Based on correctness of technical explanation, programming logic, system configuration steps, and completeness of assigned tasks.</td></tr>
<tr><td>4</td><td>Real-World Case Study / Mini Project Study and implement a Raspberry Pi-based real-world application such as smart surveillance, home automation, weather monitoring, or IoT gateway system</td><td>Literature study = 3h Prototype implementation & report = 7h Total = 10h</td><td>Based on innovation, technical implementation, report quality, practical demonstration, and presentation of findings.</td></tr>
</table></td></tr>
<tr><td>11</td><td>Mode of examination</td><td colspan="4">Theory/Jury/Practical/Viva</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MTE</td><td>ETE</td></tr>
<tr><td>25%</td><td>15%</td><td>60%</td></tr>
<tr><td></td><td>Text book/s*</td><td colspan="4">1. Internet of Things with Raspberry Pi and Arduino, Rajesh Singh, Anita Gehlot, Lovi Raj Gupta et.al, CRC Press</td></tr>
</table>

	Other References	1. Programming the Raspberry Pi, Getting started with Python, Simon Monk, Mc Graw Hill 2. Python Programming for Raspberry Pi, Richard Blum, Christine Bresnahan, Pearson Education	

PO and PSO mapping with level of strength for Course: CSOT 3200 Raspberry Pi and its Programming

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO 1	2	1	1	-	3	1	-	1	1	2	2	1	1	-
CO 2	2	2	2	-	3	2	2	1	1	1	2	3	2	2
CO 3	2	2	2	2	3	2	2	3	3	3	3	3	2	2
CO 4	2	2	2	2	3	2	2	3	3	3	3	3	2	2
CO 5	3	2	2	3	3	2	2	3	3	3	3	3	2	2
CO 6	3	3	3	3	3	3	3	3	3	3	3	3	3	2

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSOT 3200, Raspberry Pi and its Programming	2.4	2	2	2.5	3	2	2.2	2.4	2.4	2.5	2.7	2.4	2	2

Strength of Correlation:

1. Addressed to ***Slight (Low=1) extent***

2. Addressed to ***Moderate (Medium=2) extent***

3. Addressed to ***Substantial (High=3) extent***

SDG Goal	Description	Mapping Strength	Justification
United Nations SDG 4 – Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	High	The course provides practical learning in Raspberry Pi programming, embedded Linux systems, Python scripting, and IoT application development, fostering experiential and technology-oriented education.
United Nations SDG 9 – Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	High	Raspberry Pi supports innovation in embedded systems, smart automation, robotics, industrial IoT, and edge computing applications, contributing to intelligent digital infrastructure development.
United Nations SDG 11 – Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable	Moderate	Raspberry Pi-based systems are widely used in smart city applications such as smart surveillance, home automation, traffic monitoring, environmental sensing, and smart utility management.
United Nations SDG 12 – Responsible Consumption and Production	Ensure sustainable consumption and production patterns	Moderate	Raspberry Pi enables automation and intelligent monitoring systems that optimize energy usage, resource management, and operational efficiency in homes and industries.
United Nations SDG 13 – Climate Action	Take urgent action to combat climate change and its impacts	Moderate	Raspberry Pi-based environmental monitoring, weather sensing, and smart agriculture applications support climate monitoring, sustainability, and efficient environmental management.

United Nations SDG 7 – Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all	Moderate	Raspberry Pi systems are used in smart energy monitoring, renewable energy automation, and intelligent power management solutions for efficient energy utilization.
United Nations SDG 8 – Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Moderate	The course equips students with embedded computing, IoT programming, Linux, and automation skills relevant to modern technology industries and digital innovation sectors.
United Nations SDG 17 – Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Low	Collaborative projects, interdisciplinary applications, and open-source development using Raspberry Pi encourage teamwork, innovation sharing, and collaborative technological development.

<table>
<tr><td colspan="2">School: SSCSE</td><td colspan="2">Batch: 2026-2030</td></tr>
<tr><td colspan="2">Program: B.Tech</td><td colspan="2">Current Academic Year: 2028-29</td></tr>
<tr><td colspan="2">Branch: CSE</td><td colspan="2">Semester: V</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="2">CSOT 3201</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="2">Raspberry Pi and its Programming Lab</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="2">1</td></tr>
<tr><td>4</td><td>Contact Hours
(L-T-P-SL)</td><td colspan="2">0-0-2-1</td></tr>
<tr><td></td><td>Course Status</td><td colspan="2">Elective</td></tr>
<tr><td>5</td><td>Course Objective</td><td colspan="2">The primary objective of this course to provide a platform to get started with the Internet of Things with Raspberry Pi along with the basic knowledge of programming and interfacing of the input/output devices</td></tr>
<tr><td>6</td><td>Course Outcomes</td><td colspan="2">CO1: List the basic components of Raspberry Pi
CO2: Demonstrate the Face recognition and LED Blink using Raspberry Pi
CO3: Demonstrate the Pull-Down and Pull-Up Configuration using Raspberry Pi
CO4: Build Relay and DC Motor using Raspberry Pi
CO5: Construct interfaces for LCD and ultrasonic sensor using Raspberry Pi
CO6: Design and develop various applications using Raspberry Pi</td></tr>
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<tr><td>9</td><td colspan="2">Outline syllabus</td><td>CO Mapping</td></tr>
<tr><td></td><td>Unit 1</td><td colspan="2">Basics of Raspberry Pi</td></tr>
</table>

		Installing the Remote Desktop Server	CO1, CO6
		Raspberry Pi Camera as a USB Video Device	CO1, CO6
	Unit 2	**Programming with Raspberry Pi-I**	
		Face Recognition Using Raspberry Pi	CO2, CO6
		LED Blink Using Function	CO2, CO6
	Unit 3	**Programming with Raspberry Pi-II**	
		Pull-Down Configuration	CO3, CO6
		Pull-Up Configuration	CO3, CO6
	Unit 4	**Interfacing with Raspberry Pi - I**	
		Interfacing of Relay with Raspberry Pi	CO4, CO6
		Interfacing of DC Motor with Raspberry Pi	CO4, CO6
	Unit 5	**Interfacing with Raspberry Pi - II**	
		Interfacing of LCD with Raspberry Pi	CO5, CO6
		Interfacing of Ultrasonic Sensor with Raspberry Pi	CO5, CO6

<table>
<tr><td>10</td><td>List of Activities for Self Learning (SL: 15h)</td><td colspan="3"><table>
<tr><th>S. No.</th><th>Name of the Activity</th><th>No. of Hours</th><th>Evaluation Criteria</th></tr>
<tr><td>1</td><td>Programming and GPIO Interfacing using Raspberry Pi with Python (LED blinking, sensor interfacing, switch control, etc.)</td><td>5 small programming/interfacing tasks of 1h each, Total = 5h</td><td>Based on correctness of circuit connection, successful execution of Python code, and demonstration of hardware output</td></tr>
<tr><td>2</td><td>Raspberry Pi OS Exploration and System Configuration using Linux Commands, SSH, and Networking Tools</td><td>System setup = 2h; Command-line practice = 2h; Remote access configuration = 1h, Total = 5h</td><td>Correctness of system configuration, command execution, networking setup, and practical demonstration/report submission</td></tr>
<tr><td>3</td><td>Mini IoT Project Development using Raspberry Pi and Sensors (temperature, motion, humidity, etc.) with Data Monitoring</td><td>Hardware interfacing = 2h; Programming and testing = 2h; Documentation and demonstration = 1h, Total = 5h</td><td>Functionality of IoT application, coding quality, sensor data monitoring accuracy, and project presentation/report submission</td></tr>
</table></td><td></td></tr>
<tr><td>11</td><td>Mode of examination</td><td colspan="3">Practical/Viva</td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>CE(Viva)</td><td>ETE</td><td></td></tr>
<tr><td>30%</td><td>30%</td><td>40%</td><td></td></tr>
<tr><td></td><td>Text book/s*</td><td colspan="3">1. Internet of Things with Raspberry Pi and Arduino, Rajesh Singh, Anita Gehlot, Lovi Raj Gupta et.al, CRC Press</td><td></td></tr>
<tr><td></td><td>Other References</td><td colspan="3">1. Programming the Raspberry Pi, Getting started with Python, Simon Monk, Mc Graw Hill
2. Python Programming for Raspberry Pi, Richard Blum, Christine Bresnahan, Pearson Education</td><td></td></tr>
</table>

PO and PSO mapping with level of strength for Course: CSOT 3201, Raspberry Pi and its Programming Lab

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO 1	2	1	1	-	3	1	-	2	2	2	2	1	1	-
CO 2	2	2	2	1	3	2	2	1	1	1	2	3	2	2
CO 3	2	2	2	1	3	2	2	3	3	3	3	3	2	2
CO 4	2	2	2	2	3	2	2	3	3	3	3	3	2	2
CO 5	3	2	2	3	3	2	2	3	3	3	3	3	2	2
CO 6	3	3	3	3	3	3	3	3	3	3	3	3	3	2

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSOT 3201, Raspberry Pi and its Programming Lab	2.4	2	2	2	3	2	2.2	2.5	2.5	2.5	2.7	2.4	2	2

Strength of Correlation:

1. Addressed to ***Slight (Low=1) extent***

2. Addressed to ***Moderate (Medium=2) extent***

3. Addressed to ***Substantial (High=3) extent***

Total Mapped SDGs: 4 out of 17

SDG Goal	Description	Mapping Strength	Justification
SDG 4	Quality Education	3	Practical exposure to Raspberry Pi programming, Linux-based computing, hardware interfacing, and IoT experimentation enhances technical competency, problem-solving ability, and experiential learning in embedded systems and computing technologies.
SDG 8	Decent Work &	3	Develops industry-oriented skills in embedded

	Economic Growth		programming, automation, IoT system development, and sensor integration, thereby improving employability in electronics, robotics, automation, and smart technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3	Encourages innovation through development of smart devices, automation systems, IoT applications, and real-time monitoring solutions using Raspberry Pi and open-source technologies for industrial and societal applications.
SDG 11	Sustainable Cities & Communities	2	Supports the development of smart city solutions such as environmental monitoring, intelligent lighting, traffic control, and energy-efficient automation systems using Raspberry Pi-based embedded applications.

COURSE PLAN

Disaster Recovery Management (CSCF3200)

Sharda School of Computing Science & Engineering |B. Tech CSE, Cyber Security & Forensics | Semester VI | Batch 2026–2030
Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE- Sharda School of Computing Science & Engineering	**Batch:**	2026 – 2030
Program:	B. Tech	**Current Academic Year:**	2028-29
Branch:	Cyber Security & Forensics	**Semester:**	V
Course Code:	**CSCF3200**	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCF3200**
2	**Course Title**	**Disaster Recovery Management**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs. Classroom + 45 hrs. Self-Learning = 90 hrs. total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1.Understanding of the core principles and strategies of Disaster Recovery (DR) through structured lectures and guided assignments. 2. Apply theoretical DR concepts to real-world scenarios, enhancing their analytical and problem-solving skills. 3. Investigate current issues, risks, and challenges in Business Continuity Management (BCM), including technical, organizational, and regulatory aspects. 4. Evaluate key regulations and standards governing BCM practices, enabling them to design compliant and resilient recovery plans.

7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** **CO1 (Understand – L1/L2):** Explain disaster concepts and risk reduction strategies. **CO2 (Understand/Apply – L2/L3):** Illustrate the disaster management cycle and its stages. **CO3 (Apply – L3):** Adapt the knowledge of Business Continuity Management in emergency situations. **CO4 (Analyze – L3/L4):** Summarize the application of the Business Continuity Management development process. **CO5 (Analyze/Evaluate – L4/L5):** Analyze and evaluate research work in the field of emergencies and disaster management, with insight into the role and limitations of science in society. **CO6 (Apply/Analyze – L3/L4):** Demonstrate the capacity to manage public health aspects during disasters.
8	**Course Description**	This course aims to introduce students to the fundamental concepts and techniques in disaster recovery and business continuity management.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs. | Self Learning (SL): 45 hrs. | Total: 90 hrs.
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1. Michael Wallace and Lawrence Webber, *The Disaster Recovery Handbook: A Step-by-Step Plan to Ensure Business Continuity and Protect Vital Operations, Facilities, and Assets*, 2nd Edition, AMACOM, 2017. 2. Susan Snedaker, *Business Continuity and Disaster Recovery Planning for IT Professionals*, 2nd Edition, Syngress (Elsevier), 2013.
12	**References**	**1. Michael E. Whitman, Herbert J. Mattord, and Andrew Green, *Principles of Incident Response and Disaster Recovery*, 3rd Edition, Cengage Learning, 2018.** *(Useful for incident response, disaster recovery lifecycle, emergency response, recovery operations.)* **2. Harold F. Tipton and Micki Krause, *Information Security Management Handbook*, 6th Edition, Auerbach Publications / CRC Press.** *(Reference for BCM governance, security resilience, organizational continuity.)* **3. Ravi Das, *Business Recovery and Continuity in a Mega Disaster: Cybersecurity Lessons Learned from the COVID-19 Pandemic*, Apress, 2022.** *(Ravi Das is an Indian-origin cybersecurity author; this is highly relevant for cyber resilience, BCM, continuity planning, and disaster recovery in cybersecurity contexts.)*

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
Unit 1	**Introduction to Disaster and Disaster Recovery**	
A	Concepts of hazards, vulnerability, risk, disaster recovery, natural and man-made disasters, rapid onset and slow onset disasters, impact on organizations and critical systems	**CO1**
B	Difference between accidents and disasters, simple and complex disasters, socio-economic and organizational impacts, psychosocial issues, emergency recovery considerations	**CO1, CO6**

C	Relationship between disasters, development, and resilience; stakeholders in disaster recovery; rehabilitation, resettlement, inter-sectoral coordination, recovery models	**CO1, CO2, CO6**
Unit 2	**Disaster Risk Reduction and Preparedness**	
A	Disaster risk reduction strategies, disaster management cycle, preparedness planning, action plans, early warning systems, disaster relief components, community-based resilience	**CO2**
B	Vulnerability assessment, risk analysis, preparedness policies, capacity analysis, public awareness mechanisms, disaster readiness planning	**CO2, CO4**
C	Sustainable disaster recovery management, rehabilitation planning, reconstruction strategies, psychosocial recovery, long-term resilience building	**CO2, CO5, CO6**
Unit 3	**Disaster Recovery Management Cycle and Critical Infrastructure Recovery**	
A	Disaster recovery lifecycle, pre-disaster risk assessment, risk mapping, mitigation planning, business impact analysis, critical infrastructure preparedness	**CO2, CO3**
B	Emergency response, evacuation, communication systems, search and rescue coordination, incident command systems, emergency operations center functions	**CO3, CO4, CO6**
C	Restoration of critical infrastructure, early recovery, reconstruction, redevelopment, international recovery frameworks and standards	**CO3, CO4, CO5**
Unit 4	**Business Continuity Management (BCM)**	
A	Introduction, definition, scope, importance of business continuity management in disaster recovery	**CO3**
B	BCM framework, continuity planning drivers, risk management integration, resilience planning	**CO3, CO4**
C	Roles, responsibilities, governance, communication plans, continuity teams, stakeholder coordination	**CO4, CO5**
Unit 5	**Development and Implementation of BCM**	
A	Developing effective BCM capabilities, continuity planning lifecycle, recovery planning, testing and validation	**CO4, CO5**
B	Software tools and technologies supporting BCM, backup strategies, recovery automation, disaster recovery systems	**CO3, CO5**
C	BCM implementation case studies, best practices, lessons learned, continuous improvement in disaster recovery planning	**CO5, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓		✓		
3	1.C	✓	✓	✓	✓		
4	2.A	✓	✓	✓			
5	2.B	✓	✓	✓	✓		
6	2.C	✓	✓	✓	✓	✓	
7	3.A	✓	✓	✓	✓		
8	3.B	✓	✓	✓	✓		
9	3.C	✓	✓	✓	✓	✓	
10	4.A	✓	✓				
11	4.B	✓	✓	✓	✓		
12	4.C	✓	✓	✓	✓	✓	
13	5.A	✓	✓	✓	✓	✓	✓
14	5.B	✓	✓	✓	✓	✓	
15	5.C	✓	✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓					✓											
CO2		✓	✓				✓	✓					✓	✓				
CO3		✓	✓	✓				✓	✓				✓	✓	✓			
CO4			✓	✓	✓				✓					✓	✓			
CO5				✓	✓	✓			✓	✓				✓	✓			
CO6		✓	✓	✓	✓			✓	✓				✓	✓	✓			

Legend: ✓= Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs.) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YYYY	Introduction to Disaster Recovery Management and Course Overview	Unit 1	8
DD/MM/YYYY	Concepts of Hazard, Vulnerability, Risk and Disaster Recovery		
DD/MM/YYYY	Natural Disasters: Earthquake, Cyclone, Floods, Volcanoes		
DD/MM/YYYY	Man-Made Disasters and Organizational Impact		
DD/MM/YYYY	Slow Onset and Rapid Onset Disasters		
DD/MM/YYYY	Difference between Accidents and Disasters; Simple vs Complex Disasters		
DD/MM/YYYY	Social, Economic, Gender and Psychosocial Issues in Disasters, Disaster, Development, Stakeholders,		
DD/MM/YYYY	Rehabilitation and Recovery Models		
DD/MM/YYYY	Disaster Risk Reduction Strategies	Unit 2	9
DD/MM/YYYY	Disaster Management Cycle and Disaster Phases		
DD/MM/YYYY	Preparedness Plans, Action Plans and Early Warning Systems		
DD/MM/YYYY	Disaster Relief Components: Water, Food, Shelter, Sanitation, Health		
DD/MM/YYYY	Community-Based DRR and Structural/Non-Structural Measures		
DD/MM/YYYY	Vulnerability Assessment and Risk Analysis		
DD/MM/YYYY	Preparedness Policies, Roles, Responsibilities and Public Awareness		
DD/MM/YYYY	Sustainable Recovery, Reconstruction and Capacity Building		
DD/MM/YYYY	Psychosocial Recovery and Long-Term Resilience Planning		
DD/MM/YYYY	Disaster Recovery Lifecycle and Paradigm Shift	Unit 3	9
DD/MM/YYYY	Risk Assessment, Risk Mapping, Zonation and Micro zonation		
DD/MM/YYYY	Prevention, Mitigation and Business Impact Analysis		
DD/MM/YYYY	Early Warning Systems and Capacity Development		
DD/MM/YYYY	Emergency Response, Evacuation and Disaster Communication		
DD/MM/YYYY	Search & Rescue, Incident Command System, Emergency Operations Centre		
DD/MM/YYYY	Relief, Rehabilitation and Damage Assessment		
DD/MM/YYYY	Critical Infrastructure Restoration and Early Recovery		
DD/MM/YYYY	Reconstruction, Redevelopment and International Frameworks		
DD/MM/YYYY	Introduction, Scope and Importance of BCM	Unit 4	8

DD/MM/YYYY	BCM Framework and Core Concepts		
DD/MM/YYYY	Drivers of Business Continuity Management		
DD/MM/YYYY	BCM Risk Management Integration		
DD/MM/YYYY	Organizational Resilience and Recovery Governance		
DD/MM/YYYY	Roles and Responsibilities in BCM		
DD/MM/YYYY	Communication Planning and Crisis Coordination		
DD/MM/YYYY	BCM Teams and Stakeholder Management		
DD/MM/YYYY	BCM Policy Development and Recovery Documentation		
DD/MM/YYYY	Developing Effective BCM Capabilities	**Unit 5**	**10**
DD/MM/YYYY	Business Continuity Planning Lifecycle		
DD/MM/YYYY	Recovery Planning, Testing and Validation		
DD/MM/YYYY	Software Tools Supporting BCM		
DD/MM/YYYY	Backup Strategies and Disaster Recovery Automation		
DD/MM/YYYY	Disaster Recovery Systems and Technologies		
DD/MM/YYYY	BCM Best Practices and Real-World Case Studies		
DD/MM/YYYY	Lessons Learned and Continuous Improvement		
DD/MM/YYYY	Lessons Learned and Continuous Improvement		
DD/MM/YYYY	Course Revision / Integrated Case Discussion		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment

TS1	Conceptual Recall & Disaster Fundamentals	Recall and explain fundamental concepts of disasters, hazards, vulnerabilities, risks, disaster recovery principles, disaster classifications, and risk reduction terminology	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Disaster Management Interpretation & Preparedness Planning	Explain disaster management cycle, preparedness strategies, risk reduction mechanisms, emergency planning, and community resilience frameworks	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Business Continuity & Recovery Application	Apply business continuity principles, disaster recovery planning methods, infrastructure resilience concepts, continuity frameworks, and emergency response planning	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	Disaster Recovery Analysis & Framework Evaluation	Analyze disaster recovery processes, emergency response mechanisms, continuity frameworks, risk assessment outputs, and organizational recovery effectiveness	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	Strategic BCM Evaluation & Recovery Planning	Evaluate BCM development processes, continuity capabilities, disaster recovery strategies, organizational resilience planning, and best practices	CO5 | L4–L5	ETE Sec B/C
TS6	Public Health & Operational Disaster Recovery Management	Analyze public health response, psychosocial recovery, emergency coordination, communication systems, operational recovery planning, and rehabilitation mechanisms	CO6 | L3–L5	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M		M		H

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Conceptual / Case-based / Planning Exercises)	5 Assignments	15	CO1, CO2, CO3, CO4	CO1, CO2, CO3, CO4
Technical Video Learning Report + Presentation	1 Report + Presentation	5	CO2, CO3, CO4	TS2, TS3, TS4
Real-World Disaster Recovery / BCM Case Study Report	1 Report	5	CO4, CO5, CO6	CO4, CO5, CO6
TOTAL	—	25	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Disaster fundamentals: hazards, vulnerabilities, risks, disaster classifications, disaster recovery concepts	CO1	TS1	5 hrs.	Conceptual understanding, terminology accuracy, disaster scenario interpretation
Assignment 2	Disaster management cycle, preparedness planning, risk reduction strategies, emergency planning	CO2	TS2	5 hrs.	Preparedness planning, disaster cycle interpretation, structured response design
Assignment 3	Business continuity management, disaster recovery planning, infrastructure resilience, continuity frameworks	CO3	TS3	5 hrs.	BCM application, recovery planning logic, continuity strategy formulation
Assignment 4	Disaster recovery framework analysis, emergency response evaluation, continuity process assessment	CO4	TS4	5 hrs.	Analytical reasoning, framework comparison, response effectiveness evaluation
Assignment 5	BCM development strategies, organizational recovery capability, public health operational recovery analysis	CO5, CO6	TS5, TS6	5 hrs.	Strategic evaluation, operational recovery analysis, recommendations
Video Learning Report	Technical video on disaster recovery, BCM implementation, emergency response frameworks, resilience planning (minimum 3 hrs)	CO2, CO3, CO4	TS2, TS3, TS4	9 hrs.	Report on learning outcomes, concept understanding, BCM/disaster recovery insights, self-reflection; Presentation (10 min)
Case Study Report	Real-world disaster recovery / BCM case study (e.g., COVID business continuity, cyberattack recovery, infrastructure disruption, disaster response failure/success)	CO4, CO5, CO6	TS4, TS5, TS6	11 hrs.	Technical depth, case investigation, factual analysis, recovery evaluation, mitigation recommendations

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Conceptual Recall & Disaster Fundamentals TS2 — Disaster Management & Preparedness Planning	**CO1, CO2**	**Short-answer questions:** disaster definitions, hazard/vulnerability concepts, disaster classifications, risk reduction strategies, disaster management cycle, preparedness planning, emergency concepts
Section B	**15**	TS3 — BCM & Recovery Application TS4 — Recovery Analysis & Framework Evaluation	**CO2, CO3, CO4**	**Analytical/application questions:** disaster recovery planning, emergency response scenarios, business continuity concepts, framework comparison, disaster communication, critical infrastructure recovery
TOTAL	**25**	**TS1–TS4**	**CO1–CO4**	**Units 1–3 only. CO5 and CO6 assessed in ETE only.**

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1 — Conceptual Recall & Disaster Fundamentals TS2 — Disaster Management & Preparedness Planning	CO1, CO2	**Short questions (all units):** definitions, frameworks, BCM concepts, disaster recovery terminology, preparedness principles, emergency response concepts
Section B	25	TS3 — BCM & Recovery Application TS4 — Recovery Analysis & Framework Evaluation TS5 — Strategic BCM Evaluation	CO3, CO4, CO5	**Medium analytical questions:** disaster recovery planning, business continuity framework application, risk analysis, BCM development, continuity strategy evaluation, recovery planning scenarios
Section C	10	TS5 — Strategic BCM Evaluation TS6 — Public Health & Operational Recovery	CO5, CO6	**Long/evaluation questions:** BCM case analysis, organizational resilience evaluation, public health disaster response, rehabilitation strategies, disaster recovery case studies
TOTAL	50	TS1–TS6 (all)	CO1–CO6	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary

CO1	Explain disaster concepts, hazards, vulnerabilities, risks, and disaster recovery fundamentals	✓	✓	✓	TS1	PO1, PO2
CO2	Illustrate disaster management cycle, preparedness planning, and risk reduction strategies	✓	✓	✓	TS2	PO1, PO2, PO3
CO3	Apply principles of business continuity management and disaster recovery planning	✓	✓	✓	TS3	PO1, PO3, PO5
CO4	Analyze disaster recovery frameworks, emergency response mechanisms, and continuity processes	✓	✓	✓	TS4	PO2, PO4, PO5
CO5	Evaluate BCM development strategies, disaster recovery capabilities, and organizational resilience	✓	—	✓	TS5	PO3, PO4, PO12
CO6	Examine public health, communication, and operational recovery aspects during disasters	✓	—	✓	TS6	PO2, PO6, PO8

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 is covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | - = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	2	-	-	-	2	-	-	3
CO2	3	3	-	2	-	2	2	1	-	-	2	-	-	3
CO3	3	-	-	-	2	-	-	-	-	2	2	2	-	3
CO4	-	-	2	-	2	-	-	-	2	2	-	2	-	-
CO5	3	3	-	2	-	2	3	2	-	2	3	3	-	3
CO6	2	-	-	2	-	3	3	-	2	-	2	2	2	2
Avg	2.80	2.67	2.00	2.00	2.00	2.25	2.50	1.50	2.00	2.00	2.20	2.25	2.00	2.80

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M				M	M				M			H
CO2	H	H		M		M	M				M			H
CO3	H				M					M	M	M		H
CO4			M		M				M	M		M		
CO5	H	H		M		M	H	M		M	H	H		H
CO6	M			M		H	H		M		M	M	M	M

H = High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	Technical Video-Based Learning related to Disaster Recovery / BCM / Emergency Management (e.g., disaster response case documentaries, BCM implementation, crisis management, cyber disaster recovery, public health emergency response)	**Total = 15 hrs.**	CO2, CO3, CO4 TS2, TS3, TS4	Report + presentation based on learning outcomes, disaster preparedness concepts, BCM understanding, recovery planning insights, case interpretation, and self-reflection
2	Real-World Case Study Analysis (e.g., COVID continuity management, flood recovery planning, earthquake emergency response, cyberattack recovery, healthcare disaster response)	**Total = 15 hrs.**	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, disaster recovery analysis, factual investigation, strategic evaluation, public health recovery understanding, and mitigation recommendations
3	Technical Video-Based Learning related to Disaster Recovery / BCM / Emergency Management (e.g., disaster response case documentaries, BCM implementation, crisis management, cyber disaster recovery, public health emergency response)	**Total = 15 hrs.**	CO2, CO3, CO4 TS2, TS3, TS4	Report + presentation based on learning outcomes, disaster preparedness concepts, BCM understanding, recovery planning insights, case interpretation, and self-reflection
	TOTAL Self-Learning Hours	45 Hours	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)

L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (45 hrs.)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

CSCF3200— Disaster Recovery Management

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

School: SET		**Batch: 2026-2030**	
Program: B Tech.		**Current Academic Year: 2028-29**	
Branch: CSE		**Semester: V**	
1	Course Code	**CCP3001**	
2	Course Title	Community Connect	
3	Credits	2	
4	Contact Hours (L-T-P-SL)	0-0-4-0	
	Course Status	Compulsory	
5	Course Objective	1. The objective of assigning the project related to community work is to expose our students to different social issues faced by the people in different sections of society. 2. This type of project work will help the students to develop better understanding of problems of people living in disadvantage position in the society, may be socially, medically, economically, or otherwise. 3. This type of live project work will help our students to connect their class-room learning with practical issues/problems in the society.	
6	Course Outcomes	Students will be able to: 1. **CO1: Students develop awareness** of the social, health, and environmental challenges faced by the community 2. **C02: Students are more appreciative** of socio-economic realities beyond textbooks and classrooms 3. **CO3: Students learn to apply their knowledge** through research, awareness creation, and services for community benefit 4. **CO4: Students are able to carry** out community-based projects with sincerity, teamwork and timely delivery 5. **CO5: Students learn to respectfully engage** with communities with purposive intent to contribute to society and sustainable development 6. **C06: Students are able to document and present** their community project findings in an academically robust manner	
7	Course Description	In Community Connect projects, students will learn how to identify problems of rural and underprivileged communities by conducting surveys or will help the communities by providing services or solutions for the issues faced by them.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Team/Group formation and Project Assignment. Problem Definition & Finalizing the problem statement, Resource requirement, if any.	CO1, CO2
	Unit 2	Develop a useful questionnaire or service to the community that will aid in achieving the objectives of the project.	CO2, CO3. CO4
	Unit 3	Learn how to interact with the community members, whether in survey or service-based project – to help develop a more open mindset in the students.	CO3, CO4, CO5
	Unit 4	Analysis of survey data and/or impact on the community members.	CO3, CO4
	Unit 5	Demonstrate and justify their findings in light of the data they have gathered, or show the benefits to the community of the actions they have taken.	CO4, CO5, CO6

	Mode of examination	Practical /Viva		
	Weight age Distribution	CA	CE	ESE
		30%	30%	40%

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	**CO1: Students develop awareness** of the social, health, and environmental challenges faced by the community	PO6, PO7, PO8, PO11
2.	**C02: Students are more appreciative** of socio-economic realities beyond textbooks and classrooms	PO6, PO7, PO8, PO11
3.	**CO3: Students learn to apply their knowledge** through research, awareness creation, and services for community benefit	PO2, PO6, PO7, PO9, PO10, PO11
4.	**CO4: Students are able to carry** out community-based projects with sincerity, teamwork and timely delivery	PO9, PO10, PO11
5.	**CO5: Students learn to respectfully engage** with communities with purposive intent to contribute to society and sustainable development	PO6, PO7, PO8, PO9, PO11
6.	**CO6: Students are able to document and present** their community project findings in an academically robust manner	PO10, PO11

PO and PSO mapping with level of strength for Course Name: Community Connect (Course Code CCP3001)

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	–	1	–	–	–	3	3	2	1	1	2	–	–	–
CO2	–	1	–	–	–	2	2	2	1	1	2	–	–	–
CO3	1	2	1	1	–	2	2	1	2	2	2	–	1	–
CO4	–	1	1	–	–	1	1	1	3	2	2	–	–	–
CO5	–	1	–	–	–	3	3	3	2	1	2	–	–	–
CO6	1	1	–	1	–	–	–	1	1	3	2	–	–	1
Avg PO attained	1	0.83	1	1	0	1.2	1.2	1	1.33	1.33	1.33	0	1	1

Strength of Correlation: 13.22
1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

COURSE PLAN

Communication, Coding & Career Readiness Skills (SKP3501)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester V | Batch 2026–2030

Lab-Only Course Plan — All 6 Lab COs (CO1–CO6) | New AICTE 11-PO Framework | Full Skill Mapping

PART I COURSE SYLLABUS *Course Identification, Details, Outcomes, BTL Mapping & Lab Session Plan*

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2028–2029
Branch:	CSE	**Semester:**	V
Course Code:	SKP3501	**Course Type:**	Core - Practical

2. Course Details

🔬 **LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.**

1	**Course Code**	SKP3501
2	**Course Title**	Communication, Coding & Career Readiness Skills
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	0-0-6-0 (Lab: 90 hrs =Total: 90 hrs)
5	**Course Status**	Core — Lab Only (No Theory Lecture Component)
6	**Course Objectives**	The objective of this course is to develop learners into confident, industry-ready, and effective communicators by strengthening their verbal ability, soft skills, quantitative aptitude, and logical reasoning competencies, while concurrently developing advanced computational problem-solving, Generative AI fundamentals, modern frontend engineering, and optimization techniques using advanced algorithms and React-based application development. The course enables students to understand transformer architectures, prompt engineering, retrieval-augmented systems, dynamic programming, graph algorithms, and scalable frontend state management for building industry-oriented intelligent applications and modern web systems. It aims to enhance professional communication through activities such as elevator pitches, group discussions, JAM sessions, public speaking, and LSRW practices while fostering leadership, managerial effectiveness, decision-making abilities, and workplace etiquette. It also focuses on preparing learners for recruitment and corporate environments through LinkedIn profile optimization, HR sensitization, understanding KRAs/KPAs/CTC, and constructive feedback mechanisms. In addition, the course seeks to improve analytical thinking, problem-solving skills, and reasoning ability through quantitative aptitude, critical reasoning, data interpretation, seating arrangements, inequalities, and statement-based reasoning exercises. By the end of the course, learners will demonstrate improved confidence, clarity of expression, professional readiness, analytical aptitude, and the ability to communicate, build, and perform effectively in academic, corporate, and real-world technological situations.
7	**Course Outcomes (COs)**	After successful completion of this course, the students will be able to: **CO1 (Remember – L1):Fundamentals of Professional Communication &**

		Intelligent Systems Recall and identify the fundamental concepts of professional communication, self-branding, business etiquette, managerial skills, HR sensitization, Generative AI, transformer architectures, React fundamentals, greedy strategies, and optimization techniques used in intelligent systems, frontend development, and academic or corporate environments. **CO2 (Understand – L2): Principles of Leadership, AI Models & Frontend Architecture** Explain the principles of leadership, decision-making, public speaking, constructive feedback, language modeling workflows, prompt engineering techniques, dynamic programming paradigms, React state management, and API-driven frontend architectures for effective professional interaction and software development. **CO3 (Apply – L3): Application of Employability Skills & Computational Workflows** Demonstrate effective communication and employability skills through elevator pitches, group discussions, and LinkedIn optimization, while applying React components, hooks, routing, APIs, dynamic programming, graph algorithms, and Generative AI workflows to solve computational and real-world application problems. **CO4 (Analyze – L4):Analysis of Communication Competencies & Scalable System Design** Analyze spoken and written content by applying listening, speaking, reading, and writing (LSRW) skills and critical reasoning, while simultaneously analyzing transformer architectures, fine-tuning strategies, graph traversal techniques, asynchronous frontend workflows, and optimization algorithms for scalable system development. **CO5 (Evaluate – L5): Evaluation of Analytical Reasoning & Application Performance** Evaluate and solve quantitative and logical reasoning problems (involving data interpretation, time-speed-distance, and inequalities), while also evaluating AI model outputs, ethical implications, optimization techniques, React application performance, and algorithmic efficiencies for intelligent application design. **CO6 (Create – L6): Creation of Professional Profiles & AI-Powered Applications** Create structured verbal and written responses, professional profiles, and logical solutions, and design and develop complete AI-powered React applications by integrating prompt engineering, APIs, advanced algorithms, state management, and communication skills for real-world corporate and technical scenarios.
8	**Course Description**	This course provides an interdisciplinary framework integrating professional communication, employability skills, and logical reasoning with Generative AI, advanced algorithms, and modern React-based frontend engineering. Learners enhance their presentation skills, public speaking, group discussion abilities, and LSRW competencies through structured activities such as elevator pitches, JAM sessions, leadership exercises, and workplace communication practices. Parallel, students are introduced to transformer architectures, prompt engineering, LLM ecosystems, retrieval-augmented generation, and responsible AI practices. The course strengthens analytical and computational thinking through quantitative aptitude, critical reasoning, data interpretation, and advanced algorithmic techniques including greedy algorithms, dynamic programming, backtracking, branch and bound, and advanced graph algorithms. Furthermore, it develops practical frontend engineering competencies using React, hooks, routing, APIs, authentication workflows, Redux Toolkit, and deployment methodologies. By emphasizing project-based learning, LinkedIn profile optimization, HR sensitization, business etiquette, and industry-oriented software engineering practices, this course prepares students to communicate confidently, solve complex problems, and build scalable, intelligent applications in real-world, career-oriented situations."
9	**Teaching & Learning Scheme**	Lab Instructions (LI): 90 hrs | Tutorial (T): 0 hrs | Self Learning (SL): 0 hrs | Total: 90 hrs | Credits: 3
10	**Mode of Examination**	Lab Only. CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
11	**Self Learning (SL: 0 hrs)**	-.
12	**Textbook**	1. **Soft Skills: Know Yourself & Know the World –** Dr. Alex K. 2. **Quantitative Aptitude for Competitive Examinations–** R.S. Aggarwal 3. **A Modern Approach to Verbal & Non-Verbal Reasoning –** R.S. Aggarwal 4. **Business Communication –** Meenakshi Raman & Prakash Singh

		5. Word Power Made Easy – Norman Lewis 6. Jurafsky and Martin – Speech and Language Processing 7. AurélienGéron – Hands-On Machine Learning with Scikit-Learn and TensorFlow 8. Jon Duckett – React and Modern Frontend Development 9. Thomas H. Cormen – Introduction to Algorithms 10. Full Stack Open Documentation and React Official Docs
13	**References**	1 Ian Goodfellow – Deep Learning 2 Sebastian Raschka – Build a Large Language Model From Scratch 3 Kyle Simpson – You Don't Know JS 4. Aditya Bhargava – Grokking Algorithms 5 David Flanagan – JavaScript: The Definitive Guide 6 Hugging Face Documentation 7 OpenAI API Documentation 8 React Official Documentation 9 Redux Toolkit Documentation 10 LeetCode Advanced DSA Problems 11 GeeksforGeeks – DP and Graph Algorithms 12 LangChain Documentation

3. Outline Syllabus — Lab Units with CO Mapping

i All CO mappings refer to Lab COs (CO1–CO6). This is a lab-only course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit 1 : Professional Branding, Corporate Communication, and Generative AI Foundations and Language Models (0-0-18-0 = 18hrs)	
A	Elevator Pitch – Art of Self Branding, professional self-introduction, confidence building, and personal branding techniques.	**CO1**
B	LinkedIn Profile Optimization, professional networking, profile enhancement, and digital professional presence.	**CO1**
C	Profile Updating on Job Portals & Placement Consultancies, HR Sensitization – KRAs/KPAs – Understanding CTC, recruitment awareness, and employability readiness.	**CO1**
D	Introduction to Generative AI, Key Concepts, Comparison with Traditional AI, Applications in Text, Image and Code Generation **OR** Introduction to React, SPA Architecture, Virtual DOM and Modern Frontend Workflow	**C01**
E	Language Modeling Fundamentals, Statistical vs Neural Models, N-Grams, Perplexity and Training Objectives **OR** React Setup using Vite, npm, Folder Structure and React DevTools	**C02**
F	Evolution of LLMs and Generative AI Landscape: Word2Vec to GPT, Transfer Learning, Pretraining vs Fine-Tuning, GPT-4o, Claude, Gemini, LLaMA, Mistral	**C02**
G	Greedy Choice Property, Optimal Substructure and Exchange Argument Proofs, Activity Selection, Interval Scheduling and Meeting Room Problems, Huffman Encoding, Fractional Knapsack and Minimum Platforms Problem	**C03**
H	Dijkstra's Algorithm, Prim's MST and Kruskal's MST with Union-Find	**C03**
	Unit 2: Managerial Skills & Tech Foundations: LLMs, Frontend Components, and Dynamic Programming-— 1D & 2D (0-0-18-0 = 18hrs)	
A	Introduction to Managerial Skills, workplace coordination, organizational behavior, and professional responsibilities.	**CO2**

B	Business Etiquette, workplace communication ethics, professional behavior standards, and Crisis Management.	**CO2**
C	Introduction to Leadership Skills, Decision Making Skills, Constructive Criticism & Feedback, leadership qualities, and professional interaction strategies.	**CO2**
D	Attention Mechanism, Self-Attention and Positional Encoding **OR** Functional Components, Props and Reusable Components	**C04**
E	Transformer Architecture, Encoder-Decoder Models, BERT, GPT, T5 and LLaMA **OR R**useState Hook, Event Handling and Dynamic UI Updates	**C03**
F	Multimodal Transformers, CLIP, Scaling Laws, Zero-Shot and Few-Shot Learning **OR** Controlled Components, Forms Handling and Validation	**C05**
G	Dynamic Programming Fundamentals, Memorization and Tabulation, 1D Dynamic Programming: Fibonacci, Climbing Stairs, Coin Change and LIS, 2D Dynamic Programming: Grid Paths, Edit Distance and LCS,	**CO2**
H	DP on Strings, Wildcard Matching and Distinct Subsequences	**C04**
	Unit 3: Public Speaking, Group Discussion & Verbal Communication Skills / Prompt Engineering, APIs and Toolkits / Hooks, Rendering & React APIs / Advanced DP & Divide and Conquer (0-0-18-0 = 18hrs)	
A	Advance Toastmaster – Public Speaking, speech organization, audience engagement, voice modulation, and confidence building.	**CO3**
B	JAM Sessions, Group Discussion – Case Study, spontaneous speaking, teamwork, and discussion participation skills.	**CO3**
C	LSRW 2 – Listening, Speaking, Reading & Writing, Contextual Vocabulary, Active & Passive Voice – Company & AMCAT Specific, grammar accuracy, and verbal communication enhancement.	**CO4**
D	Prompt Engineering Fundamentals, Zero-shot, One-shot and Few-shot Prompting **OR** useEffect Hook, Dependency Arrays and Side Effects	**CO2**
E	Chain-of-Thought, Tree-of-Thought, ReAct and Self-Consistency Prompting **OR** Conditional Rendering, Dynamic Rendering, Error and Loading States	**CO4**
F	OpenAI API, Anthropic API, Hugging Face, LangChain and Function Calling **OR** Custom Hooks and Reusable Logic Extraction	**CO6**
G	DP on Trees, Tree Diameter and Tree DP Patterns, DP on Graphs, Bellman-Ford and Floyd-Warshall Algorithms	**C04**
H	Bitmask DP, Interval DP and Partition DP	**CO5**
	Unit 4: Quantitative Aptitude & Numerical Problem-Solving Skills.Fine-Tuning, Evaluation, Bias and Ethics Backtracking & Branch and Bound Routing, API Integration & Authentication (0-0-18-0 = 18 hrs)	
A	Number Series – Missing & Wrong, pattern recognition, logical numerical analysis, and aptitude-solving techniques.	**CO5**
B	Allegation & Mixtures, Time & Work (LCM and Efficiency Based), Time, Speed & Distance, quantitative problem-solving methods and analytical calculations.	**CO5**
C	Clocks, Data Interpretation – Line/Bar, Tabular/Pie, Radar/Web Charts, graphical data analysis, and interpretation techniques.	**CO5**
D	Fine-Tuning LLMs, LoRA, QLoRA and PEFT Techniques **OR** React Router, Nested Routes, Protected Routes and Navigation	**CO4**

E	BLEU, ROUGE, Perplexity and AI Output Evaluation **OR** Fetch API, Axios, Async/Await and API Integration	**C05**
F	Bias, Hallucination, Red Teaming and Responsible AI Frameworks **OR** Authentication, Token Storage and Frontend–Backend Integration	**C05**
G	Backtracking Templates, State-Space Exploration and Decision Tree Pruning, Permutations, Combinations, N-Queens, Sudoku Solver and Word Search	**CO4**
H	Constraint Propagation, Arc Consistency and Pruning Heuristics, Branch and Bound, 0/1 Knapsack and Graph Coloring	**CO5**
	Unit 5: Logical Reasoning & Critical Thinking Skills, RAG Applications/Advanced React State Management & Project Development Advanced Graph Algorithms (0-0-18-0 = 18 hrs)	
A	Critical Reasoning – Moderate to Advance, analytical thinking, logical interpretation, and reasoning strategies.	**CO4**
B	Statement & Conclusions, Statement & Assumptions, logical analysis, inference building, and argument evaluation.	**CO4**
C	Linear Sitting Arrangement, Circular Sitting Arrangement, Rectangular and Square Seating Arrangement, Inequalities (Reasoning), arrangement-based reasoning and logical problem-solving techniques.	**CO5**
D	Chatbots, AI Tutors, Creative Writing and Code Completion Systems **OR** Context API, createContext and useContext	**C06**
E	Retrieval-Augmented Generation, Embeddings and Vector Databases **OR** Redux Toolkit, Reducers, Store Management and ReduxDevTools	**CO4**
F	End-to-End LLM Project Design and AI Workflow Integration **OR** Performance Optimization, Lazy Loading, Deployment and Git Workflow	**CO6**
G	Bellman-Ford, SPFA and Negative Cycle Detection, Floyd-Warshall, Transitive Closure and Path Reconstruction	**CO4**
H	Tarjan's SCC, Articulation Points and Bridges, Max Flow, Edmonds-Karp, Bipartite Matching and Min-Cut	**CO5**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A – Elevator Pitch & Self Branding	✔	✔	✔			
2	1.B – LinkedIn Profile Optimization	✔	✔	✔			✔
3	1.C – HR Sensitization & Employability Readiness	✔	✔	✔			
4	1.D – Generative AI Fundamentals / React Architecture	✔	✔		✔		
5	1.E – Language Modeling / React Setup using Vite	✔	✔	✔			
6	2.A – Managerial & Leadership Skills		✔	✔	✔		
7	2.B – Transformer Architecture / React Components	✔	✔	✔	✔		
8	2.C – Dynamic Programming Fundamentals	✔	✔	✔	✔	✔	
9	3.A – Public Speaking & Group Discussion	✔	✔	✔	✔		
10	3.B – Prompt Engineering / React Hooks	✔	✔	✔	✔		
11	3.C – OpenAI APIs, LangChain & Custom Hooks	✔	✔	✔	✔	✔	✔
12	4.A – Quantitative Aptitude & Data Interpretation	✔	✔	✔	✔	✔	
13	4.B – Fine-Tuning, Evaluation & Responsible AI	✔	✔	✔	✔	✔	

14	4.C – Backtracking & Branch and Bound	✔	✔	✔	✔	✔	
15	5.A – Critical Reasoning, RAG & Advanced Graph Algorithms	✔	✔	✔	✔	✔	✔

5. CO vs Bloom's Taxonomy — All Three Domains

i Only strong/dominant alignments are mapped. Lab COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**A1**	**A2**	**A3**	**A4**	**A5**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
CO1	✔	✔						✔	✔					✔	✔			
CO2		✔	✔					✔	✔	✔				✔	✔			
CO3			✔	✔				✔	✔	✔	✔			✔	✔	✔		
CO4			✔	✔	✔				✔	✔	✔				✔	✔	✔	
CO5				✔	✔				✔	✔	✔				✔	✔	✔	
CO6			✔	✔	✔	✔				✔	✔				✔	✔	✔	

Legend: ✓ = Strong / Dominant mapping only.

6. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	30	CO1–CO6 | Communication Skills | Aptitude | AI/React Activities | Problem-Solving Exercises
Course Examination (CE)	30%	30	CO1–CO6 | Public Speaking | Coding Skills | APIs | Dynamic Programming | Practical + Viva
End Semester Examination (ESE)	40%	40	CO1–CO6 | Quantitative & Logical Reasoning | Algorithm Design | AI Workflows | Frontend Development
TOTAL	**100%**	**100**	**All COs assessed across communication, reasoning, AI, React, and advanced problem-solving domains**

7. Continuous Assessment (CA) — 30 Marks

7.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Lab Skill Dimensions Covered	Marking Guide	Lab CO
Communication & Professional Participation	1	Public speaking, GD participation, LinkedIn/profile	1.0: Active & professional | 0.5:	CO1–CO3

		activities, HR interaction, teamwork	Partial participation | 0: Absent	
Technical Implementation & Problem Solving	1	React implementation, API usage, AI workflows, DP/Graph algorithms, coding exercises	1.0: Correct & executable | 0.5: Minor issues | 0: Incomplete/incorrect	CO2–CO5
Analysis, Documentation & Interpretation	0.75	Output interpretation, reasoning analysis, prompt evaluation, aptitude/problem-solving documentation	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO3–CO5
Professional Ethics & Collaboration	0.25	Responsible AI practices, teamwork, constructive feedback, professional conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO6
Total	**3**	**Communication, AI, React, Aptitude, Reasoning & Coding dimensions covered**		**CO1–CO6**

7.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
>10	Best 10	**30 Marks**	Best 10 of all sessions (3 marks × 10 = 30)
< 10	All attended	**≤ 30 Marks**	Each missed session = zero; cannot be compensated

8. Continuous Evaluation (CE) — 30 Marks

ℹ CE is a mid-point practical/theoretical evaluation covering Units 1–3 (CO1–CO3). Advanced analytical, optimization, and project-oriented outcomes from CO4–CO6 are primarily assessed in ESE.

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	Communication Skills, Professional Branding, Prompting Fundamentals, React/AI Basics	CO1, CO2	Activities based on elevator pitch, LinkedIn optimization, React setup, AI fundamentals, aptitude basics, or short implementation tasks
Sec B	10	Problem Solving, Dynamic Programming, APIs, Reasoning & Analysis	CO2, CO3	Coding/problem-solving questions on DP, graph algorithms, prompt engineering, APIs, React hooks, reasoning or quantitative aptitude
Sec C (Viva)	10	Documentation, Analytical Interpretation, Professional Interaction	CO1–CO3	Viva based on communication skills, AI workflows, React concepts, algorithm design, output interpretation, and practical activities
TOTAL	**30**	**Communication, AI, React, Aptitude, Reasoning & Coding Skills**	**CO1–CO3**	**Units 1–3 focused assessment. Higher-order evaluation and project integration assessed in ESE.**

9. End Semester Examination (ESE) — 40 Marks

ℹ ESE is comprehensive — all 5 units and all 6 COs are assessed. The examination evaluates communication proficiency, analytical reasoning, AI workflows, React/frontend development, aptitude, and advanced algorithmic problem-solving. Minimum 16/40 required to pass.

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A	10	Technical Implementation, Communication Skills, React/AI Fundamentals	CO1, CO2, CO4	Short-answer/problem-solving questions on Generative AI, React fundamentals, aptitude, professional communication, DP basics, or frontend implementation
Sec B	20	Algorithm Analysis, Reasoning, APIs, Optimization & Output Interpretation	CO3, CO4, CO5	Analytical and coding-based questions involving graph algorithms, DP, prompt engineering, API integration, reasoning, quantitative aptitude, and optimization analysis
Sec C	10	Design Thinking, Innovation, AI Workflow Integration & System Development	CO5, CO6	Case-study/project-oriented questions involving AI-powered application design, React integration, RAG workflows, performance optimization, or scalable system design
TOTAL	**40**	**Communication, AI, React, Aptitude, Reasoning, Design & Advanced Problem-Solving Skills**	**CO1–CO6**	**Comprehensive assessment across all five units. Minimum 16/40 required to pass.**

9.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	Skill Dimensions	PO Primary
CO1	Recall fundamentals of communication, AI, React & optimization techniques	✔	✔	✔	Communication, AI Basics, Professional Skills	PO1, PO2, PO9
CO2	Explain leadership, AI workflows, React architecture & DP concepts	✔	✔	✔	Analytical Thinking, Leadership, Frontend Concepts	PO1, PO2, PO3
CO3	Apply employability skills, APIs, React workflows & algorithms	✔	✔	✔	Coding, APIs, Communication & Problem Solving	PO1, PO3, PO5
CO4	Analyze LSRW skills, transformer architectures & scalable systems	✔	—	✔	Reasoning, Analysis, Optimization & System Design	PO1, PO2, PO4
CO5	Evaluate aptitude, AI outputs & algorithmic efficiencies	✔	—	✔	Quantitative Aptitude, Evaluation &	PO1, PO2, PO8, PO10

					Performance Analysis	
CO6	Create AI-powered applications & professional solutions	✔	—	✔	Innovation, Integration, Project Development & Deployment	PO1, PO3, PO10, PO11

⚠ *CO4, CO5, and CO6 are primarily assessed through CA activities and comprehensive ESE evaluation. CE focuses mainly on foundational and applied concepts from Units 1–3.*

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

10. CO–PO and CO–PSO Mapping Matrix

i Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	2	-	-	-	2	3	2	2	2	1
CO2	2	3	2	1	2	1	1	-	3	3	2	3	3	2
CO3	2	3	3	2	3	1	1	-	3	3	2	3	3	3
CO4	2	3	3	3	3	1	2	2	3	2	3	3	3	3
CO5	2	3	2	2	2	2	2	2	2	3	3	2	3	2
CO6	2	3	3	3	3	2	2	3	3	3	3	3	3	3
Avg	**2**	**2.83**	**2.5**	**2.2**	**2.5**	**1.4**	**1.6**	**1.75**	**2.67**	**2.83**	**2.5**	**2.67**	**2.83**	**2.33**

11. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M		M				M	H	M	M	M	
CO2	M	H	M		M				H	H	M	H	H	M
CO3	M	H	H	M	H				H	H	M	H	H	H
CO4	M	H	H	H	H		M	M	H	M	H	H	H	H
CO5	M	H	M	M	M	M	M	M	M	H	H	M	H	M
CO6	M	H	H	H	H	M	M	H	H	H	H	H	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

12. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems 4 — Analyze: Break down information, examine patterns 5 — Evaluate: Judge, justify, assess, make decisions 6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend \n A2 — Responding: Active participation and reaction \n A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

ℹ OBE Compliance Statement: This is a lab-only course. All 6 COs span all three domains — Cognitive (L3–L6) as the primary domain, Psychomotor (P3–P6) for implementation and design skills, and Affective (A2–A4) for professional and collaborative conduct — reflecting the skill-based, hands-on nature of laboratory assessment.

13. Attendance Policy & Pass/Fail Criteria

13.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Lab / Practical Sessions	**75%**	All sessions	Debarred from ESE, if below threshold

⚠ Minimum 75% attendance is mandatory in practical/activity sessions. Non-submission of self-learning tasks, coding activities, analytical exercises, or communication assignments directly impacts internal assessment and is not compensable through external examination performance.

13.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 16 / 40**	**MANDATORY**	40% of ESE marks required; failing ESE means failing the course regardless of CA + CE performance
Overall Total (CA + CE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 30 + CE 30 + ESE 40 = 100; 40% overall minimum required

SKP 3501 — COURSE PLAN — MEASUREMENT ARCHITECTURE
11 ProgrammeOutcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments →
CO1–CO3: Apply/Analyse → LS1–LS3, LS6 → CA + CE + ESE
CO4–CO5: Analyse/Evaluate → LS3–LS5, LS7 → CA + ESE
CO6: Create → LS7–LS8 → CA + ESE Sec C
Marks: CA 30 + CE 30 + ESE 40 = Total 100

Semester 6, Credits: 23	
COURSE CODE	**COURSE NAME**
CSCR3313	Compiler Design
CSCR3314	Cryptography and Network Security
CSCR3113	Digital Image Processing
CSCR3601	Project Based Learning (PBL) -4 (Product Based)
BST3351	Management for Engineers
	Program Elective-3
CSHC3102	Brain Computer Interface
CSAI3103	Deep Learning & Its Applications
CSOT3206	Data Analytics for IoT
CSCF3202	Web Application Security
	Open Elective – 1
SKP3601	Strategic Professionalism and Computational Informatics

COURSE PLAN

Digital Image Processing (CSCR3113)

Sharda School of Computing Sciences & Engineering (SSCSE) | B.Tech CSE | Semester VI | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	VI
Course Code:	CSCR3113	**Course Type:**	Core - Theory Only

2. Course Details

📘 THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.

S.No	Attribute	Details
1	**Course Code**	**CSCR3113**
2	**Course Title**	**Digital Image Processing**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 Hrs Classroom + 45 Hrs Self Learning = 90 Hrs total)
5	**Course Status**	**Program Elective — Theory Only (No Laboratory Component)**
6	**Course Objectives**	The objective of this course is • To introduce the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images. • To understand the principles and methods used for image sampling, quantization, image transforms, image enhancement and restoration, image encoding, image analysis that are required for pattern recognition applications. • To apply digital image processing techniques to solve real-world problems in several areas including medical, remote sensing and surveillance. • To develop the insights necessary to use the tools of digital image processing to solve any new problem.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:**

		CO1 (Recall/Understand – L1/L2): Recall the basic concepts of visual perception, terminologies of digital image processing, colour fundamentals and understand image acquisition and transform techniques. CO2 (Understand – L2): Understand the principles of image enhancement in spatial and spectral domains CO3 (Apply – L3): Apply Image restoration technique to recover lost details from images, design and implement different compression techniques for digital images. CO4 (Analyze – L4): Analyze and interpret the effectiveness and efficiency different image segmentation algorithms. CO5 (Evaluate – L5): Evaluate the effectiveness different morphological operations and algorithms that are used for image pre-processing. CO6 (Create– L6): Create image processing applications for better image representation suitable for real-word applications.
8	**Course Description**	Images and visual information are integral parts of our day-to-day life. Digital image processing plays an important role in various practical applications that include television, medical imaging modalities such as X-ray or ultrasound, photography, security, astronomy and remote sensing. This course introduces the fundamental principles of digital image processing and manipulation techniques for digital images for a better image understanding and representation.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 Hrs. | Self Learning (SL): 45 Hrs. | Total: 90 Hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	1. Digital Image Processing 2nd Edition, Rafael C. Gonzalez and Richard E. Woods. Published by: Pearson Education.
12	**References**	1. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY. 2. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ. 3. Image Processing, Analysis and Machine Vision, by Milan Sonka, Vaclav Hlavac, Roger Boyle Cengage Learning 3rd Edition 4. Digital Image Processing, by S Jayaraman, S Esakkirajan, T Veerakumar TMH Publication

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
Unit 1	**Introduction to Digital Image Processing**	
A	Fundamentals of digital image processing, Elements of human visual perception system, Applications of digital image progressing	**CO1**
B	Image sampling and quantization, Relationships between pixels, Image sensing and acquisition	**CO1**
C	Color image fundamentals: RGB, HSI models; Two-dimensional mathematical preliminaries, 2D transforms: 2DDFT, 2DDCT, 2DDWT.	**CO1**
Unit 2	**Image Enhancement in Spatial and Frequency Domain**	

A	Spatial Domain Techniques: Gray level Transformations, pixel-based processing, Histogram based processing, Brightness and Contrast enhancement, Basics of Spatial Filtering, Smoothing and Sharpening.	CO1, CO2
B	Frequency Domain techniques: Introduction to Fourier Transform, properties of Fourier transform specific to image processing.	CO1, CO2
C	Low-pass, High-pass Band-pass filters in frequency domain, Frequency response of filters.	CO1, CO2
Unit 3	**Image Restoration and Compression**	
A	Restoration Process model, Noise models, Mean Filters, Order Statistics, Adaptive filters	CO1
B	Frequency Domain Filtering: Band-reject filters, Band-pass filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering.	CO2, CO3, CO4
C	Encoder-Decoder model, Types of redundancies, Brief Overview of Lossy and Lossless Compression Techniques, Huffman encoding.	CO2, CO3, CO4
Unit 4	**Image Segmentation**	
A	Boundary. detection-based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform.	CO1, CO2
B	Thresholding, Global Thresholding, adaptive thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding	CO3, CO4, CO5
C	Region based segmentation, Watershed algorithm, Use of motion in segmentation	CO3, CO4
Unit 5	**Morphological Image Processing**	
A	Morphological operators, Basics, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform	CO1, CO2, CO3, CO5
B	Morphological Algorithms: Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning	CO2, CO4, CO5, CO6
C	Geodesic Dilation, Erosion, Reconstruction by dilation and erosion. Applications of Morphological Image Processing, Case studies on real-word digital image processing applications	CO4, CO5, CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create

1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓				
4	2.A		✓	✓			
5	2.B		✓	✓			
6	2.C			✓	✓		
7	3.A	✓	✓				
8	3.B			✓	✓		
9	3.C			✓	✓	✓	
10	4.A		✓				
11	4.B			✓	✓		
12	4.C			✓	✓	✓	
13	5.A		✓	✓			
14	5.B			✓	✓		
15	5.C		✓	✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓															
CO3			✓	✓											✓			
CO4				✓	✓				✓									
CO5				✓	✓			✓										
CO6		✓	✓	✓														

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures /45 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Date	Topics to be Covered / Title	UNIT	Total Lectures
DD/MM/YY	Introduction to Digital Image Processing and Applications	Unit 1	1
DD/MM/YY	Human Visual System and Image Perception	Unit 1	2
DD/MM/YY	Fundamentals of Digital Images and Pixel Concepts	Unit 1	3
DD/MM/YY	Image Sampling and Quantization	Unit 1	4
DD/MM/YY	Relationships Between Pixels and Connectivity	Unit 1	5
DD/MM/YY	Image Sensing and Acquisition Techniques	Unit 1	6
DD/MM/YY	Color Models: RGB and HSI	Unit 1	7
DD/MM/YY	Two-Dimensional Mathematical Preliminaries	Unit 1	8
DD/MM/YY	2D Fourier Transform (2DDFT)	Unit 1	9
DD/MM/YY	2D DCT and 2D DWT	Unit 1	10
DD/MM/YY	Introduction to Image Enhancement Techniques	Unit 2	11
DD/MM/YY	Gray Level Transformations	Unit 2	12
DD/MM/YY	Pixel-Based Processing Techniques	Unit 2	13
DD/MM/YY	Histogram Processing Techniques	Unit 2	14
DD/MM/YY	Brightness and Contrast Enhancement	Unit 2	15
DD/MM/YY	Basics of Spatial Filtering	Unit 2	16
DD/MM/YY	Smoothing and Sharpening Filters	Unit 2	17
DD/MM/YY	Introduction to Fourier Transform in Image Processing	Unit 2	18
DD/MM/YY	Properties of Fourier Transform	Unit 2	19
DD/MM/YY	Frequency Domain Filters: LPF, HPF, BPF	Unit 2	20
DD/MM/YY	Frequency Response of Filters and Numerical Problems	Unit 2	21
DD/MM/YY	Image Restoration Process and Noise Models	Unit 3	22
DD/MM/YY	Mean Filters and Order Statistics Filters	Unit 3	23
DD/MM/YY	Adaptive Filters and Applications	Unit 3	24
DD/MM/YY	Band Reject and Band Pass Filters	Unit 3	25

DD/MM/YY	Notch Filters and Optimum Notch Filtering	Unit 3	26
DD/MM/YY	Inverse Filtering and Wiener Filtering	Unit 3	27
DD/MM/YY	Encoder-Decoder Model and Redundancies	Unit 3	28
DD/MM/YY	Lossy and Lossless Compression Techniques	Unit 3	29
DD/MM/YY	Huffman Encoding and Compression Applications	Unit 3	30
DD/MM/YY	Introduction to Image Segmentation	Unit 4	31
DD/MM/YY	Point, Line and Boundary Detection	Unit 4	32
DD/MM/YY	Edge Detection and Edge Linking	Unit 4	33
DD/MM/YY	Local, Regional Processing and Hough Transform	Unit 4	34
DD/MM/YY	Thresholding and Global Thresholding	Unit 4	35
DD/MM/YY	Adaptive and Iterative Thresholding	Unit 4	36
DD/MM/YY	Otsu's Method and Multivariable Thresholding	Unit 4	37
DD/MM/YY	Region-Based Segmentation Techniques	Unit 4	38
DD/MM/YY	Watershed Algorithm and Motion-Based Segmentation	Unit 4	39
DD/MM/YY	Fundamentals of Morphological Image Processing	Unit 5	40
DD/MM/YY	Erosion, Dilation, Opening and Closing	Unit 5	41
DD/MM/YY	Hit-or-Miss Transform and Morphological Operations	Unit 5	42
DD/MM/YY	Boundary Detection, Hole Filling and Connected Components	Unit 5	43
DD/MM/YY	Convex Hull, Thinning, Thickening and Skeletons	Unit 5	44
DD/MM/YY	Geodesic Operations, Reconstruction and Real-World Case Studies	Unit 5	45

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Recall basics and identification of terminologies**	Recall the basic concepts of visual perception, terminologies of digital image processing, colour fundamentals and understand image acquisition and transform techniques.	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Understand the concepts principles of image enhancement**	Understand the principles of image enhancement in spatial and spectral domains	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Application & Implementation of image restoration**	Apply Image restoration techniques to recover lost details from images, design and implement different compression techniques for digital images.	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Analysis & interpret Performance Evaluation**	Analyze and interpret the effectiveness and efficiency different image segmentation algorithms.	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	**Evaluation of Morphological operations and algorithms for DIP**	Evaluate the effectiveness different morphological operations and algorithms that are used for image pre-processing.	CO5 | L4–L5	ETE Sec B/C
TS6	**Create applications for meeting the real-world requirements**	Create image processing applications for better image representation suitable for real-word applications.	CO6 | L2–L4	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M		M	M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Numerical / Real-world Problem-based)	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Basic concepts of visual perception, terminologies of digital image processing, colour fundamentals and image acquisition and transform techniques.	CO1	TS1	5h SL	Documentation, research depth, originality, correctness, aesthetic and ethical responsibility
Assignment 2	Principles and techniques for image enhancement in spatial and spectral domains	CO2	TS2	5h SL	Documentation, research depth, originality, correctness, aesthetic and ethical responsibility
Assignment 3	Image restoration techniques to recover lost details from images, design and implement different compression techniques for digital images.	CO2, CO3	TS2, TS3	5h SL	Documentation, research depth, originality, correctness, aesthetic and ethical responsibility
Assignment 4	Image segmentation algorithms- Analysis and comparison	CO3, CO4	TS3, TS4	5h SL	Documentation, research depth, originality, correctness, aesthetic and ethical responsibility

Assignment 5	Morphological operations and algorithms that are used for image pre-processing.	CO3, CO4, CO5	TS3, TS4, TS5	5h SL	Documentation, research depth, originality, correctness, aesthetic and ethical responsibility
Video Learning Report	Video report on image processing applications for better image representation suitable for real-word applications.	CO2, CO3	TS2, TS3	9h SL	Report: learning outcomes, key concepts, self-reflection. Presentation: 10 min
Case Study Report	Create image processing applications for better image representation suitable for real-word applications.	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, data collection, fact finding, comparative analysis

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Conceptual Recall & Terminology understanding TS2 — Conceptual Explanation & Process Interpretation	**CO1, CO2**	Short-answer: define image processing, visual perception mechanism, describe colour systems, distinguish between spatial and spectral techniques
Section B	**15**	TS3 — Application of techniques and methodologies TS4 — Analysis & Performance Evaluation of image processing techniques	**CO2, CO3, CO4**	Numerical problems: Histogram based processing, brighteness and contrast enhancement, Compression strategies, Image restoration framework.
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**15**	TS1 — Conceptual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions (all units): definitions, visual perception mechanism, describe colour systems, distinguish between spatial and spectral techniques

Section B	**25**	TS3 — Application of image processing techniques TS4 — Image enhancement and restoration TS5 — Image segmentation	**CO3, CO4, CO5**	Medium questions: Histogram based processing, brightness and contrast enhancement, Compression strategies, Image restoration framework, Image thresholding, Image segmentation algorithms
Section C	**10**	TS5 — Morphological image processing TS6 real-world image processing applications	**CO5, CO6**	Long/evaluation questions: Human visual perception system, colour standards and conversions, feature extraction, image 2D transforms, enhancement and restoration, segmentation, morphological operations, real-world applications
TOTAL	**50**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Recall the basic concepts of visual perception, terminologies of digital image processing, colour fundamentals and understand image acquisition and transform techniques.	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Understand the principles of image enhancement in spatial and spectral domains	✓	✓	✓	TS2	PO1, PO3, PO4
CO3	Apply Image restoration technique to recover lost details from images, design and implement different compression techniques for digital images	✓	✓	✓	TS3	PO1, PO2, PO3, PO4
CO4	Analyze and interpret the effectiveness and efficiency different image segmentation algorithms.	✓	✓	✓	TS4	PO9, PO10, PO11
CO5	Evaluate the effectiveness different morphological operations and algorithms that are used for image pre-processing.	✓	—	✓	TS5	PO1, PO2, PO8, PO9, PO10
CO6	Create image processing applications for better image representation suitable for real-word applications.	✓	—	✓	TS6	PO1, PO2, PO10, PO11

⚠ ***CO5 and CO6 are NOT assessed in MTE (only Units 1–3 is covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.***

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	–	–	–	2	2	1	2	1	3	2	2
CO2	3	2	3	3	–	–	–	2	2	2	1	1	2	3	2
CO3	3	3	3	3	–	–	–	1	1	1	3	2	3	2	1
CO4	2	2	2	2	1	–	–	2	3	3	3	1	2	2	2
CO5	2	2	3	–	–	–	–	3	3	1	2	–	3	–	–
CO6	3	2	–	–	–	–	–	–	–	2	3	–	2	2	–
Avg	**2.67**	**2.33**	**2.80**	**2.75**	**1.00**	**–**	**–**	**2.00**	**2.20**	**1.67**	**2.33**	**1.25**	**2.50**	**2.20**	**1.75**

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H				M	M	M	M	M	H	M	M
CO2	H	M	H	H				M	M	M	M	M	M	H	M
CO3	H	H	H	H				M	M	M	H	M	H	M	M
CO4	M	M	M	M	M			M	H	H	H	M	M	M	M
CO5	M	M	H					H	H	M	M		H		
CO6	H	M								M	H		M	M	

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 30 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Numerical Assignment Writing (5 assignments, problem-based, one per unit focus area)**	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on the assignment submitted; correctness, steps shown, comparison of algorithm performance
2	**Technical Video-Based Learning related to the subject (e.g., Human visual perception, Colour models, Image enhancement and restoration)**	Video viewing: 3 hrs Report preparation: 3 hrs Presentation: 3 hrs Total = 9 hrs	CO2, CO3 TS2, TS3	Report + Presentation based on video learning outcomes; must capture key concepts, algorithms, and personal reflections
3	**Real-World Case Studies (e.g., Image compression strategies, Restoration and enhancement techniques)**	Data collection/study: 4 hrs Report preparation: 2 hrs Total = 6 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on in-depth study, technical depth, data collected, fact finding, and analytical conclusions drawn
	TOTAL Self-Learning Hours	**30 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

------ — MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

COURSE PLAN

Cryptography and Network Security (CSCR3314)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester III | Batch 2026–2030
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	VI

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR3314
2	**Course Title**	Cryptography and Network Security
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	To provide students with an overview of Cryptography and essential security algorithms used in data communication across computer networks, forming the foundation of modern organizations worldwide, while enabling understanding of techniques like Advanced Encryption Standard and RSA algorithm to ensure secure and reliable information exchange.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember– L1):Analyze the conventional Network security technique which are basically designed to maintain confidentiality. CO2 (Understand – L2):Compare the techniques of algorithms developed in modern cryptographic era. CO3 (Apply– L3):Explain the tools and methodologies used to perform Security analysis CO4 (Analyze – L4):Summarize the working knowledge of the Crytography application during Network Security to maintain security. CO5 (Evaluate – L5):Examine security at application layer, transport layer and network layer. CO6 (Create – L6): Interpret use of cryptographic data integrity algorithms and user authentication protocols **LAB COs — Assessed via Laboratory Assessment only:** CO7 (L4 – Analyze): Identify and analyze security vulnerabilities and attacks in cryptographic systems and networks.

		CO8 (L5/L6 – Create):Prepare and present structured security analysis reports for cryptographic and network security findings. CO9 (L3 – Apply):Collaborate with stakeholders to implement secure cryptographic and network security solutions. CO10 (L3 – Apply):Demonstrate ethical, legal, and professional conduct in cryptography and network security practices.
8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 45 hrs)**	1. Perform Network Scanning and Vulnerability Mapping using Nmap 2. Open Source Intelligence (OSINT) and Footprinting Analysis using Maltego 3. Packet Inspection and Traffic Analysis using Wireshark
11	**References**	Textbook: 1. Behrouz A. Forouzan, "Cryptography And Network Security"- McGraw Hill. 2. **Cryptography and Network Security: Principles and Practice** Author: William Stallings 3. Introduction to Modern Cryptography Authors: Jonathan Katz, Yehuda Lindell Edition: 4th Edition (2025) 4. Cryptography: Theory and Practice Author: Douglas R. Stinson, Maura Paterson Edition: 4th Edition

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction to Network Security & Ethics (8-0-0-6 = 14hrs)**	
A	Computer Security Concepts- OSI security Architecture, Security attacks, Services, mechanism, model of network security	CO1, CO2, CO3
B	Classical encryption techniques- Substitution Cipher (Mono-alphabetic, Poly-alphabetic), Transposition cipher, Steganography	
C	Block Cipher- Encryption Principles, DES & strength of DES	
Tools Used	NA	
Activities	**Objective:** • Understand computer security concepts, OSI security architecture, and network security models. • Learn classical encryption techniques including substitution, transposition, and steganography. • Apply block cipher principles and analyze Data Encryption Standard and its strength.	

Unit 2	**Mathematics of Cryptography (10-0-0-9= 19 hrs)**	
A	Euclidean, Extended Euclidean Algorithm, Euler's Totient Function, Ferment little Theorem, Euler's Theorem	CO3, CO4
B	Primality Testing-Miller Rabin test, Chinese Remainder Theorem	
C	Exponential- square and multiply method, Discrete Logarithm	
Tools Used	NA	
Activities	**Objective:** • Understand number theory concepts including Euclidean and Extended Euclidean algorithms, Euler's Totient function, Fermat's Little Theorem, and Euler's Theorem. • Learn primality testing methods such as Miller–Rabin test and apply the Chinese Remainder Theorem. • Apply modular exponentiation using square-and-multiply method and analyze discrete logarithm problems.	
Unit 3	**Asymmetric Cryptography & Key Exchange (9-0-0-10 = 19 hrs)**	
A	Public Key cryptography-RSA, Cryptanalysis of RSA	CO2, CO3, CO4
B	Key management & distribution: KDC	
C	Diffie Hellman key exchange	
Tools Used	NA	
Activities	**Objective:** • Understand public key cryptography concepts and implementation of RSA algorithm along with its cryptanalysis. • Learn key management and secure key distribution using Key Distribution Centers (KDC). • Apply secure key exchange mechanisms such as Diffie-Hellman key exchange.	
Unit 4	**Digital Signatures (9-0-0-10 = 19 hrs)**	
A	User Authentication protocol- Kerberos,	CO3, CO4, CO6
B	Digital Signature –RSA, Elgamal DSS,	
C	Data integrity algorithms-Hash Functions MD5, SHA-512	
Tools Used	NA	
Activities	**Objective:**	

	• Understand public key cryptography concepts and implementation of RSA algorithm along with its cryptanalysis. • Learn key management and secure key distribution using Key Distribution Centers (KDC).	
Unit 5	**Message Authentication & hash function (9-0-0-10 = 19 hrs)**	
A	Authentication requirement & functions, Message Authentication Code	CO5, CO6
B	Security of Hash function & MAC	
C	Secure HASH & MAC algorithm.	
Tools Used	NA	
Activities	**Objective:** • Analyze the security properties of hash functions and MAC algorithms against various attacks.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	
CO7			✓		✓			✓					✓	✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓			✓	

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 45 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Computer Security Concepts- OSI security Architecture	**UNIT-1**	**8**
DD/MM/YY	Security attacks		
DD/MM/YY	Services, mechanism,		
DD/MM/YY	model of network security		
DD/MM/YY	Classical encryption techniques- Substitution Cipher (Mono-alphabetic, Poly-alphabetic)		
DD/MM/YY	Transposition cipher, Steganography		
DD/MM/YY	Block Cipher- Encryption Principles		
DD/MM/YY	DES & strength of DES		
DD/MM/YY	Mathematics in Cryptography	**UNIT-2**	**10**
DD/MM/YY	Euclidean		
DD/MM/YY	Extended Euclidean Algorithm		
DD/MM/YY	Euler's Totient Function		
DD/MM/YY	Ferment little Theorem		
DD/MM/YY	Euler's Theorem		
DD/MM/YY	Primality Testing-		
DD/MM/YY	Miller Rabin test,		
DD/MM/YY	Chinese Remainder Theorem		
DD/MM/YY	Exponential- square and multiply method,		

DD/MM/YY	Discrete Logarithm		
DD/MM/YY	Public Key cryptography	**UNIT-3**	**9**
DD/MM/YY	RSA		
DD/MM/YY	Cryptanalysis of RSA		
DD/MM/YY	Key management & distribution		
DD/MM/YY	KDC		
DD/MM/YY	Key Management		
DD/MM/YY	Diffie Hellman key exchange		
DD/MM/YY	Attacks on Diffie-Hellman		
DD/MM/YY	Applications of Diffie-Hellman		
DD/MM/YY	Digital Signatures	**UNIT-4**	**9**
DD/MM/YY	User Authentication protocol		
DD/MM/YY	Kerberos		
DD/MM/YY	Digital Signature –RSA		
DD/MM/YY	Elgamal		
DD/MM/YY	DSS,		
DD/MM/YY	Data integrity algorithms-Hash Functions		
DD/MM/YY	MD5, SHA-512		
DD/MM/YY	Message Authentication	**UNIT-5**	**9**
DD/MM/YY	hash function		
DD/MM/YY	Authentication		
DD/MM/YY	Authentication requirement & functions		
DD/MM/YY	Message Authentication Code		
DD/MM/YY	Security of Hash function		
DD/MM/YY	MAC		
DD/MM/YY	Secure HASH Algo		
DD/MM/YY	MAC algorithm.		
DD/MM/YY	HMAC		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Perform the following implementation Encryption and Decryption with Ceaser cipher	CO7	3.0
	S-1.2	Write a program to demonstrate brute-force attack on Caesar cipher.		
W2	S-2.1	Encryption and Decryption with Playfair cipher	CO7	3.0
	S-2.2	Encryption and Decryption with Hill cipher		
W3	S-3.1	Encryption and Decryption with Vigenere cipher	CO7	3.0
	S-3.2	Perform frequency analysis attack on a monoalphabetic cipher.		
W4	S-4.1	Implement image steganography using LSB in Python.	CO7	3.0
	S-4.2	Perform the following implementation Transposition using Rail Fence Cipher		
W5	S-5.1	Transposition using Columnar Transposition	CO7	3.0
	S-5.2	Transposition using Route Cipher		
W6	S-6.1	Transposition using Scytale Cipher	CO7	3.0
	S-6.2	Implement Euclidean Algorithm to compute GCD of two number		
W7	S-7.1	Write code for Extended Euclidean Algorithm to find modular inverse.	CO7	3.0
	S-7.2	Verify Fermat's Little Theorem using Python for multiple values.		
W8	S-8.1	Simulate Man-in-the-Middle attack on Diffie-Hellman	CO8/CO9	3.0
	S-8.2	Implement modular exponentiation using Square-and-Multiply.		
W9	S-9.1	i. Implement Miller-Rabin Primality Test. i.Input: large integer ii. Output: prime/composite	CO8/CO10	3.0
	S-9.2	Compute Euler's Totient Function φ(n) for a given integer.		
W10	S-10.1	Perform the following implementation Encryption and Decryption with DES	CO9/CO10	3.0
	S-10.2	Encryption and Decryption with 3-DES		
W11	S-11.1	Encryption and Decryption with AES	CO7	3.0
	S-11.2	Encryption and Decryption with IDEA		
W12	S-12.1	Perform the following implementation Encryption and Decryption with RSA	CO7	3.0
	S-12.2	Encryption and Decryption with Diffie-Hellman		
W13	S-13.1	Encryption and Decryption with DSA	CO8	3.0
	S-13.2	Perform the following implementation Digital signature of data using RSA		
W14	S-14.1	Digital signature of data using Diffie-Hellman	CO8/CO9	3.0
	S-14.2	Hashing function – SHA-1		
	S-15.1	Demonstrate RSA attack by factorizing small n.	CO8/CO9	

W15	S-15.2	Implement ElGamal Digital Signature Algorithm.		3.0

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall cryptography terminology, security principles, encryption techniques, network security models, cipher types, authentication concepts, and hashing algorithms	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Explain classical and modern cryptographic algorithms, security attacks, authentication protocols, key exchange mechanisms, and interpret cryptographic workflows logically	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply mathematical cryptographic techniques such as RSA, Diffie–Hellman, DES operations, modular arithmetic, primality testing, hashing, and security analysis methodologies	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Analyze cryptographic applications in network security, evaluate vulnerabilities, compare encryption strengths, assess authentication methods, and interpret security outcomes	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Compare cryptographic protocols, evaluate security at application/transport/network layers, assess efficiency of MAC and hash algorithms, and justify security mechanisms	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design secure communication frameworks using cryptographic integrity algorithms, authentication protocols, digital signatures, and integrated network security practices	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions.
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Long and descriptive answers
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions.
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: Comparison, Tools and Techniques, Algorithms
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: Applications, working principles/
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CA experiments
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project/Case Study	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	**CA1** — Identification of cryptographic/security problem, objective definition, scope identification **CA2** — Experiment planning, cipher/algorithm selection, tool and environment configuration **CA7** — Cryptographic methodology, workflow planning, attack-defense/security analysis approach	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	**CA3** — Correct execution of encryption/decryption, hashing, digital signature, key exchange, and authentication tasks **CA4** — Efficient and optimized use of cryptographic tools, scripts, and implementations	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	**CA5** — Analysis and interpretation of ciphertexts, hashes, authentication outputs, packet/log results **CA6** — Evidence validation, screenshots, observations, report preparation, and conclusion documentation	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CA6 — Structured report, screenshots, references, conclusion CA8 — Viva-voce understanding and communication PO7/CO9 — Ethical and responsible cybersecurity practices	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define cryptographic problem, objectives, scope, and success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Configure cryptographic tools, environments, and security utilities	CO7
CA3	**Code Implementation & Execution**	Execute encryption, hashing, authentication, and security experiments	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate performance and optimize cryptographic implementations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyze ciphertexts, logs, packets, and security outputs	CO8
CA6	**Documented Outcome with Verification**	Record observations, screenshots, outputs, and validate results	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Design secure workflows and cryptographic methodologies	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain lab records and demonstrate conceptual understanding	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	Problem Scoping & Requirements	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	Innovative Solution Proposal	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	Professional Toolchain	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	End-to-End Implementation	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	System Commissioning & Testing	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	Individual Skill Growth Mapping	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	Professional Attitude, Ethics & Responsibility	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions	CA Skill Dimensions	Project Skill Dimensions

	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	2	-	-	3	-	-	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	2	2	3	-	-	2	-	3	2	3
CO4	3	3	3	-	3	2	3	-	2	-	2	3	-	-
CO5	3	3	2	3	2	-	2	-	3	3	3	2	2	2
CO6	2	3	3	2	3	3	3	3	-	-	3	3	2	3
CO7	–	2	1	–	3	2	–	–	–	–	–	2	3	3
CO8	–	1	3	1	2	3	–	–	–	–	–	2	3	3
CO9	–	–	2	–	–	2	3	–	–	1	3	–	1	2
CO10	2	–	–	–	–	1	–	3	3	3	2	2	2	2
Avg	2.71	2.63	2.56	2.00	2.38	2.13	2.80	3.00	2.75	2.25	2.60	2.43	2.25	2.57

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	H	H	-	M	M	-	-	H	-	-
CO2	H	H	H	M	M	-	-	-	-	-	-
CO3	H	H	H	M	M	M	H	-	-	M	-
CO4	H	H	H	-	H	M	H	-	M	-	M
CO5	H	H	M	H	M	-	M	-	H	H	H
CO6	M	H	H	M	H	H	H	H	-	-	H

CO7	–	M		–	H	M	–	–	–	–	–
CO8	–		H		M	H	–	–	–	–	–
CO9	–	–	M	–	–	M	H	–	–		H
CO10	M	–	–	–	–		–	H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

PPS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

COURSE PLAN

Compiler Design (CSCR3313)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2028–29
Branch:	CSE	**Semester:**	VI

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	CSCR3313
2	**Course Title**	**Compiler Design (CD)**
3	**Credits**	4
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Core
6	**Course Objective**	1.To provide students with an overview of the issues that arise in compiler construction as well as to throw light upon the significant theoretical developments and tools that are deep rooted into computer science. 2. To introduce the major phases of compiler construction and also its theoretical aspects including regular expressions, context-free grammars, Finite Automata etc.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1):.Explain the concepts and different phases of compilation with compile time error handling. CO2 (Understand – L2): Represent language tokens using regular expressions, context free grammar and finite automata and design lexical analyzer for a language. CO3 (Apply – L3): compare top down with bottom up parsers, and develop appropriate parser to produce parse tree representation of the input CO4 (Analyze – L4): Design syntax directed translation schemes for a given context free grammar. CO5 (Evaluate – L5): Generate intermediate code for statements in high level language, Benefits and limitations of automatic memory management. CO6 (Create – L6): Apply optimization techniques to intermediate code and generate machine code for high level language program **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Apply different compiler writing tools to implement the different Phases CO8 (Create – L5/L6): Construct thw Symbol table

		CO9 (Apply – L2/L3): Understand and define the role of lexical analyzer , use of regular expression and transtition diagrams CO10 (Apply – L3): Compare various code Optimization techniques.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. LEX/Flex: For developing the lexical analyzer (scanner). YACC/Bison: For developing the syntax analyzer 2. Virtual Labs (NPTEL): CD programming experiments. 3. MOOC course on Compiler Design(SWAYAM/Coursera).
11	**References**	Textbook: **"Compilers: Principles, Techniques, and Tools"** by Aho, Sethi, and Ullman (commonly referred to as the "Dragon Book"). Reference: "Engineering a Compiler" **by Cooper and Torczon.** **Reference:** "Compiler Design" **by Santanu Chattopadhyay.**

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction (4-0-10-6 = 20 hrs)**	
A	Introduction to Compiler , Phases and passes, Bootstraping , Cross-Compiler	CO1, CO2
B	Finite state machines and regular expressions and their applications to lexical analysis	
C	Lexical-analyzer generator, Lexical Phase errors	
Tools Used	**Lexical Analyzer Generators**: **LEX** (POSIX standard) [3] or Flex (Fast Lexical Analyzer), **Cross-Compilation Toolchains**: **MinGW-w64, FSM Simulators and Modeling Software**: **JFLAP,** Whiteboards, sticky notes, gcc compiler, Virtual Labs	

Activities	• Objective: To explore cross-compilers and bootstrapping concepts by manually tracing compiler migration logic using T-diagram representations, allowing students to verify how a language becomes self-hosting on new target architectures. To design formal regular expression rules for standard programming tokens and visually simulate their execution paths using an automata tool to analyze the mathematical structural conversion from an NFA to a minimized DFA.
	  ○ Map out the three-stage bootstrapping sequence required to compile a brand-new language ((L)) using an existing subset compiler until the compiler for (L) is written entirely in (L) itself.
	  ○ Understanding of gcc compiler, writing code in C, compiling and executing on Linux Environment.
	• Designing Regular Expressions and Simulating Finite State Automata	

Unit 2	**Parsing techniques (6-0-12-6 = 24 hrs)**	
A	The syntactic specification of programming languages: Context free grammars, derivation and parse trees	CO2, CO3

B	Basic Parsing Techniques: Parsers, Shift reduce parsing, Operator precedence parsing , top down parsing , predictive parsers. Automatic Construction of efficient Parsers:LR Parsers, the canonical Collection of LR(0) items,constructing SLR parsing tables	
C	Constructing Canonical LR parsing tables,Constructing LALR parsing tables, using ambiguous grammars. Syntactic phase errors and semantic errors.	
Tools Used	**Parser Generators (Compiler-Compilers)**: Tools like **YACC** or **Bison, Integrated LL/LR Modeling Software**: JFLAP, **Static Code Analysis and Linter Tools**: **Clang Static Analyzer**	
Activities	**Objective:** To systematically evaluate context-free grammars, manually track derivations, and deploy automated parser generators like Bison to construct optimized shift-reduce and predictive parsing routines, while simultaneously developing robust syntax-error recovery filters and semantic validation engines. • Grammar Engineering and Derivation Diagnostics • Predictive LL(1) Parsing Implementation	
Unit 3	**Syntax Directed Translations and Intermediate Code Generation (8-0-16-6 = 30 hrs)**	
A	Syntax Directed Definition, Construction of syntax trees,syntax directed translation schemes	CO4, CO5
B	Variants of Syntax Trees, Three Address Codes	
C	Translation of Expression, Type Checking and control flow.	
Tools Used	Compiler-Compiler Frameworks with Semantic Actions: Bison and YACC, Abstract Syntax Tree (AST) Frameworks: ANTER (ANother Tool for Language Recognition), Intermediate Representation Engines: LLVM Infrastructure, Type Evaluation and Simulation Environments: Aho-Ullman SDD Simulators and tree visualization tools (such as Graphviz)	
Activities	• **Objective:** To formally spec programming language semantics using Syntax-Directed Definitions and Translation Schemes, programmatically construct Abstract Syntax Trees and Directed Acyclic Graphs to optimize expressions, translate complex source structures and control statements into linearized Three-Address Code representations, and design a semantic verification subsystem capable of checking type compliance and routing control-flow paths. • Designing S-Attributed and L-Attributed SDD Evaluators • Programmatic Abstract Syntax Tree (AST) and DAG Generation • Three-Address Code Generation and Data Formatting • Implementing a Static Type Checking System • Control Flow and Short-Circuit Backpatching Engine	
Unit 4	**Symbol table (6-0-12-6 = 24 hrs)**	
A	Data structure for symbol tables, representing scope information	CO5
B	Run-Time Administration:Implemention of simple stack allocation scheme	
C	Run Time Storage Management	
Tools Used	**(JVM)** or **V8 JavaScript Engine, GDB** (GNU Debugger) or **Valgrind, Hardware and Architecture Simulators**: Frameworks like **MARS** (MIPS Assembler and Runtime Simulator)	

Activities	**Objective:** To analyze and implement compile-time symbol tables and scoping hierarchies using high-performance data structures, while building low-level memory administration engines that mimic standard runtime storage allocation, function activation records, stack frame pointers, and heap management behaviors.. • Scoped Hash-Table Symbol Directory Construction. • Runtime Activation Record Simulator Engine • Tracking Scoped Variable Closures with Static Links • Simulating Stack Allocation Pointer Mechanics • Heap Storage Profiling and Allocation Map Simulation	
Unit 5	**Code Generation and Optimization (6-0-10-6 = 22 hrs)**	
A	Sources of Optimization of basic blocks and flow graphs	CO4, CO6
B	Basic Blocks, Flow graphs , DAG	
C	Global Data Flow Analysis	
Tools Used	LLVM **and** GCC, Graphviz **(using the DOT scripting language), Tools like** Soot **(for Java) or** WALA.	
Activities	Objective: To systematically analyze intermediate compiler code by partitioning raw instructions into isolated basic blocks, build visual control flow graphs to isolate runtime loop segments, and apply local and global optimization algorithms—including Directed Acyclic Graph (DAG) generation, code motion, strength reduction, and iterative data-flow data propagation—to streamline target execution performance. • Leader Identification and Flow Graph Construction • Local Block Optimization using Expression DAGs • Loop Invariant Identification and Code Motion Hoisting • Strength Reduction and Induction Variable Minimization. • Iterative Reaching Definitions and Available Expressions Solver	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓	✓	✓		
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓	✓		
5	2.B			✓	✓		
6	2.C			✓	✓		
7	3.A			✓	✓		
8	3.B			✓	✓		
9	3.C			✓	✓		
10	4.A		✓	✓			

11	4.B		✓	✓			
12	4.C		✓	✓			
13	5.A			✓	✓		
14	5.B			✓	✓		
15	5.C			✓	✓		

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓															
CO4				✓														
CO5					✓									✓	✓	✓		
CO6				✓					✓					✓	✓	✓		
CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Compilers: Language Translators, Compiler vs. Interpreter	Unit 1	6
DD/MM/YY	Detailed Analysis of Compilation Phases and Multi-pass Compilers		
DD/MM/YY	Cross-Compilers, T-Diagrams, and the Bootstrapping Process		
DD/MM/YY	Role of the Lexical Analyzer, Tokens, Patterns, and Lexemes		
DD/MM/YY	Finite State Machines: Designing Thompson's NFA for Programming Tokens		
DD/MM/YY	Conversion of NFA to DFA via Subset Construction and State Minimization		
DD/MM/YY	Role of Parser, Syntactic Specifications, and Context-Free Grammars (CFG)		

DD/MM/YY	Derivations (LMD/RMD), Parse Trees, and Resolving Grammar Ambiguity	Unit 2	6
DD/MM/YY	Top-Down Parsing: Recursive Descent Parsing and Eliminating Left-Recursion		
DD/MM/YY	LL(1) Parsing: Computation of mathematical \(\text{FIRST}\) and \(\text{FOLLOW}\) Sets		
DD/MM/YY	Constructing Non-Recursive Predictive LL(1) Parsing Tables		
DD/MM/YY	Bottom-Up Parsing: Shift-Reduce Parsing Mechanics and Handle Pruning		
DD/MM/YY	Introduction to LR Parsing: Working Mechanics of LR(0) Table Generation	Unit 3	6
DD/MM/YY	Simple LR (SLR(1)) Parsing Tables: Utilizing (text{FOLLOW}\) Sets for Reduction		
DD/MM/YY	Canonical LR (CLR(1)) Parsing: Building Item Collections with Lookaheads		
DD/MM/YY	Look-Ahead LR (LALR(1)) Parsing: Merging States and Table Compression		
DD/MM/YY	Parsing Ambiguous Grammars with Bison/YACC		
DD/MM/YY	Handling Syntax Errors		
DD/MM/YY	Semantics: Syntax-Directed Definitions (SDD), S-Attributed vs. L-Attributed	Unit 4	6
DD/MM/YY	Syntax-Directed Translation Schemes (SDTS) and Abstract Syntax Tree (AST) Nodes		
DD/MM/YY	Intermediate Representations: Quadruples, Triples, and Indirect Triples		
DD/MM/YY	Translation of Expressions, Boolean Operations, and Backpatching Jumps		
DD/MM/YY	Static Type Checking: Type Systems, Type Synthesis, and Coercion Handling		
DD/MM/YY	Examples		
DD/MM/YY	Run-Time Environments: Source Scope Tables and Storage Hierarchy Layouts	Unit 5	6
DD/MM/YY	Stack Allocation Schemes: Activation Records, Access Links, and Control Links		
DD/MM/YY	Optimization: Constructing Basic Blocks, Identifying Leaders		
DD/MM/YY	CFG Graphs		
DD/MM/YY	Value Directed Acyclic Graphs (DAG		
DD/MM/YY	Code Motion, and Global Data-Flow Analysis		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Design a DFA which will accept all the strings containing even number of 0's and even number of 1's over an alphabet {0,1} and write a program to implement the DFA	CO7	3.0
	S-1.2	Design a DFA which will accept all the strings containing odd number of 0's and odd number of 1's over an alphabet {0,1} and write a program to implement the DFA		
	S-2.1	Practice Examples using LEX tool	CO7	

W2	S-2.2	Write a code using JFLEX	**CO7**	3.0
W3	S-3.1	Design a DFA which will accept all the strings starting with 0 and end with 1	**CO7**	3.0
	S-3.2	Practice examples	**CO7**	
W4	S-4.1	Write codes for different types of DFAs	**CO7**	3.0
	S-4.2	Write codes for different types of NFAs	**CO7**	
W5	S-5.1	Design a DFA which will accept all the strings containing mod 3 of 0's over an alphabet{0,1} and write a program to implement the DFA	**CO7**	3.0
	S-5.2	Examples	**CO7**	
W6	S-6.1	Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces,tabs and new lines	**CO7**	3.0
	S-6.2	Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces,tabs and new lines(Sample C code)	**CO7**	
W7	S-7.1	Write an algorithm and program on Recursive Descent parser	**CO7**	3.0
	S-7.2	Recursive Descent parser for a given CFG	**CO7**	
W8	S-8.1	Write an algorithm and program to compute FIRST and FOLLOW function	**CO7**	3.0
	S-8.2	Write an algorithm and program to compute FIRST and FOLLOW function for different grammars	**CO7**	
W9	S-9.1	Develop an Operator precedence parser for a given Language	**CO7**	3.0
	S-9.2	Develop an Operator precedence parser for a some Language	**CO7**	
W10	S-10.1	Implementation of shift reduce parsing algorithm	**CO7**	3.0
	S-10.2	Implementation of shift reduce parsing algorithm for different parsers	**CO7**	
W11	S-11.1	Implementation of LR Parsers	**CO7**	3.0
	S-11.2	Implementation of C, LALR LR Parsers	**CO7**	
W12	S-12.1	Write code to generate abstract syntax trees	**CO7**	3.0
	S-12.2	Write code to generate abstract syntax trees for some examples	**CO7**	
W13	S-13.1	Intermediate code generation	**CO8**	3.0
	S-13.2	Intermediate code generation for different expressions	**CO8**	
W14	S-14.1	Implementaion of Directed Acyclic Graph	**CO8/CO9**	3.0
	S-14.2	Implementaion of Directed Acyclic Graph for different expressions	**CO8/CO10**	
W15	S-15.1	Implementation of code generation	**CO8/CO9**	3.0
	S-15.2	Implementation of code generation for sample C code	**CO9/CO10**	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Recall keywords, data types, operators, I/O constructs, and syntax; identify correct terminology	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Explain constructs and working; interpret program flow; predict output through step-by-step reasoning	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply constructs to write correct programs solving standard computational problems	CO3 | L3	MTE Sec B | ETE Sec B
TS4	**Analytical Reasoning & Program Tracing**	Trace execution manually; detect bugs; assess correctness; explain algorithmic behaviour	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Compare approaches; evaluate time/space trade-offs; justify optimal choice with evidence	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design well-structured, modular, documented C programs for complex specifications	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short-answer: definitions, output prediction, syntax identification
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Program writing; program tracing — detect errors and trace execution
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type

Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions: definitions, syntax, output tracing, concept MCQs (all units)
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Medium questions: program writing, debugging, algorithm comparison, complexity analysis
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Long/design questions: design modular solutions, justify choices, complete application
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO

Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11

Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment (gcc, IDE, Linux CLI, debugger)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	**SDG Alignment & Social Relevance**	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	**Problem Scoping & Requirements**	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	**Communication & Testing Strategy**	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	**Innovative Solution Proposal**	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	**Professional Toolchain**	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	**End-to-End Implementation**	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	**System Commissioning & Testing**	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	**Measurable Impact & Outcome**	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	**Critical Analysis & Reporting**	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	**Professional Presentation & Teamwork**	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9

P11	**Financial Feasibility & Planning**	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	**Individual Skill Growth Mapping**	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	**Professional Attitude, Ethics & Responsibility**	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					

CO6			M		M	H																			
CO7						H	H	H	M		M	M	H					H	M	H					
CO8						M		M		H	H	H		H	H		H	M	H	M	H	M			
CO9													M											H	H
CO10																H						M	H	H	

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV
COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		–	–	3	–	–	2	–	–	3	2	1	–
CO2	2	2	3	3	2	–	–	–	1	–	2	3	2	–
CO3	3	3	3	–	–	–	–	–	1	–	–	3	2	–
CO4	1	2	3	3	3	–	–	3	–	–	–	–	3	2
CO5	1	1	2	3	2	–	–	3	–	–	3	1	2	2
CO6	2		3	3	2	–	–	3	1	1	3	3	2	3
CO7	2	2	3	3	2	–	–	–	–	–	2	3	2	–
CO8	3	3	3	–	–	–	–	–	–	–	–	3	2	–
CO9	1	2	3	3	3	–	–	3	–	–	–	–	3	2
CO10	1	1	2	3	2	–	–	3	–	–	3	1	2	2
Avg	2.50	2.14	2.33	1.75	2.33	1.80	3.00	2.50	1.50	2.00	2.13	2.22	2.30	2.38

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	H	M							M		
CO3	M	H	M		M	M			M		
CO4	M	H	M	H	M						
CO5	M	H	H	M	M						
CO6	M	M	H	M	H	M		M	M	M	M
CO7			M		H	M					
CO8		M	H	M	M	H					
CO9							H				H
CO10						M		H	H	H	M

H = High / Primary M = Medium / Secondary *Blank = No direct alignment*

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance

L6 — Create: Design, develop, produce new solutions		P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

CD INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

School: SSCSE		**Batch :2025-2029**	
Program: B.Tech		**Current Academic Year: 2025**	
Branch: CSE		**Semester: VI**	
1	**Course Code**	**CSCR3601 | Course Name: Project Based Learning -4**	
2	Course Title	Project Based Learning -4 (Product Based)	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	1. To align student's skill and interests with a realistic problem or project. 2. To understand the significance of problem and its scope. 3. Students will make decisions within a framework.	
6	Course Outcomes	Students will be able to: CO1: Identify and formulate problem statement. CO2: Design relational database schema. CO3: Develop the solution by using different aspects of programming language. CO4: Classify and understand various test techniques for verification and validation of project. CO5: Analyze and make use of modern for solving real word problems. CO6: Develop teamwork and need to engage in life-long learning, along with the ability to communicate effectively with others.	
7	Course Description	In PBL-4, the students will learn how to define the problem for developing projects, and Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.	
8	Outline syllabus		CO Mapping
	Unit 1	Problem Definition and identification, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.	CO1,CO4
	Unit 2	Use of the relational algebra operations from mathematical set theory (union, intersection, difference, and Cartesian product) and the relational algebra operations developed specifically for relational databases (select (restrict), project, join, and division)..	CO2,CO6
	Unit 3	Design; implement project work in any programming language.	CO3
	Unit 4	Use of various test tools and techniques for software verification and validation of project	CO4,CO5
	Unit 5	Demonstrate and execute Project with the team.	CO6
		Report should include Abstract, Hardware / Software Requirement, Problem Statement, Design/Algorithm, ER diagrams, Use Case Diagrams, State Diagrams, Sequence Diagrams, Communication Diagrams, and Activity Diagrams, Implementation Detail. Validation Reports. References, Test cases if any. The presentation, report, work done during the term supported by the documentation, forms the basis of assessment.	
	Mode of examination	Lab	

	Weight age Distribution				
		CA	CE(Viva)	ESE	
		30%	30%	40%	

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Identify and formulate problem statement.	PO1, PO2, PO4, PO6, PO8, PO9, PO10, PO11, PSO1, PSO2, PSO3
2.	CO2: Design relational database schema.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO11, PSO1, PSO2, PSO3
3.	CO3: Develop the solution by using different aspects of programming language.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO11, PSO1, PSO2
4.	CO4: Classify and understand various test techniques for verification and validation of project.	PO1, PO2, PO3, PO4, PO5, PO8, PO9, PO10, PO11, PSO1, PSO2, PSO3
5.	CO5: Analyze and make use of modern for solving real word problems.	PO1, PO2, PO5, PO6, PO7, PO8, PO9, PSO1, PSO2
6.	CO6: Develop teamwork and need to engage in life-long learning, along with the ability to communicate effectively with others.	PO2, PO4, PO8, PO9, PO10, PO11, PSO1, PSO3

PO and PSO mapping with level of strength for Course Name Project Based Learning – 4 (Course Code CSCR3601)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	2	-	1	1	2	-	2	1	2	2	3
CO2	3	2	2	2	2	-	1	2	-	2	1	2	1	1
CO3	3	2	2	2	2	3	1	2	-	2	1	2	2	-
CO4	3	3	2	2	3	-	1	2	-	-	1	2	2	2
CO5	3	2	-	-	3	-	1	2	-	-	1	2	2	-
CO6	-	1	-	1	-	-	2	2	3	3	3	1	-	1
Avg PO	3	2.2	1	1.5	1.7	0.7	1.2	2	1	2	1	2	1.5	1.2

School: SSCSE		**Batch: 2026-2030**	
Program: B Tech		**Current Academic Year: 2028-29**	
Branch:		**Semester: VI**	
1	Course Code	BST2351	
2	Course Title	Management for Engineers	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to expose the students to understand the basics of Management Foundations. The students will be given detailed grounding for the theories and cases related to the general management. The aim of the course is to orient the students in theories and practices of Management so as to apply the acquired knowledge in actual business practices. This is a gateway to the real world of management and decision-making.	
6	Course Outcomes	CO1: Define basic principles and concepts related to management in an organization including the functions, different theories of management and roles they play in an organization. CO2: Explain the primary function Planning with its process. Also, how forecasting is done in organizations with various techniques are used. CO3: Use of organizing by studying different types of organization and also using decentralization and span of control in organizations. CO4: Analyse jobs, recruitment process, manpower planning, job rotation, trainings and rewards in various organizations. CO5: Measure motivation and management control concepts to obtain effective controlling in management system in organizations. CO6: Develop proper system in an organization by using all the functions of management.	
7	Course Description	This course gives an overview of engineering management and help to understand the various functions of management used in an organization. The focus of the course is the development of individual skills and teamwork.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction of Management & Organization**	
	A	Management-Definition of Management & Organization	CO1, CO6
	B	Concept, Nature, Scope and Functions of Management, Levels of Management, Management Theories - Taylors principle, Fayol's Principles, Hawthorne Studies, Systems Approach and Contingency Approach to Management.	CO1, CO6

	C	Mintzberg's Managerial Roles, Skills of Manager, Functions of management	CO1, CO6
	Unit 2	Management Planning Process	CO2, CO6
	A	Planning objectives and characteristics.	CO2, CO6
	B	Hierarchies of planning.	CO2, CO6
	C	The concept and techniques of forecasting.	CO2, CO6
	Unit 3	Organizing	C03, C06
	A	Meaning, Importance and Principles	C03, C06
	B	Departmentalization, Span of Control	CO3, CO6
	C	Types of Organization, Authority, Delegation of Authority	CO3, CO6
	Unit 4	Staffing	CO4, C06
	A	Meaning, Job analysis	CO4, C06
	B	Manpower planning, Recruitment, Transfers and Promotions	CO4, CO6
	C	Appraisals, Management Development, Job Rotation, Training, Rewards and Recognition,	CO4, CO6
	Unit 5	Directing &Controlling	CO5, CO6
	A	Motivation, Co-ordination, Communication,	CO5, CO6
	B	Directing and Management Control, Decision Making,	CO5, CO6
	C	Management by objectives (MBO) the concept and relevance. Objectives and Process of Management Control	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / ESE	
		25% / 75%	
	Text book/s*	1. Principles & practice of Mgmt., L.M. Prasad	
	Other References	1. Management Today, Burton & Thakur 2. Principles & Practices of Mgmt., C.B. Gupta 3. Understanding Management, Richard L.Daft 4. Management, Stoner, Freemand& Gilbert 5. Essential of Management, Koontz O' Donnel	

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	1	1	0	0	0	1	0	1	0	1	1	0	0	1
CO 2	0	2	1	0	0	0	0	0	0	0	1	0	0	1
CO 3	0	1	2	0	0	1	0	0	1	0	1	0	0	2
CO 4	0	2	2	0	0	1	0	0	1	0	2	0	0	2

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 5	0	1	2	0	0	1	0	1	1	0	2	0	0	2
CO 6	1	2	2	0	0	1	0	1	1	1	2	0	0	3
Avg. PO	1.0	1.5	1.8	-	-	1.0	-	1.0	1.0	1.0	1.5	-	-	1.83

Strength of Correlation: 11.63

School: SSCSE		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2028-29**	
Branch: CSE(AR/VR)		**Semester: VI**	
1	**Course Code**	**CSHC3102**	**Course Name: Brain Computer Interface**
2	**Course Title**	**Brain Computer Interface**	
3	**Credits**	**3**	
4	**Contact Hours (L-T-P)**	**3-0-0-3**	
5	**Course Status**	**Specialization Elective**	
6	**Course Objective**	1. Develop the ability to design, 2. Implement and manipulate Brain Computer Interface technology. 3. Introduce concepts of Data Streaming and Data Processing using suitable tools. 4. Apply Brain Computer Interface technology concepts to various examples and real-life applications.	
7	**Course Outcomes**	After the completion of this course students will be able to: **CO1:** Understand the fundamental concepts of Brain-Computer Interface (BCI), its applications, and historical development. **CO2:** Demonstrate the different methods of acquiring brain signals such as EEG, ECoG, and MEG. **CO3:** Implement classification techniques using machine learning algorithms for BCI signal analysis. **CO4:** Analyze ethical, legal, and societal issues related to the development and deployment of BCI technologies.. **CO5:** Assess the Recent Trends and Future Directions in BCI. **CO6:** Design an experiment to test a perceptual phenomenon.	
8	**Course Description**	To provide students with a solid understanding of the basic concepts, principles, and technologies behind BCIs, including brain signal acquisition and processing techniques. This course provides hands-on experience in designing and implementing Brain-Computer Interface systems, such as controlling prosthetic devices, communication aids, and assistive technologies. Students will gain latest research, advancements, and future directions in the field of Brain-Computer Interfaces, including the integration of AI and potential applications in healthcare, entertainment, and human augmentation.	
9	**Teaching and Learning Scheme (in Hours per Semester)**		

Classroom Instructions (CI)		Lab Instructions (LI)	Team Work (TW) and Self Learning (SL) (TW+SL)	Total Number of Hours	Total Credits TH/30
L	T	P	SL	TH	
45	0	0	45	90	3

10	**Outline syllabus**		**CO Mapping**
	Unit 1	**Introduction to Brain-Computer Interface (BCI)**	

	A	Overview of Brain-Computer Interface (BCI), Applications of BCI (Neuroprosthetics, communication systems, gaming, rehabilitation)	CO1, CO2
	B	Basic Neurophysiology (Neurons, brain activity, brain regions)	
	C	Types of BCIs: Non-invasive vs. Invasive, Active vs. Passive. History and evolution of BCI technologies	
	Unit 2	**Brain Signal Acquisition**	
	A	Electroencephalography (EEG) – Principles, Electrode placements, and Types.	CO3
	B	Electrocorticography (ECoG) and Magnetoencephalography (MEG)	
	C	Signal Acquisition Hardware: EEG cap, amplifiers, and devices. Signal quality, Noise, and Artifacts in BCI data	
	Unit 3	**Signal Processing for BCI**	
	A	Preprocessing: Filtering (Bandpass, Notch filters), Artifact Removal (Eye blink, Muscle activity). Feature Extraction: Time-domain, Frequency-domain, and Time-Frequency domain features	CO1, CO3
	B	Signal Classification: Machine learning algorithms for BCI (SVM, k-NN, Random Forest)	
	C	Overview of Common Signal Processing Tools and Software (MATLAB, Python libraries)	
	Unit 4	**Ethical, Legal, and Societal Impacts of BCIs**	
	A	Privacy concerns and data security in BCI systems. Ethical implications of invasive BCI systems.	CO5
	B	Accessibility and inclusion issues for people with disabilities.	
	C	Legal and regulatory challenges in BCI deployment	
	Unit 5	**Recent Trends and Future Directions in BCI**	
	A	Advances in Non-invasive BCI technologies	CO5, CO6
	B	BCI and Artificial Intelligence (AI) integration	
	C	Brain-to-Brain communication and future possibilities	
	Mode of examination	Theory	

11 **List of activities for Self Learning**

(SL: 45h)

S. No.	Name of the Activity	No of Hours	Evaluation Criteria
1	Study of Brain-Computer Interface (BCI) concepts, applications of BCI, neurophysiology, and types of BCIs through research papers, videos, and case studies	15	Quiz / written test and understanding of BCI concepts and applications
2	Hands-on exploration of brain signal acquisition methods such as EEG, ECoG, and MEG, including	20	Viva / report submission based on signal acquisition

			study of electrode placements, signal acquisition hardware, noise, and artifacts		techniques and hardware understanding	
	Weightage Distribution	CA	MTE		ETE	
		25%	15%		60%	
	Text book/s*	1. Niedermeyer, E., & da Silva, F. L. (2004). Electroencephalography: Basic Principles, Clinical Applications, and Related Fields. Lippincott Williams & Wilkins. 2. He, H., & Wu, D. (2017). Brain-Computer Interface: Principles and Applications. Springer.				
	Other References	1. Lebedev, M. A., & Nicolelis, M. A. (2006). Brain–machine interfaces: past, present and future. Trends in Neurosciences, 29(9), 536-546. 2. Lebedev, M. A., & Nicolelis, M. A. (2006). Brain–machine interfaces: past, present and future. Trends in Neurosciences, 29(9), 536-546.				

PO and PSO mapping with level of strength for Course: CSHC3102- Brain Computer Interface

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	-	-	-	-	2	-	-	-	-	3	3	3	-
CO2	2	-	-	-	3	2	-	2	-	-	3	3	3	-
CO3	3	3	3	-	3	2	-	-	-	-	2	2	3	-
CO4	3	3	3	3	-	2	2	3	-	-	2	-	-	3
CO5	1	3	2	-	2	2	2	-	-	-	1	-	3	-
CO6	3	3	3	3	3	3	3	3	3	2	3	-	-	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSHC3102/ Brain Computer Interface	3	3.00	2.33	3.00	2.75	2.17	2.33	2.67	3.00	2.00	2.33	2.67	3.00	3.00

Strength of Correlation:
1. Addressed to ***Slight (Low=1) extent***
2. Addressed to ***Moderate (Medium=2) extent***

3. Addressed to ***Substantial (High=3) extent***

Syllabus: CSAI3103, Deep Leaning and its Applications

<table>
<tr><td colspan="2">School: SSCSE</td><td colspan="3">Batch : 2025-2029</td></tr>
<tr><td colspan="2">Program: B.Tech.</td><td colspan="3">Current Academic Year: 2025-26</td></tr>
<tr><td colspan="2">Branch: CSE (AIML)</td><td colspan="3">Semester: VI</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="3">CSAI3103</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="3">Deep Leaning and its Applications</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="3">3</td></tr>
<tr><td>4</td><td>Contact Hours (L-T-P-SL)</td><td colspan="3">3-0-0-3</td></tr>
<tr><td></td><td>Course Status</td><td colspan="3">CORE</td></tr>
<tr><td>5</td><td>Course Objective</td><td colspan="3">This course aims to present the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data. We will delve into selected topics of Deep Learning, discussing recent models from both supervised and unsupervised learning. Special emphasis will be on convolutional architectures, invariance learning, unsupervised learning and non-convex optimization.To understand and demonstrate how to solve general learning from a large series of data using computer based deep learning algorithms</td></tr>
<tr><td>6</td><td>Course Outcomes (CO’s)</td><td colspan="3">Upon successful completion of the course, students will be able to:
CO-1. Recall Neural Networks relate it with Deep Learning concepts to solve real life applications
CO-2. Compare and classify Regularization approaches for Deep Learning.
CO-3. Build Convolutional Neural Networks models for image analysis and its applicability in societal problem solving.
CO-4. Examine the Sequence models and analyse the relationships among them.
CO-5. Assess the different Deep learning models based on their design processes.
CO-6. Predict the behaviour of Deep learning models and apply them to solve real life applications.</td></tr>
<tr><td>7</td><td>Course Description</td><td colspan="3">This course starts with introduction to Deep Learning and further build, train, and deploy real world applications such as object recognition and Computer Vision, image and video processing, text analytics, Natural Language Processing, recommender systems, and other types of classifiers.</td></tr>
<tr><td>8</td><td>Teaching and Learning Scheme (in Hours per Semester)</td><td colspan="3"><table><tr><td colspan="2">Classroom Instructions (CI)</td><td>Lab Instruction s (LI)</td><td>Team Work (TW) and Self Learning (SL) (TW+SL)</td><td>Total number of Hours</td><td>Total Credits TH/30</td></tr><tr><td>L</td><td>T</td><td>P</td><td>SL</td><td>TH</td><td></td></tr><tr><td>45</td><td>0</td><td>0</td><td>45</td><td>90</td><td>3</td></tr></table></td></tr>
<tr><td>9</td><td colspan="2">Syllabus Outline</td><td colspan="2">CO Mapping</td></tr>
<tr><td rowspan="4"></td><td>Unit 1</td><td colspan="2">Deep Feed forward Networks</td><td></td></tr>
<tr><td>A</td><td colspan="2">Recall Neural networks, Deep learning and its Practical aspects for real life applications ,Introduction to Simple Deep Neural Networks, Platform for Deep Learning, Deep Learning Software Libraries</td><td>CO1, CO6</td></tr>
<tr><td>B</td><td colspan="2">Introduction to Deep Feed Forward Networks ,Learning XOR, Gradient-Based Learning, Activation Functions, ReLU, Softmax, Sigmoid , Error Functions</td><td>CO1</td></tr>
<tr><td>C</td><td colspan="2">Architecture Design- Hidden Units Back-Propagation and Other Differentiation Algorithms</td><td>CO1</td></tr>
<tr><td></td><td>Unit 2</td><td colspan="2">Regularization for Deep Learning</td><td></td></tr>
</table>

	A	Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multitask Learning, Early Stopping, Parameter Tying and Parameter Sharing, Bagging , Drop Out, Difficulty of training deep neural networks, Greedy layer wise training, Adversarial Training	CO2
	B	How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Momentum, Nesterov Momentum Parameter Initialization Strategies Algorithms with Adaptive Learning Rates, AdaGrad. RMSProp. Adam	CO2
	C	Introduction to Autoencoder, Undercomplete Autoencoder, Regularized Autoencoders, Representational Power, Layer Size and Depth. Stochastic Encoders and Decoders, Applications of Encoder Decoder models	CO2
	Unit 3	**Convolutional Neural Networks**	
	A	Why CNN?, Its role, significance and applicability in societal problem solving , The Convolution Operation, Motivation, Pooling, The Neuroscientific Basis for Convolutional Networks	CO1, CO3, CO6
	B	Prior probability distribution, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data types with different dimensionalities and number of channel	CO1, CO3
	C	Efficient Convolution Algorithms, Random or Unsupervised Features of CNN , Normalization, Applications of CNN in Computer Vision – ImageNet	CO1, CO3, CO6
	Unit 4	**Sequence Modeling: Recurrent Neural Networks**	
	A	Sequence Learning Problems , Recurrent Neural Network and its significance in real world, RNN model, Backpropagation through time ,Bidirectional RNNs	CO4, CO6
	B	Different types of RNNs, Gated Recurrent Unit (GRU) Recursive Neural Networks , The Challenge of Long-Term Dependencies	CO4
	C	Introduction of Long Short Term Memory Neural Networks, Learning Algorithm of LSTM/ RNN Bidirectional LSTMs	CO4
	Unit 5	**Deep Networks and design process**	
	A	Introduction to Generative Adversarial Networks , Generative Adversarial Networks – Architecture,	CO5,CO6
	B	DCGAN, GAN hack, Applications of Generative Adversarial Networks	CO5,CO6
	C	Practical design process for deep learning techniques based on real world problems: Performance Metrics , Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies	CO5,CO6
10	**List of activities for Self Learning (SL)**		

S. No.	**Name of the Activity**	**No. of Hours**	**Evaluation Criteria**

		1	Study and implementation of Deep Neural Networks, activation functions, and regularization techniques (Unit 1 & 2)	12	Concept clarity, implementation accuracy, comparative analysis
		2	Design and development of Convolutional Neural Network (CNN) for image classification with real-world application study (Unit 3)	11	Model performance, architecture design, application relevance
		3	Implementation and analysis of Sequence Models (RNN, LSTM, GRU) for prediction problems (Unit 4)	11	Correct implementation, comparison, output quality
		4	Mini Project: Design a complete Deep Learning solution using GAN/CNN/RNN including model tuning and performance evaluation (Unit 5)	11	Innovation, end-to-end implementation, report and presentation

	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		25%	15%	60%
	Text Books	**1.** Deep Learning, by Goodfellow I., Bengio Y. & Courville A. (2016) **2.** Visualizing and Understanding Convolutional Networks, by Matt Zeiler, Rob Fergus **3.** TensorFlow: a system for large-scale machine learning, by Martín A., Paul B., Jianmin C., Zhifeng C., Andy D. et al. (2019)		
	Reference Books	1. Deep learning in neural networks, by JuergenSchmidhuber (2015) 2. Deep Learning: A Practitioner's Approach by Josh Patterson, Oreilly.		
	Online Materials	https://towardsdatascience.com/september-edition-machine-learning-case-studies-a3a61dc94f23		

PO and PSO mapping with level of strength for Course Name: Introduction to Deep Leaning (Course Code-CSAI3103)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
	Engineering Knowledge	**Problem Analysis**	**Design/Development of Solutions**	**Conduct Investigations of Complex Problems**	**Engineering Tool Usage**	**The Engineer and The World**	**Ethics**	**Individual and Collaborative Team work**	**Communication**	**Project Management and Finance**	**Life-Long Learning**	**Familiarity and practical proficiency**	**Understand, analyze and develop**	**Apply standard Software**
CO1	3	2	2	2	2	-	-	-	-	-	2	2	2	1

CO2	2	1	-	-	-	-	-	-	-	-	1	1	1	2
CO3	3	3	3	3	2	-	-	-	-	-	1	3	2	2
CO4	2	2	2	2	2	-	-	-	-	-	1	1	1	2
CO5	3	2	2	2	2	-	-	-	-	-	1	1	1	2
CO6	3	3	3	3	3	-	-	-	-	-	2	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	**PO1** Engineering Knowledge	**PO2** Problem Analysis	**PO3** Design/Development of Solutions	**PO4** Conduct Investigations of Complex Problems	**PO5** Engineering Tool Usage	**PO6** The Engineer and The World	**PO7** Ethics	**PO8** Individual and Collaborative Team work	**PO9** Communication	**PO10** Project Management and Finance	**PO11** Life-Long Learning	**PSO1** Familiarity and practical proficiency	**PSO2** Understand, analyze and develop	**PSO3** Apply standard Software
CSAI3103/ Introduction to Deep Leaning	2.67	2.17	2.40	2.40	2.20	-	-	-	-	-	1.33	1.83	1.67	2.00

Strength of Correlation

1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

Course-to-SDG Matrix

The Course-to-SDG (Sustainable Development Goals) matrix for the subject *CSAI3103: Deep Learning and its Applications* highlights the alignment of course outcomes with global sustainability objectives by integrating advanced computational techniques to address real-world challenges. The course contributes significantly to SDG 4 (Quality Education) by equipping students with cutting-edge knowledge in deep learning, fostering innovation and research skills. It supports SDG 9 (Industry, Innovation, and Infrastructure) through the development of intelligent systems for automation, predictive analytics, and smart technologies. Additionally, applications of deep learning in climate modeling, healthcare diagnostics, and resource optimization align with SDG 3 (Good Health and Well-being) and SDG 13 (Climate Action). By encouraging ethical AI practices and responsible data usage, the course also indirectly contributes to SDG 16 (Peace, Justice, and Strong Institutions). Overall, the subject empowers students to apply deep learning methodologies for sustainable development and societal benefit.

Mapping uses a 3-point scale:

- Addressed to ***Substantial (High=3) extent***: Core content directly contributes
- Addressed to ***Moderate (Medium=2) extent***: Supports through skills/activities
- Addressed to ***Slight (Low=1) extent***: Indirect awareness/benefit

SDG Goal	Description	Mapping Strength	Justification
SDG 4	Quality Education	3 (High)	The course builds strong knowledge in deep learning concepts, enhancing analytical and computational skills in modern AI technologies.
SDG 8	Decent Work and Economic Growth	3 (High)	Students develop industry-ready skills in deep learning, improving employability and contributing to economic growth.
SDG 9	Industry, Innovation and Infrastructure	3 (High)	The course promotes development of intelligent systems such as CNNs, RNNs, and GANs, supporting innovation and digital infrastructure.
SDG 16	Peace, Justice and Strong Institutions	2 (Moderate)	Deep learning applications are used responsibly in areas like data analysis and decision-making, supporting ethical AI practices.

Total Mapped SDGs: 4 out of 17.

School:		**School of Computing Science and Engineering**
Department		**Department of Computer Science and Engineering**
Program:		**B. Tech.**
Branch:		**CSE with Specialization in AIOT**
1	Course Code	CSOT3206
2	Course Title	Data Analytics for IoT
3	Credits	3
4	Contact Hours (L-T-P-SL)	3-0-0-3
	Course Status	Elective
5	Course Objective	The objective of this course is to learn techniques to solve unique problems associated with IoT and examine and analyze data from your IoT devices
6	Course Outcomes	After completion of the course, Student will be able to: CO1: Identify the main challenges of IoT analytics systems development and deployment. CO2: Utilize IoT, Cloud and BigData Integration for IoT Analytics CO3: Evaluate the development tools for real-life applications using IoT analytics CO4: Explain the paradigm for on-demand IoT analytics as a service based on the open-source framework. CO5: Analyze the data in smart buildings, including data stemming from sensors and IoT devices. CO6: Assess the popular tools for IoT data analytics, along with their use in practical projects and applications.
7	Course Description	Data Analytics has a significant role to play in the growth and success of IoT applications and investments. There are different types of data analytics that can be used and applied in the IoT investments to gain advantages.

8	Teaching and Learning Scheme (Hours per Semester)	Classroom Instructions (CI)		Lab Instruction **(LI)**	Team work (TW) and Self Learning (SL) (TW+SL)	Total Hours	Total Credits TH /30
		L	T	P	SL	TH	
		45	0	0	45	90	3

9	Outline syllabus		CO Mapping
	Unit 1	**Introducing IoT Analytics**	**CO1**
	A	Defining IoT analytics and IoT, The concept of constrained	**CO1**

	B	IoT Data and BigData, Challenges of IoT Analytics Applications	**CO1**
	C	IoT Analytics Lifecycle and Techniques	**CO1**
	Unit 2	**IoT, Cloud and BigData Integration for IoT Analytics**	**CO2**
	A	Cloud-based IoT Platform, Data Analytics for the IoT, Data Collection Using Low-power, Long-range Radios	**CO2**
	B	WAZIUP Software Platform	**CO2**
	C	iKaaS Software Platform	**CO2**
	Unit 3	**Development Tools for IoT Analytics Applications**	**CO3**
	A	Introduction, The VITAL Architecture for IoT Analytics Applications	**CO3**
	B	VITAL Development Environment: Overview, VITAL Nodes	**CO3**
	C	IoT Analytics Applications	**CO3**
	Unit 4	**An Open-Source Framework for IoT Analytics as a Service**	**CO4**
	A	Architecture for IoT Analytics-as-a-Service, Sensing-as-a-Service Infrastructure Anatomy	**CO4**
	B	Scheduling, Metering and Service Delivery	**CO4**
	C	From Sensing-as-a-Service to IoT-Analytics- as-a-Service	**CO4**
	Unit 5	**Data Analytics in Smart Buildings**	**CO5, CO6**
	A	Addressing Energy Efficiency in Smart Buildings	**CO5, CO6**
	B	General Architecture for Management Systems of Smart Buildings	**CO5, CO6**
	C	IoT-based Information Management System for Energy Efficiency in Smart Buildings	**CO5, CO6**

10	List of Self-Learning (SL) Activities [Total SL: 45 hours]	S. No.	Name of the Activity	No. of Hours	Evaluation Criteria
		1	Problem Solving / Data Analytics using Python for IoT Implement IoT data analytics tasks using Python libraries such as Pandas, NumPy, Matplotlib, and Scikit-learn for sensor data preprocessing, visualization, anomaly detection, and predictive analysis	5 coding exercises × 3h each Total = 15h	Based on correctness of analytical implementation, data visualization quali model performance, code quality, and documentation of analytical results.
		2	Technical Video-Based Learning NPTEL/YouTube technical sessions on IoT analytics, big data processing, cloud analytics, machine learning for IoT, and real-time sensor data visualization	Video viewing = 5h Report preparation & Presentation = 10h Total = 15h	Report/presentation based on learning outcomes. Marks for understanding of concepts, circuit explanation, presentation quality, and viva-voce performance..
		3	Assignment Writing (Data Processing & Visualization) Prepare assignments on IoT data preprocessing, statistical analysis, dashboard design, time-series analytics, and machine learning applications in IoT systems	5 assignments × 2h each Total = 10h	Based on correctness of analytical methods, visualization techniques, interpretation results, completeness of assigned tasks.
		4	Real-World Case Study / Mini Project Study and analyze a real-world IoT analytics application such as smart healthcare analytics, predictive maintenance, smart agriculture monitoring, or smart city data analysis	Literature study & implementation = 4h Report & demonstration = 6h Total = 10h	Based on innovation, working prototype, technical accuracy, report quality, presentation, and practical demonstration..

11	Mode of examination	Theory/Jury/Practical/Viva		
	Weightage Distribution	CA	MSE	ESE
		25%	15%	60%
	Textbook/s*			
	Other References			

PO and PSO mapping with level of strength for Course Name Data Analytics for IoT (Course Code CSOT3206)

Course Code_ Course Name	CO's	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO2	PSO3
CSOT 3209 Data Analytics for IoT	CO1	2	3	-	2	-	-	-	-	-	-	-	-	1	-
	CO2	3	-	-	2	2	-	-	-	-	-	2	2	1	-
	CO3	3	2	3	2	2	-	-	-	-	2	2	2	1	-
	CO4	2	-	-	2	-	-	-	-	-	2	2	-	1	-
	CO5	3	3	3	2	2	3	2	-	2	2	2	2	2	-
	CO6	3	3	3	2	3	3	2	2	2	2	2	3	2	-

Average of non-zeros entry in following table (should be auto calculated).

Course Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CSOT3206	Data Analytics for IoT	2.7	2.8	3.0	2.0	2.3	3.0	2.0	2.0	2.0	2.0	2.0	2.3	1.3	0.0

Strength of Correlation

1. Addressed to ***Slight (Low=1) extent*** ***2.*** Addressed to ***Moderate (Medium=2) extent***
3. Addressed to ***Substantial (High=3) extent***

SDG Goal	Description	Mapping Strength	Justification
SDG 4 – Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	High	The course develops analytical, computational, and decision-making skills through IoT data processing, visualization, machine learning, and real-time analytics, promoting advanced digital education and lifelong learning.
SDG 9 – Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	High	Data analytics for IoT supports intelligent industrial systems, predictive maintenance, smart automation, and data-driven innovation essential for Industry 4.0 and digital infrastructure.

SDG 11 – Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable	High	IoT analytics enables smart city applications such as traffic management, environmental monitoring, smart healthcare, waste management, and intelligent urban planning through real-time data insights.
SDG 12 – Responsible Consumption and Production	Ensure sustainable consumption and production patterns	High	IoT data analytics improves resource optimization, energy efficiency, predictive monitoring, and operational sustainability in industrial and domestic environments.
SDG 13 – Climate Action	Take urgent action to combat climate change and its impacts	Moderate	IoT analytics supports climate monitoring, pollution analysis, disaster prediction, smart agriculture, and environmental sustainability through real-time sensing and predictive analytics.
SDG 7 – Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all	Moderate	IoT analytics can optimize smart grids, energy monitoring systems, renewable energy forecasting, and efficient power consumption management.
SDG 8 – Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Moderate	The course equips students with IoT analytics, AI, cloud computing, and big data skills relevant to modern industries, smart enterprises, and data-driven economic ecosystems.
SDG 17 – Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Low to Moderate	IoT data ecosystems encourage collaborative innovation, cloud-based data sharing, interdisciplinary research, and partnerships among industries, governments, and research organizations.

COURSE PLAN

Web Application Security (CSCF3202)

Sharda School of Computing Science & Engineering | B.Tech CSE | Semester VI | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE- Sharda School of Computing Science & Engineering	**Batch:**	2026 – 2030
Program:	B. Tech	**Current Academic Year:**	2028-29
Branch:	Cyber Security & Forensics	**Semester:**	VI
Course Code:	**CSCF3202**	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCF3202**
2	**Course Title**	**Web Application Security**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs. Classroom + 45 hrs. Self-Learning = 90 hrs. total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Understand the fundamentals of web application security and common web vulnerabilities. 2. Develop practical skills to identify and mitigate security threats in web applications. 3. Apply digital forensics techniques for investigating web-based security incidents. 4. Enhance hands-on skills in secure web application development and testing.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:**

		CO1 (Understand – L1/L2): Understand and enhance communication and problem-solving skills in the context of web application security. CO2 (Apply – L2/L3): Identify, explain, and demonstrate insecure coding practices and apply appropriate methods to rectify vulnerabilities in web applications. CO3 (Understand – L1/L2): Understand the IT infrastructure and foundational concepts associated with web application security. CO4 (Analyze – L3/L4): Analyze the challenges, limitations, and effectiveness of application security techniques. CO5 (Design – L4/L5): Design and apply data mining-based solutions for addressing security issues in web applications. CO6 (Examine – L3/L4): Examine database security concerns and web-specific input validation issues in secure web applications.
8	**Course Description**	This course introduces advanced aspects of Cyber Crime, encompassing the Laws and its domains comprising many activities such as data breaches and all, and choose the relevant countermeasures.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs. | Self Learning (SL): 45 hrs. | Total: 90 hrs.
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Bryan Sullivan and Vincent Liu, Web Application Security: A Beginner's Guide, 1st Edition, McGraw-Hill Education, 2011, ISBN: 978-0071776165.
12	**References**	1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, 1st Edition, O'Reilly Media, 2020, ISBN: 978-1492053118. 2. Dafydd Studdard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2nd Edition, Wiley, 2011, ISBN: 978-1118026472. 3. Michal Zalewski, The Tangled Web: A Guide to Securing Modern Web Applications, No Starch Press, 2011, ISBN: 978-1593273880.

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
Unit 1	**Introduction to Web Application Security**	
A	Need for secure web systems, evolution of web security threats, security goals and attack surface analysis	**CO1, CO3, CO4**
B	Proactive security development lifecycle, secure software development process, risk assessment methodologies	**CO1, CO3, CO5**
C	Fundamental security principles, threat modeling concepts, attacker mindset, vulnerability classification	**CO1, CO3, CO4**
Unit 2	**Secure Coding Practices and Common Vulnerabilities using C**	
A	Secure coding fundamentals, input validation, authentication basics, insecure coding practices	**CO2**

B	Common web vulnerabilities: buffer overflows, injection flaws, improper error handling	**CO2, CO4**
C	Vulnerability mitigation strategies, secure coding standards, defensive programming practices	**CO2, CO5**
Unit 3	**Secure Coding in C++ and Java for Web Applications**	
A	Dynamic memory management in web applications, common memory handling errors, secure resource management	**CO2, CO4**
B	Memory managers, double free vulnerabilities, memory corruption issues affecting web application security	**CO2, CO4**
C	Integer security vulnerabilities, insecure input handling, exception handling, and mitigation strategies for secure web applications	**CO2, CO5**
Unit 4	**Database and Web-Specific Input Security**	
A	Quoting user input, secure input validation, encoding and sanitization techniques	**CO2, CO6**
B	Use of stored procedures, building SQL statements securely, prepared statements and secure database interaction	**CO5, CO6**
C	SQL Injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), attacks and remedies	**CO2, CO4, CO6**
Unit 5	**Software Security Engineering for Web Applications**	
A	Security requirements engineering, misuse cases, abuse cases, secure architecture principles	**CO3, CO5**
B	QUARE (Quality Requirements Engineering) process model, secure software design methodologies, threat analysis and risk mitigation approaches	**CO4, CO5**
C	Software security practices, architectural and design security knowledge, code review and deployment security considerations	**CO1, CO2, CO3, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓		✓		
2	1.B		✓	✓	✓		✓
3	1.C	✓	✓		✓	✓	
4	2.A	✓	✓	✓			
5	2.B	✓	✓	✓	✓		
6	2.C		✓	✓	✓	✓	
7	3.A	✓	✓	✓			
8	3.B	✓	✓	✓	✓		

9	3.C		✓	✓	✓	✓	
10	4.A	✓	✓	✓			
11	4.B	✓	✓	✓	✓		
12	4.C	✓	✓	✓	✓	✓	
13	5.A	✓	✓		✓		✓
14	5.B		✓	✓	✓	✓	
15	5.C		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓					✓											
CO2		✓	✓	✓				✓					✓	✓				
CO3		✓	✓	✓			✓						✓	✓				
CO4				✓	✓				✓									
CO5			✓	✓	✓	✓			✓					✓	✓			
CO6		✓	✓	✓	✓			✓					✓	✓				

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs.) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YYYY	Introduction to Web Application Security and Course Overview	Unit 1	10
DD/MM/YYYY	Need for Secure Web Systems		
DD/MM/YYYY	Evolution of Web Security Threats		
DD/MM/YYYY	Security Goals: Confidentiality, Integrity, Availability		
DD/MM/YYYY	Attack Surface Analysis in Web Applications		
DD/MM/YYYY	Secure Software Development Lifecycle (SSDLC)		

DD/MM/YYYY	Proactive Security Development Process		
DD/MM/YYYY	Risk Assessment Methodologies		
DD/MM/YYYY	Security Principles and Best Practices		
DD/MM/YYYY	Threat Modeling Concepts and Vulnerability Classification		
DD/MM/YYYY	Introduction to Secure Coding Practices	**Unit 2**	**10**
DD/MM/YYYY	Common Insecure Coding Practices		
DD/MM/YYYY	Input Validation Principles		
DD/MM/YYYY	Buffer Overflow Vulnerabilities		
DD/MM/YYYY	Injection Flaws and Exploits		
DD/MM/YYYY	Improper Error Handling		
DD/MM/YYYY	Defensive Programming Concepts		
DD/MM/YYYY	Secure Coding Standards		
DD/MM/YYYY	Vulnerability Mitigation Techniques		
DD/MM/YYYY	Dynamic Memory Management in Web Applications	**Unit 3**	**9**
DD/MM/YYYY	Memory Allocation and Deallocation Errors		
DD/MM/YYYY	Secure Resource Management		
DD/MM/YYYY	Memory Managers and Secure Handling		
DD/MM/YYYY	Double Free Vulnerabilities		
DD/MM/YYYY	Memory Corruption in Web Applications		
DD/MM/YYYY	Integer Overflow and Underflow Issues		
DD/MM/YYYY	Input Handling and Exception Security		
DD/MM/YYYY	Mitigation Strategies for Secure Web Applications		
DD/MM/YYYY	Secure Input Validation and Sanitization	**Unit 4**	**8**
DD/MM/YYYY	Quoting User Input Securely		
DD/MM/YYYY	Stored Procedures and Secure Database Access		
DD/MM/YYYY	Building SQL Statements Securely		
DD/MM/YYYY	Prepared Statements and Parameterized Queries		
DD/MM/YYYY	SQL Injection Attacks		
DD/MM/YYYY	Cross-Site Scripting (XSS)		
DD/MM/YYYY	Cross-Site Request Forgery (CSRF)		
DD/MM/YYYY	Security Requirements Engineering	**Unit 5**	**9**
DD/MM/YYYY	Misuse Cases in Secure Software Design		
DD/MM/YYYY	Abuse Cases in Security Engineering		

DD/MM/YYYY	QUARE Process Model		
DD/MM/YYYY	Secure Design Methodologies		
DD/MM/YYYY	Threat Analysis and Risk Mitigation		
DD/MM/YYYY	Software Security Practices		
DD/MM/YYYY	Architectural Security Principles		
DD/MM/YYYY	Code Review and Deployment Security		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Conceptual Recall & Security Fundamentals**	Recall fundamental web security terminology, security principles, threat categories, attack surface concepts, and secure development lifecycle fundamentals	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Secure Coding Interpretation &**	Explain secure coding principles, identify insecure coding practices, interpret vulnerability scenarios	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A

	Vulnerability Identification	including buffer overflow, memory misuse, and unsafe input handling		
TS3	**Security Application & Secure Implementation**	Apply secure coding practices, database security techniques, secure input validation, and mitigation strategies in web application contexts	CO3 / CO6 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Threat Analysis & Security Evaluation**	Analyze attack scenarios, vulnerability exploitability, limitations of security mechanisms, and compare mitigation effectiveness across techniques	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	**Secure Design & Software Security Engineering**	Evaluate secure architecture principles, threat modeling outputs, QUARE model usage, and software security engineering practices for robust application design	CO5 | L4–L5	ETE Sec B/C
TS6	**Database & Web Attack Investigation**	Analyze web-specific attack vectors such as SQL Injection, XSS, CSRF, database vulnerabilities, and assess remediation strategies through case-based evaluation	CO6 | L3–L5	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3	M		H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M	M	M		H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Problem-based / Vulnerability Analysis / Secure Coding Tasks)	5 Assignments	15	CO1, CO2, CO3, CO6	TS1, TS2, TS3, TS4
Technical Video Learning Report + Presentation	1 Report + Presentation	5	CO1, CO3, CO4	TS2, TS3, TS4
Real-World Case Study (Security Incident / Web Attack Analysis Report)	1 Report	5	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	25	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 concepts: web security fundamentals, threat landscape, security goals, threat modeling	**CO1, CO3**	**TS1, TS2**	**5h SL**	Conceptual problem-solving, short analytical report, vulnerability identification
Assignment 2	Secure coding practices: insecure coding examples, buffer overflow, input validation issues	**CO2**	**TS2, TS3**	**5h SL**	Code analysis, vulnerability identification, mitigation strategy explanation
Assignment 3	Secure coding in C++/Java: memory vulnerabilities, integer overflow, secure resource handling	**CO2, CO4**	**TS2, TS3**	**5h SL**	Secure coding exercises, vulnerability tracing, comparative mitigation analysis
Assignment 4	Database and web-specific attacks: SQL Injection, XSS, CSRF, secure query building	**CO4, CO6**	**TS3, TS4**	**5h SL**	Attack scenario analysis, remediation design, secure implementation recommendations
Assignment 5	Software security engineering: misuse cases, abuse cases, QUARE model, secure design practices	**CO5, CO6**	**TS4, TS5**	**5h SL**	Secure architecture/design solution, threat analysis, justification of design choices
Video Learning Report	Technical video on web security tools/secure coding practices/OWASP Top 10 (minimum 3 hrs); structured report + class presentation	**CO1, CO3, CO4**	**TS2, TS3, TS4**	**9h SL**	Report covering learning outcomes, concepts understood, vulnerability insights, self-reflection; Presentation (10 min)
Case Study Report	Real-world web application security incident (e.g., SQL injection breach, XSS exploit, authentication bypass, major web attack case); detailed technical analysis	**CO4, CO5, CO6**	**TS4, TS5, TS6**	**6h SL**	Technical depth, incident analysis, attack vector identification, mitigation recommendations, comparative evaluation

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Conceptual Recall & Security Fundamentals TS2 — Secure Coding Interpretation & Vulnerability Identification	**CO1, CO2, CO3**	**Short-answer:** define web security concepts, explain security principles, threat modeling, secure development lifecycle, identify common vulnerabilities, explain secure coding practices, memory handling/security flaws
Section B	**15**	TS3 — Security Application & Secure Implementation TS4 — Threat Analysis & Security Evaluation	**CO2, CO3, CO4**	**Analytical/application questions:** analyze vulnerability scenarios, identify insecure code and suggest remediation, apply secure coding principles, compare mitigation techniques, evaluate attack scenarios and security mechanisms
TOTAL	**25**	**TS1–TS4**	**CO1–CO4**	**Units 1–3 only. CO5 and CO6 assessed in ETE only.**

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1 — Conceptual Recall & Security Fundamentals TS2 — Secure Coding Interpretation & Vulnerability Identification	CO1, CO2, CO3	Short questions (all units): definitions of web security concepts, threat identification, security principles, secure development lifecycle, secure coding concepts, vulnerability identification, threat modeling, memory/security flaw concepts
Section B	25	TS3 — Security Application & Secure Implementation TS4 — Threat Analysis & Security Evaluation TS5 — Secure Design & Software Security Engineering	CO3, CO4, CO5	Medium questions: secure coding analysis, vulnerability mitigation design, SQL injection/XSS attack analysis, secure database implementation, threat analysis, QUARE model application, software security engineering case-based questions
Section C	10	TS5 — Secure Design & Software Security Engineering TS6 — Database & Web Attack Investigation	CO5, CO6	Long/evaluation questions: secure architecture evaluation, software security practices, database security analysis, SQL injection/XSS/CSRF case study analysis, mitigation strategy evaluation, real-world web security incident analysis
TOTAL	50	TS1–TS6 (all)	CO1–CO6	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand fundamental concepts, principles, and threats in web application security	✓	✓	✓	TS1	PO1, PO2, PO8
CO2	Identify insecure coding practices and apply mitigation techniques in web applications	✓	✓	✓	TS2	PO1, PO2, PO3, PO5
CO3	Understand IT infrastructure and foundational web application security mechanisms	✓	✓	✓	TS3	PO1, PO2, PO5
CO4	Analyze challenges, threats, vulnerabilities, and limitations of security techniques	✓	✓	✓	TS4	PO2, PO4, PO8
CO5	Design and apply secure software engineering and web security solutions	✓	—	✓	TS5	PO3, PO4, PO5, PO12
CO6	Examine database security and web-specific attack vectors and mitigation strategies	✓	—	✓	TS6	PO2, PO4, PO5

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | - = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	3	-	-	-	3	-	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	-	2	-	-	-	2	-	-	2	3	-	3
CO4	3	3	-	3	2	3	-	2	-	-	-	-	-	3	3
CO5	3	2	3	-	-	-	-	3	3	-	-	-	-	3	3

CO6	3	3	-	3	3	3	3	-	-	3	3	-	3	-	3
Avg	3.00	2.83	2.33	3.00	2.25	3.00	3.00	2.67	2.50	3.00	3.00	2.50	3.00	3.00	3.00

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H			M			H				H		
CO2	H	H	M											
CO3	H	H	M		M				M			M	H	
CO4	H	H		H	M	H		M						H
CO5	H	M	H					H	H					H
CO6	H	H		H	H	H	H			H	H		H	

= High / Primary alignment **M** = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Assignment Writing (5 assignments, one per unit focus area covering web security concepts, secure coding, vulnerability analysis, database/web attacks, software security engineering)**	5 assignments × 5 hrs. each Total = 25 hrs.	CO1–CO6 TS1–TS5	Evaluated based on assignment submission, conceptual clarity, vulnerability identification, mitigation strategy design, secure coding correctness, analytical justification
2	**Technical Video-Based Learning related to Web Application Security (e.g., OWASP Top 10, secure coding practices, SQL Injection/XSS prevention, threat modeling, software security engineering)**	Video viewing: 3 hrs. Report preparation: 3 hrs. Presentation: 3 hrs. Total = 9 hrs.	CO2, CO3, CO4 TS2, TS3, TS4	Report + presentation based on technical understanding, learning outcomes, secure development insights, vulnerability interpretation, and self-reflection
3	**Real-World Web Security Case Studies (e.g., Equifax breach, SQL injection attacks, XSS exploitation, authentication bypass incidents, web application vulnerability disclosures)**	Data collection / study: 4 hrs. Report preparation: 4 hrs. Presentation / discussion: 3 hrs. Total = 11 hrs.	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, attack analysis, factual investigation, security weakness identification, mitigation recommendations, comparative evaluation
	TOTAL Self-Learning Hours	45 Hours	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (45 hrs.)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks

ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

CSCF3202— MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A

CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B

CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

COURSE PLAN

Strategic Professionalism and Computational Informatics (SKP3601)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester VI | Batch 2026–2030

Lab-Only Course Plan — All 6 Lab COs (CO1–CO6) | New AICTE 11-PO Framework | Full Skill Mapping

PART I COURSE SYLLABUS *Course Identification, Details, Outcomes, BTL Mapping & Lab Session Plan*

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech.	**Current Academic Year:**	2028–29
Branch:	CSE	**Semester:**	VI
Course Code:	SKP3601	**Course Type:**	Core — Practical

2. Course Details

LAB-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), Course Examination (CE), and End Semester Examination (ESE). No theory lecture component.

1	**Course Code**	SKP3601
2	**Course Title**	Strategic Professionalism and Computational Informatics
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	0-0-6-0 (Tutorial: 00 hrs | Lab: 90 hrs | Self Learning: 00 hrs | Total: 90 hrs)
5	**Course Status**	Core
6	**Course Objectives**	The objective of this course is to develop students' technical competency, quantitative aptitude, logical reasoning, verbal ability, and professional employability skills through industry-oriented and application-based learning. The course focuses on strengthening problem-solving, algorithmic thinking, software development, analytical reasoning, and workplace readiness by integrating advanced data structures, Agentic AI/Full Stack Development concepts, deployment practices, aptitude training, and professional communication skills. It also aims to enhance students' communication, presentation, collaboration, and decision-making abilities required for academic excellence, campus placements, and professional success. By the end of the course, students will be able to apply technical, analytical, and interpersonal skills effectively in real-world and industry-driven environments.
7	**Course Outcomes (COs)**	After successful completion of this course, the students will be able to: **CO1 (Remember – L1):** Technical, Aptitude & Reasoning Foundations Recall and identify fundamental concepts of advanced data structures (Red-Black Trees, Segment Trees, Tries, DSU, String Algorithms), Agentic AI/Full Stack development frameworks, quantitative aptitude formulas, verbal ability concepts, and logical reasoning techniques used in problem-solving and computational thinking. **CO2 (Understand – L2):** Analytical Systems, Communication & Workflow Understanding Explain the working principles of graph-based agent workflows, backend architectures, APIs, databases, logical reasoning patterns, data sufficiency

		approaches, professional communication strategies, and workplace interaction techniques used in technical and professional environments. **CO3 (Apply – L3):** Application Development, Quantitative Problem Solving & Professional Communication Apply LangChain, LangGraph, CrewAI, Node.js, Express.js, MongoDB, and advanced data structure operations along with quantitative aptitude techniques, data interpretation methods, group discussion strategies, presentation skills, and logical reasoning approaches to solve technical, analytical, and workplace problems. **CO4 (Analyze – L4):** Critical Thinking, Data Analysis & Verbal Reasoning Analyze multi-agent system architectures, REST API workflows, algorithmic efficiency, reading comprehension passages, verbal reasoning patterns, puzzles, data sufficiency problems, and workplace communication scenarios using critical thinking, analytical reasoning, and interpretation skills. **CO5 (Evaluate – L5):** Technical Evaluation, Decision-Making & Workplace Effectiveness Evaluate agent frameworks, deployment strategies, authentication workflows, quantitative approaches, logical arguments, communication effectiveness, team collaboration practices, LinkedIn profiling strategies, and decision-making processes for performance, scalability, accuracy, and professional impact. **CO6 (Create – L6):** Integrated Technical Solutions & Employability Development Design and develop production-ready technical solutions, capstone projects, full stack applications, multi-agent AI systems, technical documents, corporate presentations, debate responses, and professional communication deliverables by integrating software development, analytical aptitude, logical reasoning, verbal ability, and employability skills.
8	**Course Description**	This course is an industry-oriented and practice-based course designed to develop students' technical competency, quantitative aptitude, logical reasoning, verbal ability, and professional employability skills required for academic excellence, campus placements, and workplace success. The course integrates advanced data structures such as Red-Black Trees, Segment Trees, Tries, DSU, and String Algorithms with Agentic AI/Full Stack Development concepts including LangChain, LangGraph, CrewAI, Node.js, Express.js, MongoDB, REST APIs, authentication systems, and deployment workflows. The course also strengthens quantitative problem-solving, data interpretation, verbal reasoning, reading comprehension, group discussion, presentation, technical writing, LinkedIn profiling, debating, LSRW skills, and workplace communication practices through structured and application-based learning. Students enhance their problem-solving, analytical thinking, computational reasoning, software development, collaboration, decision-making, and communication abilities through technical exercises, mock assessments, collaborative activities, and capstone-oriented practice. The course equips learners with technical, analytical, and professional skills required for real-world, industry-driven, and technology-enabled environments.
9	**Teaching & Learning Scheme**	Tutorial (T): 90 hrs | Total: 90 hrs | Credits: 3
10	**Mode of Examination**	CA: 30% | CE: 30% | ESE: 40% | Total: 100 marks
11	**Textbook**	1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal 2. A Modern Approach to Verbal & Non-Verbal Reasoning – R.S. Aggarwal 3. Russell, S. & Norvig, P. (2022). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. [Data Science Track] 4. Flanagan, D. (2020). JavaScript: The Definitive Guide (7th ed.). O'Reilly Media. [Full Stack Track] 5. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to Algorithms (4th ed.). MIT Press. [Data Structures – Mandatory]
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3. Outline Syllabus — Units with CO Mapping

i All CO mappings refer to COs (CO1–CO6). This is a practical course; all assessment is via CA, CE, and ESE.

	Topic / Activity	CO Mapping
	Unit 1: Quantitative Aptitude, Generative AI to Agentic AI & Backend Foundations	
A	Problem on Ages, Simple Interest, Compound Interest, Partnerships	**CO1**
B	Profit & Loss – Advanced, Time & Work – Chain Rule & Wages, Time & Work – Advanced	**CO1**
C	Pipe & Cistern, Boats & Streams, Problems on Trains	**CO1**
D	Recap and Bridge: Limitations of Static LLMs, Introduction to Agentic AI, Characteristics and Goal-Directed Behavior OR Introduction to Backend Development, Client-Server Architecture, APIs, Runtime Environment, Node.js, Event Loop, Non-Blocking Architecture	**CO2**
E	Generative AI vs Agentic AI: Key Differences, Planning, Autonomy, Real-World Transition Examples OR npm Workflow, package.json, Dependencies vs Dev Dependencies, Scripts, Project Initialization, Backend Folder Structure	**CO2**
F	Industry Landscape and Governance: Agentic AI in Healthcare, Finance, Retail, Manufacturing, AI Governance and Safety OR File System (fs) Module, Path Module, Environment Variables (.env), Nodemon, Backend Debugging Workflow	**CO2**
G	Red-Black Tree Properties, Rotations and Recoloring, Insert and Delete Cases	**CO1**
H	Segment Tree: Build and Query, Lazy Propagation, Range Update Patterns	**CO1**
	Unit 2: Logical Reasoning, LangChain, Express.js & Trie-Based Systems	
A	Puzzles – Floor/Week, Puzzles – Box/Month, Puzzles – Miscellaneous	**CO3**
B	Deductive Reasoning, Binary Logic, Selection Based on Given Conditions, Visual Flow Chart	**CO2**

C	Mirror & Water Image, Paper Cutting & Folding, Game-Based Puzzles, Data Sufficiency – Reasoning	**CO4**
D	LangChain and LCEL: Agents, Tools, Memory, RunnableSequence, RunnableParallel, RunnableLambda OR Express.js Setup, Routing, Request-Response Cycle	**CO1**
E	Vector Databases and Data Ingestion OR HTTP Methods, Parameters, Response Handling	**CO2**
F	MCP Fundamentals, Client-Server Setup, Integration OR Middleware, API Design Principles	**CO3**
G	Trie Insert, Search, startsWith, Compressed Trie, Trie Memory Optimization	**CO1**
H	Suffix Array Construction, LCP Array, Pattern Matching via Suffix Array	**CO4**
	Unit 3: Data Interpretation, Quantitative Problem Solving, Building AI Agents with LangGraph, MongoDB & Database Integration, Disjoint Set Union	
A	Data Interpretation – Caselet Based Analysis, Quantitative Data Evaluation	**CO4**
B	Mensuration, Set Theory, Permutation & Combination, Probability	**CO3**
C	Data Sufficiency – Quantitative Aptitude Based, Integrated Quantitative Problem Solving	**CO5**
D	Introduction to LangGraph: Graph-Based Architectures, Agent State Management, State Schema Design **OR** SQL vs NoSQL Concepts, Databases, Collections, Documents, Introduction to MongoDB, MongoDB Compass, MongoDB Atlas	**CO2**
E	Memory and Message Management: State Reducers, Context Trimming, Short-Term and Long-Term Memory **OR** Mongoose, Schemas, Models, Validation, Relationships, Query Methods	**CO3**
F	Human-in-the-Loop and Real-Time Agents: HITL, Streaming Agents, Tool-Using and Decision-Making Agents **OR** CRUD Operations, Filtering, Sorting, Pagination, Search Functionality, API Query Handling	**CO5**
G	Union-Find with Path Compression, Union by Rank/Size, Amortized Analysis, DSU Applications: Kruskal's Algorithm, Cycle Detection	**CO6**
	Unit 4: Verbal Ability, Critical Reasoning, Multi-Agent Systems, Authentication, MVC & Secure Backend Design, String Algorithms	
A	Reading Comprehension – Company Specific, Skimming & Scanning Techniques, Interpretation & Inference	**CO4**
B	Parajumbles – Advanced Level, Passage Completion, Cloze Test Techniques	**CO3**
C	Vocabulary – Company Test Specific, Strong & Weak Arguments, Cause & Effect	**CO5**
D	Introduction to Multi-Agent Systems: Coordination, Delegation, Parallelism, CrewAI Fundamentals **OR** Error Handling using try/catch, API Response Structure, Async Error Handling, Reusable Utility Functions	**CO2**
E	CrewAI Architecture Patterns: Sequential and Hierarchical Crews, Task Dependencies, Collaborative Workflows **OR** Password Hashing using bcrypt, JWT Authentication, Token Validation, Signup/Login Flow, Protected Routes, Authentication Middleware, Authorization Basics	**CO3**
F	MCP Deep Dive and Framework Comparison: LangGraph vs CrewAI vs AutoGen, Agent-to-Agent Communication **OR** MVC Architecture, Routes, Controllers, Models, Services, Utils, API Documentation, README Writing	**CO5**
G	KMP Algorithm: Failure Function, O(n+m) Pattern Matching, Z-Algorithm, Rabin-Karp Rolling Hash	**CO1**
H	Manacher's Algorithm for Palindromes, Longest Palindromic Substring O(n), Eertree Concept	**CO1**

	Unit 5: Professional Communication, Employability Skills, Full Stack Integration & Deployment Workflow	
A	Group Discussion – Abstract, Team Building & Collaboration, Time, Priority & Stress Management	**CO3**
B	Art of Networking – Professional LinkedIn Profiling, Culture Sensitization, MUN – Model United Nations	**CO5**
C	The Art of Debating & Elocution, Corporate Style Presentation, Introduction to Technical Writing, LSRW 3, Decision Making	**CO4**
D	AI Observability and Evaluation: Langfuse, LangSmith, Monitoring, Tracing, Prompt Management **OR** Frontend Integration, CORS, API Consumption Workflow, Backend Testing using Postman and Thunder Client	**CO2**
E	Deployment and Optimization: MLOps for Agents, CI/CD, Cost Optimization, FastAPI, Docker, Serverless Deployment **OR** Git Workflow for Teams, Branching Strategy, Pull Requests, Logging, Security Best Practices, Rate Limiting Basics	**CO5**
F	Enterprise Integration and Capstone: CRM/ERP Integration, Single-Agent and Multi-Agent Project Development, Final Review **OR** Complete Full Stack Project: Authentication System, CRUD APIs, React Frontend Integration, Protected Routes, Database Integration, State Management, Deployment Workflow, Production Optimization	**CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A - Problem on Ages, Simple Interest, Compound Interest, Partnerships	✓	✓				
2	1.B - Profit & Loss – Advanced, Time & Work – Chain Rule & Wages, Time & Work – Advanced		✓	✓			
3	1.C - Pipe & Cistern, Boats & Streams, Problems on Trains		✓	✓	✓		
4	1.D - Recap and Bridge: Limitations of Static LLMs, Introduction to Agentic AI, Characteristics and Goal-Directed Behavior OR Introduction to Backend Development, Client-Server Architecture, APIs, Runtime Environment, Node.js, Event Loop, Non-Blocking Architecture	✓	✓	✓			
5	1.E - Generative AI vs Agentic AI: Key Differences, Planning, Autonomy, Real-World Transition Examples OR npm Workflow, package.json, Dependencies vs DevDependencies, Scripts, Project Initialization, Backend Folder Structure		✓	✓	✓		
6	1.F - Industry Landscape and Governance: Agentic AI in Healthcare, Finance, Retail, Manufacturing, AI Governance and Safety OR File System (fs) Module, Path Module, Environment Variables (.env), Nodemon, Backend Debugging Workflow		✓	✓	✓	✓	
7	1.G - Red-Black Tree Properties, Rotations and Recoloring, Insert and Delete Cases	✓	✓	✓	✓		
8	1.H - Segment Tree: Build and Query, Lazy Propagation, Range Update Patterns		✓	✓	✓	✓	

9	2.A - Puzzles – Floor/Week, Puzzles – Box/Month, Puzzles – Miscellaneous		✓	✓	✓		
10	2.B - Deductive Reasoning, Binary Logic, Selection Based on Given Conditions, Visual Flow Chart		✓	✓	✓		
11	2.C - Mirror & Water Image, Paper Cutting & Folding, Game-Based Puzzles, Data Sufficiency – Reasoning		✓	✓	✓	✓	
12	2.D - LangChain and LCEL: Agents, Tools, Memory, RunnableSequence, RunnableParallel, RunnableLambda OR Express.js Setup, Creating Server, Routing, Listening on Ports, Request-Response Cycle, API Structure	✓	✓	✓			
13	2.E - Vector Databases and Data Ingestion: FAISS, Chroma, Pinecone, Document Loaders, Chunking Strategies OR HTTP Methods (GET, POST, PUT, PATCH, DELETE), Route Parameters, Query Parameters, Request Body, Response Handling, Status Codes		✓	✓	✓		
14	2.F - Model Context Protocol (MCP): MCP Fundamentals, MCP Client and Server Setup, API and Database Integration OR Middleware, express.json(), Custom Middleware, Error-Handling Middleware, Request Logging, API Design Principles		✓	✓	✓	✓	
15	2.G - Trie Insert, Search, startsWith, Compressed Trie, Trie Memory Optimization	✓	✓	✓	✓		
16	2.H - Suffix Array Construction, LCP Array, Pattern Matching via Suffix Array		✓	✓	✓	✓	
17	3.A - Data Interpretation – Caselet Based Analysis, Quantitative Data Evaluation		✓	✓	✓	✓	
18	3.B - Mensuration, Set Theory, Permutation & Combination, Probability		✓	✓	✓	✓	
19	3.C - Data Sufficiency – Quantitative Aptitude Based, Integrated Quantitative Problem Solving		✓	✓	✓	✓	✓
20	3.D - Introduction to LangGraph: Graph-Based Architectures, Agent State Management, State Schema Design OR SQL vs NoSQL Concepts, Databases, Collections, Documents, Introduction to MongoDB, MongoDB Compass, MongoDB Atlas	✓	✓	✓	✓		
21	3.E - Memory and Message Management: State Reducers, Context Trimming, Short-Term and Long-Term Memory OR Mongoose, Schemas, Models, Validation, Relationships, Query Methods		✓	✓	✓	✓	
22	3.F - Human-in-the-Loop and Real-Time Agents: HITL, Streaming Agents, Tool-Using and Decision-Making Agents OR CRUD Operations, Filtering, Sorting, Pagination, Search Functionality, API Query Handling		✓	✓	✓	✓	✓
23	3.G - Union-Find with Path Compression, Union by Rank/Size, Amortized Analysis, DSU Applications: Kruskal's Algorithm, Cycle Detection	✓	✓	✓	✓	✓	

24	4.A - Reading Comprehension – Company Specific, Skimming & Scanning Techniques, Interpretation & Inference		✓	✓	✓		
25	4.B - Parajumbles – Advanced Level, Passage Completion, Cloze Test Techniques		✓	✓	✓	✓	
26	4.C - Vocabulary – Company Test Specific, Strong & Weak Arguments, Cause & Effect		✓	✓	✓	✓	✓
27	4.D - Introduction to Multi-Agent Systems: Coordination, Delegation, Parallelism, CrewAI Fundamentals OR Error Handling using try/catch, API Response Structure, Async Error Handling, Reusable Utility Functions	✓	✓	✓	✓		
28	4.E - CrewAI Architecture Patterns: Sequential and Hierarchical Crews, Task Dependencies, Collaborative Workflows OR Password Hashing using bcrypt, JWT Authentication, Token Validation, Signup/Login Flow, Protected Routes, Authentication Middleware, Authorization Basics		✓	✓	✓	✓	
29	4.F - MCP Deep Dive and Framework Comparison: LangGraph vs CrewAI vs AutoGen, Agent-to-Agent Communication OR MVC Architecture, Routes, Controllers, Models, Services, Utils, API Documentation, README Writing		✓	✓	✓	✓	✓
30	4.G - KMP Algorithm: Failure Function, O(n+m) Pattern Matching, Z-Algorithm, Rabin-Karp Rolling Hash	✓	✓	✓	✓	✓	
31	4.H - Manacher's Algorithm for Palindromes, Longest Palindromic Substring O(n), Eertree Concept		✓	✓	✓	✓	✓
32	5.A - Group Discussion – Abstract, Team Building & Collaboration, Time, Priority & Stress Management		✓	✓	✓	✓	
33	5.B - Art of Networking – Professional LinkedIn Profiling, Culture Sensitization, MUN – Model United Nations		✓	✓	✓	✓	
34	5.C - The Art of Debating & Elocution, Corporate Style Presentation (Business Review/Sales Review/HR Review), Introduction to Technical Writing, LSRW 3 – Listening, Speaking, Reading & Writing, Decision Making		✓	✓	✓	✓	✓
35	5.D - AI Observability and Evaluation: Langfuse, LangSmith, Monitoring, Tracing, Prompt Management OR Frontend Integration, CORS, API Consumption Workflow, Backend Testing using Postman and Thunder Client	✓	✓	✓	✓		
36	5.E - Deployment and Optimization: MLOps for Agents, CI/CD, Cost Optimization, FastAPI, Docker, Serverless Deployment OR Git Workflow for Teams, Branching Strategy, Pull Requests, Logging, Security Best Practices, Rate Limiting Basics		✓	✓	✓	✓	
37	5.F - Enterprise Integration and Capstone: CRM/ERP Integration, Single-Agent and Multi-Agent Project Development, Final Review OR Complete Full Stack Project: Authentication System, CRUD APIs, React Frontend Integration, Protected Routes, Database Integration, State Management, Deployment Workflow, Production Optimization		✓	✓	✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ Only strong/dominant alignments are mapped. COs span all three domains — Cognitive (L3–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of lab and project work.

	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**A1**	**A2**	**A3**	**A4**	**A5**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
CO1	✓							✓						✓	✓			
CO3			✓					✓	✓						✓	✓		
CO4				✓				✓	✓	✓					✓	✓		
CO5					✓			✓	✓	✓						✓	✓	
CO6						✓		✓	✓	✓	✓					✓	✓	✓
	Legend: ✓ = Strong / Dominant mapping only.																	

6. Evaluation Scheme — Overview

Component	Weightage	Marks	COs & Skill Dimensions Assessed
Continuous Assessment (CA)	30%	**30**	All COs (CO1–CO6) | Practical Exercises, Aptitude Assignments, Communication Activities, Technical Implementations, Presentations, Group Discussions & Lab Performance
Course Examination (CE)	30%	**30**	CO1–CO6 | Practical Demonstration, Problem Solving, Aptitude & Reasoning Assessment, Technical Tasks, Viva-Voce
End Semester Examination (ESE)	40%	**40**	CO1–CO6 | Integrated Problem Solving, Technical Implementation, Case Analysis, Project Demonstration, Presentation & Viva
TOTAL	**100%**	**100**	**All COs assessed through continuous, mid-semester, and end-semester performance evaluation**

7. Continuous Assessment (CA) — 30 Marks

7.1 Per-Experiment CA Rubric (3.0 Marks each)

Criterion	Marks	Skill Dimensions Covered	Marking Guide	CO
Problem Understanding & Solution Planning	**1.00**	Problem Identification & Analysis. Solution Design, Strategy Formulation & Planning	1.00: Clear understanding with appropriate approach0.50: Partial understanding0: Inadequate preparation	CO1–CO4
Technical / Analytical Execution	**1.00**	Technical Implementation & Application. Analytical Reasoning, Tool Usage & Problem Solving	1.00: Accurate and complete execution0.50: Minor errors or gaps0: Unable to perform task	CO1–CO5

Interpretation, Communication & Documentation	**0.75**	Result Analysis & Interpretation. Reporting, Presentation, Documentation & Communication	0.75: Comprehensive explanation and documentation0.50: Adequate explanation0.25: Limited evidence0: Not submitted / unable to explain	CO3–CO5
Professionalism, Collaboration & Ethical Conduct	**0.25**	Professional Behaviour, Teamwork, Integrity & Continuous Improvement	0.25: Consistently demonstrated0.10: Partially demonstrated0: Not demonstrated	CO6
Total	**3.00**			**CO1–CO6**

7.2 Best-N-of-15 Scoring Scheme

Conducted	Best N Counted	Max Score	Note
>10	Best 10	**30 Marks**	Best 10 of all sessions (3 marks × 10 = 30)
< 10	All attended	**≤ 30 Marks**	Each missed session = zero; cannot be compensated

8. Continuous Evaluation (CE) — 30 Marks

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A: Technical & Analytical Assessment	**10**	Problem Identification & Analysis. Technical Implementation & Application	CO1, CO2, CO3	Aptitude, logical reasoning, data interpretation, DSA, Agentic AI/Full Stack practical exercises, and analytical problem-solving tasks requiring application of concepts and techniques.
Sec B: Case Study / Problem-Solving Assessment	**10**	Analytical Reasoning & Solution Development. Result Interpretation & Evaluation	CO3, CO4, CO5	Scenario-based technical or workplace case studies requiring analysis, decision-making, interpretation of results, justification of solutions, and structured problem-solving approaches.
Sec C: Group Discussion / Presentation / Viva	**10**	Communication & Documentation. Solution Planning & Presentation. Professional Behaviour & Collaboration	CO3, CO4, CO5, CO6	Group discussion, presentation, debate, technical explanation, professional communication exercise, or viva voce. Assessment focuses on communication effectiveness, teamwork, critical thinking, confidence, leadership, professional etiquette, and articulation of ideas.
TOTAL	**30**		**CO1–CO6**	**Assessment integrates technical competency, analytical reasoning, communication skills, professional behaviour, teamwork, and problem-solving abilities developed across the course.**

9. End Semester Examination (ESE) — 40 Marks

ℹ ESE is comprehensive — all 5 units and all 6 COs.. Minimum 16/40 required to pass.

Section	Marks	Skill Dimensions	COs Assessed	Question Type & Guidance
Sec A: Technical Competency Assessment	**10**	Technical Implementation & Application. Analytical Reasoning & Solution Development	CO1, CO2, CO3, CO4	Practical exercises involving aptitude, logical reasoning, advanced data structures, Agentic AI/Full Stack implementation tasks, data interpretation, and technical problem-solving. Students demonstrate application of concepts and appropriate use of tools, techniques, and frameworks.
Sec B: Case Analysis & Decision-Making Assessment	**20**	Critical Analysis & Evaluation. Interpretation & Judgement. Solution Design & Planning	CO3, CO4, CO5	Case studies, scenario-based problem solving, analytical reasoning tasks, technical architecture evaluation, workplace simulations, quantitative analysis, communication scenarios, and decision-making exercises. Students justify solutions, evaluate alternatives, and recommend appropriate approaches.
Sec C: Project Demonstration, Presentation & Innovation Assessment	**10**	Solution Planning & PresentationLS8 — Innovation, Professional Behaviour & Continuous Improvement	CO5, CO6	Capstone project demonstration, technical presentation, viva voce, group project review, deployment showcase, innovation proposal, or professional communication exercise. Assessment focuses on creativity, solution design, implementation quality, presentation effectiveness, teamwork, leadership, and professional readiness.
TOTAL	**40**		**CO1–CO6**	**Comprehensive assessment of technical, analytical, communication, professional, and innovation competencies. Minimum 16/40 marks required to pass. Scaled from a 100-mark examination, if applicable.**

9.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (30)	CE (30)	ESE (40)	Skill Dims	PO Primary
CO1	Apply quantitative aptitude, logical reasoning, and fundamental technical concepts to solve structured problems	✓	✓	✓	Quantitative Aptitude, Logical Reasoning, Analytical Thinking, Problem Solving	PO1, PO2
CO2	Demonstrate understanding of advanced data structures, Agentic AI / Full Stack concepts, and analytical techniques	✓	✓	✓	Technical Knowledge, Data Structures, AI/Full Stack Concepts, Analytical Skills	PO1, PO2, PO3
CO3	Apply analytical reasoning, data interpretation, communication, and technical problem-solving skills in practical scenarios	✓	✓	✓	Data Interpretation, Critical Thinking, Communication Skills, Technical Problem Solving	PO1, PO2, PO3, PO10

CO4	Analyze complex technical and workplace problems using appropriate tools, methods, and structured reasoning approaches	✓	✓	✓	Problem Analysis, Decision Making, Technical Evaluation, Professional Reasoning	PO1, PO2, PO4, PO8
CO5	Evaluate alternative solutions, make informed decisions, and demonstrate effective communication and professional interaction skills	✓	✓	✓	Communication Skills, Group Discussion, Presentation Skills, Team Collaboration, Decision Making	PO1, PO2, PO8, PO9, PO10
CO6	Design, develop, present, and deploy innovative technical solutions while demonstrating teamwork, leadership, and professional readiness	✓	✓	✓	Project Development, Innovation, Leadership, Teamwork, Professional Readiness, Deployment Skills	PO3, PO9, PO10, PO11

PART III COMBINED MAPPINGS & REFERENCE *CO–PO Matrix, CO–PO Alignment, Bloom's Reference, Attendance & Pass/Fail*

10. CO–PO and CO–PSO Mapping Matrix

i Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	–	1	–	–	–	–	1	–	2	1	1
CO2	2	2	3	–	2	–	–	–	–	1	–	2	3	2
CO3	2	3	2	1	1	–	–	–	1	3	–	2	2	2
CO4	3	3	2	2	1	–	–	1	1	2	–	2	2	3
CO5	2	3	1	2	–	–	–	3	3	3	1	2	2	2
CO6	2	2	3	2	2	–	–	2	3	3	3	2	3	3
Avg	2.33	2.50	2.00	1.75	1.40	–	–	2.00	2.00	2.17	2.00	2.00	2.17	2.17

11. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	M							M		M		
CO2	M	M	H		M					M		M	H	M
CO3	M	H	M						M	H		M	M	M
CO4	H	H	M	M				M	M	M		M	M	H
CO5	M	H		M				H	H	H	M	M	M	M
CO6	M	M	H	M	M			M	H	H	H	M	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

12. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns, relationships, and causes L5 — Evaluate: Judge, justify, assess, compare alternatives, and make decisions L6 — Create: Design, develop, integrate, and produce innovative solutions	A1 — Receiving: Awareness and willingness to participate A2 — Responding: Active participation and engagement A3 — Valuing: Demonstrating commitment, responsibility, and appreciation of values A4 — Organizing: Integrating values into personal and professional behaviour A5 — Characterizing: Consistent demonstration of professional ethics, leadership, and lifelong learning attitudes	P1 — Perception: Use sensory cues to guide actions P2 — Set: Mental and physical readiness to perform tasks P3 — Guided Response: Perform tasks through guided practice and instruction P4 — Mechanism: Demonstrate proficiency through habitual and confident performance P5 — Complex Overt Response: Execute complex tasks with accuracy and efficiency P6 — Adaptation: Modify skills and approaches for new situations and challenges P7 — Origination: Create innovative methods, solutions, or products independently

ℹ OBE Compliance Statement: This is a practical course. All 6 COs span all three domains — Cognitive (L3–L6) as the primary domain, Psychomotor (P3–P6) for implementation and design skills, and Affective (A2–A4) for professional and collaborative conduct — reflecting the skill-based, hands-on nature of laboratory assessment.

13. Attendance Policy & Pass/Fail Criteria

13.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Lab / Practical Sessions	**75%**	All sessions	Debarred from ESE if below threshold

⚠ Minimum 75% attendance is mandatory in practical/activity sessions. Non-submission of self-learning tasks, coding activities, analytical exercises, or communication assignments directly impacts internal assessment and is not compensable through external examination performance.

13.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ESE Score	**≥ 16 / 40**	**MANDATORY**	40% of ESE marks required; failing ESE means failing the course regardless of CA + CE performance
Overall Total (CA + CE + ESE)	**≥ 40 / 100**	**Must pass overall**	CA 30 + CE 30 + ESE 40 = 100; 40% overall minimum required

_____ — COURSE PLAN — MEASUREMENT ARCHITECTURE
11 Programme Outcomes → 6 Lab COs (CO1–CO6) → 3 Assessment Instruments →
CO1–CO3: Apply/Analyse → LS1–LS3, LS6 → CA + CE + ESE
CO4–CO5: Analyse/Evaluate → LS3–LS5, LS7 → CA + ESE
CO6: Create → LS7–LS8 → CA + ESE Sec C
Marks: CA 30 + CE 30 + ESE 40 = Total 100

Semester 7, Credits: 15	
COURSE CODE	**COURSE NAME**
CSCR4600	Capstone - 1
CSCR4700	Summer Internship-II
	Program Elective-4
CSAI4200	Introduction to Natural Language Processing
CSDS4302	Healthcare Analytics
CSOT4200	Image Processing with IoT
CSCF4200	Cloud Security
	Program Elective-5
CSAI4201	Recommender Systems
CSDS4303	Applied Pattern Recognition
CSOT4204	Fog Computing and IoT
CSCF4202	Exploit Writing
	Program Elective-6
CSAI4202	Robotics and Intelligent Systems
CSDS4304	Applied Computer Vision
CSOT4206	IoT in Healthcare
CSCF4204	Digital Watermarking & Steganography
	Open Elective – 2

School: SET		**Batch: 2026-2030**	
Program: B.Tech.		**Current Academic Year: 2029-30**	
Branch: CSE		**Semester: VII**	
1	Course Code	**CSCR4600**	
2	Course Title	Major Project -1	
3	Credits	2	
4	Contact Hours (L-T-P-SL)	0-0-4-4	
	Course Status	Compulsory	
5	Course Objective	Project being the student's last activity at the institution, it fulfills a purpose of synthesis of all the knowledge they have acquired throughout the different years. In addition, this knowledge must be used in a particular way, in order to solve a specific problem, which lets student demonstrate their aptitude by applying this knowledge.	
6	Course Outcomes	Students will be able to: CO1: Identify problem statement in engineering and technology in selected field of interest. CO2: Analyze the gathered information required to develop a project. CO3: Apply prior knowledge of mathematics, computer science and engineering. CO4: Participate in different teams and to focus on getting a working project done on time with each student being held accountable for their part of the project. CO5: Prepare the designs requirements, functional and conceptual design. CO6: Initiate the actual implementation of the project work to produce the deliverables and explain the work in written and oral forms.	
7	Course Description	The object of Major Project-I is to enable the student to take up investigative study in the broad field of Computer Science & Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Problem identification, Literature survey/Gather & analyze information from multiple sources	CO1, CO2, CO4,
	Unit 2	Formulate solution/ Problem Description: Project Planning, Time and Cost Estimation and budgeting, Risk Management, Project scheduling and Planning Tools: Work Breakdown structure/ LRC/ Gantt charts/CPM/PERT Networks. Creating System Requirement Specifications (Functional & Non Functional)	CO1, CO2, CO3
	Unit 3	Preparing Design: Data Flow Diagrams & Flow Charts, Use of appropriate tools and techniques for project design	CO3, CO4
	Unit 4	Identify and Implement Project Modules.	CO4, CO5
	Unit 5	Use of appropriate tools/technologies for coding the modules	CO2, CO5, CO6
		Report on final problem statement, specifications, project schedule, final concept design and project schedule	

		Report and Presentation - Project Modules development		
	Mode of examination	Practical		
	Weight age Distribution	CA	CE(Viva)	ESE
		30%	30%	40%
	Text book/s*			
	Other References			

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Identify problem statement in engineering and technology in selected field of interest.	PO2, PO1, PSO1
2.	CO2: Analyze the gathered information required to develop a project.	PO2, PO4, PSO1, PO1, PO3, PO11, PSO2
3.	CO3: Apply prior knowledge of mathematics, computer science and engineering.	PO1, PSO1, PO2, PO3, PO5, PSO2
4.	CO4: Participate in different teams and to focus on getting a working project done on time with each student being held accountable for their part of the project.	PO9, PO10, PO11
5.	CO5: Prepare the designs requirements, functional and conceptual design.	PO3, PSO1, PO1, PO2, PO4, PO5, PSO2
6.	CO6: Initiate the actual implementation of the project work to produce the deliverables and explain the work in written and oral forms.	PO3, PO5, PO10, PSO1, PO1, PO2, PO4, PO9, PO11, PSO2

PO and PSO mapping with level of strength for Course Name Major Project -1 (Course Code CSP497)

COs \ POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	2	3	1	1	–	–	–	–	–	1	1	2	–	–
CO2	2	3	2	3	1	–	–	–	–	1	2	3	2	–
CO3	3	2	2	1	2	–	–	–	–	–	1	3	2	1
CO4	–	1	1	–	–	–	–	1	3	2	2	–	1	–
CO5	2	2	3	2	2	–	–	–	1	1	1	3	2	1
CO6	2	2	3	2	3	–	–	–	2	3	2	3	2	1
Avg.	2.2	2.2	2	1.8	2	-	-	1	2	1.6	1.5	2.8	1.8	1

Strength of Correlation: 21.9
1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

School: SET		**Batch: 2026-2030**		
Program: B Tech		**Current Academic Year: 2029-30**		
Branch: CSE		**Semester: VII**		
1	Course Code	CSCR4700		
2	Course Title	**Summer Internship-II**		
3	Credits	2		
4	Contact Hours (L-T-P-SL)	0-0-4-0		
	Course Status	UG		
5	Course Objective	1. Experience the activities and functions of business professionals. 2. Develop and refine oral and written communication skills. 3. Identify areas for future knowledge and skill development.		
6	Course Outcomes	Students will be able to: CO1. Integrate the concepts and strategies of academic study in a real time environment. CO2. Identify, formulate and model problems and find engineering solutions based on a systems approach. CO3. Develop teamwork and apply prior acquired knowledge in problem solving. CO4. Develop communication, interpersonal and other critical skills required for career growth. CO5. Practice engineer's responsibilities, self-understanding, self-discipline and ethical standards. CO6. Explore career alternatives prior to graduation.		
7	Course Description	An internship experience provides the student with an opportunity to explore career interests while applying knowledge and skills learned in the classroom in a work setting. The experience also helps students gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks.		
8	Outline syllabus			CO Mapping
	Unit 1	Define objectives and conditions for the internship, ensuring students that it is related to the study path carried out at the University		**CO1, CO2**
	Unit 2	Problem Definition and identification, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.		**CO2**
	Unit 3	The internship work plan is drawn up by developing team work and applies prior acquired knowledge in problem solving.		**CO3**
	Unit 4	Demonstrate and execute Project with the team. Submission of evaluation form and final report completed by the intern.		**CO4**
	Unit 5	Final evaluation form completed by the supervisor at the Host Organization and final presentation before departmental committee.		**CO5, CO6**
	Mode of examination	**Practical**		
		CA	CE (Viva)	ETE

	Weightage Distribution	30%	30%	40%
	Text book/s*	NA		
	Other References			

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1. Integrate the concepts and strategies of academic study in a real time environment.	PO1, PO2, PO9, PO10, PO11, PSO1
2.	CO2. Identify, formulate and model problems and find engineering solution based on a systems approach.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2
3.	CO3. Develop teamwork and apply prior acquired knowledge in problem solving.	PO2, PO3, PO9, PO10, PO11, PSO1
4.	CO4. Develop communication, interpersonal and other critical skills required for career growth.	PO9, PO10, PO11
5.	CO5. Practice engineer's responsibilities, self-understanding, self-discipline and ethical standards.	PO6, PO8, PO9, PO10, PO11
6.	CO6. Explore career alternatives prior to graduation.	PO10, PO11

PO and PSO mapping with level of strength for Course Name Summer Internship-II (CSP398)

COs \ POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	2	1	–	1	1	–	–	2	2	2	2	1	–
CO2	2	3	2	2	2	–	–	–	1	1	1	3	2	1
CO3	1	2	2	1	1	–	–	–	3	2	2	2	1	–
CO4	–	–	–	–	–	1	–	1	2	3	2	–	–	1
CO5	–	–	–	–	–	2	1	3	2	2	2	–	–	1
CO6	–	–	–	–	–	1	–	–	1	2	3	–	1	1
Avg PO attained	1.67	2.33	1.67	1.5	1.33	1.25	1	2	1.83	2	2	2.33	1.25	1

Strength of Correlation: 23.16
1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

Syllabus : CSAI4200, Introduction to Natural Language Processing

<table>
<tr><td colspan="2">School: SSCSE</td><td colspan="3">Batch: 2026-2030</td></tr>
<tr><td colspan="2">Program: B.Tech.</td><td colspan="3">Current Academic Year: 2025-26</td></tr>
<tr><td colspan="2">Branch: CSE (AIML)</td><td colspan="3">Semester: VII</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="3">CSAI4200</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="3">Introduction to Natural Language Processing</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="3">3</td></tr>
<tr><td>4</td><td>Contact Hours (L-T-P-SL)</td><td colspan="3">3-0-0-3</td></tr>
<tr><td></td><td>Course Status</td><td colspan="3">Specialization Elective</td></tr>
<tr><td>5</td><td>Course Objective</td><td colspan="3">Students will try to learn
1. Basics of natural language processing.
2. How to apply basic algorithms in natural language processing.
3. Algorithmic description of the main language levels morphology, syntax, semantics, and pragmatics.
4. Basics of knowledge representation, inference, and relations to the artificial intelligence.
5. Techniques such as tokenization, stemming, and lemmatization.</td></tr>
<tr><td>6</td><td>Course Outcomes</td><td colspan="3">Upon successful completion of the course, students will be able to:
CO-1. Define Computational Linguistics phenomena and making decisions using it.
CO-2. Explain how to access Text Corpora and Lexical Resources.
CO-3. Apply processing of raw text using NLP programming concepts.
CO-4. Analyze tagging of words and Extracting Information from Text.
CO-5. Discuss analysis of sentences using CFG and Propositional Logic.
CO-6. Design NLP based applications for different business environment.</td></tr>
<tr><td>7</td><td>Course Description</td><td colspan="3">This course provides an introduction to the field of computational linguistics, aka natural language processing (NLP). We will learn how to create systems that can understand and produce language, for applications such as information extraction, machine translation, automatic summarization, question-answering, and interactive dialogue systems. The course will cover linguistic (knowledge-based) and statistical approaches to language processing in the three major subfields of NLP: syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context).</td></tr>
<tr><td>8</td><td>Teaching and Learning Scheme (in Hours per Semester)</td><td colspan="3">
<table>
<tr><td colspan="2">Classroom Instructions (CI)</td><td>Lab Instructions (LI)</td><td>Team Work (TW) and Self Learning (SL) (TW+SL)</td><td>Total number of Hours</td><td>Total Credits TH/30</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SL</td><td>TH</td><td></td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>45</td><td>90</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>9</td><td colspan="3">Outline syllabus</td><td>CO Mapping</td></tr>
<tr><td></td><td>Unit 1</td><td colspan="2">Introduction and Computational Linguistics</td><td></td></tr>
</table>

	A	Natural Language Processing, hands-on demonstrations, Ambiguity and uncertainty in language, The Turing test	CO1
	B	Computing with Language Texts and Words Implementation of NLTK, Searching Text, Counting Vocabulary, A Closer Look at Python Texts as Lists of Words, Computing with Language Simple Statistics, Frequency Distributions, Fine-grained Selection of Words, Collocations and Bigrams,	CO1
	C	Making Decisions and Taking Control, Conditionals, Operating on Every Element, Nested Code Blocks, Looping with Conditions	CO1
	Unit 2	**Accessing Text Corpora and Lexical Resources**	
	A	Automatic Natural Language Understanding, Word Sense Disambiguation, Pronoun Resolution, Generating Language Output, Machine Translation, Spoken Dialog Systems, Textual Entailment, Limitations of NLP	CO2
	B	Accessing Text Corpora, Gutenberg Corpus, Web and Chat Text, Brown Corpus, Reuters Corpus, Inaugural Address Corpus, Annotated Text Corpora, Corpora in Other Languages	CO2
	C	Text Corpus Structure, Loading your own Corpus, Conditional Frequency Distributions, Conditions and Events, Counting Words by Genre, Plotting and Tabulating Distributions, Generating Text with Language Models	CO2
	Unit 3	**Processing Raw Text**	
	A	Lexical Resources, Word list Corpora, A Pronouncing Dictionary, Comparative Wordlists, Shoebox and Toolbox Lexicons, WordNet, Senses and Synonyms, The WordNet Hierarchy, Lexical Relations, Semantic Similarity	CO3
	B	Accessing Text from the Web and from Disk, Strings Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting From Lists to Strings	CO3
	C	NLP Programming Sequences, Style, Functions for text processing, Program Development & Algorithm Design using, Python Libraries	CO3
	Unit 4	**Tagging & Information Extraction**	
	A	Categorizing and Tagging Words Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, Determine the Category of a Word	CO4
	B	Text classification Supervised Classification, Examples of Supervised Classification, Evaluation, Text Classification using Scikit-learn (SVM, Logistic Regression) Classifiers, Maximum Entropy Classifiers, Modeling Linguistic Patterns	CO4
	C	Extracting Information from Text Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction	CO4
	Unit 5	**Analysis of sentences**	
	A	Analyzing Sentence Structure Grammatical Dilemmas, Use of Syntax, Sequence Models: RNNs and LSTMs for sentence classification, Dependencies and Dependency Grammar, Grammar Development	CO5
	B	Analyzing the Meaning of Sentences Natural Language Understanding, Propositional Logic, First-Order Logic, The Semantics of English Sentences, Discourse Semantics, Overview of sentence classification and semantic similarity using pre-trained transformer models.	CO5, CO6

	C	Managing Linguistic Data Corpus Structure, The Life Cycle of a Corpus, Acquiring Data, Working with XML, Working with Toolbox Data, Describing Language Resources Using OLAC Metadata	CO6

	List of activities for Self Learning (SL)	**S. No.**	**Name of the Activity**	**No. of Hours**	**Evaluation Criteria**
		1	Study and implementation of NLP basics including text preprocessing (tokenization, stemming, lemmatization), working with text corpora (NLTK), and lexical resources (WordNet) (Unit 1 & 2)	15	Concept understanding, correct implementation, practical demonstration
		2	Processing and analysis of raw text using Python: regular expressions, text normalization, corpus handling, and basic NLP programming tasks (Unit 3)	15	Code quality, correctness, application of techniques
		3	Mini Project: Design an NLP-based application (such as text classification, sentiment analysis, or information extraction) including tagging and evaluation (Unit 4 & 5)	15	Innovation, implementation, performance, report and presentation

	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		25%	15%	60%
	Text book/s*	1. Speech and Language processing An introduction to Natural Language Processing, Computational Linguistics and speech Recognition by Daniel Jurafsky and James H. Martin (ISBN13: 978-0131873216) 2. Ruslan Mitkov, The Oxford Handbook of Computational Linguistics, Oxford University Press, 2005		
	Other References	1. Charu C. Aggarwal and Cheng Xiang Zhai, Mining Text Data, Springer, 2012 2. Hopcroft, J.E. and Ullman, J.D., Introduction to Automata, Theory and Languages, Addison-Wesley, 1979		

PO and PSO mapping with level of strength for Course Name Natural Language Processing **(Course Code CSAI4200)**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
	Engineering Knowledge	**Problem Analysis**	**Design/Development of Solutions**	**Conduct Investigations of Complex Problems**	**Engineering Tool Usage**	**The Engineer and The World**	**Ethics**	**Individual and Collaborative Team work**	**Communication**	**Project Management and Finance**	**Life-Long Learning**	**Familiarity and practical proficiency**	**Understand, analyze and develop**	**Apply standard Software**
CO1	3	2	-	-	2	-	-	-	-	-	2	2	2	2
CO2	2	2	-	-	3	-	-	-	-	-	2	2	2	2
CO3	2	2	3	-	3	-	-	1	-	1	2	3	3	3
CO4	2	3	-	-	3	-	-	-	-	-	2	1	1	1

CO5	2	3	-	-	1	-	-	-	-	-	1	1	1	1
CO6	3	3	3	3	3	2	-	3	-	2	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	**PO1** Engineering Knowledge	**PO2** Problem Analysis	**PO3** Design/Development of Solutions	**PO4** Conduct Investigations of Complex Problems	**PO5** Engineering Tool Usage	**PO6** The Engineer and The World	**PO7** Ethics	**PO8** Individual and Collaborative Team work	**PO9** Communication	**PO10** Project Management and Finance	**PO11** Life-Long Learning	**PSO1** Familiarity and practical proficiency	**PSO2** Understand, analyze and develop	**PSO3** Apply standard Software
CSAI4200/ Natural Language Processing	2.33	2.50	3.00	3.00	2.50	2.00	-	2.00	-	1.50	2.00	2.00	2.00	2.00

Strength of Correlation

1. Addressed to **Slight (Low=1) extent**
2. Addressed to **Moderate (Medium=2) extent**
3. Addressed to **Substantial (High=3) extent**

Course-to-SDG Matrix

The course CSAI4200 – Introduction to Natural Language Processing aligns with multiple Sustainable Development Goals by promoting advanced computational skills and real-world problem solving. It strongly supports SDG 4 (Quality Education) through comprehensive learning of NLP concepts, tools, and hands-on applications, and SDG 9 (Industry, Innovation and Infrastructure) by enabling students to develop intelligent systems such as text processing, dialogue systems, and deep learning models. The course also contributes to SDG 8 (Decent Work and Economic Growth) by enhancing employability and industry-relevant skills in AI and data processing. Additionally, it supports SDG 10 (Reduced Inequalities) through applications like machine translation and accessible language technologies, and SDG 16 (Peace, Justice and Strong Institutions) by equipping students with techniques for information extraction and ethical handling of textual data. Overall, the course fosters innovation, inclusivity, and responsible AI development aligned with global sustainability goals.

Mapping uses a 3-point scale:

- Addressed to ***Substantial (High=3) extent***: Core content directly contributes
- Addressed to ***Moderate (Medium=2) extent***: Supports through skills/activities
- Addressed to ***Slight (Low=1) extent***: Indirect awareness/benefit

SDG Goal	Description	Mapping Strength	Justification
SDG 4	Quality Education	3 (High)	The course develops strong foundational and advanced knowledge in NLP, enhancing technical skills and promoting quality education in AI-driven technologies.
SDG 8	Decent Work and Economic Growth	3 (High)	Students gain industry-relevant NLP and AI skills, improving employability and supporting innovation and economic growth.
SDG 9	Industry, Innovation and Infrastructure	3 (High)	The course enables development of intelligent NLP systems such as chatbots, text processing tools, and automation solutions supporting innovation.
SDG 16	Peace, Justice and Strong Institutions	2 (Moderate)	NLP techniques are used for responsible information extraction and ethical AI practices, supporting transparency and informed decision-making.

Total Mapped SDGs: 4 out of 17.

COURSE PLAN

Health Care Analytics (CSDS4302)
School of Computing Science & Engineering (SSCSE) | B.Tech CSE with Specialization in DSA | Semester VI | Batch 2025–2029
Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I
COURSE SYLLABUS
Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	Batch:	2025–2029
Program:	B.Tech	Current Academic Year:	2026–27
Branch:	CSE with Specialization in DSA	Semester:	VI

2. Course Details

★ Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) — Course CSDS4200, via CA + ETE; Lab COs (CO7–CO10) — Course CSDS4301, via Laboratory Assessment (CA + CE Viva + ETE). No cross-evaluation.

S.No	Attribute	Details
1	Course Code	CSDS4200 (Theory) / CSDS4301 (Lab)
2	Course Title	Health Care Analytics (Theory + Lab)
3	Credits	3 (2 Theory + 1 Lab)
4	Contact Hours (L-T-P-SL)	2-0-2-2
5	Course Status	Minor-Elective
6	Course Objective	This course introduces healthcare-analysis concepts and methods for students with little prior data-analytics experience. Topics include the creation and structure of datasets, data warehousing, working with large healthcare databases, public-health and healthcare datasets, descriptive analytics, and predictive analytics. Students gain skills in data manipulation for program evaluation and analysis, understand how data analysis improves healthcare systems, and learn tools, activities and methods for developing, reporting, and analyzing data for the improvement of healthcare organizations.

7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via CA + ETE (Course CSDS4200):** CO1 (Remember – L1): Define the role of data analytics in healthcare quality and performance-improvement efforts. CO2 (Understand – L2): Explain the tools and techniques used for data analytics in healthcare organizations. CO3 (Apply – L3): Identify techniques to communicate insights gained from healthcare data analysis. CO4 (Analyze – L4): Analyse the potential of, and challenges to, incorporating big data analytics to improve the development and testing of precision medicine / nursing interventions. CO5 (Evaluate – L5): Demonstrate and evaluate the knowledge of health data and the tools of big-data analysis used in health-related research. CO6 (Create – L6): Adapt the basics and learnings available to build the relationship of healthcare and data analytics in production and operational systems for data intelligence. **LAB COs — Assessed via Laboratory Assessment only (Course CSDS4301):** CO7 (Apply – L3): Acquire, prepare and structure healthcare data from diverse sources and formats for predictive modeling, including patient selection, sample sizing and object detection in modality images. CO8 (Apply – L3): Implement feature segmentation, feature selection, dimensionality reduction and pre-processing/transformation of biomedical and sensor data. CO9 (Analyze – L4): Model and denoise time-series and biomedical signals (ECG, multivariate signals) and analyze chronic-disease/wellness data using statistical and machine-learning techniques. CO10 (Evaluate/Create – L5/L6): Design, implement and evaluate knowledge-based and non-knowledge-based Clinical Decision Support Systems (CDSS), and execute a mini project applying healthcare analytics end-to-end.
8	Teaching & Learning	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 30 hrs = 90 hrs
9	Mode of Examination	Theory (CSDS4200, 100 marks): CA 25% + ETE 75%. Lab (CSDS4301, 100 marks): CA 30% + CE (Viva) 30% + ETE 40%. Theory COs (CO1–CO6): Theory CA + ETE only. Lab COs (CO7–CO10): Lab CA + CE + ETE only. No cross-evaluation.
10	Self Learning (SL: 30 hrs)	• Practice descriptive and predictive analytics problems on sample healthcare datasets. Perform Healthcare Analytics / Data Science virtual labs (NPTEL / Virtual Labs) on data quality, visualization, and predictive modeling. Complete a MOOC/NPTEL/SWAYAM course on Healthcare Analytics, Health Informatics or Biomedical Data Science.
11	References	**Text Book** Trevor L. Strome (2013). Healthcare Analytics for Quality and Performance Improvement. John Wiley & Sons, Inc. Chandan K. Reddy and Charu C. Aggarwal, Healthcare Data Analytics, CRC Press ©2015. **Reference Books** Big Data Analytics in Healthcare, edited by Anand J. Kulkarni, Patrick Siarry, Pramod Kumar Singh, Ajith Abraham, Mengjie Zhang, Albert Zomaya, Fazle Baki. Health Care Information Systems: A Practical Approach for Health Care Management, by Karen A. Wager, Frances W. Lee, John P. Glaser. Statistics & Data Analytics for Health Data Management, by Nadinia A. Davis, Betsy J. Shiland.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).

	Topic / Activity	CO Mapping
Unit 1	Introduction to Quality Improvement and Data Analytics for Healthcare	
A	Toward Healthcare Improvement Using Analytics, Healthcare Transformation — Challenges and Opportunities, Current State of Healthcare Costs and Quality.	CO1, CO2
B	Leveraging Information for Healthcare Improvement, Analytics Knowledge Gap, Beginning the Analytics Journey in Healthcare.	CO1, CO2
C	Fundamentals of Healthcare Analytics, How Analytics Can Improve Decision Making, Analytics, Quality, and Performance, Applications and Components of Healthcare Analytics.	CO1, CO2
Tools Used	MS Excel, Python (pandas, NumPy), Sample Public-Health/Healthcare Datasets, Whiteboards, NPTEL Virtual Labs	
Activities	Objective: To understand healthcare-analytics fundamentals, the analytics journey, and how analytics improves decision making in healthcare. Study of healthcare analytics fundamentals and the healthcare-improvement lifecycle. Comparison of analytics knowledge gaps across healthcare organizations. Demonstration of components of healthcare analytics- Descriptive, diagnostic, predictive and prescriptive analytics. Case discussion on real-world healthcare quality/cost datasets. Practical exposure using sample healthcare datasets- Loading, inspecting and profiling healthcare datasets in Python/Excel. Group discussion on analytics-driven healthcare improvement case studies.	
Unit 2	Healthcare Strategies, Quality and Governance	
A	Purpose of Analytics Strategy, Analytics and Business Intelligence, Strategic Development versus Development by Aggregation.	CO1, CO3
B	Analytics Strategy Framework with a Focus on Quality/Performance Improvement, Strategies for Working Well with Stakeholders.	CO1, CO4
C	Data Quality, Management, and Governance; Developing an Analytics Strategy; Defining Healthcare Quality and Value; Components of Healthcare Quality Measurement.	CO3, CO4
Tools Used	MS Excel, Power BI/Tableau, Data-Governance Checklists, Whiteboards, Virtual Labs	
Activities	Objective: To understand analytics strategy, business intelligence, stakeholder alignment, and data quality/governance in healthcare.	

	Study of analytics-strategy frameworks and business-intelligence concepts. Comparison of strategic development versus development by aggregation. Demonstration of data-governance and data-quality checks- Completeness, accuracy, consistency and timeliness dimensions. Working and applications of quality/performance-improvement strategy frameworks. Practical exposure using stakeholder and quality-measurement case studies- Mapping healthcare-quality components to measurable indicators. Strategy-framework simulation using sample healthcare-organization scenarios.	
Unit 3	Working with Healthcare Data	
A	Data: The Raw Material of Analytics; Preparing Data for Analytics; Types of Data (Categorical, Ordinal, Interval and Ratio); Levels of Measurement; Summarizing Data Effectively.	CO3, CO4
B	The Need for Effective Data Management, Data Quality, Data Governance and Management, Data Stewardship, Enterprise-wide Visibility and Opportunity.	
C	Overview of Healthcare QI, Common QI Frameworks in Healthcare, Six Sigma DMAIC Process and Methodology, Data Quality and Governance.	
Tools Used	Python (pandas, NumPy, scikit-learn), MS Excel, Six Sigma DMAIC Templates, Virtual Labs	
Activities	Objective: To prepare, summarize and manage healthcare data, and apply QI frameworks such as Six Sigma DMAIC. Classification of healthcare data by type and level of measurement. Descriptive summarization of healthcare datasets: mean, median, variance and distribution. Demonstration of data stewardship and enterprise data-visibility practices- Data cleaning, missing-value handling and outlier detection. Application of the Six Sigma DMAIC process to a healthcare QI scenario. Practical exposure using healthcare datasets- Data preparation and summarization exercises in Python/Excel. Case study on data governance and management in a hospital/clinic setting.	
Unit 4	Effective Indicators and Methods in Healthcare	
A	Measures, Metrics, and Indicators; Key Performance Indicators; Using Indicators to Guide Healthcare Improvement Activities; Leveraging Analytics in Quality Improvement Activities.	CO4, CO5
B	Moving from Analytics Insight to Healthcare Improvement; Analytics in the Problem Definition Stage; Using Analytics to Identify Improvement Opportunities; Analytics in the Project Execution Phase.	

C	Using Analytics to Evaluate Outcomes and Maintain Sustainability; Basic Statistical Methods and Control-Chart Principles; Statistical and Graphical Methods for Detecting Changes in Quality/Performance.	
Tools Used	MS Excel (Control Charts), Python (matplotlib, SciPy), KPI Dashboards, Virtual Labs	
Activities	Objective: To define KPIs and apply statistical/graphical methods to detect and evaluate changes in healthcare quality/performance. Identification of measures, metrics and KPIs for a healthcare improvement activity. Construction of control charts to monitor process performance. Demonstration of statistical methods for detecting changes in quality- Run charts, control limits and special-cause variation. Application of analytics across problem-definition, execution and evaluation stages. Practical exposure using KPI datasets- KPI-dashboard creation in Excel/Power BI. Sustainability evaluation of a simulated quality-improvement project.	
Unit 5	Visualization and Advanced Analytics in Healthcare	
A	Presentation and Visualization of Information; Data Visualization for Quality and Performance Improvement; Agents and Alerts; Accessibility and Usability of Analytics Systems.	CO6
B	Overview and Applications of Advanced Analytics; Enablers of Predictive Analytics in Healthcare (Methods, Data and System); Developing, Testing and Deploying Advanced Analytics Models.	
C	Determining Requirements of the Healthcare Organization; Preparing Health Data; Overview of Predictive Algorithms (Regression, Machine Learning, Pattern Recognition); Analytical Team Challenges and Requirements.	
Tools Used	Python (scikit-learn), Power BI/Tableau, Regression & ML Toolkits, Virtual Labs	
Activities	Objective: To visualize healthcare data effectively and apply predictive-analytics models (regression, ML, pattern recognition) for healthcare decision support. Design of dashboards and visualizations for quality/performance improvement. Demonstration of alerting/agent-based monitoring concepts. Implementation of basic regression and machine-learning models on healthcare data- Linear/logistic regression and classification for patient-outcome prediction. Model deployment considerations and analytical team requirements. Practical exposure using predictive-analytics tools- End-to-end predictive model build and evaluation in Python. Presentation of visualization and predictive-analytics mini case study.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B	✓	✓				

3	1.C	✓	✓				
4	2.A	✓		✓			
5	2.B	✓			✓		
6	2.C			✓	✓		
7	3.A		✓	✓	✓		
8	3.B			✓	✓		
9	3.C			✓	✓		
10	4.A				✓	✓	
11	4.B				✓	✓	
12	4.C				✓	✓	
13	5.A					✓	✓
14	5.B					✓	✓
15	5.C						✓

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓						✓											
CO2		✓						✓										
CO3			✓						✓									
CO4				✓						✓								
CO5					✓						✓							
CO6						✓					✓							
CO7			✓					✓	✓			✓	✓	✓				
CO8			✓	✓					✓	✓				✓	✓	✓		
CO9				✓	✓				✓	✓	✓				✓	✓	✓	
CO10					✓	✓				✓	✓					✓	✓	✓

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to healthcare analytics: transformation, challenges and opportunities	Unit 1	6
DD/MM/YY	Current state of healthcare costs and quality		
DD/MM/YY	Leveraging information for healthcare improvement; analytics knowledge gap		
DD/MM/YY	Beginning the analytics journey in healthcare		
DD/MM/YY	Fundamentals of healthcare analytics and decision making		
DD/MM/YY	Applications and components of healthcare analytics		
DD/MM/YY	Purpose of analytics strategy; analytics and business intelligence	Unit 2	6
DD/MM/YY	Strategic development versus development by aggregation		
DD/MM/YY	Analytics strategy framework for quality/performance improvement		
DD/MM/YY	Strategies for working well with stakeholders		
DD/MM/YY	Data quality, management and governance		
DD/MM/YY	Defining healthcare quality, value and quality-measurement components		
DD/MM/YY	Data: the raw material of analytics; preparing data for analytics	Unit 3	6
DD/MM/YY	Types of data and levels of measurement		
DD/MM/YY	Getting started with analyzing and summarizing healthcare data		
DD/MM/YY	The need for effective data management; data stewardship		
DD/MM/YY	Overview of healthcare QI and common QI frameworks		
DD/MM/YY	Six Sigma DMAIC process, methodology, data quality and governance		
DD/MM/YY	Measures, metrics and indicators; key performance indicators	Unit 4	6
DD/MM/YY	Using indicators to guide healthcare improvement activities		
DD/MM/YY	Leveraging analytics in quality-improvement activities		
DD/MM/YY	Moving from analytics insight to healthcare improvement		

DD/MM/YY	Analytics in problem-definition and project-execution stages		
DD/MM/YY	Basic statistical methods and control-chart principles		
DD/MM/YY	Statistical and graphical methods for detecting changes in quality/performance	Unit 5	6
DD/MM/YY	Presentation and visualization of information		
DD/MM/YY	Data visualization for quality and performance improvement		
DD/MM/YY	Agents, alerts, accessibility and usability of analytics systems		
DD/MM/YY	Overview and applications of advanced/predictive analytics		
DD/MM/YY	Predictive algorithms (regression, ML, pattern recognition); analytical team requirements; revision		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

🔬 W1–W9: Experiments develop CO7 skills (data acquisition, preparation, professional implementation and documentation). W10–W12 (teal rows): CO8 (feature engineering/design). W13–W14: CO9 (signal analysis/ethics-reflection). W14 also introduces CO10 (CDSS/teamwork/presentation via mini project). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	To acquire healthcare data from various sources and formats: instrument-specific data formats (.doc, .xml), schema description data (e.g. XML), and flexible formats.	CO7	2.0
W2	S-2.1	To prepare data for predictive modeling: understanding retrospective and prospective data, and patient selection.	CO7	2.0
W3	S-3.1	To prepare a sample size: potential predictor variables and sample-size selection (avoiding overfitting).	CO7	2.0
W4	S-4.1	To apply various data-driven object-detection methods on chosen modality images.	CO7	2.0
W5	S-5.1	To implement feature segmentation in images using clustering.	CO8	2.0
W6	S-6.1	To implement feature selection and dimensionality reduction on the chosen modality image.	CO8	2.0
W7	S-7.1	Pre-processing and transformation of sensor data from distributed sources (linear e.g. Fourier/Wavelet Transform, and nonlinear transformations).	CO8	2.0
W8	S-8.1	Modelling of time-series sensor data in real time (discrete state-estimation approaches such as dynamic Bayesian networks/HMMs; continuous approaches such as Kalman filters/RNNs).	CO8	2.0
W9	S-9.1	Chronic disease and wellness data management in home environments.	CO8	2.0
W10	S-10.1	Denoising of ECG (single/multichannel) signals: PCA, Wavelet, Wavelet-Wiener, Pilot Estimation Method.	CO9	2.0

W11	S-11.1	Multivariate biomedical signal analysis: non-Gaussianity through Kurtosis (FastICA), through Negentropy (Infomax), and Joint Approximate Diagonalization of Eigenmatrices (JADE).	CO9	2.0
W12	S-12.1	Recent trends in biomedical signal analysis — literature review, case study and reflection report.	CO9	2.0
W13	S-13.1	Knowledge-based CDSS: inference engine and knowledge base — design and implementation.	CO9/CO10	2.0
W14	S-14.1	Non-knowledge-based CDSS: ANN and GA — implementation, team-based mini project demonstration and presentation.	CO10	2.0

ℹ Instructions: Use Python (pandas, NumPy, scikit-learn, SciPy) and/or R for data preparation, feature engineering, signal processing and predictive modeling; maintain a lab record with code, outputs and result interpretation for every session.

PART II
THEORY ASSESSMENT FRAMEWORK
Theory Skill Dimensions, CA & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 THEORY COs (CO1–CO6) — Assessed exclusively via CA and ETE only (Course CSDS4200)

★ Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of CA and ETE, providing a clear NBA-auditable assessment rationale.

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Basic Healthcare-Analytics Concepts & Terminology	Recall basic healthcare-analytics concepts, the analytics journey, healthcare transformation, and terminology used across healthcare organizations.	CO1 | L1	CA | ETE Sec A
TS2	Understanding of Analytics Strategy & Tools	Explain analytics strategy, business intelligence, and the tools/techniques used for data analytics in healthcare organizations.	CO2 | L2	CA | ETE Sec A
TS3	Communication of Healthcare Data Insights	Identify and apply techniques to prepare, summarize and communicate insights gained from healthcare data analysis.	CO3 | L3	ETE Sec B
TS4	Analysis of Big-Data & Indicator-Based Methods	Analyze the potential of, and challenges to, incorporating big-data analytics, KPIs and statistical methods into healthcare improvement.	CO4 | L4	ETE Sec B
TS5	Evaluation of Health Data & Advanced-Analytics Tools	Demonstrate and evaluate the knowledge of health data and the tools of big-data analysis used in health-related research and visualization.	CO5 | L5	ETE Sec B/C
TS6	Adaptation to Production & Operational Data Intelligence	Adapt analytics fundamentals to build the relationship of healthcare and data analytics in production and operational systems for data intelligence.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO3 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	15	TS1 — Basic Healthcare-Analytics Concepts & Terminology / TS2 — Understanding of Analytics Strategy & Tools	CO1, CO2	Short-answer questions: definitions, analytics-journey concepts, strategy/BI fundamentals, and healthcare-transformation concepts
Sec B	10	TS3 — Communication of Healthcare Data Insights	CO3	Short-answer/analytical questions: data-summarization techniques, data types, levels of measurement, and communication of insights
TOTAL	25	TS1–TS3	CO1–CO3	Units 1–3 covered; CO4, CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	25	TS1 — Basic Healthcare-Analytics Concepts & Terminology / TS2 — Understanding of Analytics Strategy & Tools	CO1, CO2	Short questions: healthcare-analytics fundamentals, analytics strategy, business intelligence, stakeholder engagement and data-governance concepts
Sec B	25	TS3 — Communication of Healthcare Data Insights / TS4 — Analysis of Big-Data & Indicator-Based Methods	CO3, CO4	Medium questions: data preparation, summarization, QI frameworks (Six Sigma DMAIC), KPIs, control charts, and big-data analytics challenges
Sec C	25	TS5 — Evaluation of Health Data & Advanced-Analytics Tools / TS6 — Adaptation to Production & Operational Data Intelligence	CO5, CO6	Long-answer/design questions: data visualization, advanced/predictive analytics, regression and ML models, and analytics in production/operational systems
TOTAL	75	TS1–TS6 (all)	CO1–CO6	Theory ETE weightage 75%. Combined with CA (25%) for Theory (CSDS4200) total of 100.

PART III
LABORATORY ASSESSMENT FRAMEWORK
Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed
Theory — Continuous Assessment (CA)	25% of Theory	25	Theory COs: CO1–CO6 (CSDS4200)
Theory — End Semester Examination (ETE)	75% of Theory	75	Theory COs: CO1–CO6 (CSDS4200)
Lab — Continuous Assessment (CA)	30% of Lab	30	Lab COs: CO7–CO10 (CSDS4301)
Lab — Comprehensive Evaluation (CE / Viva)	30% of Lab	30	Lab COs: CO7–CO10 (CSDS4301)
Lab — End Term Examination (ETE)	40% of Lab	40	Lab COs: CO7–CO10 (CSDS4301)
TOTAL	Theory /100 + Lab /100	3 Credits	Independently evaluated (2:1 credit-weighted); no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + CE Viva + ETE, Course CSDS4301)

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 14	20	2.0 marks each — assesses CO7, CO8 and CO9 through data preparation, implementation, analysis and documentation
Mini Project (CA)	1 Project	10	Healthcare-analytics/CDSS mini project — assesses all Lab COs (CO7–CO10) through design, implementation, demonstration and presentation
CE (Viva-Voce)	1 Viva	30	Comprehensive viva-voce assessing conceptual understanding across all Lab COs (CO7–CO10)
ETE (Practical Examination)	1 Exam	40	End-term practical examination assessing CO7–CO10 end-to-end
TOTAL	—	100	Laboratory Assessment (Course CSDS4301)

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO

Problem Understanding & Data/Tool Setup	0.5	CA1 — Understanding of the healthcare-analytics problem and objectives CA2 — Tool/environment configuration and dataset setup CA7 — Planning of solution/algorithm approach	0.5: Proper understanding and correct setup | 0.25: Partial understanding/setup | 0: Incorrect or missing	CO7, CO8
Implementation & Execution	0.75	CA3 — Correct execution of code/model/pipeline CA4 — Efficient implementation and troubleshooting using analytics tools	0.75: Correct execution with proper results | 0.5: Partially correct execution | 0: Failed execution	CO7, CO8
Result Analysis & Lab Documentation	0.5	CA5 — Analysis and interpretation of outputs/results CA6 — Proper documentation and verification of results CA8 — Lab record completion and viva understanding	0.5: Complete analysis and documentation | 0.25: Adequate/partial | 0: Absent	CO8, CO9
Professional Conduct & Ethical Practices	0.25	CA9-style Responsible use of healthcare data and documentation ethics; professional behaviour during lab sessions	0.25: Consistent and professional | 0.10: Occasional compliance | 0: Absent	CO9
Total	2.0	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	20 Marks	x lowest experiment scores are dropped
10	All 10	20 Marks	No score dropped
< 10	All Conducted	≤ 20 Marks	Missing experiments treated as zero (deficit = zero)

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	1.5	P1 — SDG mapping and societal relevance of the healthcare-analytics application P2 — Problem scope, data requirements and measurable objectives P4 — Suitable analytics/CDSS solution with possible alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO10 / PO3, PO6
Project Planning & Resource Utilization	1.5	P2 — Timeline, milestones and implementation planning P11 — Effective use of datasets, analytics tools and lab resources	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & Model Testing	2.0	P5 — Appropriate analytics/ML tool selection P6 — Complete implementation and integration of data pipeline, model or CDSS P7 — Testing, troubleshooting and verification of outputs	2: Fully functional | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5

Result Analysis & Technical Documentation	2.0	P8 — Analysis of outputs/results against objectives P9 — Comparative analysis, visualizations/logs and technical report preparation	2: Thorough | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO4, PO6
Communication, Presentation & Teamwork	2.0	P3 — Demonstration planning and communication strategy P10 — Professional presentation, viva performance and teamwork	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Conduct	1.0	P12 — Reflection on learning and skill development P13 — Ethical practices, responsible data usage and professional conduct	1.0: Reflective & professional | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	10	All 13 Project Skill Dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	Healthcare-Data Problem Understanding & Setup Planning	Understand the healthcare-analytics problem; identify required datasets, tools, and expected outcomes.	CO7, CO8
CA2	Experimental Design & Tool Configuration	Plan experiments and configure analytics/ML tools such as Python (pandas, scikit-learn), R, or signal-processing toolkits.	CO7, CO9
CA3	Implementation, Configuration & Execution	Correctly configure data pipelines, implement algorithms/models and execute analyses to obtain expected outputs.	CO7, CO8
CA4	Troubleshooting, Testing & Performance Analysis	Troubleshoot data/model errors; analyze predictive-model and signal-processing performance.	CO7, CO8
CA5	Output Analysis & Result Interpretation	Analyze outputs, model performance, signal/denoising results and CDSS outcomes logically.	CO8, CO10
CA6	Documentation & Result Verification	Maintain proper lab records, plots/logs and verify outputs against experiment objectives.	CO7, CO8, CO9
CA7	Algorithm & Model Design	Develop feature-engineering logic, model architecture, or CDSS design before execution; justify approach.	CO8, CO9, CO10
CA8	Lab Record Maintenance, Viva & Professional Practice	Maintain complete lab records and demonstrate conceptual understanding, analytics knowledge and professional conduct during viva.	CO7, CO9, CO10

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

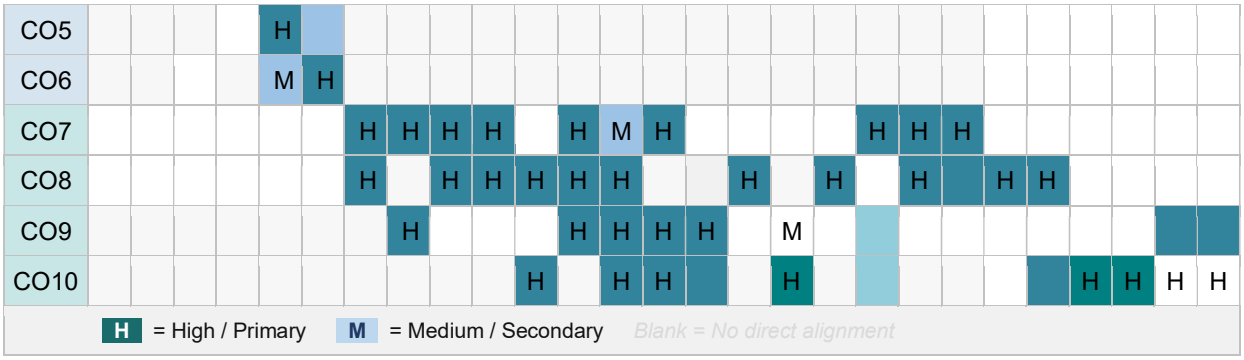
ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Relate the healthcare-analytics project to societal needs, public-health outcomes or clinical decision support applications.	CO10 | PO6

P2	Problem Scoping & Data Requirements	Define project scope, data requirements, and measurable objectives clearly.	CO8 | PO2
P3	Communication & Testing Strategy	Plan team communication, testing procedures, validation and task coordination.	CO10 | PO9
P4	Analytics/CDSS Solution Design	Propose a suitable analytics, predictive-modeling or CDSS solution with alternatives and justification.	CO8 | PO3
P5	Professional Toolchain & Resource Usage	Select and use appropriate analytics/ML/signal-processing tools and configure the project environment properly.	CO7 | PO5
P6	End-to-End Implementation	Develop and integrate a complete healthcare-analytics solution using multiple syllabus concepts and tools.	CO7, CO8 | PO3
P7	System Testing & Troubleshooting	Execute testing, troubleshoot errors and verify correct working of the data pipeline/model/CDSS.	CO7, CO8 | PO5
P8	Result Evaluation & Performance Analysis	Evaluate outputs against objectives and analyze model/analytics performance using observations/metrics.	CO8 | PO6
P9	Technical Analysis & Documentation	Perform comparative analysis, maintain visualizations/logs and prepare structured technical documentation/report.	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver project presentation/demo professionally and demonstrate teamwork and task sharing.	CO10 | PO8, PO9
P11	Project Planning & Resource Management	Plan implementation stages, manage available datasets/software resources and justify tool utilization.	CO10 | PO10
P12	Skill Development & Learning Reflection	Reflect on learning outcomes, analytics skills gained and individual contribution to the project.	CO9 | PO11
P13	Professional Ethics & Responsible Practice	Demonstrate ethical conduct, originality, responsible use of healthcare data and proper documentation practices.	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ Theory COs (CO1–CO6) are fully mapped to TS1–TS6. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1	TS2	TS3	TS4	TS5	TS6	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	P1	P2	P3	P4	P5	P6	P7	P8 I	P9	P10	P11	P12	P13
CO1	H																										
CO2	M	H																									
CO3			H																								
CO4			M	H																							



PART IV
COMBINED MAPPINGS & REFERENCE
CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	–	2	3	1	2	–	–	–	–	–	1	2	1	–
CO2	2	–	3	–	1	–	3	2	–	–	1	2	3	–
CO3	–	–	–	–	–	–	–	–	3	3	1	3	3	–
CO4	–	2	–	3	2	–	–	2	3	3	1	3	3	–
CO5	2	2	–	3	–	–	–	–	3	3	1	3	3	–
CO6	2	2	3	2	3	–	–	2	3	3	2	3	3	–
CO7	–	1	2	1	3	–	–	–	–	–	1	2	3	2
CO8	–	2	3	2	2	2	–	–	–	–	1	2	3	3
CO9	–	1	2	2	3	1	3	–	1	–	3	2	3	3
CO10	–	2	3	2	2	2	2	2	2	1	2	2	3	3
Avg	2.00	1.75	2.71	2.00	2.25	1.67	2.67	2.00	2.50	2.60	1.40	2.40	2.80	2.75

★ PO7 (Ethics) receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1		M	H	M	M						M

CO2	M		H		M		H	M			M
CO3									H	H	M
CO4		M		H	M			M	H	H	M
CO5	M	M		H					H	H	M
CO6	M	M	H	M	H			M	H	H	M
CO7		M	M	M	H						M
CO8		M	H	M	M	M					M
CO9		M	M	M	H	M	H		M		H
CO10		M	H	M	M	M	M	M	M	M	M

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 3	Good Health & Well-Being	3 (High)	Develops analytics capabilities that directly support healthcare quality, patient outcomes, predictive modeling and clinical decision support (CO1–CO6, CO9, CO10).
SDG 4	Quality Education	3 (High)	Builds strong understanding of healthcare-analytics fundamentals, data-driven decision making and lifelong analytical skills (CO1–CO6, CO9).
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Supports development of predictive models, CDSS and data-driven healthcare-improvement infrastructure through practical implementation (CO7–CO10).
SDG 17	Partnerships for the Goals	2 (Moderate)	Encourages collaborative, ethical use of healthcare data and stakeholder engagement across analytics teams and organizations (CO6, CO9, CO10).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (Theory, scaled)	≥ 30 / 75	MANDATORY	40% of Theory ETE; equivalent to ≥ 40/100 on the full Theory paper
Overall Total (Theory + Lab, credit-weighted)	≥ 40 / 100 each	Must pass both	Theory: CA 25 + ETE 75 = 100. Lab: CA 30 + CE 30 + ETE 40 = 100. 40% minimum required in each.

HEALTH CARE ANALYTICS INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (CSDS4200, CA + ETE): PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO11 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (CSDS4301, Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Theory 100 (CA 25 + ETE 75) + Lab 100 (CA 30 [Experiments 20 + Mini Project 10] + CE 30 + ETE 40) = 3 Credits Total

Health Care Analytics Theory & Lab Syllabus Summary

Unit 1: Introduction to Quality Improvement and Data Analytics for Healthcare
Unit 2: Healthcare Strategies, Quality and Governance
Unit 3: Working with Healthcare Data
Unit 4: Effective Indicators and Methods in Healthcare
Unit 5: Visualization and Advanced Analytics in Healthcare

Laboratory Experiments

- Healthcare data acquisition from multiple sources and formats
- Predictive-modeling data preparation: patient selection & sampling
- Object detection and feature segmentation on modality images
- Feature selection and dimensionality reduction
- Sensor-data pre-processing, transformation and time-series modelling
- ECG/biomedical signal denoising and multivariate signal analysis
- Knowledge-based and non-knowledge-based CDSS mini project

School: SSCSE		**Batch: 2026-2030**	
Program: B. Tech.		**Current Academic Year: 2029-30**	
Branch: B.Tech.(CSE) with Specialization in AIOT		**Semester: VII**	
1	Course Code	CSOT4200	Course Name: Image Processing with IoT
2	Course Title	Image Processing with IoT	
3	Credits	2	
4	Contact Hours (L-T-P-SL)	2-0-0-2	
	Course Status	Elective	
5	Course Objective	The objective of this course is to explore multiple techniques, frameworks, and libraries for capturing, processing, and displaying digital images.	
6	Course Outcomes	CO1: Recall the list the basic components of Raspberry Pi CO2: Illustrate the concept of image processing using IoT platform CO3: Make use of different basic operations on Images CO4: Assess the different advance operations on Images CO5: Apply the transformations and filter methods on images CO6: Design and develop image processing applications using Raspberry Pi	
7	Course Description	The course describes the concept of image processing with the help of Python and Raspberry Pi. This course covers an interactive GUI for the image processing demos using Tkinter, scipy.misc and scipy.ndimage etc to process images.	

8	Teaching and Learning Scheme (in Hours per Semester)								
		Classroom Instructions (CI)		Lab Instructions (LI)	Team Work (TW) and Self Learning (SL) (TW+SL)	Total number of Hours	Total Credits TH/30		
		L	T	P	SL	TH			
		30	0	0	30	60	2		

9	**Outline syllabus**		CO Mapping
	Unit 1	**Introduction to Raspberry Pi & Python**	
	A	The Raspberry Pi, Raspberry Pi Setup, The Raspbian OS	CO1
	B	Connecting the Raspberry Pi to a Network and to the Internet, Updating the Pi, Shutting Down and Restarting Pi	
	C	Features of Python, Running a Python Program and Python Modes, IDEs for Python	
	Unit 2	**Introduction to Digital Image Processing**	
	A	Signal Processing, Image Processing, Using IoT Platform and Python for Digital Image Processing (DIP)	CO1, CO2
	B	Image Sources: Using the Webcam and The Pi Camera Module	
	C	Working with Images, Build in Functions, Image Properties,	
	Unit 3	**Basic Operations on Images**	
	A	Image Module: Splitting and Merging Image Channels, Image Mode Conversion, Image Blending	CO3, CO6
	B	Resizing an Image, Rotating an Image, Crop and Paste Operations, Copying and Saving Images to a File	
	C	Knowing the Value of a Particular Pixel, ImageChops Module, ImageOps Module	
	Unit 4	**Advanced Operations on Images**	
	A	The ImageFilter Module	CO4, CO6
	B	The ImageEnhance Module	
	C	Color Quantization, Histograms and Equalization	
	Unit 5	**Transformations and Filters**	

	A	Transformations: shift(), zoom()	CO5, CO6
	B	Measurements:	
	C	Filters: Low-Pass, High-Pass and Fourier Filters	

10	List of activities for Self Learning (SL: 30h)	S. No.	Name of the Activity	No of Hours	Evaluation Criteria	
		1	Problem Solving / Image Processing Programming using Python Implement image processing techniques using Python libraries such as OpenCV, NumPy, and TensorFlow for image acquisition, filtering, edge detection, object recognition, and IoT-based image analytics	5 programming exercises × 2h each Total = 10h	Based on correctness of image proce implementation, analytical accuracy, code quality, visualization of results, and documentation of outputs.	
		2	Technical Video-Based Learning NPTEL/YouTube technical sessions on digital image processing, computer vision, OpenCV, IoT-enabled surveillance systems, and AI-based image analytics	Video viewing = 2h Report preparation & Presentation = 3h Total = 5h	Report/presentation based on learning outcomes. Marks for concept clarity, workflow diagrams, image analysis explanation, and viva-voce performance.	
		3	Assignment Writing (Image Analytics & IoT Integration) Prepare assignments on image enhancement, segmentation, feature extraction, object detection, image transmission in IoT systems, and computer vision workflows	5 assignments × 1h each Total = 5h	Based on correctness of analytical explanation, algorithm understanding workflow representation, and completeness of assigned tasks.	
		4	Real-World Case Study / Mini Project Study and implement a real-world image processing IoT application such as smart surveillance, traffic monitoring, medical image analysis, or smart agriculture monitoring	Literature study = 3h Prototype implementation & report = 7h Total = 10h	Based on innovation, technical implementation, analytical depth, referencing quality, visualization of findings, and presentation performance. .	

11	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	15%	60%	
	Text book/s*	1. Raspberry Pi Image Processing Programming, Ashwin Pajankar, Apress			
	Other References				

PO and PSO mapping with level of strength for Course: CSOT4200 : Image Processing with IoT

	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO 3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO 1	3	-	-	-	2	-	-	2	-	-	-	2	-	2
CO 2	3	2	2	2	3	2	-	-	2	2	2	2	2	2
CO 3	3	2	2	2	3	2	-	2	2	2	-	2	2	2
CO 4	3	3	3	3	3	-	-	-	2	2	-	2	2	2
CO 5	3	3	3	3	3	3	-	2	2	2	-	3	2	3
CO 6	3	3	3	3	3	3	3	2	3	3	3	3	2	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO 11	PSO1	PSO 2	PSO3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSOT4200/ Image Processing with IoT	3.0	2.6	2.6	2.6	2.8	2.5	3.0	2.0	2.2	2.2	2.5	2.3	2.0	2.3

Strength of Correlation:

1. Addressed to ***Slight (Low=1) extent***

2. Addressed to ***Moderate (Medium=2) extent***

3. Addressed to ***Substantial (High=3) extent***

SDG Goal	Description	Mapping Strength	Justification
SDG 4 – Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	High	The course develops interdisciplinary skills in image processing, computer vision, IoT systems, and AI-driven analytics, promoting practical and research-oriented learning in emerging technologies.

SDG 9 – Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	High	Image processing integrated with IoT supports intelligent automation, smart surveillance, industrial inspection, robotics, and advanced infrastructure monitoring systems.
SDG 11 – Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable	High	IoT-enabled image processing applications are widely used in smart traffic management, smart surveillance, crowd monitoring, public safety systems, and intelligent urban infrastructure.
SDG 3 – Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages	Moderate	Image processing with IoT can support smart healthcare systems such as medical imaging, patient monitoring, disease detection, and remote health diagnostics.
SDG 12 – Responsible Consumption and Production	Ensure sustainable consumption and production patterns	Moderate	Intelligent image-based monitoring systems improve industrial quality control, waste detection, defect analysis, and efficient resource utilization in manufacturing and operational environments.
SDG 13 – Climate Action	Take urgent action to combat climate change and its impacts	Moderate	IoT-integrated image processing systems can support environmental monitoring, forest surveillance, pollution tracking, disaster management, and climate-responsive smart systems.

SDG 8 – Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Moderate	The course equips students with computer vision, IoT, and AI application development skills relevant to smart industries, automation, healthcare, surveillance, and robotics sectors.
SDG 16 – Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable institutions	Moderate	IoT-enabled image processing supports intelligent surveillance, security monitoring, facial recognition, and public safety applications that strengthen institutional security systems.
SDG 17 – Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	Low	The interdisciplinary integration of IoT, AI, image analytics, and cloud systems promotes collaborative innovation among academia, industries, healthcare, and smart technology sectors.

COURSE PLAN

Cloud Security (CSCF4200)

SSCSE-Sharda School of Computing Science & Engineering) | B.Tech CSE | Semester VII | Batch 2025–2029

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE-Sharda School of Computing Science & Engineering	**Batch:**	2025–2029
Program:	B.Tech	**Current Academic Year:**	2025-26
Branch:	CSE	**Semester:**	VII
Course Code:	CSCF4200	**Course Type:**	Core — Theory Only

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCF4200**
2	**Course Title**	**Cloud Security**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1.Provide students with an overview of the fundamental concepts of Cloud Computing. 2.Gain insight into the challenges and limitations Models of cloud computing. 3.To learn the various technologies of the cloud computing paradigm and learn about recent advances in Cloud Computing and enabling technologies. 4.Prepare students for research in the area of cloud Computing risks and cloud security challenges.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Understand – L1/L2): Identify and understand the fundamental concepts, characteristics, and models of cloud computing.

		CO2 (Understand/Explore – L2/L3): Explain the evolution of cloud computing and examine the role of enabling technologies, including physical and logical infrastructure. CO3 (Apply – L3): Understand and implement cloud access control methods and security mechanisms in cloud environments. CO4 (Analyze – L4/L5): Analyze cloud monitoring, auditing, and management techniques to evaluate cloud system performance and security. CO5 (Analyze – L4/L5): Compare different types of computer viruses and evaluate their objectives, impacts, and prevention techniques. CO6 (Analyze/Evaluate – L4/L5): Analyze various intrusion detection systems and evaluate firewall design principles for ensuring network and cloud security.
8	**Course Description**	This course introduces advanced aspects of Cloud Computing, encompassing the principles, to analyze the cloud, identify the problems, and choose the relevant models and algorithms to apply.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Thomas Erl & Eric Barcelo Monroy — Cloud Computing: Concepts, Technology, Security, and Architecture (2nd Ed.), Pearson, 2024.
12	**References**	1.Jamuna S. Murthy, Siddesh G. M., & Srinivasa K. G. — Cloud Security: Concepts, Applications and Practices (1st Ed.), Chapman & Hall/CRC Press, 2024. 2.Preeti Mishra, Emmanuel S. Pilli, & R. C. Joshi — Cloud Security: Attacks, Techniques, Tools, and Challenges, CRC Press, 2024. 3. Mark Buckwell, Stefaan Van Daele, & Carsten Horst — Security Architecture for Hybrid Cloud: A Practical Method for Designing Security Using Zero Trust Principles, O'Reilly Media, 2024.

3. Outline Syllabus with CO Mapping

All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.

	Topic	CO Mapping
	Unit 1: Introduction Cloud Computing	
A	Introduction to distributed systems, Defining Cloud Computing	**CO1, CO2**
B	Understanding of Cloud Architecture: Composability, Infrastructure, Platform	**CO1, CO2**
C	Virtual Appliances, Communication Protocols, Applications, Understanding Services: SaaS, PaaS, IaaS	**CO1,CO2**
	Unit 2: Secure Isolation of Physical & Logical Infrastructure	
A	Isolation: Compute, Network and Storage	**CO1, CO2, CO4**

B	Common attack vectors and threats, Secure Isolation Strategies, Multitenancy, Virtualization strategies	**CO1, CO2, CO4**
C	Inter-tenant network segmentation strategies, Storage isolation strategies	**CO1, CO2, CO4**
	Unit 3: Data Protection for Cloud Infrastructure and Services	
A	Understand the Cloud based Information Life Cycle, Data protection for Confidentiality and Integrity	**CO1, CO2,CO3**
B	Common attack vectors and threats, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key Management, Assuring data deletion	**CO1, CO2, CO3**
C	Data retention, deletion and archiving procedures for tenant data, Data Protection Strategies	**CO1, CO2, CO3**
	Unit 4: Enforcing Access Control for Cloud Infrastructure based Services	
A	Understand the access control requirements for Cloud infrastructure.	**CO1, CO3, CO4**
B	Authentication and Authorization, Roles-based Access Control, Multi-factor authentication.	**CO1, CO2, CO4**
C	Securing remote access, Verified and measured boot, Firewalls, IDS, IPS and honeypots	**CO1, CO2, CO4**
	Unit 5: Monitoring, Auditing and Management	
A	Proactive activity monitoring, Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts	**CO5, CO6**
B	Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs	**CO5, CO6**
C	Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management	**CO5, CO6**

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓				
4	2.A		✓	✓			
5	2.B		✓	✓			✓

6	2.C			✓	✓		✓
7	3.A	✓	✓				✓
8	3.B			✓	✓		✓
9	3.C			✓	✓	✓	✓
10	4.A		✓				
11	4.B			✓	✓		
12	4.C			✓	✓	✓	
13	5.A		✓	✓			
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓	✓																
CO2		✓	✓															
CO3			✓	✓										✓				
CO4				✓	✓				✓									
CO5				✓	✓				✓									
CO6		✓	✓	✓	✓									✓				

Legend: ✓ = Strong / Dominant mapping. Theory-oriented Cloud Security course: Cognitive domain is primary. Psychomotor domain (P3) is limited to implementation and practical analysis of cloud security mechanisms, intrusion detection, and firewall configuration. Affective domain (A3) reflects valuing security, monitoring, and efficient protection mechanisms in cloud environments.

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs) are structured separately in Section 11.*

Date	Topics to be Covered/Title	UNIT	Total Lectures
DD/MM/YY	Introduction to distributed systems and basic concepts	UNIT-1	10
DD/MM/YY	Defining Cloud Computing and characteristics of cloud computing		
DD/MM/YY	Understanding Cloud Architecture and composability		
DD/MM/YY	Cloud Infrastructure and Platform concepts		
DD/MM/YY	Virtual Appliances and virtualization concepts		
DD/MM/YY	Communication protocols used in cloud environments		
DD/MM/YY	Cloud applications and service delivery models		
DD/MM/YY	Understanding SaaS, PaaS and IaaS		
DD/MM/YY	Cloud deployment models and practical examples		
DD/MM/YY	Revision and discussion on cloud architecture concepts		
DD/MM/YY	Introduction to secure isolation in cloud environments	UNIT-2	8
DD/MM/YY	Isolation techniques for Compute resources		
DD/MM/YY	Network and Storage isolation mechanisms		
DD/MM/YY	Common attack vectors and threats in cloud systems		
DD/MM/YY	Secure Isolation Strategies and multitenancy concepts		
DD/MM/YY	Virtualization strategies and hypervisor security		
DD/MM/YY	Inter-tenant network segmentation strategies		
DD/MM/YY	Storage isolation strategies and practical security measures		
DD/MM/YY	Understanding the Cloud-based Information Life Cycle	UNIT-3	10
DD/MM/YY	Data protection requirements for Confidentiality and Integrity		
DD/MM/YY	Common attack vectors and threats to cloud data		
DD/MM/YY	Encryption techniques and secure data storage		

DD/MM/YY	Data Redaction and Tokenization techniques		
DD/MM/YY	Obfuscation methods and data masking concepts		
DD/MM/YY	PKI and Key Management systems		
DD/MM/YY	Assuring secure data deletion in cloud systems		
DD/MM/YY	Data retention, deletion and archiving procedures for tenant data		
DD/MM/YY	Cloud Data Protection Strategies and case discussions		
DD/MM/YY	Introduction to access control requirements for cloud infrastructure	UNIT-4	10
DD/MM/YY	Authentication concepts and techniques in cloud computing		
DD/MM/YY	Authorization mechanisms and access management		
DD/MM/YY	Role-Based Access Control (RBAC) in cloud environments		
DD/MM/YY	Multi-factor authentication and identity verification		
DD/MM/YY	Securing remote access in cloud systems		
DD/MM/YY	Verified and measured boot mechanisms		
DD/MM/YY	Firewalls and cloud network protection		
DD/MM/YY	Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS)		
DD/MM/YY	Honeypots and advanced cloud security practices		
DD/MM/YY	Introduction to Quality of Services and Secure Management	UNIT-5	8
DD/MM/YY	User management and Identity management concepts		
DD/MM/YY	Security Information and Event Management (SIEM)		
DD/MM/YY	Proactive activity monitoring techniques		

DD/MM/YY	Incident Response planning and management		
DD/MM/YY	Monitoring unauthorized access and malicious traffic		
DD/MM/YY	Monitoring abuse of system privileges, intrusion detection, events and alerts		
DD/MM/YY	Auditing, record generation, reporting, management and tamper-proofing audit logs		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Cloud Computing Fundamentals & Identification	Recall fundamental cloud computing concepts, characteristics, service models, and deployment models; identify suitable cloud solutions for different computing environments	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Cloud Infrastructure & Technology Interpretation	Explain the evolution of cloud computing and interpret the role of enabling technologies including virtualization, physical infrastructure, and logical infrastructure	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Cloud Security Mechanisms & Access Control Application	Apply authentication, authorization, and access control techniques in cloud environments; implement basic cloud security mechanisms and policies	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	Cloud Monitoring, Auditing & Management Analysis	Analyze cloud monitoring, auditing, and management techniques; evaluate system performance, reliability, and security trade-offs in cloud environments	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	Malware & Virus Analysis	Analyze different types of computer viruses, malware objectives, attack methods, and prevention mechanisms; evaluate the effectiveness of security countermeasures	CO5 | L4–L5	ETE Sec B/C

TS6	Intrusion Detection & Firewall Evaluation	Analyze intrusion detection systems, firewall architectures, and network security mechanisms; evaluate comparative efficiency and suitability for cloud security scenarios	CO6 | L2–L5	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Conceptual Recall	TS2 Process Interpretation	TS3 Algorithmic Application	TS4 Performance Evaluation	TS5 Memory System Analysis	TS6 File & Disk Evaluation
CO1	H	M				
CO2	M	H	M			
CO3		M	H	M		
CO4			M	H	M	
CO5				M	H	M
CO6		M	M	M	M	H

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5	5 assignments	**15**	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Video Learning Report	1 Report + Presentation	**5**	CO2, CO3	TS2, TS3
Real-World Case Study (Report)	1 Report	**5**	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	—	**25**	CO1–CO6	TS1–TS6

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria

Assignment 1	Unit 1 concepts: cloud computing fundamentals, characteristics, service and deployment models	CO1	TS1	5h SL	Report submission + conceptual evaluation
Assignment 2	Cloud infrastructure, virtualization, and enabling technologies	CO2	TS2	5h SL	Short-answer and conceptual analysis
Assignment 3	Cloud access control, authentication, and authorization mechanisms	CO2, CO3	TS2, TS3	5h SL	Security mechanism implementation + comparative analysis
Assignment 4	Cloud monitoring, auditing, and management techniques	CO3, CO4	TS3, TS4	5h SL	Analytical report + security evaluation
Assignment 5	Malware, virus prevention, intrusion detection systems, and firewall techniques	CO4, CO5, CO6	TS4, TS5, TS6	5h SL	Threat analysis + comparative performance evaluation
Video Learning Report	Technical video on cloud security, virtualization, IDS, or firewall mechanisms (min 3 hrs); structured report + class presentation	CO2, CO3	TS2, TS3	10h SL	Report: learning outcomes, key concepts, self-reflection. Presentation: 10 min
Case Study Report	Real-world cloud security case study (e.g., AWS security model, Azure monitoring, Google Cloud IAM, enterprise firewall deployment); in-depth analysis report	CO4, CO5, CO6	TS4, TS5, TS6	10h SL	Technical depth, data collection, fact finding, comparative analysis

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**10**	TS1 — Cloud Fundamentals Recall & Identification TS2 — Infrastructure & Technology Interpretation	CO1, CO2	Short-answer: define cloud computing models, explain cloud characteristics, identify deployment/service models, describe virtualization concepts, and explain enabling technologies and cloud infrastructure
Section B	**15**	TS3 — Security Mechanism Application TS4 — Monitoring, Auditing & Security Performance Evaluation	CO3, CO4	Application and analytical problems: apply authentication and access control techniques, analyze cloud monitoring and auditing mechanisms, evaluate security policies, compare cloud security approaches, and assess performance and reliability of cloud security solutions
TOTAL	**25**	TS1–TS4	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	**20**	TS1 — Cloud Fundamentals Recall TS2 — Infrastructure & Technology Interpretation	CO1, CO2	Short questions (all units): cloud concepts, service/deployment models, virtualization basics, enabling technologies, cloud infrastructure, and security terminology
Section B	**25**	TS3 — Security Mechanism Application TS4 — Monitoring & Management Analysis TS5 — Malware & Virus Analysis	CO3, CO4, CO5	Medium questions: access control techniques, authentication mechanisms, cloud auditing and monitoring, malware classification, virus prevention methods, and comparative security analysis
Section C	**15**	TS5 — Malware & Virus Analysis TS6 — IDS & Firewall Evaluation	CO5, CO6	Long/evaluation questions: malware attack analysis, intrusion detection system comparison, firewall design principles, cloud security case studies, and evaluation of network protection techniques
TOTAL	**60**	TS1–TS6 (all)	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand fundamental concepts, characteristics, and models of cloud computing	✓	✓	✓	TS1	**PO1, PO2, PO3, PO4**
CO2	Explain cloud evolution and enabling physical/logical infrastructure	✓	✓	✓	TS2	**PO1, PO2, PO3, PO4**
CO3	Apply cloud access control methods and security mechanisms	✓	✓	✓	TS3	**PO1, PO3, PO4, PO5**
CO4	Analyze cloud monitoring, auditing, and management techniques	✓	✓	✓	TS4	**PO2, PO4, PO9, PO10**
CO5	Compare computer viruses and evaluate prevention techniques	✓	—	✓	TS5	**PO1, PO2, PO8, PO9, PO10**
CO6	Analyze intrusion detection systems and firewall design principles	✓	—	✓	TS6	**PO1, PO2, PO4, PO10, PO11**

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	2	2	2	2	1	3	2
CO2	2	2	3	3	2	3	3	2	2	2	1	1	2	3
CO3	3	3	3	3	-	2	3	1	1	1	3	2	3	2
CO4	2	2	1	2	2	3	2	2	3	3	3	1	2	2
CO5	-	-	-	3	2	-	2	2	2	-	-	-	2	-
CO6	-	2	-	-	-	-	-	-	-	2	2	2	2	-
Avg	1.67	2.00	1.50	2.16	1.00	1.33	1.67	1.50	1.67	1.67	1.83	1.16	2.33	1.50

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	M				M	M	M	M		H	M	H
CO2	M	M	H	H	M	H	H	M	M	M			M	H	M
CO3	H	H	H	H		M	H				H	M	H	M	H
CO4	M	M		M	M	H	M	M	H	H	H		M	M	M
CO5				H	M		M	M	M				M		
CO6		M								M	M	M	M		

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	**Assignment Writing (5 assignments, problem-based, one per unit focus area)**	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on the assignment submitted; correctness, steps shown, performance Cloud Deployment
2	**Technical Video-Based Learning related to the subject (e.g.AWS, Cloud Deployment)**	Video viewing: 7 hrs Report preparation: 7 hrs Presentation: 6 hrs Total = 20 hrs	CO2, CO3 TS2, TS3	Report + Presentation based on video learning outcomes; must capture key concepts, Cloud infrastructure, resource making in AWS
3	**Real-World Case Studies (e.g.S3 bucket integration, Load balancer)**	Data collection/study: 5 hrs Report preparation: 5 hrs Total = 10 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on in-depth study, technical depth, data collected, fact finding, and analytical conclusions drawn
	TOTAL Self-Learning Hours	**45 hours**	CO1–CO6	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence

Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

CSCF4200— Cloud Security

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

School: SSCSE		**Batch: 2026-2030**
Program: B-TECH		**Current Academic Year: 2029-30**
Branch: CSE		**Semester: VII**
1	**Course Code**	CSAI4201
2	**Course Title**	Recommender Systems
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3
	Course Status	Specialization Elective
5	**Course Objective**	To develop state-of-the-art recommender systems that automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations 1. To introduce fundamental techniques in recommender systems. 2. To introduce the ideas of Non-personalized and project-association recommenders through content-based and collaborative techniques. To become familiar with to various approaches for building recommender systems including collaborative, content-based, knowledge-based, and hybrid methods.
6	**Course Outcomes (CO's)**	Upon successful completion of the course, students will be able to: CO-1. Define the basics of Recommender Systems and its types. CO-2. Explain the similarity measures used in formation of neighbourhood of samples of data. CO-3. Apply various techniques of content and knowledge based recommendation for real life applications. CO-4. Analyse and categorize the various recommendation techniques for hybridization. CO-5. Choose the suitable type of Recommender systems for societal problems CO-6. Design the recommender system to support all online applications of folksonomies and Social Networking sites.
7	**Course Description**	Recommender systems offer personalized access to online information in product catalogs, social media networks, and document collections, among other applications. It will introduce students to various approaches for building recommender systems including collaborative, content-based, knowledge-based, and hybrid methods.
8	**Teaching and Learning Scheme (in Hours per Semester)**	Classroom Instructions (CI) / Lab Instructions (LI) / Team Work (TW) and Self Learning (SL) (TW+SL) / Total number of Hours / Total Credits TH/30

Classroom Instructions (CI)		Lab Instructions (LI)	Team Work (TW) and Self Learning (SL) (TW+SL)	Total number of Hours	Total Credits TH/30
L	T	P	SL	TH	
45	0	0	45	90	3

9	**Syllabus Outline**		**CO Mapping**
	Unit 1	**Introduction**	
	A	Introduction to Recommender Systems, Neighbourhood-based methods Recommendation, Applications of recommender systems, Case study of movie lens, group lens and amazon.com etc.	CO1,
	B	Introduction to Information retrieval, Introduction to collaborative filtering	CO1,
	C	Knowledge sources, Neighbourhood-based methods.	CO1
	Unit 2	**Memory and Model-based Collaborative Recommendation**	
	A	Similarity measures used in Collaborative Filtering, Model-based Collaborative Recommendation Dimensionality reduction. Regression: Slope1 and SLIM models. Association rules and Naïve Bayes models,	CO2, CO6
	B	Factorization Methods of Collaborative Recommendation, Latent factor models.	CO2, CO6
	C	Optimization techniques. Singular value decomposition, constrained matrix factorization.	CO2, CO6
	Unit 3	**Content-based and Knowledge-based Recommendation**	

	A	High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Content-based Recommendation Feature representation, extraction, and selection.	CO3, CO6
	B	User profiles. Learning models, Item profiles, Discovering features of documents, Obtaining item features from tags	CO3, CO6
	C	Knowledge-based Recommendation Constraint-based recommendation. Critiquing systems.	CO3, CO6
	Unit 4	**Hybrid recommendation and Evaluation**	CO3, CO6
	A	Hybrid Recommendation Complementarities between recommendation techniques and knowledge sources.	CO3, CO6
	B	Combining recommendation methods. Types of evaluation for recommender systems	CO3, CO6
	C	Evaluation design. Prediction metrics and ranking metrics. A/B Testing	CO3, CO6
	Unit 5	**Context-aware recommendation**	
	A	Context effects in recommendation. Types and representations of context.	CO5, CO6
	B	Pre-filtering, post-filtering and contextual modelling, Temporal and location-sensitive models	CO5, CO6
	C	Recommender Systems and communities: Communities, collaboration and recommender systems in personalized web search, Social tagging recommender systems, Trust and Recommendations, Group recommender systems and their applications in solving societal problems.	CO5, CO6

10 List of activities for Self Learning (SL)

S. No.	Name of the Activity	No. of Hours	Evaluation Criteria
1	Technical Video Based Learning on Recommender Systems Techniques	Duration of video = 5h; Report preparation = 5h; Presentation = 5h, **Total = 15h**	Report / presentation based on understanding of collaborative filtering, content-based methods, and hybrid recommendation models
2	Case Study Analysis of Real-World Recommender Systems (E-commerce / Streaming Platforms)	Data collection / study = 5h; Analysis = 5h; Report writing = 5h, **Total = 15h**	Based on technical depth, understanding of recommendation algorithms, and relevance to real-world applications
3	Comparative Study of Recommendation Algorithms and Similarity Measures	Algorithm study = 10h; Summary report = 5h, **Total = 15h**	Based on comparison of techniques (e.g., user-based vs item-based, model-based methods), clarity of concepts, and correctness of analysis

	Mode of examination	Theory	
	Weightage Distribution	CA	ETE
		Assessment 1 (10) / Assessment 2 (5) / Assignment 1 (5) / Assignment 2 (5)	75
	Text Books	1. Aggarwal, C. C. Recommender Systems: The Textbook. Springer 2019. ISBN 978-3-319-29657-9. Available through the DePaul library.	
	Reference Books	http://www.deitel.com/ResourceCenters/Web20/RecommenderSystems/RecommenderSystemsCourseSyllabi/tabid/1321/Default.aspx	
	Online Materials	Francesco Ricci, LiorRokach and BrachaShapira Recommender Systems Handbook, 2005	

Topic-wise BTL Mapping – CSAI4201

S. No.	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	Introduction to Recommender Systems	✓	✓				
2	Applications of Recommender Systems	✓	✓				
3	Case Study: MovieLens, GroupLens, Amazon		✓	✓		✓	
4	Introduction to Information Retrieval	✓	✓				
5	Collaborative Filtering	✓	✓	✓	✓		
6	Neighbourhood-based Methods	✓	✓	✓			
7	Similarity Measures in Collaborative Filtering		✓	✓	✓	✓	
8	Model-based Collaborative Filtering		✓	✓	✓		
9	Dimensionality Reduction Techniques		✓	✓	✓		
10	Regression Models: Slope One & SLIM		✓	✓	✓		
11	Association Rules & Naïve Bayes Models		✓	✓	✓	✓	
12	Factorization & Latent Factor Models		✓	✓	✓	✓	
13	Singular Value Decomposition (SVD) & Optimization		✓	✓	✓	✓	
14	Content-Based & Knowledge-Based Recommendation		✓	✓	✓	✓	✓
15	Hybrid, Evaluation & Context-Aware Recommender Systems		✓	✓	✓	✓	✓

Unit 1 Lecture Plan Outline (9 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Introduction to Recommender Systems	CO1	9
DD/MM/YY	Types and Applications of Recommender Systems	CO1	
DD/MM/YY	Introduction to Information Retrieval (IR)	CO1, CO2	
DD/MM/YY	Basics of Collaborative Filtering	CO1, CO2	
DD/MM/YY	Types of Collaborative Filtering (User-based & Item-based)	CO1, CO2	
DD/MM/YY	Knowledge Sources in Recommender Systems	CO1, CO2	
DD/MM/YY	Neighbourhood-Based Methods (User-based)	CO1, CO2	
DD/MM/YY	Neighbourhood-Based Methods (Item-based)	CO1, CO2	
DD/MM/YY	Case Studies: MovieLens, GroupLens, Amazon.com	CO1, CO2	

Unit 2 Lecture Plan Outline (10 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Similarity Measures in Collaborative Filtering	CO2	10
DD/MM/YY	Advanced Similarity Metrics (Cosine, Pearson, Jaccard, etc.)	CO2	

DD/MM/YY	Introduction to Model-Based Collaborative Recommendation	CO2, CO3	
DD/MM/YY	Dimensionality Reduction Techniques	CO2, CO3	
DD/MM/YY	Regression-Based Models: Slope One Algorithm	CO2, CO3	
DD/MM/YY	Regression-Based Models: SLIM (Sparse Linear Methods)	CO2, CO3	
DD/MM/YY	Association Rule-Based Recommendation	CO2, CO3	
DD/MM/YY	Naïve Bayes Models in Recommendation	CO2, CO3	
DD/MM/YY	Factorization Methods & Latent Factor Models	CO2, CO3	
DD/MM/YY	Optimization Techniques: Singular Value Decomposition (SVD) & Constrained Matrix Factorization	CO2, CO3	

Unit 3 Lecture Plan Outline (10 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	High-Level Architecture of Content-Based Recommender Systems	CO3	10
DD/MM/YY	Advantages and Drawbacks of Content-Based Filtering	CO3	
DD/MM/YY	Feature Representation in Content-Based Recommendation	CO3	
DD/MM/YY	Feature Extraction Techniques	CO3, CO4	
DD/MM/YY	Feature Selection Methods	CO3, CO4	
DD/MM/YY	User Profiles in Recommender Systems	CO3, CO4	
DD/MM/YY	Learning Models for Content-Based Recommendation	CO3, CO4	
DD/MM/YY	Item Profiles & Discovering Features of Documents	CO3, CO4	
DD/MM/YY	Obtaining Item Features from Tags	CO3, CO4	
DD/MM/YY	Knowledge-Based Recommendation: Constraint-Based & Critiquing Systems	CO3, CO4	

Unit 4 Lecture Plan Outline (8 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Introduction to Hybrid Recommender Systems	CO4	8
DD/MM/YY	Complementarities between Recommendation Techniques and Knowledge Sources	CO4, CO5	
DD/MM/YY	Combining Recommendation Methods	CO4, CO5	
DD/MM/YY	Types of Hybrid Recommender Systems (Weighted, Switching, Cascade, etc.)	CO4, CO5	
DD/MM/YY	Types of Evaluation for Recommender Systems	CO4, CO5	
DD/MM/YY	Evaluation Design and Experimental Setup	CO4, CO5	
DD/MM/YY	Prediction and Ranking Metrics (MAE, RMSE, Precision, Recall, NDCG)	CO4, CO5	
DD/MM/YY	A/B Testing in Recommender Systems	CO4, CO5	

Unit 5 Lecture Plan Outline (8 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Introduction to Context-Aware Recommender Systems	CO5	8
DD/MM/YY	Context Effects and Types of Context (Temporal, Spatial, Social)	CO5, CO6	
DD/MM/YY	Context Representation Techniques	CO5, CO6	
DD/MM/YY	Pre-Filtering, Post-Filtering, and Contextual Modeling	CO5, CO6	
DD/MM/YY	Temporal and Location-Sensitive Recommendation Models	CO5, CO6	
DD/MM/YY	Recommender Systems and Communities (Collaboration & Personalized Web Search)	CO5, CO6	

DD/MM/YY	Social Tagging and Trust-Based Recommender Systems	CO5, CO6	
DD/MM/YY	Group Recommender Systems and Their Applications in Societal Problems	CO5, CO6	

Course-to-SDG Matrix

This syllabus for **Recommender Systems** aligns with key **United Nations Sustainable Development Goals (SDGs)** by fostering knowledge of intelligent information filtering, personalized content delivery, and data-driven decision-making in digital ecosystems. The course emphasizes collaborative filtering, content-based recommendation, hybrid models, similarity measures, and scalable recommendation algorithms used in real-world platforms such as e-commerce, entertainment, and social media.

It equips students with the ability to design, analyze, and evaluate recommendation systems that enhance user experience, improve resource utilization, and support informed decision-making. By enabling efficient access to relevant information and services, the course contributes to innovation, inclusive digital services, and sustainable technological development in alignment with global digital transformation goals.

Mapping uses a 3-point scale:

- **Addressed to Substantial (High = 3) extent:** Core content directly contributes
- **Addressed to Moderate (Medium = 2) extent:** Supports through skills / activities
- **Addressed to Slight (Low = 1) extent:** Indirect awareness / benefit

Total Mapped SDGs: 4 out of 17

SDG Goal	Description	Mapping Strength	Justification
SDG 4	Quality Education	**3**	Develops conceptual understanding of recommender system techniques such as collaborative filtering, content-based filtering, and hybrid models, strengthening advanced knowledge in data-driven personalization and intelligent systems.
SDG 8	Decent Work & Economic Growth	**3**	Builds industry-relevant skills in recommendation technologies widely used in e-commerce, streaming platforms, and digital services, enhancing employability in data science and AI-driven industries.
SDG 9	Industry, Innovation & Infrastructure	**3**	Supports innovation through the design of scalable and efficient recommendation algorithms that power modern digital platforms, improving user engagement and intelligent information delivery.
SDG 12	Responsible Consumption & Production	**2**	Encourages efficient information filtering and personalized recommendations that reduce information overload, promote relevant content consumption, and support optimized use of digital resources.

PO and PSO mapping with level of strength for RECOMMENDER SYSTEMS (Course Code CSAI4201)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	3	3	3	1	1	1	1	2	1	3	2	2	2
CO2	3	3	3	3	2	1	1	1	2	1	3	2	3	2
CO3	3	3	3	3	2	1	1	1	2	1	3	3	2	2
CO4	3	3	3	3	2	2	1	1	2	1	3	3	3	2
CO5	3	3	3	3	2	2	1	1	2	1	3	3	3	2
CO6	3	3	3	3	2	3	1	3	2	1	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CSAI4201/ RECOMMENDER SYSTEMS	3.00	3.00	3.00	3.00	1.83	1.67	1.00	1.33	2.00	1.00	3.00	2.67	2.67	2.17

Strength of Correlation

1. Addressed to **Slight (Low=1) extent**

2. Addressed to **Moderate (Medium=2) extent**

3. Addressed to **Substantial (High=3) extent**

COURSE PLAN

Applied Pattern Recognition (CSDS4303)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE (Specialization in Data Science) | Semester VI | Batch 2025-2029

Integrated Course Plan - Theory COs (CO1-CO6) + Lab COs (CO7-CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2025-2029
Program:	B.Tech	**Current Academic Year:**	2026-27
Branch:	CSE (Specialization in Data Science)	**Semester:**	VI

2. Course Details

***** *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1-CO6) via MTE + ETE; Lab COs (CO7-CO10) via Laboratory Assessment only. No cross-evaluation.*

1	**Course Code**	CSDS4204 (Theory) / CSDS4205 (Lab)
2	**Course Title**	Applied Pattern Recognition (Theory + Laboratory)
3	**Credits**	4 (3 Theory + 1 Lab)
4	**Contact Hours (L-T-P-SL)**	3-0-2-3
5	**Course Status**	Elective (Theory) / Core (Lab)
6	**Course Objective**	Students will be introduced to the ideas of existing patterns and implement them based on data analysis; to conceptualize the working of pattern-exploration using computational algorithms; and to become familiar with feature knowledge that can be extracted from available examples and generalized to appropriate feature models, with hands-on implementation using Python-based ML tools.
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs - Assessed via MTE + ETE:** **CO1 (Remember/Understand - L1-L2):** Define pattern concept and random process ideas; understand the mathematical background of pattern recognition. **CO2 (Understand - L2):** Explain preliminary models to understand the solution environment. **CO3 (Apply - L3):** Apply existing mathematical solutions to test problems and perform subspace analysis for classification problems. **CO4 (Apply/Analyze - L3-L4):** Classify patterns using Bayesian Decision Theory. **CO5 (Evaluate - L5):** Evaluate patterns using parametric and non-parametric techniques. **CO6 (Understand/Analyze - L2-L4):** Discuss the trajectory of recent trends in pattern recognition and understand various real-world applications. **LAB COs - Assessed via Laboratory Assessment only:** **CO7 (Apply - L3):** Implement Bayesian classifiers (Naive Bayes, Bayesian Networks) for real-world classification problems. **CO8 (Apply/Analyze - L3-L4):** Apply clustering algorithms (K-Means, EM) and analyze clustering quality on real-world datasets. **CO9 (Apply/Analyze - L3-L4):** Implement feature extraction and selection techniques (PCA, Nearest Neighbor) and evaluate their effect on classification. **CO10 (Evaluate/Create - L5-L6):** Implement and evaluate advanced pattern recognition models (SVM, Neural Networks) on standard datasets.

8	**Teaching & Learning**	Classroom Instructions (CI) 45 hrs + Lab Instructions (LI) 30 hrs + Self Learning (SL) 45 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 45 hrs)**	- Practice pattern classification, Bayesian estimation and clustering numerical problems. - Perform Pattern Recognition/Machine Learning Virtual Labs (NPTEL/Virtual Labs) on classification and clustering. - Complete a MOOC/NPTEL/SWAYAM course on Pattern Recognition or Machine Learning fundamentals.
11	**References**	**Text Book** R. O. Duda, P. E. Hart and D. G. Stork - Pattern Classification, John Wiley, 2001. Christopher M. Bishop - Pattern Recognition and Machine Learning, Springer, 2006. **Reference Books** S. Theodoridis and K. Koutroumbas - Pattern Recognition, 4th Ed., Academic Press, 2009. Robert Schalkoff - Pattern Recognition: Statistical, Structural and Neural Approaches, John Wiley & Sons, 1992. A. K. Jain, R. Bolle, S. Pankanti - Biometrics: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.

3. Outline Syllabus - Theory Units with CO Mapping (CO1-CO6)

i *Unit CO mappings refer to Theory COs (CO1-CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7-CO10).*

Unit 1	**Introduction and Mathematical Preliminaries**	
A	Introduction to Pattern Recognition; application areas in medical, defence and e-commerce domains; the Design Cycle.	CO1, CO2
B	Clustering vs. Classification; learning and adaptation; relevant basics of Linear Algebra.	CO1, CO2
C	Vector spaces, Probability Theory, Estimation Theory.	CO1, CO2
Tools Used	Python (NumPy, SciPy), Jupyter Notebook, MATLAB, Whiteboards, Virtual Labs	
Activities	*Objective: To understand the pattern recognition design cycle, mathematical preliminaries and the distinction between clustering and classification.* - Study of real-world pattern recognition applications in medical, defence and e-commerce domains. - Comparison of clustering vs. classification approaches through case examples. - Refresher exercises on vector spaces, probability and estimation theory using Python/NumPy.	

Unit 2	**Bayes Decision Theory**	
A	Data processing, outliers, correlation, expectation, mean and covariance; classifiers.	CO1, CO2, CO4, CO5
B	Normal distribution, Bayesian classification, the nearest-neighbour rule.	CO1, CO2, CO4, CO5
C	Introduction to Bayesian Decision Theory; normal density and discriminant functions for the normal density.	CO1, CO2, CO4, CO5
Tools Used	Python (scikit-learn, pandas), Jupyter Notebook, Weka, Virtual Labs	
Activities	*Objective: To understand data pre-processing and apply Bayesian Decision Theory to classification problems.* - Computation of mean, covariance and correlation on sample datasets. - Implementation of the Naive Bayesian classifier and Nearest-Neighbour rule. - Demonstration of discriminant functions for normally distributed classes.	

Unit 3	**Clustering**	

A	Basics of clustering; similarity/dissimilarity measures; criterion functions for clustering; distance functions.	CO1, CO2, CO3
B	Clustering techniques: K-means algorithm, agglomerative hierarchical clustering.	CO1, CO2, CO3
C	K-medoids, DBSCAN, cluster validation.	CO1, CO2, CO3
Tools Used	Python (scikit-learn, matplotlib), Jupyter Notebook, Weka, Virtual Labs	
Activities	*Objective: To apply clustering techniques and evaluate cluster quality using validation measures.* - Implementation of K-means and hierarchical clustering on sample datasets. - Comparison of K-medoids and DBSCAN clustering outputs. - Cluster validation using internal/external validation indices.	

Unit 4	**Feature Extraction and Feature Selection**	
A	Principal Component Analysis (PCA), Kernel PCA, Singular Value Decomposition, Fisher Linear Discriminant Analysis.	CO2, CO3, CO5
B	Algorithms: Branch and Bound algorithm, sequential forward/backward selection algorithms, Maximum-Likelihood estimation.	CO2, CO3, CO5
C	Probabilistic separability-based criterion functions, interclass distance-based criterion functions, K-Nearest Neighbor estimation.	CO2, CO3, CO5
Tools Used	Python (scikit-learn), Jupyter Notebook, MATLAB, Virtual Labs	
Activities	*Objective: To apply feature extraction and feature selection techniques for dimensionality reduction.* - Implementation of PCA and Kernel PCA on standard datasets (e.g., Iris). - Demonstration of sequential forward/backward feature selection. - Comparative analysis of K-Nearest Neighbor estimation with different criterion functions.	

Unit 5	**Recent Advances in Pattern Recognition**	
A	Introduction to advanced pattern recognition schemes; resources and tools used; Gaussian Mixture Models.	CO2, CO3, CO6
B	Support Vector Machine, Neural Networks, Hidden Markov Models (HMM), Retrieval-Augmented Generation (RAG).	CO2, CO3, CO6
C	Basics of Biometrics: methodologies including fingerprints, hand geometry, facial recognition, iris scanning, retina scanning.	CO2, CO3, CO6
Tools Used	Python (scikit-learn, TensorFlow/Keras), Jupyter Notebook, Virtual Labs	
Activities	*Objective: To explore recent advances and real-world applications of pattern recognition, including biometrics.* - Implementation of SVM and Neural Network classifiers on standard datasets. - Study and demonstration of Gaussian Mixture Models and HMMs. - Case-study discussion on biometric recognition technologies.	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓				
3	1.C		✓				
4	2.A		✓	✓			
5	2.B			✓			
6	2.C			✓	✓		
7	3.A		✓	✓			

8	3.B			✓			
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓		
12	4.C				✓		
13	5.A		✓	✓			
14	5.B			✓	✓	✓	
15	5.C		✓		✓		

5. CO vs Bloom's Taxonomy - All Three Domains (10 COs)

** Only strong/dominant alignments are mapped. Lab COs (CO7-CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1		✓					✓											
CO2		✓					✓											
CO3			✓					✓										
CO4			✓	✓				✓										
CO5					✓				✓									
CO6		✓		✓				✓	✓									
CO7			✓					✓						✓	✓			
CO8			✓	✓				✓	✓					✓	✓	✓		
CO9			✓	✓				✓	✓						✓	✓	✓	
CO10					✓	✓			✓	✓	✓					✓	✓	✓

6. Lecture Plan Outline (Theory - 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Pattern Recognition; applications in medical, defence and e-commerce domains	Unit 1	6
DD/MM/YY	The Design Cycle of a pattern recognition system		
DD/MM/YY	Clustering vs. Classification; learning and adaptation		
DD/MM/YY	Basics of Linear Algebra relevant to pattern recognition		
DD/MM/YY	Vector spaces and Probability Theory		
DD/MM/YY	Estimation Theory and numerical problem solving		
DD/MM/YY	Data processing, outliers, correlation	Unit 2	6
DD/MM/YY	Expectation, mean and covariance; classifiers		
DD/MM/YY	Normal Distribution and Bayesian Classification		
DD/MM/YY	The Nearest-Neighbor Rule		
DD/MM/YY	Introduction to Bayesian Decision Theory		
DD/MM/YY	Normal density and discriminant functions for the normal density		
DD/MM/YY	Basics of clustering; similarity/dissimilarity measures	Unit 3	6

DD/MM/YY	Criterion functions for clustering; distance functions		
DD/MM/YY	K-means algorithm		
DD/MM/YY	Agglomerative hierarchical clustering		
DD/MM/YY	K-medoids and DBSCAN		
DD/MM/YY	Cluster validation techniques		
DD/MM/YY	Principal Component Analysis (PCA) and Kernel PCA	Unit 4	6
DD/MM/YY	Singular Value Decomposition		
DD/MM/YY	Fisher Linear Discriminant Analysis		
DD/MM/YY	Branch and Bound algorithm; sequential forward/backward selection		
DD/MM/YY	Maximum-Likelihood estimation		
DD/MM/YY	Probabilistic separability and interclass distance-based criterion functions; K-NN estimation		
DD/MM/YY	Introduction to advanced pattern recognition schemes; resources and tools	Unit 5	6
DD/MM/YY	Gaussian Mixture Models		
DD/MM/YY	Support Vector Machine and Neural Networks		
DD/MM/YY	Hidden Markov Models (HMM) and Retrieval-Augmented Generation (RAG)		
DD/MM/YY	Biometrics: fingerprints, hand geometry, facial and iris recognition		
DD/MM/YY	Revision, problem solving and case-study discussion		

7. Lab Session Plan - List of Experiments (Updated CO7-CO10)

[Lab] *W1-W10: Experiments develop CO7-CO9 skills (Bayesian classification, clustering, feature extraction) through implementation, tool usage and documentation. W11-W12 (teal rows): Mini Project develops CO10 (advanced model design/evaluation, teamwork and presentation). Theory knowledge is applied but NOT re-evaluated in lab.*

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Use the Naive Bayesian Classifier to classify a set of documents; compute accuracy, precision and recall.	CO7	3.0
W2	S-2.1	Implement the Naive Bayesian classifier for a sample training dataset stored as a .CSV file; compute classifier accuracy on test data.	CO7	3.0
W3	S-3.1	Construct a Bayesian network using medical data to demonstrate diagnosis of heart patients (standard Heart Disease dataset).	CO7	3.0
W4	S-4.1	Apply the EM algorithm to cluster data stored in a .CSV file; compare with K-Means clustering and comment on cluster quality.	CO8	3.0
W5	S-5.1	Construct a Bayesian network using medical data to demonstrate diagnosis of heart patients (clustering-oriented variant).	CO8	3.0
W6	S-6.1	Implement PCA on the Iris dataset using scikit-learn.	CO9	3.0
W7	S-7.1	Implement Nearest Neighbor classification on the Iris dataset and plot decision boundaries for each class.	CO9	3.0
W8	S-8.1	Perform binary classification using non-linear SVC with an RBF kernel.	CO10	3.0
W9	S-9.1	Implement SVM for classification on a standard dataset.	CO10	3.0
W10	S-10.1	Implement a Neural Network for classification on a standard dataset.	CO10	3.0
W11	Mini Project - Phase 1	Problem scoping, dataset selection and design of an end-to-end pattern recognition solution (classification/clustering) for a chosen real-world dataset.	CO8/CO9	-

W12	Mini Project - Phase 2	Implementation, evaluation, documentation and final demonstration/presentation of the mini project.	CO9/CO10	10

i *Instructions: Write Python programs (Jupyter Notebook), execute and test with suitable datasets/test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1-CO6)

8. Theory Skill Dimensions (TS1-TS6) - CO1 through CO6

[T] *THEORY COs (CO1-CO6) - Assessed exclusively via MTE and ETE only*

***** *Six theory skill dimensions - one per Bloom's level L1-L6 - correspond directly to CO1-CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Pattern Recognition Fundamentals & Terminology	Recall the pattern concept, design cycle, random processes and basic mathematical/statistical terminology used in pattern recognition.	CO1 | L1-L2	MTE Sec A | ETE Sec A
TS2	Understanding of Preliminary Models & Solution Environments	Explain preliminary models, vector spaces, probability and estimation theory used to describe the solution environment.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	Application of Mathematical Solutions & Subspace Analysis	Apply existing mathematical solutions and subspace analysis techniques to classification-style test problems.	CO3 | L3	MTE Sec B | ETE Sec B
TS4	Classification using Bayesian Decision Theory	Apply and analyze Bayesian Decision Theory, discriminant functions and the nearest-neighbour rule for pattern classification.	CO4 | L3-L4	MTE Sec B | ETE Sec B
TS5	Evaluation using Parametric & Non-Parametric Techniques	Evaluate patterns using parametric (e.g., maximum-likelihood) and non-parametric (e.g., K-NN, kernel-based) techniques.	CO5 | L5	ETE Sec C
TS6	Recent Trends & Real-World Applications	Discuss recent advances (SVM, neural networks, HMM, RAG, biometrics) and real-world applications of pattern recognition.	CO6 | L2-L4	ETE Sec C

9. Theory Assessment Structure - MTE and ETE

9.1 Mid Term Examination (MTE) - 10 Marks (CO1-CO3 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**6**	TS1 - Pattern Recognition Fundamentals & Terminology TS2 - Understanding of Preliminary Models & Solution Environments	CO1, CO2	Short-answer questions: definitions, pattern concept, design cycle, mathematical preliminaries, preliminary models
Sec B	**4**	TS3 - Application of Mathematical Solutions & Subspace Analysis	CO3	Numerical problems on subspace analysis and application of mathematical solutions to test problems
TOTAL	**10**	**TS1-TS3**	**CO1-CO3**	Units 1-2 covered; CO4, CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) - 100 Marks (Scaled to 50) (CO1-CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 - Pattern Recognition Fundamentals TS2 - Preliminary Models & Solution Environments	CO1, CO2	Short questions: pattern recognition fundamentals, design cycle, clustering vs classification, mathematical preliminaries, conceptual questions
Sec B	**50**	TS3 - Subspace Analysis TS4 - Classification using Bayesian Decision Theory	CO3, CO4	Medium questions: Bayesian Decision Theory numericals, discriminant functions, subspace analysis, nearest-neighbour rule, classification problems
Sec C	**25**	TS5 - Evaluation using Parametric/Non-Parametric Techniques TS6 - Recent Trends & Real-World Applications	CO5, CO6	Long-answer/design questions: parametric vs non-parametric evaluation, PCA/feature selection, SVM, neural networks, biometrics, recent trends
TOTAL	**100**	**TS1-TS6 (all)**	**CO1-CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7-CO10)

10. Evaluation Scheme - Overview

Component	Weightage	Marks	COs Assessed
Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation - no cross-assessment

11. Laboratory Assessment (40 Marks)

[Lab] *LAB COs (CO7-CO10) - Assessed exclusively via Laboratory Assessment only (CA + Mini Project)*

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 10	**30**	3.0 marks each - assesses CO7, CO8 and CO9 through implementation, evaluation, troubleshooting and documentation
Mini Project	1 Project	**10**	End-to-end pattern recognition solution (classification/clustering) using Python/scikit-learn - assesses all Lab COs (CO7-CO10) through design, implementation, evaluation and presentation
TOTAL	-	**40**	Laboratory Assessment only

11.2 Per-Experiment CA Rubric (3.0 Marks each - Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Understanding & Dataset Setup	1.0	CA1 - Understanding of the problem and dataset CA2 - Tool/library configuration and setup CA7 - Planning of algorithm/model approach	1.0: Proper understanding and correct setup | 0.5: Partial understanding/setup | 0: Incorrect or missing	CO7, CO8

Implementation & Execution	1.0	CA3 - Correct execution of program/model CA4 - Efficient implementation and troubleshooting	1.0: Correct execution with proper results | 0.5: Partially correct execution | 0: Failed execution	CO7
Result Analysis & Lab Documentation	0.75	CA5 - Analysis and interpretation of outputs CA6 - Documentation and result verification CA8 - Lab record completion and viva understanding	0.75: Complete analysis and documentation | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Conduct & Ethical Practices	0.25	CA8 - Responsible use of tools/data and documentation ethics	0.25: Consistent and professional | 0.10: Occasional compliance | 0: Absent	CO9
Total	**3.0**	**All 8 CA skill dimensions covered**		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> 10	Best 10	30 Marks	Lowest experiment scores beyond 10 are dropped
10	All 10	30 Marks	No score dropped
< 10	All Conducted	≤ 30 Marks	Missing experiments treated as zero (deficit = zero)

11.4 Mini Project Evaluation Rubric (10 Marks - All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	1.5	P1 - SDG mapping and societal relevance P2 - Problem definition and objectives P4 - Suitable solution with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO10 / PO3, PO6
Project Planning & Resource Utilization	1.5	P2 - Timeline and milestones P11 - Effective use of tools and lab resources	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & Testing	2.0	P5 - Appropriate tool selection P6 - Complete implementation and integration P7 - Testing, troubleshooting and verification	2: Fully functional | 1-1.5: Partial | 0-0.5: Non-functional	CO7, CO8 / PO3, PO5
Result Analysis & Technical Documentation	2.0	P8 - Analysis of outputs vs objectives P9 - Comparative analysis and technical report	2: Thorough | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO4, PO6
Communication, Presentation & Teamwork	2.0	P3 - Demonstration planning and communication P10 - Professional presentation, viva and teamwork	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Conduct	1.0	P12 - Reflection on learning and skill development P13 - Ethical practice and responsible tool usage	1.0: Reflective & professional | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	**All 13 Project Skill Dimensions; all 4 Lab COs (CO7-CO10)**		

12. CA Skill Dimensions (8 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor

CA1	Problem Understanding & Dataset Planning	Understand the classification/clustering problem; identify the dataset, required libraries and expected outcomes.	CO7, CO8
CA2	Experimental Design & Tool Configuration	Plan experiments and configure tools such as Python, scikit-learn, Jupyter Notebook and relevant ML libraries.	CO7, CO9
CA3	Implementation, Coding & Execution	Correctly implement algorithms/programs and execute them to obtain expected classification/clustering outputs.	CO7, CO8
CA4	Troubleshooting, Testing & Performance Analysis	Troubleshoot coding/execution errors; analyze accuracy, precision, recall and clustering performance.	CO7, CO8
CA5	Output Analysis & Result Interpretation	Analyze outputs, decision boundaries, cluster assignments and classification results logically.	CO8, CO9
CA6	Documentation & Result Verification	Maintain proper lab records/notebooks and verify outputs against experiment objectives.	CO7, CO8, CO9
CA7	Algorithm & Model Design	Design classifier/clustering logic and feature-selection strategy before execution; justify the chosen approach.	CO8, CO9, CO10
CA8	Lab Record Maintenance, Viva & Professional Practice	Maintain complete lab records and demonstrate conceptual understanding and professional conduct during viva.	CO7, CO9, CO10

13. Project Skill Dimensions (13 Dimensions - Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Relate the pattern recognition mini project to societal needs such as healthcare diagnostics, security or education.	CO10 | PO6
P2	Problem Scoping & Requirements	Define project scope, dataset requirements, problem statement and measurable objectives clearly.	CO8 | PO2
P3	Communication & Testing Strategy	Plan team communication, validation strategy, experiment design and task coordination.	CO10 | PO9
P4	Model/Solution Design	Propose a suitable classification/clustering solution with alternatives and justification.	CO8 | PO3
P5	Professional Toolchain & Resource Usage	Select and use appropriate ML tools/libraries (Python, scikit-learn, TensorFlow) and configure the project environment.	CO7 | PO5
P6	End-to-End Implementation	Develop and integrate a complete pattern recognition pipeline using multiple syllabus concepts and tools.	CO7, CO8 | PO3
P7	System Testing & Troubleshooting	Execute testing, troubleshoot errors and verify correct working of the implemented model.	CO7, CO8 | PO5
P8	Result Evaluation & Performance Analysis	Evaluate outputs against objectives and analyze accuracy/clustering performance using appropriate metrics.	CO8 | PO6
P9	Technical Analysis & Documentation	Perform comparative analysis, maintain plots/logs and prepare structured technical documentation/report.	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver the project presentation/demo professionally and demonstrate teamwork and task sharing.	CO10 | PO8, PO9
P11	Project Planning & Resource Management	Plan implementation stages, manage available lab/software resources and justify tool utilization.	CO10 | PO10
P12	Skill Development & Learning Reflection	Reflect on learning outcomes, pattern recognition skills gained and individual contribution to the project.	CO9 | PO11
P13	Professional Ethics & Responsible Practice	Demonstrate ethical conduct, originality, responsible use of data/tools and proper documentation practices.	CO9 | PO7

PART IV

OUTCOME MAPPING & POLICY

CO-PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

14. CO x Skill Dimensions Mapping (10 COs x [6 Theory + 8 CA + 13 Project Dimensions])

i *Theory COs (CO1-CO6) are fully mapped to TS1-TS6. Lab COs (CO7-CO10) intentionally have no TS mapping - confirming strict assessment separation. CA and Project dimensions apply only to Lab COs.*

CO	TS1	TS2	TS3	TS4	TS5	TS6	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	P1	P2	P3	P4	P5	P6	P7	P
CO1	✓																					
CO2		✓																				
CO3			✓																			
CO4				✓																		
CO5					✓																	
CO6						✓																
CO7							✓	✓	✓	✓		✓		✓					✓	✓	✓	
CO8							✓		✓	✓	✓	✓	✓			✓		✓		✓	✓	✓
CO9								✓			✓	✓	✓	✓								
CO10													✓	✓	✓		✓					

15. CO-PO and CO-PSO Mapping Matrix (All 10 COs)

i *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | - = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	2	3	3	2	2	2	2	2	2	3	2	2
CO2	3	2	2	2	3	2	-	-	3	-	-	3	2	3
CO3	3	3	3	3	3	3	3	3	2	2	-	3	2	2
CO4	3	3	3	3	3	3	2	-	2	-	-	3	2	1
CO5	-	2	3	2	3	2	2	3	2	-	2	3	2	2
CO6	3	2	3	-	3	-	2	3	2	-	-	3	2	2
CO7	2	2	2	3	3	-	-	-	-	-	1	2	2	1
CO8	2	3	2	2	3	-	-	-	-	-	1	2	2	1
CO9	2	3	3	2	2	-	-	-	-	-	2	2	1	1
CO10	2	3	2	2	2	1	1	2	2	1	2	2	1	1
Avg	**2.44**	**2.56**	**2.50**	**2.44**	**2.80**	**2.17**	**2.00**	**2.60**	**2.14**	**1.67**	**1.67**	**2.60**	**1.80**	**1.60**

***** *Lab COs (CO7-CO10) extend coverage to PO6-PO10 primarily through the Mini Project (CO10), while individual experiments (CO7-CO9) reinforce PO1-PO5 and PO11.*

16. CO x PO Alignment Map (H/M Indicators - All 10 COs x 11 POs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M		M	H	H	M	M	M	M	M	M
CO2	H	M	M	M	H	M			H		
CO3	H	H	H	H	H	H	H	H	M	M	

CO4	**H**	**H**	**H**	**H**	**H**	**H**	**M**		**M**		
CO5		**M**	**H**	**M**	**H**	**M**	**M**	**H**	**M**		**M**
CO6	**H**	**M**	**H**		**H**		**M**	**H**	**M**		
CO7	**M**	**M**	**M**	**H**	**H**						**M**
CO8	**M**	**H**	**M**	**M**	**H**						**M**
CO9	**M**	**H**	**H**	**M**	**M**						**M**
CO10	**M**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping Strength	Justification
SDG 4 - Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	**3 (High)**	Develops strong conceptual and hands-on understanding of pattern recognition, statistical modelling, classification and clustering; strengthens practical AI/ML competency and supports lifelong learning (CO1-CO6, CO9).
SDG 8 - Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.	**2 (Moderate)**	Builds industry-relevant skills in classification, clustering and feature engineering using Python/scikit-learn that are in high demand across AI, healthcare analytics, cybersecurity and data science sectors (CO7-CO10).
SDG 9 - Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	**3 (High)**	Focuses on implementation of advanced pattern recognition techniques (SVM, neural networks, biometrics) that support innovation in smart systems, automation and AI-driven applications (CO3, CO8, CO10).
SDG 3 - Good Health and Well-Being	Ensure healthy lives and promote well-being for all at all ages.	**2 (Moderate)**	Several experiments and applications (Bayesian network diagnosis of heart disease, biometric recognition) directly support healthcare diagnostics and medical decision-support applications (CO4, CO7, CO8).

18. Bloom's Taxonomy - Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain - Simpson (7 Levels)
L1 - Remember: Recall facts, definitions, basic concepts L2 - Understand: Explain ideas, concepts, principles L3 - Apply: Use knowledge to solve new problems L4 - Analyze: Break down information, examine patterns L5 - Evaluate: Judge, justify, assess, make decisions L6 - Create: Design, develop, produce new solutions	A1 - Receiving: Awareness, willingness to attend A2 - Responding: Active participation and reaction A3 - Valuing: Showing commitment, assigning value A4 - Organizing: Integrating values into personal system A5 - Characterizing: Internalized value system	P1 - Perception: Sensory cues guide motor activity P2 - Set: Mental, physical readiness to act P3 - Guided Response: Basic practice through imitation P4 - Mechanism: Habitual correct performance P5 - Complex Overt Response: Skilled performance P6 - Adaptation: Modify skills for special situations P7 - Origination: Create new solution patterns

***** *OBE Compliance Statement: Theory COs (CO1-CO6) are primarily mapped to the Cognitive domain (L1-L6). Lab COs (CO7-CO10) span all three domains - Cognitive (L2-L6), Psychomotor (P3-P7), and Affective (A2-A5) - reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	70%	All lecture sessions	Debarred from ETE
Practical / Lab	70%	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	75%	Combined sessions	Debarred from ETE

! *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	≥ 20 / 50	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	≥ 40 / 100	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

APPLIED PATTERN RECOGNITION INTEGRATED COURSE PLAN - MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1-CO6 (MTE + ETE): PO1-PO11 | 6 Theory Skill Dims (TS1-TS6)

Lab Tier CO7-CO10 (Lab only): PO1-PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

Applied Pattern Recognition - Theory & Lab Syllabus Summary

Unit 1: Introduction and Mathematical Preliminaries

Unit 2: Bayes Decision Theory

Unit 3: Clustering

Unit 4: Feature Extraction and Feature Selection

Unit 5: Recent Advances in Pattern Recognition

Laboratory Experiments

- Naive Bayesian classifier for document/data classification
- Bayesian network construction for medical diagnosis
- K-Means and EM clustering with comparison of results
- PCA-based dimensionality reduction on standard datasets
- Nearest-Neighbor classification with decision boundary visualization
- Non-linear SVM (RBF kernel) based classification
- Neural network based classification on standard datasets
- Mini project: end-to-end pattern recognition solution design and evaluation

School: SSCSE		**Batch: 2026-2030**
Program: B.Tech		**Current Academic Year: 2029-30**
Branch: CSE with specialization in AIOT		**Semester: VII**
1	Course Code	CSOT 4204
2	Course Title	**Fog Computing in IoT**
3	Credits	2
4	Contact Hours (L-T-P-SL)	2-0-0-2
	Course Status	Program Elective
5	Course Objective	1. **Introduce the fundamental concepts** of fog and edge computing. 2. **Explain the architecture and components** involved in fog and edge systems. 3. **Explore middleware technologies** that support fog and edge application development. 4. **Present practical technological solutions** for implementing real-world fog and edge applications.
6	Course Outcomes	After the completion of this course students will be able to: **CO1**: Define the IoT paradigm along with CIoT limitations **CO2:** Outline the integrated cloud-to-things system comprising cloud computing, fog computing, and the IoT **CO3:** Assess the optimization problems in Fog and Edge computing architecture **CO4:** Evaluate the conceptual architecture for the data management in fog computing environments **CO5:** Explain the different IoT applications with fog computing **CO6:** Discuss the foundations, middleware, data management and applications of fog computing.
7	Course Description	The course covers the state-of-the-art in fog and edge computing, their applications, architectures, and technologies.

8	Teaching and Learning Scheme (in Hours per Semester)	Classroom Instructions (CI)		Lab Instructions (LI)	Team Work (TW) and Self Learning (SL) (TW+SL)	Total number of Hours	Total Credits TH/30
		L	T	P	SL	TH	
		30	0	0	30	60	2

8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Fog Computing**	
	A	IoT and New Computing Paradigms: Fog and Edge Computing Completing the Cloud, Advantages, Hierarchy of Fog and Edge Computing	CO1,CO6
	B	Business Models, Opportunities and Challenges	CO1,CO6
	C	Addressing the Challenges in Federating Edge Resources: Networking and Management Challenge	CO1,CO6
	Unit 2	**Optimization Problems in FEC**	
	A	Introduction and Case for Optimization in Fog Computing	CO2
	B	Formal Modeling Framework for Fog Computing, Metrics: Performance, Resource Usage, Energy Consumption, Financial Cost	CO2
	C	Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle	CO2,CO6
	Unit 3	**Middleware for Fog and Edge Computing**	
	A	Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures	CO3, CO6
	B	System Model: Embedded Sensors or Actuators, Personal Devices, Fog Servers, Cloudlets, Cloud Servers, Proposed Architecture: API Code, Security, Device Discovery	CO3, CO6
	C	Middleware: Context Monitoring and Prediction, Selection of Participating Devices, Data Analytics, Scheduling and Resource Management, Network Management, Execution Management, Mobility Management, Sensor/Actuators	CO3, CO6
	Unit 4	**Data Management in Fog Computing**	
	A	Introduction, Fog Data Management: Fog Data Life Cycle	CO4, CO6
	B	Data Characteristics, Data Pre-Processing and Analytics	CO4, CO6
	C	Data Privacy, Data Storage and Data Placement, Proposed Architecture	CO4, CO6
	Unit 5	**Fog Computing Applications**	

<table>
<tr><td></td><td>A</td><td colspan="3">Fog Applications: Healthcare and Well-being, Smart Vehicle Management</td><td>CO5, CO6</td></tr>
<tr><td></td><td>B</td><td colspan="3">Fog Applications: Smart City Applications, Smart Data Management</td><td>CO5, CO6</td></tr>
<tr><td></td><td>C</td><td colspan="3">Other Emerging Application Sectors</td><td>CO5, CO6</td></tr>
<tr><td>10</td><td>List of activities for Self Learning
(SL: 30h)</td><td colspan="4"><table>
<tr><th>S. No.</th><th>Name of the Activity</th><th>No. of Hours</th><th>Evaluation Criteria</th></tr>
<tr><td>1</td><td>Fog and Edge Computing Architecture Exploration – Explore fog and edge computing paradigms, cloud-to-things architecture, fog hierarchy, IoT limitations, and fog-enabled system models through simulations, case studies, or conceptual analysis.</td><td>10h</td><td>Practical demonstration, conceptual understanding, report submission, architecture analysis, and viva evaluation.</td></tr>
<tr><td>2</td><td>Middleware and Data Management Analysis in Fog Computing – Study middleware technologies, device discovery, scheduling, resource management, mobility management, fog data lifecycle, data analytics, and privacy mechanisms in fog environments.</td><td>10h</td><td>Quiz, assignment, middleware understanding, performance-based assessment, and technical analysis evaluation.</td></tr>
<tr><td>3</td><td>Mini Project on Fog Computing Applications and Optimization – Design and develop a mini project or case study on fog-enabled IoT applications such as smart healthcare, smart vehicle management, smart cities, or fog-based data management with optimization techniques.</td><td>10h</td><td>Project presentation, prototype/case study demonstration, innovation, documentation quality, technical implementation, and evaluation of system functionality.</td></tr>
</table></td></tr>
<tr><td></td><td>Mode of examination</td><td colspan="3">Theory/Jury/Practical/Viva</td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MSE</td><td>ESE</td><td></td></tr>
<tr><td>25%</td><td>15%</td><td>60%</td><td></td></tr>
</table>

	Text book/s*	1. Fog and Edge Computing: Principles and Paradigms, Editor Buyya, Srirama, JohnWiley& Sons 2. Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things, Sudip Misra, Subhadeep Sarkar, Subarna Chatterjee, CRC Press	
	Other References	1. Fog and Edge Computing: Principles and Paradigms, Editor Buyya, Srirama, JohnWiley& Sons 2. Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things, Sudip Misra, Subhadeep Sarkar, Subarna Chatterjee, CRC Press	

PO and PSO mapping with level of strength for Course: CSOT 4204

	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO2	PSO 3
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	2	-	-	2	-	-	-	2	2	2	2
CO3	3	3	3	3	2	-	1	2	-	-	-	3	3	2
CO4	2	3	3	3	3	1	1	2	-	-	2	3	3	2
CO5	3	2	3	2	3	2	-	2	2	2	2	3	3	3
CO6	3	2	3	3	3	2	1	3	2	2	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software

CSOT4203, Fog Computing in IoT	2.83	2.33	2.8	2.6	2.75	1.66	1.25	2.25	2	2	2.25	2.66	2.66	2.4

Strength of Correlation:

1. Addressed to***Slight (Low=1)*** ***extent***

2. Addressed to***Moderate (Medium=2)*** ***extent***

3. Addressed to***Substantial (High=3)*** ***extent***

SDG Goal	Description	Mapping Strength	Justification
SDG 9 – Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	**High**	The course focuses on fog and edge computing, cloud-to-things architecture, middleware technologies, optimization in fog environments, and smart IoT infrastructures, promoting digital innovation and resilient computing systems.
SDG 4 – Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	**High**	The course develops technical competencies in fog computing, IoT paradigms, middleware technologies, optimization techniques, data management, and emerging edge computing systems through practical learning and self-study activities.
SDG 11 – Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable	**High**	Fog-enabled IoT applications such as smart city management, smart healthcare, vehicle management, and intelligent urban systems support sustainable, resilient, and connected communities.
SDG 12 – Responsible Consumption and Production	Ensure sustainable consumption and production patterns	**Moderate**	Fog computing improves efficient data processing, resource optimization, reduced network overhead, and energy-efficient computing, supporting sustainable digital resource management.
SDG 13 – Climate Action	Take urgent action to combat climate change and its impacts	**Moderate**	Fog-based environmental monitoring, smart sensing, real-time analytics, and distributed computing contribute to climate monitoring, energy efficiency, and environmental sustainability initiatives.
SDG 8 – Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	**Moderate**	The course equips students with skills in fog computing, edge computing, middleware systems, cloud integration, and IoT applications that are highly relevant to emerging smart technology industries and digital transformation sectors.
SDG 17 – Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development	**Low**	Fog and edge ecosystems encourage collaboration among academia, industries, cloud providers, IoT developers, and researchers for implementing distributed smart systems and innovative applications.
SDG 16 – Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable institutions	**Low**	Secure fog architectures, privacy-aware data management, and trusted distributed systems contribute to reliable digital governance and secure IoT-based infrastructures.

COURSE PLAN

Exploit Writing (CSCF4202)

Sharda School of Computing Science & Engineering | B.Tech CSE | Semester VII | Batch 2023–2027

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	VII
Course Code:	**CSCF4202**	**Course Type:**	Elective

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCF4202**
2	**Course Title**	**Exploit Writing**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Core — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Understand exploit development concepts and cybersecurity vulnerabilities, analyze memory-level attacks, 2. Learn exploit writing techniques using scripting and debugging tools, evaluate modern protection mechanisms, and develop secure and 3. Ethical practices in penetration testing and exploit development.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** After the completion of this course students will be able to: CO1 (Remember– L1) Define exploit development lifecycle, exploit writing concepts, and their role in cybersecurity CO2 (Understand – L2) Explain scripting techniques using PowerShell and Python for exploit automation CO3 (Apply– L3)

		Apply buffer overflow concepts and memory-level exploitation techniques CO4 (Analyze – L4) Analyze program execution using debugging tools and identify vulnerabilities CO5 (Evaluate – L5) Evaluate protection mechanisms such as DEP, ASLR, and fuzzing techniques CO6 (Create – L6) Design and implement exploits targeting real-world systems in Windows and Linux
8	**Course Description**	This course introduces exploit writing techniques and their role in penetration testing and security research. It focuses on exploit development lifecycle, memory vulnerabilities, debugging techniques, and modern protection mechanisms. Students gain practical exposure to exploit development in real-world systems while emphasizing ethical practices and secure system design.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Textbook: 1. The Art of Exploit Development – Josh Luberisse
12	**References**	Other References: 1. A Guide to Kernel Exploitation – Enrico Perla

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
	Unit 1: Exploit Writing Basics	
A	Overview of Exploit Writing, Lifecycle, Role in Security	CO1, CO2
B	Exploit Writing and Shellcoding	CO2, CO3
C	Types of Exploits (Stack Overflow)	CO3, CO4
	Unit 2: Programming for Exploits	
A	PowerShell Programming for Exploitation	CO2, CO3
B	Python Scripting for Exploit Development	CO2, CO3, CO6
C	Assembly Language Basics for Exploitation	CO3, CO4
	Unit 3: Debugging & Protection Mechanisms	

A	Debugging in Linux (GDB, Automation)	CO4, CO5
B	Address Space Layout Randomization (ASLR)	CO4, CO5
C	DEP and Memory Protection Mechanisms	CO4, CO5
	Unit 4: Exploit Techniques	
A	A Shellcode Techniques (Spawning, Port Binding, Reverse Shell)	CO3, CO4, CO6
B	Exploit Challenges and Antivirus Bypass	CO4, CO5, CO6
C	Advanced Exploitation (SEH, Egg Hunting)	CO4, CO5, CO6
	Unit 5: Advanced Exploit Applications	
A	Windows & Linux Buffer Overflow Exploitation	CO3, CO4, CO6
B	Kernel Exploitation (UAF, Double Free)	CO4, CO5, CO6
C	Remote Code Execution (RCE) Techniques	CO4, CO5, CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C			✓	✓		
4	2.A		✓	✓			
5	2.B		✓	✓			✓
6	2.C			✓	✓		
7	3.A				✓	✓	
8	3.B				✓	✓	
9	3.C				✓	✓	
10	4.A			✓	✓		✓
11	4.B				✓	✓	✓
12	4.C				✓	✓	✓
13	5.A			✓	✓		✓
14	5.B				✓	✓	✓

15	5.C				✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓						✓					✓						
CO2		✓					✓	✓					✓	✓				
CO3			✓					✓	✓					✓	✓			
CO4				✓					✓	✓					✓	✓		
CO5					✓				✓	✓						✓	✓	
CO6						✓				✓	✓					✓	✓	✓

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 30 hours across 5 units. Self-Learning activities (30 hrs) are structured separately in Section 11.*

Lecture No.	Date	Topics to be Covered / Title	Unit	Total Lectures
1	DD/MM/YY	Introduction to Exploit Writing	UNIT-1	9
2	DD/MM/YY	Exploit Development Lifecycle		
3	DD/MM/YY	Role of Exploits in Cyber Security		
4	DD/MM/YY	Prerequisites for Exploit Writing		
5	DD/MM/YY	Basics of Shellcoding		
6	DD/MM/YY	Stack Memory Organization		
7	DD/MM/YY	Stack Overflow Exploits		
8	DD/MM/YY	Simple Buffer Overflow Demonstration		
9	DD/MM/YY	Unit Review and Practice Session		
10	DD/MM/YY	Introduction to Programming for Exploit Development	UNIT-2	9
11	DD/MM/YY	PowerShell Programming Basics		
12	DD/MM/YY	PowerShell Scripting Fundamentals		
13	DD/MM/YY	PowerShell Exploitation Scripts		
14	DD/MM/YY	Python Scripting for Exploit Development		
15	DD/MM/YY	Python Libraries for Networking		
16	DD/MM/YY	Networking Libraries: Socket and Scapy		

17	DD/MM/YY	Assembly Language Basics for Exploits		
18	DD/MM/YY	Assembly Instructions and Registers		
19	DD/MM/YY	Introduction to Debugging Concepts in Linux	UNIT-3	9
20	DD/MM/YY	Linux Process and Memory Management		
21	DD/MM/YY	Getting Started with GDB		
22	DD/MM/YY	Breakpoints and Stack Inspection in GDB		
23	DD/MM/YY	Automating Debugging using GDB Scripts		
24	DD/MM/YY	Address Space Layout Randomization (ASLR)		
25	DD/MM/YY	Techniques for Bypassing ASLR		
26	DD/MM/YY	DEP Protection Mechanisms		
27	DD/MM/YY	Memory Protection Techniques and Review		
28	DD/MM/YY	Introduction to Shellcode Development	UNIT-4	9
29	DD/MM/YY	Writing Basic Shellcode		
30	DD/MM/YY	Shell-Spawning Techniques		
31	DD/MM/YY	Port Binding Concepts		
32	DD/MM/YY	Connect-Back Shells		
33	DD/MM/YY	Introduction to Fuzzing Techniques		
34	DD/MM/YY	SPIKE Fuzzer and Vulnerability Discovery		
35	DD/MM/YY	Exploit Challenges: KSTET and GMON		
36	DD/MM/YY	Antivirus Bypass Techniques		
37	DD/MM/YY	Introduction to Windows and Linux Exploitation	UNIT-5	9
38	DD/MM/YY	Buffer Overflow Exploitation in Windows		
39	DD/MM/YY	Buffer Overflow Exploitation in Linux		
40	DD/MM/YY	Kernel Exploitation Concepts		
41	DD/MM/YY	Use-After-Free and Double Free Vulnerabilities		
42	DD/MM/YY	Remote Code Execution (RCE) Concepts		
43	DD/MM/YY	RCE in Linux: Case Studies		
44	DD/MM/YY	RCE in Windows: Case Studies		
45	DD/MM/YY	Secure Coding Practices and Final Review		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Conceptual Recall & Exploit Fundamentals**	Recall exploit writing terminology, exploit lifecycle, shellcoding concepts, memory structures, and cybersecurity fundamentals; identify exploit categories and attack vectors	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Scripting Interpretation**	Explain PowerShell, Python scripting, assembly basics, debugging workflows, and exploit automation techniques; interpret exploit execution flow and memory behavior	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	**Exploit Development Application & Implementation**	Apply buffer overflow techniques, shellcoding methods, scripting tools, and debugging utilities to develop and test exploits in controlled environments	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	**Vulnerability Analysis & Exploit Evaluation**	Analyze program execution, trace vulnerabilities using debugging tools, identify memory corruption issues, and evaluate exploit feasibility and impact	CO4 | L4–L5	MTE Sec B | ETE Sec B
TS5	**Protection Mechanism & Security Evaluation**	Compare DEP, ASLR, fuzzing, antivirus bypass, and memory protection mechanisms; evaluate their effectiveness against modern exploitation techniques	CO5 | L4–L5	ETE Sec B/C
TS6	**Advanced Exploit Design & System-Level Exploitation**	Design and implement secure exploit strategies targeting Windows/Linux systems, kernel vulnerabilities, and remote code execution scenarios	CO6 | L5–L6	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Exploit Writing Fundamentals & Security Concepts	TS2 Scripting Techniques & Exploit Automation	TS3 Buffer Overflow & Exploit Implementation	TS4 Debugging & Vulnerability Analysis	TS5 Protection Mechanisms & Security Evaluation	TS6 Advanced Exploit Design & System Exploitation
CO1	H	H	M		-	-
CO2	H	H	M	M	M	-
CO3	H	H	M	H	H	M
CO4	M	M			M	M

CO5	M	H	M	M	H	H
CO6	H	H	H	M	H	H

H = High / Primary alignment M = Medium / Secondary alignment Blank = No direct alignment

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions
Assignments 1–5 (Exploit Development, Buffer Overflow, Shellcoding & Debugging Problems)	5 Assignments	15	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Tool Demonstration / Video Learning Report	1 Report + Presentation	5	CO2, CO3, CO5	TS2, TS3, TS5
Real-World Exploit Analysis & Vulnerability Case Study (Report)	1 Report	5	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	**—**	**25**	**CO1–CO6**	**TS1–TS6**

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	concepts: Exploit writing overview, exploit lifecycle, shellcoding basics, types of exploits	CO1, CO2	TS1, TS2	5h SL	Conceptual understanding, terminology accuracy, report submission
Assignment 2	PowerShell and Python scripting for exploit automation, assembly language basics	CO2, CO3	TS2, TS3	5h SL	Script development, workflow explanation, exploit implementation accuracy
Assignment 3	Buffer overflow concepts, shellcode techniques, debugging using GDB and automation tools	CO3, CO4	TS3, TS4	5h SL	Vulnerability analysis, practical implementation, debugging effectiveness
Assignment 4	ASLR, DEP, antivirus bypass, exploit mitigation and protection mechanisms	CO4, CO5	TS4, TS5	5h SL	Comparative analysis, security evaluation,

					mitigation strategy assessment
Assignment 5	Advanced exploitation: kernel exploits, RCE techniques, Windows/Linux exploit development	CO5, CO6	TS5, TS6	5h SL	Exploit design proposal, advanced exploitation methodology, technical justification
Video Learning Report	Technical video on exploit writing, shellcoding, debugging, fuzzing, or exploit mitigation techniques (min 3 hrs); structured report + presentation	CO2, CO3, CO5	TS2, TS3, TS5	9h SL	Learning outcomes, technical understanding, self-reflection, 10-minute presentation
Case Study Report	Real-world exploit and vulnerability case study (e.g., buffer overflow attacks, WannaCry exploitation, kernel exploits, RCE vulnerabilities)	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, exploit analysis, comparative evaluation, mitigation and defense recommendations

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	10	TS1 — Exploit Writing Fundamentals & Security Concepts TS2 — Scripting Techniques & Exploit Automation	CO1, CO2	Short-answer questions: define exploit writing concepts, explain exploit lifecycle, describe shellcoding basics, explain PowerShell/Python scripting techniques, assembly fundamentals, debugging concepts, and exploit automation workflows
Section B	15	TS3 — Buffer Overflow & Exploit Implementation TS4 — Debugging & Vulnerability Analysis	CO2, CO3, CO4	Analytical and application-based questions: buffer overflow analysis, shellcode implementation, debugging using GDB, vulnerability tracing, exploit workflow analysis, memory corruption interpretation, and exploit development case studies
TOTAL	**25**	**TS1–TS4**	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1 — Exploit Writing Fundamentals & Security Concepts TS2 — Scripting Techniques & Exploit Automation	CO1, CO2	Short questions (all units): definitions of exploit writing concepts, exploit lifecycle, shellcoding terminology, scripting fundamentals, assembly basics, debugging concepts, memory structures, and exploit automation techniques
Section B	25	TS3 — Buffer Overflow & Exploit Implementation TS4 — Debugging & Vulnerability Analysis TS5 — Protection Mechanisms & Security Evaluation	CO3, CO4, CO5	Medium questions: buffer overflow analysis, shellcode creation, debugging using GDB, exploit tracing, vulnerability identification, ASLR/DEP analysis, fuzzing techniques, antivirus bypass methods, and exploit mitigation comparisons
Section C	10	TS5 — Protection Mechanisms & Security Evaluation TS6 — Advanced Exploit Design & System Exploitation	CO5, CO6	Long/evaluation questions: Windows/Linux exploit development, kernel exploitation analysis, RCE techniques, advanced exploitation methods (SEH, Egg Hunting), exploit defense evaluation, and real-world exploit case study analysis
TOTAL	**50**	**TS1–TS6 (all)**	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand exploit development lifecycle, exploit writing concepts, and cybersecurity fundamentals	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Explain scripting techniques using PowerShell and Python for exploit automation	✓	✓	✓	TS2	PO1, PO2, PO3, PO5
CO3	Apply buffer overflow concepts and memory-level exploitation techniques	✓	✓	✓	TS3	PO1, PO2, PO3, PO5
CO4	Analyze program execution using debugging tools and identify vulnerabilities	✓	✓	✓	TS4	PO2, PO3, PO4, PO10

CO5	Evaluate protection mechanisms such as DEP, ASLR, fuzzing, and exploit mitigation techniques	✓	—	✓	TS5	PO1, PO2, PO8, PO10, PO11
CO6	Design and implement exploits targeting Windows, Linux, and real-world vulnerable systems	✓	—	✓	TS6	PO3, PO4, PO5, PO10, PO11, PO12

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	2	2	3	2
CO2	3	3	2	2	2	-	-	-	-	-	3	3	3	3
CO3	3	3	2	3	3	2	-	2	2	2	2	3	2	3
CO4	2	2	1	1	2	2	2	2	-	1	2	2	2	2
CO5	2	3	2	2	3	3	2	-	2	2	1	2	2	2
CO6	3	3	3	2	3	3	3	2	2	3	3	3	3	3
Avg	2.67	2.83	2.00	1.83	2.60	2.50	2.33	2.00	2.00	2.00	2.17	2.50	2.50	2.50

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	H	M		-	-	-	-	-	-	M	M	H	M
CO2	H	H	M	M	M	-	-	-	-	-	H	H	H	H
CO3	H	H	M	H	H	M	-	M	M	M	M	H	M	H
CO4	M	M			M	M	M	M	-		M	M	M	M
CO5	M	H	M	M	H	H	M	-	M	M		M	M	M
CO6	H	H	H	M	H	H	H	M	M	H	H	H	H	H

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	Assignment Writing (5 assignments based on exploit development, shellcoding, buffer overflow analysis, debugging, and exploit mitigation techniques)	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on assignment submission, exploit analysis accuracy, vulnerability identification, scripting/debugging tool usage, shellcode implementation, and analytical reasoning
2	Technical Video-Based Learning related to Exploit Writing and Vulnerability Research (e.g., buffer overflows, GDB debugging, shellcoding, ASLR/DEP bypass, fuzzing techniques)	Total = 15 hrs	CO2, CO3, CO5 TS2, TS3, TS5	Report + Presentation based on learning outcomes; must include exploit development concepts, debugging workflows, protection mechanisms, exploit-defense techniques, and personal technical reflections
3	Real-World Exploit & Vulnerability Case Studies (e.g., WannaCry exploitation, EternalBlue, kernel exploits, RCE vulnerabilities, antivirus bypass techniques)	Total = 15 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, exploit analysis, debugging observations, vulnerability assessment, mitigation strategies, secure exploitation practices, and analytical conclusions
	TOTAL Self-Learning Hours	**45 hours**	**CO1–CO6**	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

CSCF4202— EXPLOIT WRITING

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C
CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

School: SSCSE		**Batch: 2026-2030**
Program: B-TECH		**Current Academic Year: 2029-30**
Branch: CSE		**Semester: VII**
1	**Course Code**	CSAI4202
2	**Course Title**	Robotics and Intelligent Systems
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3
	Course Status	Specialization Elective
5	**Course Objective**	1. Fundamental principles of robot system design and operation. 2. How to apply concepts of translational and rotational motion, and gears to robot construction. 3. To design and program simple autonomous robots. To implement algorithms that enables the use of sensors and actuators to facilitate intelligent behavior, learning and perception.
6	**Course Outcomes (CO's)**	Upon successful completion of the course, students will be able to: CO-1. Define the concept and key components of robotics technologies. CO-2. Classify various robot sensors and their perception principles that enable a robot to analyze their environment, reason and take appropriate actions toward the given goal. CO-3. Apply the learned knowledge and skills in practical robotics laboratories and experiments. CO-4. Analyze problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning. CO-5. Assess stochastic control and multi agent systems for development of a robotic system. CO-6. Adapt intelligent system methodology suitable for a given type of real world application problem.
7	**Course Description**	Basic concepts of Robotics, Intelligent Systems and transformational modeling. This course provides students with a working knowledge of methods for design and analysis of robotic and intelligent systems. Particular attention is given to modeling dynamic systems, measuring and controlling their behavior, and making decisions about future courses of action

8 Teaching and Learning Scheme (in Hours per Semester)

Classroom Instructions (CI)		Lab Instructions (LI)	Team Work (TW) and Self Learning (SL) (TW+SL)	Total number of Hours	Total Credits TH/30
L	T	P	SL	TH	
45	0	0	45	90	3

9	**Syllabus Outline**		**CO Mapping**
	Unit 1	**Overview and Preliminaries**	
	A	Mobile Robots, Position, and Orientation	CO1
	B	Translational and Rotational Dynamics	CO1, CO2
	C	Flying and Swimming Robots, Articulated Robots	CO1, CO2
	Unit 2	**Transformation**,	
	A	Path Planning, and Trajectories	CO1, CO2
	B	Time Response of Dynamic Systems	CO1, CO2
	C	Dynamic Effects of Feedback Control, Control Systems	CO1, CO2
	Unit 3	**Optimization**	
	A	Sensors and Actuators	CO1, CO2, CO4
	B	Numerical Optimization	CO1, CO2, CO4
	C	Dynamic Optimal Control	CO1, CO2, CO4

	Unit 4	**Formal Logic, Algorithms, and Incompleteness**	
	A	Computers, Computing, and Sets	CO3, CO5
	B	Probability and Statistics	CO3, CO5
	C	Machine Learning, Neural Networks	CO3, CO5
	Unit 5	**Information, Search and Expert Systems**	
	A	State Estimation, Stochastic Control	CO3, CO5, CO6
	B	Parameter Estimation and Adaptive Control	CO3, CO5, CO6
	C	Task Planning and Multi-Agent Systems	CO3, CO5, CO6

10 List of activities for Self Learning (SL)

S. No.	Name of the Activity	No. of Hours	Evaluation Criteria
1	Technical Video Based Learning on Robotics and Intelligent Systems	Duration of video = 5h; Report preparation = 5h; Presentation = 5h, **Total = 15h**	Report / presentation based on understanding of robot kinematics, sensors and actuators, control systems, and AI integration in robotics
2	Case Study Analysis of Real-World Robotic Applications (Industrial / Healthcare / Service Robots)	Data collection / study = 5h; Analysis = 5h; Report writing = 5h, **Total = 15h**	Based on technical depth, understanding of robotic system design, application relevance, and problem-solving approach
3	Comparative Study of Robotic Systems and Control Techniques	Algorithm study = 10h; Summary report = 5h, **Total = 15h**	Based on comparison of robotic platforms (e.g., autonomous vs semi-autonomous systems), control methods, clarity of concepts, and correctness of analysis

	Mode of examination	Theory	

Weightage Distribution

CA				ETE
Assessment 1 (10)	Assessment 2 (5)	Assignment 1 (5)	Assignment 2 (5)	75

Text Books

1. http://www.princeton.edu/~stengel/RISVirText.html.
2. J. J. Craig, Introduction to Robotics, Addison Wesley Publishers, 2005,
3. Computational Principles of Mobile Robotics by Gregory Dudek and Michael Jenkin, Second Edition

Reference Books

1. M. Negnevitsky, Artificial Intelligence – A guide to intelligent systems Addison-Wesley, 2005,
2. Bharati A., Sangal R., ChaitanyaV..Natural language processing: a Paninian perspective, PHI, 2000

Online Materials

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Topic-wise BTL Mapping – CSAI4201

S. No.	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	Mobile Robots, Position, and Orientation	✓	✓				
2	Translational and Rotational Dynamics	✓	✓				
3	Flying and Swimming Robots, Articulated Robots		✓	✓		✓	
4	Path Planning, and Trajectories	✓	✓				

5	Time Response of Dynamic Systems	✓	✓	✓	✓		
6	Dynamic Effects of Feedback Control, Control Systems	✓	✓	✓			
7	Sensors and Actuators	✓	✓	✓	✓		
8	Numerical Optimization		✓	✓	✓		
9	Dynamic Optimal Control		✓	✓	✓		
10	Computers, Computing, and Sets		✓	✓	✓		
11	Probability and Statistics	✓	✓	✓		✓	
12	Machine Learning, Neural Networks		✓	✓	✓	✓	
13	State Estimation, Stochastic Control	✓	✓	✓		✓	
14	Parameter Estimation and Adaptive Control		✓	✓	✓	✓	✓
15	Task Planning and Multi-Agent Systems		✓	✓	✓	✓	✓

Unit 1 Lecture Plan Outline (9 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Introduction to Mobile Robots	CO1	9
DD/MM/YY	Robot Position Representation	CO1	
DD/MM/YY	Robot Orientation	CO1, CO2	
DD/MM/YY	Kinematics of Mobile Robots	CO1, CO2	
DD/MM/YY	Translational Dynamics	CO1, CO2	
DD/MM/YY	Rotational Dynamics	CO1, CO2	
DD/MM/YY	Dynamics Modeling of Robots	CO1, CO2	
DD/MM/YY	Flying and Swimming Robots	CO1, CO2	
DD/MM/YY	Articulated Robots	CO1, CO2	

Unit 2 Lecture Plan Outline (10 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Path Planning in Robotics	CO2	10
DD/MM/YY	Trajectory Generation and Optimization	CO2	
DD/MM/YY	Configuration Space (C-space) Concepts	CO2, CO3	
DD/MM/YY	Obstacle Avoidance Techniques	CO2, CO3	
DD/MM/YY	Time Response of Dynamic Systems	CO2, CO3	
DD/MM/YY	First and Second Order System Response	CO2, CO3	
DD/MM/YY	Stability Analysis of Dynamic Systems	CO2, CO3	
DD/MM/YY	Feedback Control Systems Basics	CO2, CO3	
DD/MM/YY	Dynamic Effects of Feedback Control	CO2, CO3	
DD/MM/YY	Controllers (PID, Adaptive, Robust Control)	CO2, CO3	

Unit 3 Lecture Plan Outline (10 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Sensors in Robotics	CO3	10
DD/MM/YY	Types of Sensors (Proximity, Vision, IMU, etc.)	CO3	

DD/MM/YY	Actuators in Robotic Systems	CO3	
DD/MM/YY	Types of Actuators (Electric, Hydraulic, Pneumatic)	CO3, CO4	
DD/MM/YY	Sensor–Actuator Integration	CO3, CO4	
DD/MM/YY	Introduction to Numerical Optimization	CO3, CO4	
DD/MM/YY	Optimization Techniques (Linear & Nonlinear Programming)	CO3, CO4	
DD/MM/YY	Gradient-Based and Heuristic Methods	CO3, CO4	
DD/MM/YY	Dynamic Optimal Control	CO3, CO4	
DD/MM/YY	Applications of Optimal Control in Robotics	CO3, CO4	

Unit 4 Lecture Plan Outline (8 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	Computers and Computing Fundamentals	CO4	8
DD/MM/YY	Sets and Set Theory	CO4, CO5	
DD/MM/YY	Discrete Structures in Computing	CO4, CO5	
DD/MM/YY	Probability Basics	CO4, CO5	
DD/MM/YY	Statistical Methods and Data Analysis	CO4, CO5	
DD/MM/YY	Introduction to Machine Learning	CO4, CO5	
DD/MM/YY	Neural Networks Fundamentals	CO4, CO5	
DD/MM/YY	Applications of Machine Learning and Neural Networks	CO4, CO5	

Unit 5 Lecture Plan Outline (8 Sessions)

Date	Topics to be Covered / Title	CO	Total Sessions
DD/MM/YY	State Estimation in Robotics	CO5	8
DD/MM/YY	Stochastic Control Methods	CO5, CO6	
DD/MM/YY	Parameter Estimation Techniques	CO5, CO6	
DD/MM/YY	Adaptive Control Systems	CO5, CO6	
DD/MM/YY	Task Planning and Scheduling	CO5, CO6	
DD/MM/YY	Motion Planning vs Task Planning	CO5, CO6	
DD/MM/YY	Multi-Agent Systems	CO5, CO6	
DD/MM/YY	Coordination and Communication in Multi-Agent Systems	CO5, CO6	

Course-to-SDG Matrix

This syllabus for **Robotics and Intelligent Systems** aligns with key **United Nations Sustainable Development Goals (SDGs)** by fostering knowledge of intelligent automation, robotic design, and data-driven decision-making in dynamic environments. The course emphasizes robot kinematics and dynamics, sensors and actuators, control systems, artificial intelligence integration, and autonomous system design for real-world applications such as manufacturing, healthcare, agriculture, and smart infrastructure.

It equips students with the ability to design, analyze, and implement intelligent robotic systems that enhance productivity, improve operational efficiency, and support safe and reliable automation. By enabling advanced technological solutions for complex real-world problems, the course contributes to innovation, sustainable industrial development, and the advancement of intelligent infrastructure in alignment with global technological transformation goals.

Mapping uses a 3-point scale:

- **Addressed to Substantial (High = 3) extent:** Core content directly contributes
- **Addressed to Moderate (Medium = 2) extent:** Supports through skills / activities
- **Addressed to Slight (Low = 1) extent:** Indirect awareness / benefit

Total Mapped SDGs: 4 out of 17

SDG Goal	Description	Mapping Strength	Justification
SDG 4	Quality Education	**3**	Develops foundational and advanced knowledge in robotics, artificial intelligence, sensing, and control systems, enhancing students' understanding of intelligent automation and interdisciplinary technologies.
SDG 8	Decent Work & Economic Growth	**3**	Builds industry-relevant skills in robotics, automation, and intelligent systems widely used in manufacturing, healthcare, logistics, and service industries, improving employability in emerging technology sectors.
SDG 9	Industry, Innovation & Infrastructure	**3**	Supports innovation through the design and development of robotic systems, autonomous machines, and intelligent control frameworks that strengthen modern industrial and technological infrastructure.
SDG 12	Responsible Consumption & Production	**2**	Promotes efficient resource utilization through automation, precision manufacturing, and intelligent decision-making systems that reduce waste and improve production efficiency.

PO and PSO mapping with level of strength for Course Name Robotics and Intelligent Systems **(Course Code CSAI4202)**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
	Engineering Knowledge	**Problem Analysis**	**Design/Development of Solutions**	**Conduct Investigations of Complex Problems**	**Engineering Tool Usage**	**The Engineer and The World**	**Ethics**	**Individual and Collaborative Team work**	**Communication**	**Project Management and Finance**	**Life-Long Learning**	**Familiarity and practical proficiency**	**Understand, analyze and develop**	**Apply standard Software**
CO1	3	3	3	3	2	1	1	1	3	1	3	3	3	1
CO2	3	3	3	3	3	3	1	3	3	3	3	3	3	3
CO3	3	3	3	3	3	2	1	2	3	3	3	3	3	3
CO4	3	3	3	3	3	2	1	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	1	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	2	3	3	3	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO1 Engineering Knowledge	PO2 Problem Analysis	PO3 Design/Development of Solutions	PO4 Conduct Investigations of Complex Problems	PO5 Engineering Tool Usage	PO6 The Engineer and The World	PO7 Ethics	PO8 Individual and Collaborative Team work	PO9 Communication	PO10 Project Management and Finance	PO11 Life-Long Learning	PSO1 Familiarity and practical proficiency	PSO2 Understand, analyze and develop	PSO3 Apply standard Software
CSAI4202/ Robotics and Intelligent Systems	3.00	3.00	3.00	3.00	2.83	2.33	1.17	2.33	3.00	2.67	3.00	3.00	3.00	2.67

Strength of Correlation

1. Addressed to **Slight (Low=1) extent**

2. Addressed to **Moderate (Medium=2) extent**

3. Addressed to **Substantial (High=3) extent**

COURSE PLAN

Applied Computer Vision (CSDS4304)

School of Computing Science & Engineering (SSCSE) | B.Tech CSE | Semester I | Batch 2026–2030

Integrated Course Plan — Theory COs (CO1–CO6) + Lab COs (CO7–CO10) | New AICTE 11-PO Framework | Full Skill Mapping

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture/Lab Plans

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B. Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	VII

2. Course Details

★ *Integrated theory + laboratory model. 10 COs in two tiers: Theory COs (CO1–CO6) via MTE + ETE; Lab COs (CO7–CO10) via Laboratory Assessment only. No cross-evaluation.*

S.No	Attribute	Details
1	**Course Code**	-----
2	**Course Title**	**Applied Computer Vision (ACV)**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	2-0-2-2
5	**Course Status**	Core
6	**Course Objective**	To implement fundamental image processing techniques required for computer vision. To develop applications using computer vision techniques
7	**Course Outcomes (COs)**	**After successful completion of this course, the student will be able to:** **THEORY COs — Assessed via MTE + ETE:** CO1 (Remember – L1): Define biological significance of Neural Network and list ANN components. CO2 (Understand – L2): Classify various learning paradigms based on real file problems. CO3 (Apply – L3): Apply basic concepts to build single and multi-layer feed-forward neural networks. CO4 (Analyze – L4): Analyse and train radial-basis function and recurrent networks. CO5 (Evaluate – L5): Explain self-organizing map for real life problems. CO6 (Create – L6): Discuss and adapt appropriate neural networks model for real life applications. **LAB COs — Assessed via Laboratory Assessment only:** CO7 (Apply – L3): Fundamentals and Image Processing: Define and implement fundamental computer vision techniques, including image filtering, opening/closing operations, and processing on color images. CO8 (Create – L5/L6): Image Transformations: Apply advanced image transformation techniques suitable for real-time and real-world computational applications.

		CO9 (Apply – L2/L3): Feature Extraction and Pattern Analysis: Analyze various feature extraction methods and evaluate pattern recognition techniques, including clustering and classification, across different problem domains. CO10 (Apply – L3): Application Development: Design and build integrated computer vision applications to solve complex real-world problems.
8	**Teaching & Learning**	Classroom Instructions (CI) 30 hrs + Lab Instructions (LI) 60 hrs + Self Learning (SL) 30 hrs = 120 hrs
9	**Mode of Examination**	Lab (40 marks) + MTE (10 marks) + ETE (50 marks) = 100 marks. Theory COs: MTE + ETE only. Lab COs: Lab only.
10	**Self Learning (SL: 30 hrs)**	1. Virtual Labs (NPTEL): Computer Vision programming experiments. 2. MOOC course on Computer Vision/ Applied Computer Vision (SWAYAM/Coursera).
11	**References**	1. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall. 2. R. C. Gonzalez, R. E. Woods. Digital Image Processing. Addison Wesley Longman, Inc., 1992. 3. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall, Englewood Cliffs, 1982.

3. Outline Syllabus — Theory Units with CO Mapping (CO1–CO6)

ℹ *Unit CO mappings refer to Theory COs (CO1–CO6) only. Lab experiments reinforce these units but are assessed under Lab COs (CO7–CO10).*

	Topic / Activity	CO Mapping
Unit 1	**Introduction (4-0-5-6 = 15 hrs)**	
A	Computer Vision and Computer Graphics, what is Computer Vision - Low-level, Mid-level, High-level	CO1, CO2, CO3
B	Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis	
C	Face detection, Face recognition, Eigen faces, Active appearance and 3D shape models of faces, Surveillance, foreground-background separation, vehicle vision system: locating roadway, road markings, identifying road signs, locating pedestrians	
Tools Used	Windows Environment, Whiteboards, sticky notes, python, Virtual Labs	
Activities	**Objective:** To familiarize students with python and develop a clear understanding of the python programming environment along with its basic tools and libraries: • Study of different libraries • Demonstration and use of different data types, variables, constants, Operators • Create a comparative study program that demonstrates the difference between computer graphics (synthesizing images from models) and computer vision (extracting information from images) by visualizing low-level (pixel processing), mid-level (grouping/segmentation), and high-level (object recognition) operations..	

Unit 2	**Image Formation Models (6-0-6-6 = 19 hrs)**	
A	Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, Brightness, color etc,	CO3, CO4
B	Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems	
C	Multiple views geometry, Structure determination, shape from shading, Weak perspective projection and orthographic projection, Concept of image coordinate system and camera coordinate system;	
Tools Used	Windows Environment, Whiteboards, sticky notes, python, Virtual Labs, GitHub.	
Activities	**Objective:** To analyze the fundamental physics of image formation, geometric projection models, and multi-view geometry necessary to establish accurate coordinate systems for computer vision task. • Conduct an experiment to measure and analyze the relationships between radiance, irradiance, and perceived brightness under varying light sources to understand the physics of image formation. • Implement a program to calculate camera calibration parameters using a standard pattern and demonstrate the visual differences between orthographic and perspective projection. • Develop a prototype to estimate 3D structure and depth information by performing coordinate system transformations across multiple camera viewpoints	
Unit 3	**Image Processing (8-0-8-6 = 22 hrs)**	
A	Image preprocessing: The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Discrete Cosine Transform (DCT)	CO2, CO3, CO4, CO5, CO6
B	Wavelet Transforms in One Dimension-The Discrete Wavelet Transform (DWT) and The Continuous Wavelet Transform. Wavelet Decomposition,	
C	Orthogonal, Euclidean, Affine, Projective, etc; Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.	
Tools Used	Windows Environment, Whiteboards, sticky notes, python, Virtual Labs, GitHub.	
Activities	**Objective:** To analyze and apply mathematical transformation techniques, image enhancement, and restoration algorithms to effectively preprocess image data for improved visual quality and computational analysis. • Implement programs to compute the 2-D Discrete Fourier Transform (DFT) and Discrete Cosine Transform (DCT) to analyze image frequency components. • Develop a procedure to perform one-dimensional Discrete Wavelet Transform (DWT) to decompose images into different resolution scales. • Create a suite of image processing functions to perform histogram processing, spatial convolution filtering, and geometric transformations (such as Euclidean, Affine, and Projective) for image restoration.	
Unit 4	**Image Processing Operations (6-0-6-6 = 18 hrs)**	
A	Image Filtering (spatial domain), Mask-based (e.g., correlation, convolution), Smoothing (e.g., Gaussian), Sharpening (e.g., gradient)	CO3, CO4, CO5

B	Segmentation: Edge-based (e.g., voting, optimization, perceptual grouping), Pixel-based (e.g., clustering)	
C	Colour fundamentals, Colour models, Colour transformation, Smoothing and Sharpening, Colour segmentation	
Tools Used	Windows Environment, Whiteboards, sticky notes, python, Virtual Labs, GitHub.	
Activities	**Objective:** To develop proficiency in applying spatial domain filtering, image segmentation, and color transformation techniques to isolate features and enhance structural information in digital images • Implement mask-based convolution and correlation operations to perform Gaussian smoothing and gradient-based sharpening on images. • Develop programs to execute edge-based segmentation using perceptual grouping or optimization, and pixel-based segmentation utilizing clustering algorithms. • Create a suite of functions to transform color models, apply smoothing and sharpening to color channels, and perform color-based image segmentation.	
Unit 5	**Feature Extraction (6-0-5-6 = 17 hrs)**	
A	Edge detection: Canny, Laplacian of Gaussian; Line detectors (Hough Transform)	CO2, CO3, CO4, CO5, CO6
B	Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH	
C	Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters	
Tools Used	Windows Environment, Whiteboards, sticky notes, python, Virtual Labs, GitHub.	
Activities	**Objective:** To develop the ability to detect and describe salient image features—such as edges, corners, and descriptors—across different scales and orientations to facilitate robust image recognition and analysis • Implement Canny and Laplacian of Gaussian operators to identify edges, and utilize the Hough Transform to detect lines within an image. • Develop programs to extract corners using Harris and Hessian Affine detectors, and generate robust feature descriptors such as SIFT, SURF, and HOG. • Construct image pyramids and apply Gaussian derivative filters or Gabor filters to perform multi-scale analysis and texture-based feature extraction	

4. Topic-wise Bloom's Taxonomy Level Mapping (Theory)

S.No	Topic	L1	L2	L3	L4	L5	L6
1	1.A	✓	✓				
2	1.B		✓	✓			
3	1.C		✓	✓			
4	2.A			✓			

5	2.B			✓			
6	2.C			✓	✓		
7	3.A			✓	✓		✓
8	3.B		✓	✓		✓	
9	3.C			✓	✓		
10	4.A			✓	✓		
11	4.B			✓	✓	✓	
12	4.C			✓			
13	5.A		✓	✓		✓	✓
14	5.B			✓	✓		
15	5.C			✓	✓	✓	

5. CO vs Bloom's Taxonomy — All Three Domains (Updated for 10 COs)

ℹ *Only strong/dominant alignments are mapped. Lab COs (CO7–CO10) extend into Psychomotor and Affective domains, reflecting the skill-based nature of lab and project work.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓																	
CO2		✓																
CO3			✓											✓				
CO4				✓											✓			
CO5					✓											✓		
CO6						✓			✓							✓	✓	
CO7			✓					✓						✓	✓			
CO8					✓	✓			✓						✓	✓	✓	
CO9			✓							✓	✓							
CO10			✓					✓			✓			✓				

Legend: ✓ = Strong / Dominant mapping only. Theory COs: primarily Cognitive. Lab COs: span all three domains.

6. Lecture Plan Outline (Theory — 30 Lectures)

Date	Topics to be Covered	Unit	Total Lectures
DD/MM/YY	Introduction to Computer Vision	Unit 1	4
DD/MM/YY	Overview of Computer Vision Applications		
DD/MM/YY	Face Analysis and Modelling		

DD/MM/YY	Surveillance and Foreground Analysis		
DD/MM/YY	Intelligent Vehicle Vision Systems	Unit 2	6
DD/MM/YY	Synthesis and Practical Integration		
DD/MM/YY	The Physics of Image Formation		
DD/MM/YY	Monocular Imaging and Radiosity		
DD/MM/YY	Geometric Projection Models		
DD/MM/YY	Camera Modeling and Calibration		
DD/MM/YY	Binocular Imaging and Stereo Vision	Unit 3	8
DD/MM/YY	Multiple View Geometry and Structure Determination		
DD/MM/YY	Frequency Domain Foundations		
DD/MM/YY	Wavelet Transforms		
DD/MM/YY	Geometric Transformations		
DD/MM/YY	Convolution and Spatial Filtering		
DD/MM/YY	Image Enhancement and Restoration		
DD/MM/YY	Histogram Processing		
DD/MM/YY	Spatial Domain Filtering Basics	Unit 4	6
DD/MM/YY	Smoothing and Sharpening Filters		
DD/MM/YY	Fundamentals of Image Segmentation		
DD/MM/YY	Advanced Segmentation Techniques		
DD/MM/YY	Color Fundamentals and Models		
DD/MM/YY	Color Image Processing and Segmentation		
DD/MM/YY	Edge Detection Foundations	Unit 5	6
DD/MM/YY	Line Detection and Structural Analysis		
DD/MM/YY	Corner Detection Algorithms		
DD/MM/YY	Feature Descriptors		
DD/MM/YY	Advanced Feature Descriptors and Texture		
DD/MM/YY	Scale-Space Analysis		

7. Lab Session Plan — List of Experiments (Updated CO7–CO10)

W1–W12: All experiments develop CO7 skills (professional implementation, tool usage, documentation). W13–W15 (teal rows): CO8 (design/real-world), CO9 (ethics/reflection), CO10 (teamwork/presentation). Theory knowledge is applied but NOT re-evaluated in lab.

Week	Session	Experiment	Lab CO	Marks
W1	S-1.1	Visualizing Computer Vision vs. Computer Graphics: Comparative demonstration of synthesis vs. interpretation	CO7	3.0

	S-1.2	Hierarchy of Vision Tasks (Low-to-High): Implementing a pipeline from filtering to recognition.	CO7	
W2	S-2.1	Application-Specific Feature Demo: Binarization, tracking, and basic medical image analysis	CO7	3.0
	S-2.2	Facial Analysis via Eigenfaces: Dimensionality reduction for face recognition	CO7	
W3	S-3.1	Surveillance & Foreground Extraction: Background-foreground separation	CO7	3.0
	S-3.2	Intelligent Vehicle Vision Prototype: Roadway and sign identification.	CO7	
W4	S-4.1	Physics of Image Formation: Measuring radiance and irradiance	CO7	3.0
	S-4.2	Camera Calibration: Determining intrinsic parameters via chessboard patterns.	CO7	
W5	S-5.1	Orthographic vs. Perspective Projection: Comparative visualization of projection models	CO7	3.0
	S-5.2	Binocular Disparity Mapping: Depth estimation using stereo vision.	CO7	
W6	S-6.1	Shape from Shading: Estimating 3D surface orientation.	CO7	3.0
	S-6.2	Multiple View Geometry: Coordinate transformations across camera viewpoints.	CO7	
W7	S-7.1	Multiple View Geometry: Coordinate transformations across camera viewpoints.	CO7	3.0
	S-7.2	Spatial Convolution: Applying custom masks for image modification.	CO7	
W8	S-8.1	2-D Discrete Fourier Transform (DFT): Frequency domain analysis.	CO7	3.0
	S-8.2	Discrete Cosine Transform (DCT): Analysis for image compression.	CO7	
W9	S-9.1	Discrete Wavelet Transform (DWT): Multi-resolution image decomposition	CO7	3.0
	S-9.2	Geometric Transformations: Affine and projective alignment of images	CO7	
W10	S-10.1	Spatial Domain Filtering: Gaussian smoothing and gradient sharpening	CO7	3.0
	S-10.2	Color Space Transformation: Converting between RGB, HSV, and Lab models	CO7	
W11	S-11.1	Edge-based Segmentation: Implementing perceptual grouping or optimization	CO7	3.0

	S-11.2	Pixel-based Clustering: K-means clustering for image partitioning.	CO7	
W12	S-12.1	Color-based Segmentation: Isolating objects via chromatic information.	CO7	3.0
	S-12.2	Color Channel Filtering: Applying smoothing/sharpening to specific color planes.	CO7	
W13	S-13.1	Canny/LoG Edge Detection: Identifying intensity boundaries.	CO8	3.0
	S-13.2	Hough Transform: Detecting geometric lines in an image	CO8	
W14	S-14.1	Harris Corner Detector: Detecting local intensity variations	CO8/CO9	3.0
	S-14.2	Feature Description (SIFT/SURF): Generating robust keypoint descriptors.	CO8/CO10	
W15	S-15.1	Histogram of Oriented Gradients (HOG): Feature extraction for object detection	CO8/CO9	3.0
	S-15.2	Scale-Space Analysis: Constructing image pyramids and Gaussian derivative filters.	CO9/CO10	

ℹ *Instructions: Write C programs, compile, execute and test with suitable test cases. Lab record (aim, algorithm, code, output, result) must be submitted before the next session.*

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, MTE & ETE Structure for Theory COs (CO1–CO6)

8. Theory Skill Dimensions (TS1–TS6) — CO1 through CO6

📘 **THEORY COs (CO1–CO6) — Assessed exclusively via MTE and ETE only**

★ *Six theory skill dimensions — one per Bloom's level L1–L6 — correspond directly to CO1–CO6. They define the competency measured in each section of MTE and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	**Factual Recall & Conceptual Recognition**	Define neural network significance; list ANN components and basic CV terminology.	CO1 | L1–L2	MTE Sec A | ETE Sec A
TS2	**Conceptual Explanation & Logical Interpretation**	Classify learning paradigms; explain image formation/CV application scenarios.	CO2 | L2	MTE Sec A | ETE Sec A
TS3	**Procedural Application & Problem Solving**	Apply basic concepts to build single/multi-layer feed-forward networks and pre-processing techniques.	CO3 | L3	MTE Sec B | ETE Sec B

TS4	**Analytical Reasoning & Program Tracing**	Analyze and trace RBF, recurrent networks, and image transformation pipelines	CO4 | L4	MTE Sec B | ETE Sec B
TS5	**Comparative Evaluation & Algorithmic Justification**	Evaluate Self-Organizing Maps (SOM) and compare vision algorithms for real-life problem solving.	CO5 | L5	ETE Sec B/C
TS6	**Synthesis & Holistic Design**	Design and adapt appropriate neural network/vision models for complex real-world applications.	CO6 | L6	ETE Sec C

9. Theory Assessment Structure — MTE and ETE

9.1 Mid Term Examination (MTE) — 10 Marks (CO1–CO4 only)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**4**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Definitions, basic output prediction, and syntax identification related to factual recall and conceptual explanation.
Sec B	**6**	TS3 — Procedural Application TS4 — Analytical Reasoning	**CO3, CO4**	Procedural application and analytical reasoning, specifically requiring students to detect errors and trace execution flow.
TOTAL	**10**	TS1–TS4	**CO1–CO4**	Units 1–3 covered; CO5 and CO6 assessed only in ETE

9.2 End Term Examination (ETE) — 100 Marks (Scaled to 50) (CO1–CO6)

Section	Marks	Skill Dimensions	COs	Question Type
Sec A	**25**	TS1 — Factual Recall TS2 — Conceptual Explanation	**CO1, CO2**	Short questions, including definitions, syntax tasks, output tracing, and conceptual Multiple Choice Questions (MCQs) covering all units
Sec B	**50**	TS3 — Procedural Application TS4 — Analytical Reasoning TS5 — Comparative Evaluation	**CO3, CO4, CO5**	Procedural application, analytical reasoning, and comparative evaluation
Sec C	**25**	TS5 — Comparative Evaluation TS6 — Synthesis & Design	**CO5, CO6**	Synthesis and design, requiring students to design modular solutions, justify their design choices, and complete complex applications
TOTAL	**100**	TS1–TS6 (all)	**CO1–CO6**	Scaled to 50 marks. Minimum 20/50 required to pass.

PART III

LABORATORY ASSESSMENT FRAMEWORK

Evaluation Scheme, CA Rubric, Mini Project Rubric, Skill Dimensions for Lab COs (CO7–CO10)

10. Evaluation Scheme — Overview

Component	Weightage	Marks	COs Assessed

Laboratory Assessment	40%	**40**	Lab COs only: CO7 (CA experiments), CO8, CO9, CO10 (Mini Project)
Mid Semester Examination (MTE)	10%	**10**	Theory COs only: CO1, CO2, CO3, CO4
End Semester Examination (ETE)	50%	**50**	Theory COs only: CO1, CO2, CO3, CO4, CO5, CO6
TOTAL	**100%**	**100**	Strict separation — no cross-assessment

11. Laboratory Assessment (40 Marks)

🔬 **LAB COs (CO7–CO10) — Assessed exclusively via Laboratory Assessment only (CA + Mini Project)**

11.1 Component Breakdown

Sub-Component	Quantum	Marks	Remarks
Lab Experiments (CA)	Best 10 of 12	**30**	3.0 marks each — assesses CO7, CO8, CO9
Mini Project	1 Project	**10**	Design, implementation, demo & reflection — all 4 Lab COs (CO7–CO10)
TOTAL	—	**40**	

11.2 Per-Experiment CA Rubric (3.0 Marks each — Assesses CO7, CO8, CO9)

Criterion	Marks	CA Skill Dimensions Covered	Marking Guide	Lab CO
Problem Definition & Experimental Design	**1.0**	CA1 — Problem definition: attributes, metrics, success criteria CA2 — Experimental design and tool configuration CA7 — Algorithm/flowchart/solution plan	1.0: Well-defined with design | 0.5: Partial | 0: Missing	CO7, CO8
Code Execution & Computational Efficiency	**1.0**	CA3 — Execution correctness; output matches expected CA4 — Efficiency: time/space complexity, optimization	1.0: Correct & efficient | 0.5: Correct, not optimized | 0: Fails	CO7
Output Analysis, Outcome & Lab Documentation	**0.75**	CA5 — Output analysis and result interpretation CA6 — Documented outcome with verification CA8 — Lab record completeness; viva-voce comprehension	0.75: Thorough | 0.5: Adequate | 0.25: Partial | 0: Absent	CO8, CO9
Professional Attitude & Ethical Conduct	**0.25**	CO9 — Documentation ethics, responsible practice PO7 — Professional responsibility and ethical conduct	0.25: Consistent | 0.10: Occasional | 0: Absent	CO9
Total	**3.0**	All 8 CA skill dimensions covered		

11.3 Best-10-of-N Scoring Scheme

Conducted	Best N Counted	Max Score	Note
> (10 + x)	Best 10	**30 Marks**	x worst dropped
10	All 10	**30 Marks**	No drop
< 10	All	**≤ 30 Marks**	Deficit = zero

11.4 Mini Project Evaluation Rubric (10 Marks — All 4 Lab COs)

Criterion	Marks	Project Skill Dimensions	Marking Guide	Lab CO / PO
SDG Alignment & Problem Scoping	**1.5**	P1 — SDG mapping; societal relevance P2 — Problem scope and stakeholder requirements P4 — Innovative solution proposal with alternatives	1.5: Comprehensive | 1.0: Adequate | 0.5: Partial | 0: Absent	CO8 / PO3, PO6
Project Planning & Financial Awareness	**1.5**	P2 — Timeline, milestones, resource planning P11 — Financial feasibility and cost estimation	1.5: Detailed | 1.0: Adequate | 0.5: Basic | 0: Absent	CO10 / PO10
End-to-End Implementation & System Operation	**2.0**	P5 — Professional toolchain selection P6 — Complete project build and integration P7 — System commissioning and operational testing	2: Fully operational | 1–1.5: Partial | 0–0.5: Non-functional	CO7, CO8 / PO3, PO5
Impact Assessment & Critical Reporting	**2.0**	P8 — Measurable outcome vs stated goals P9 — Statistical/comparative analysis; technical report	2: Rigorous | 1.5: Good | 1: Basic | 0: Absent	CO8, CO10 / PO6
Communication, Presentation & Teamwork	**2.0**	P3 — Communication plan and testing strategy P10 — Professional presentation quality and delivery	2: Excellent | 1.5: Good | 1: Adequate | 0: Poor	CO10 / PO8, PO9
Skill Reflection, Ethics & Professional Attitudes	**1.0**	P12 — Skill growth mapping (pre/post project) P13 — Professional attitudes and ethical conduct	1.0: Reflective & honest | 0.5: Partial | 0: Absent	CO9 / PO7, PO11
Total	**10**	All 13 Project skill dimensions; all 4 Lab COs (CO7–CO10)		

12. CA Skill Dimensions (8 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO Anchor
CA1	**Problem Definition & Metrics**	Define experiment problem; identify measurable attributes, parameters, success criteria	CO7, CO8
CA2	**Experimental Design & Tool Setup**	Plan experiment; configure development environment)	CO7
CA3	**Code Implementation & Execution**	Write correct code; compile and execute to produce expected output	CO7
CA4	**Computational Efficiency & Optimization**	Evaluate time/space complexity; identify bottlenecks; propose optimizations	CO7
CA5	**Output Analysis & Result Interpretation**	Analyse output critically; explain deviations; draw evidence-based inferences	CO8
CA6	**Documented Outcome with Verification**	Record final outcome formally; verify against the problem statement	CO7, CO8
CA7	**Algorithmic Design & Solution Planning**	Produce algorithm/flowchart/pseudocode before coding; justify design choices	CO7, CO8
CA8	**Lab Record Maintenance & Viva-Voce**	Maintain complete lab records; demonstrate conceptual understanding orally	CO7, CO9

13. Project Skill Dimensions (13 Dimensions — Lab COs only)

ID	Dimension	What is Measured	Lab CO / PO Anchor
P1	SDG Alignment & Social Relevance	Map project to relevant SDGs; articulate societal value and intended impact	CO8 | PO6
P2	Problem Scoping & Requirements	Define boundaries; produce formal problem statement with measurable goals	CO8 | PO2
P3	Communication & Testing Strategy	Develop communication plan; design testing strategy; coordinate group activities	CO10 | PO9
P4	Innovative Solution Proposal	Propose solution with alternatives; justify selection using design criteria	CO8 | PO3
P5	Professional Toolchain	Select and justify development tools; configure professional project environment	CO7 | PO5
P6	End-to-End Implementation	Build complete integrated solution incorporating at least 3 syllabus topics	CO7, CO8 | PO3
P7	System Commissioning & Testing	Deploy and operate system; conduct edge-case and stress tests	CO7, CO8 | PO5
P8	Measurable Impact & Outcome	Evaluate actual outcomes against goals; quantify impact using defined metrics	CO8 | PO6
P9	Critical Analysis & Reporting	Perform comparative/statistical analysis; produce structured technical report	CO8, CO10 | PO2, PO4
P10	Professional Presentation & Teamwork	Deliver professional presentation; evidence team collaboration and role differentiation	CO10 | PO8, PO9
P11	Financial Feasibility & Planning	Estimate project cost; justify resource allocation; discuss cost-effectiveness	CO10 | PO10
P12	Individual Skill Growth Mapping	Document pre/post skill gaps; map personal contributions to project dimensions	CO9 | PO11
P13	Professional Attitude, Ethics & Responsibility	Demonstrate integrity, ethical conduct, and responsible use of tools/data throughout	CO9 | PO7

14. CO × Skill Dimensions Mapping (10 COs × [6 Theory+ 8 CA + 13 Project Dimensions])

ℹ *Theory COs (CO1–CO6) are fully mapped. Lab COs (CO7–CO10) intentionally have no TS mapping — confirming strict assessment separation.*

ℹ *Theory COs (CO1–CO6) have NO CA alignment — confirms they are NOT evaluated in lab. All CA alignments confined to Lab COs (CO7–CO10).*

ℹ *Theory COs (CO1–CO6) have NO project alignment — confirms strict lab-only assessment. All 13 Project dimensions anchored exclusively to Lab COs (CO7–CO10).*

CO	Theory Skill Dimensions						CA Skill Dimensions								Project Skill Dimensions												
	TS1 Factual Recall	TS2 Conceptual Expl.	TS3 Procedural App.	TS4 Analytical Rsng	TS5 Compar. Eval.	TS6 Synthesis & Design	CA1 :Prob.Def.	CA2 Exp.Setup	CA3 Execution	CA4 Efficiency	CA5 Output Anal.	CA6 Doc.Outcome	CA7 Algo.Design	CA8 Lab Rec./Viva	P1 SDG	P2 Scoping	P3 Comm.	P4 Solution	P5 Tools	P6 Impl.	P7 Sys.Op.	P8 Impact	P9 Analysis	P10 Present.	P11 Financial	P12 Skill Map	P13 Attitude
CO1	H	M																									
CO2	M	H	M																								
CO3		M	H	M																							
CO4			M	H	M																						
CO5				M	H	M																					
CO6			M		M	H																					
CO7							H	H	H	M		M	M	H					H	M	H						
CO8							M		M		H	H	H		H	H		H	M	H	M	H	M				
CO9														M												H	H
CO10																	H						M	H	H		

H = High / Primary M = Medium / Secondary Blank = No direct alignment

PART IV

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, SDG Mapping, Bloom's Taxonomy Reference, Attendance & Pass/Fail

15. CO–PO and CO–PSO Mapping Matrix (All 10 COs)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Column averages computed over non-zero entries only.*

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	1	2	3	1
CO2	2	2	-	-	-	-	-	-	-	-	2	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO4	3	2	-	-	-	-	-	-	-	-	2	2	3	2
CO5	3	3	3	3	2	-	-	-	-	-	2	1	1	2
CO6	3	3	3	3	2	-	-	-	-	-	3	3	3	3
CO7	3	2	1	1	2	-	-	-	-	-	–	2	2	1
CO8	3	3	1	1	1	-	-	-	-	-	–	2	2	-
CO9	3	3	2	2	2	-	-	-	-	-	3	2	2	-
CO10	3	2	2	2	2	-	-	-	-	-	2	2	2	1
Avg	**2.89**	**2.56**	**2.17**	2	**1.8**						**2.13**	**2**	**2.22**	**2.17**

★ *PO7 (Ethics) now receives mapping from CO9 (strength 3). PO11 (Life-Long Learning) is addressed by both Theory COs and CO9. Lab COs (CO7–CO10) extend coverage to POs 3, 5, 6, 7, 8, 9, 10, 11.*

16. CO × PO Alignment Map (H/M Indicators — All 10 COs × 11 POs)

CO	PO1 Eng.Know.	PO2 Prob.Analysis	PO3 Design	PO4 Investigation	PO5 Tool Usage	PO6 Engineer & World	PO7 Ethics	PO8 Teamwork	PO9 Comm.	PO10 Proj.Mgmt	PO11 Lifelong
CO1	H	M									
CO2	M	M									
CO3	H	H	H								
CO4	H	M									
CO5	H	H	H	H	M						
CO6	H	H	H	H	M						M
CO7	H	M	L	L	M						
CO8	H	H	L	L	L						
CO9	H	H	M	M	M						H
CO10	H	M	M	M	M						M

H = High / Primary M = Medium / Secondary Blank = No direct alignment

17. Course-to-SDG Mapping Matrix

SDG Goal	Description	Mapping	Justification
SDG 4	Quality Education	3 (High)	Builds strong foundation in computational thinking and structured programming; aligned with lifelong learning (CO1–CO6, CO9).
SDG 8	Decent Work & Economic Growth	3 (High)	Develops industry-relevant programming and professional tool skills (CO7) directly applicable to employment in technology sectors.
SDG 9	Industry, Innovation & Infrastructure	3 (High)	Enables development of efficient software solutions; fosters innovation through real-world application design (CO6, CO8) and team-based projects (CO10).
SDG 12	Responsible Consumption & Production	2 (Moderate)	Promotes efficient, optimized coding; encourages ethical coding and responsible use of computational resources (CO9, CO7).

18. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, principles L3 — Apply: Use knowledge to solve new problems L4 — Analyze: Break down information, examine patterns L5 — Evaluate: Judge, justify, assess, make decisions L6 — Create: Design, develop, produce new solutions	A1 — Receiving: Awareness, willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Showing commitment, assigning value A4 — Organizing: Integrating values into personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Basic practice through imitation P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: Theory COs (CO1–CO6) are primarily mapped to the Cognitive domain (L1–L6). Lab COs (CO7–CO10) span all three domains — Cognitive (L2–L6), Psychomotor (P3–P7), and Affective (A2–A5) — reflecting the skill-based nature of laboratory and project assessment.*

19. Attendance Policy & Pass/Fail Criteria

19.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**70%**	All lecture sessions	Debarred from ETE
Practical / Lab	**70%**	All lab sessions	Debarred from ETE
Combined (Theory + Lab)	**75%**	Combined sessions	Debarred from ETE

⚠ *Both theory and practical attendance must independently meet 70%. The combined must be 75%. Satisfying one does NOT compensate for a shortfall in the other.*

19.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score (scaled)	**≥ 20 / 50**	**MANDATORY**	40% of ETE; equivalent to ≥ 40/100 on the full paper
Overall Total	**≥ 40 / 100**	**Must pass overall**	Lab 40 + MTE 10 + ETE 50 = 100; 40% overall minimum required

APPLIED COMPUTER VISION INTEGRATED COURSE PLAN — MEASUREMENT ARCHITECTURE

11 AICTE Programme Outcomes → 10 COs (6 Theory + 4 Lab) → 3 Assessment Instruments → 27 Skill Dimensions (6 TS + 8 CA + 13 Project)

Theory Tier CO1–CO6 (MTE + ETE): PO1, PO2, PO3, PO4, PO9 | 6 Theory Skill Dims (TS1–TS6)

Lab Tier CO7–CO10 (Lab only): PO3, PO5, PO6, PO7, PO8, PO9, PO10, PO11 | 8 CA Dims + 13 Project Dims

Marks: Lab 40 (Experiments 30 @ 3.0 each + Project 10) + MTE 10 + ETE 50 = Total 100

<table>
<tr><td colspan="2">School: SSCSE</td><td colspan="3">Batch: 2025-2029</td></tr>
<tr><td colspan="2">Program: B.Tech</td><td colspan="3">Current Academic Year: 2025-26</td></tr>
<tr><td colspan="2">Branch: CSE with specialization in AIOT</td><td colspan="3">Semester: VII</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="3">CSOT4206</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="3">IoT in Healthcare</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="3">3</td></tr>
<tr><td>4</td><td>Contact Hours (L-T-P-SL)</td><td colspan="3">3-0-0-3</td></tr>
<tr><td></td><td>Course Status</td><td colspan="3">Program Elective</td></tr>
<tr><td>5</td><td>Course Objective</td><td colspan="3">1. Remembering: Identify key components of an IoT-based smart health ecosystem.
2. Understanding: Explain the concept of a people-focused view in smart health IoT applications.
3. Analyzing: Examine the dimensions to consider when designing smart health solutions.
4. Evaluating: Assess the challenges hindering the widespread adoption of smart IoT healthcare applications.</td></tr>
<tr><td>6</td><td>Course Outcomes</td><td colspan="3">CO1: Outline the elements of IoT-based health care ecosystems.
CO2: Explain the different types of applications that utilize IoT in Healthcare
CO3: Discuss the IoT that enables the realization of smart ambulance
CO4: Assesses the adoption of this model for diagnosis and prognosis of chronic obstructive pulmonary disease.
CO5: Elaborate security, privacy and ethical issues in smart sensor health and well-being application
CO6: Discuss the integration of the IoT in patient-focused health applications.</td></tr>
<tr><td>7</td><td>Course Description</td><td colspan="3">IoT can automate patient care workflow with the help healthcare mobility solution and other new technologies, and next-gen healthcare facilities. IoT in healthcare enables interoperability, machine-to-machine communication, information exchange, and data movement that makes healthcare service delivery effective.</td></tr>
<tr><td>8</td><td>Teaching and Learning Scheme (Hours per Semester)</td><td colspan="3"><table>
<tr><td colspan="2">Classroom Instructions (CI)</td><td>Lab Instruction (LI)</td><td>Team work (TW) and Self Learning (SL) (TW+SL)</td><td>Total Hours</td><td>Total Credits TH /30</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SL</td><td>TH</td><td></td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>45</td><td>90</td><td>3</td></tr>
</table></td></tr>
<tr><td>9</td><td colspan="3">Outline syllabus</td><td>CO Mapping</td></tr>
<tr><td></td><td>Unit 1</td><td colspan="2">IoT and People in Health Care</td><td></td></tr>
</table>

	A	Introduction to Smart Health Care Ecosystem, The patient at the centre, Health care providers	CO1
	B	Devices and sensors, Applications and Interfaces	CO1
	C	Other Stakeholders: Social Support, Connecting the components	CO1
	Unit 2	**Dimensions of IoT Applications in Health Care**	
	A	Well-being-Illness, Physical, Temporary-Cure, Prevent-Cure, Monitor-Manage , Internal-External Measures, Health Care Provider-Individual Dimensions	CO1, CO2
	B	Examples of IoT Related Health Care Applications and Their Dimensions	CO1, CO2
	C	Challenges, Lack of Standards,Data Issues, Changing the Health Care Provider-Patient Roles	CO1, CO2
	Unit 3	**Internet of Things in Smart Ambulance and Emergency Medicine**	
	A	IoT in Emergency Medicine, Point-of-CareEnvironment	CO3, CO6
	B	Biosensing Network, Hierarchical Cloud Architecture, Weather Observation for Remote Rescue	CO3, CO6
	C	Integration and Compatibility, Operational Consistency and Reliability Assurance, Electronic Patient Record Retrieval in Multihop Communication	CO3, CO6
	Unit 4	**Case Study: Chronic Obstructive Pulmonary Disease**	
	A	On-scene Diagnosis and Prognosis, Data Acquisition and Analytics	CO4, CO6
	B	Decision and Selection Process, Patient and the Ambient Environment, Smart Ambulance Challenges, Reliability	CO4, CO6
	C	Standards, Staff Training and Operating Procedures, Security and Privacy	CO4, CO6
	Unit 5	**Security, Privacy and Ethical Issues**	
	A	Smart Health and well-being Applications Risk Analysis	CO5, CO6
	B	Cyber-Physical-Social Systems, Machine Ethics, Physical Safety	CO5, CO6
	C	Software Quality, IT Security, Privacy, Risk of Technology Misuse	CO5, CO6

<table>
<tr><td>10</td><td>List of Self-Learning (SL) Activities [Total SL: 45 hours]</td><td colspan="3"><table>
<tr><th>S. No.</th><th>Name of the Activity</th><th>No. of Hours</th><th>Evaluation Criteria</th></tr>
<tr><td>1</td><td>Problem Solving / Smart Healthcare IoT Implementation Implement IoT-based healthcare monitoring systems using sensors, wearable devices, health monitoring applications, biosensing networks, cloud integration, and patient data communication. Practice smart healthcare use-cases such as remote patient monitoring and emergency healthcare systems.</td><td>5 practical/case-based exercises × 3h eachTotal = 15h</td><td>Based on correctness of implementation, sensor integration accuracy, healthcare monitoring effectiveness, troubleshooting skills, technical understanding, and documentation of outcomes.</td></tr>
<tr><td>2</td><td>Technical Video-Based Learning NPTEL/YouTube technical sessions on smart healthcare ecosystems, wearable healthcare devices, IoT in emergency medicine, smart ambulances, healthcare security, privacy, and ethical issues in digital healthcare.</td><td>Video viewing = 5hReport preparation & Presentation = 10hTotal = 15h</td><td>Report/presentation based on learning outcomes. Marks for understanding of concepts, healthcare IoT architecture explanation, technical clarity, presentation quality, and viva-voce performance.</td></tr>
<tr><td>3</td><td>Assignment Writing (Healthcare IoT & Security Analysis) Prepare assignments on smart healthcare ecosystems, IoT healthcare applications, biosensing networks, smart ambulance systems, chronic disease monitoring, healthcare privacy, ethical concerns, and secure patient-focused healthcare solutions.</td><td>5 assignments × 2h eachTotal = 10h</td><td>Based on technical correctness, healthcare application analysis, stepwise explanation, conceptual clarity, security and privacy understanding, and completeness of assigned tasks.</td></tr>
<tr><td>4</td><td>Real-World Case Study / Mini Project Study and analyze a real-world IoT healthcare application such as remote patient monitoring, wearable healthcare devices, smart ambulance systems, chronic disease monitoring, healthcare data privacy, or emergency healthcare management.</td><td>Literature study & implementation = 5hReport & demonstration = 5hTotal = 10h</td><td>Based on innovation, technical accuracy, healthcare applicability, report quality, presentation, implementation approach, and practical demonstration.</td></tr>
</table></td><td></td></tr>
<tr><td></td><td>Mode of examination</td><td colspan="3">Theory/Jury/Practical/Viva</td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="2">Weightage Distribution</td><td>CA</td><td>MSE</td><td>ESE</td><td></td></tr>
<tr><td>25%</td><td>15%</td><td>60%</td><td></td></tr>
<tr><td></td><td>Text book/s*</td><td colspan="3">1. Internet of Things A to Z Technologies and Applications, Qusay F. Hassan
2. Intelligent Data Sensing and Processing for Health and Well-being Applications, Miguel Antonio Wister Ovando, Pablo Pancardo Garcia, Francisco Diego Acosta Escalante, Jose Adan Hernandez Nolasco</td><td></td></tr>
<tr><td></td><td>Other References</td><td colspan="3"></td><td></td></tr>
</table>

PO and PSO mapping with level of strength for Course: IoT in Healthcare CSOT 4206

	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO2	PSO 3

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	2	2	2	1	1	2	-	-	-	2	2	2	3
CO3	3	3	3	3	2	2	1	2	-	-	-	2	2	3
CO4	2	3	3	3	3	1	2	2	1	-	2	2	2	2
CO5	3	2	3	2	3	2	3	2	2	1	2	3	3	3
CO6	3	2	3	3	3	2	1	3	2	2	3	3	3	3

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name C SOT 4205	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
	Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Teamwork	Communication	Project Management and Finance	Life-Long Learning	Familiarity and practical proficiency	Understand, analyze and develop	Apply standard Software
	2.833333	2.4	2.8	2.6	2.4	1.6	1.8	2.25	1.666667	1.5	2.25	2.4	2.333333	2.5

Strength of Correlation:

1. Addressed to***Slight (Low=1)*** ***extent***

2. Addressed to***Moderate (Medium=2)*** ***extent***

3. Addressed to***Substantial (High=3)*** ***extent***

SDG Goal	*Description*	*Mapping Strength*	*Justification*
SDG 3 – Good	*Ensure healthy lives and promote*	*High*	*The course directly focuses on smart healthcare*

SDG Goal	***Description***	***Mapping Strength***	***Justification***
Health and Well-Being	*well-being for all at all ages*		*ecosystems, IoT-enabled patient monitoring, smart ambulances, biosensing networks, chronic disease monitoring, and emergency healthcare services, improving healthcare accessibility and patient well-being.*
SDG 4 – Quality Education	*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*	*High*	*The course develops technical understanding of healthcare IoT systems, smart sensing technologies, patient-focused healthcare applications, healthcare analytics, and digital health ecosystems, promoting advanced learning in emerging healthcare technologies.*
SDG 9 – Industry, Innovation and Infrastructure	*Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*	*High*	*IoT in healthcare promotes innovation in smart medical infrastructure, intelligent patient monitoring, healthcare automation, wearable devices, cloud-enabled health systems, and emergency medical response technologies.*
SDG 11 – Sustainable Cities and Communities	*Make cities and human settlements inclusive, safe, resilient and sustainable*	*Moderate*	*Smart healthcare systems, emergency response mechanisms, remote health monitoring, and connected ambulance services contribute to resilient and safe healthcare infrastructure in urban and rural communities.*
SDG 16 – Peace, Justice and Strong Institutions	*Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable institutions*	*Moderate*	*Security, privacy, ethical issues, healthcare data protection, cyber-physical-social systems, and secure patient information management contribute to trustworthy and accountable healthcare systems.*
SDG 8 – Decent Work and Economic Growth	*Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*	*Moderate*	*The course equips students with healthcare IoT and digital health technology skills relevant to smart healthcare industries, medical technology startups, and digital health enterprises.*
SDG 12 – Responsible Consumption and Production	*Ensure sustainable consumption and production patterns*	*Low*	*Smart healthcare monitoring and IoT-enabled resource optimization contribute to efficient utilization of healthcare resources, medical equipment, and digital health infrastructure.*
SDG 17 – Partnerships for the Goals	*Strengthen the means of implementation and revitalize the global partnership for sustainable development*	*Low*	*IoT healthcare ecosystems encourage collaboration among healthcare providers, researchers, technology developers, government agencies, and medical institutions for better healthcare delivery.*

COURSE PLAN

Digital Watermarking & Steganography (CSCF4204)

School of Computing Engineering and Technology (SSCSE) | B.Tech CSE | Semester VII | Batch 2026–2030

Theory-Only Course Plan — All 6 COs (CO1–CO6) | Theory Skill Dimensions TS1–TS6 | CA + MTE + ETE Assessment

PART I

COURSE SYLLABUS

Course Identification, Details, Outcomes, BTL Mapping & Lecture Plan

1. Course Identification

School:	SSCSE	**Batch:**	2026–2030
Program:	B.Tech	**Current Academic Year:**	2026–27
Branch:	CSE	**Semester:**	VII
Course Code:	**CSCF4204**	**Course Type:**	Elective

2. Course Details

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

S.No	Attribute	Details
1	**Course Code**	**CSCF4204**
2	**Course Title**	**Digital Watermarking & Steganography**
3	**Credits**	3
4	**Contact Hours (L-T-P-SL)**	3-0-0-3 (Theory: 45 hrs Classroom + 45 hrs Self Learning = 90 hrs total)
5	**Course Status**	**Elective — Theory Only (No Laboratory Component)**
6	**Course Objectives**	1. Understand information hiding techniques including digital watermarking and steganography, 2. Explore transform domain methods and secure embedding techniques, analyze security, robustness, and perceptual models, 3. Evaluate watermarking systems and attacks, and develop secure data hiding mechanisms.
7	**Course Outcomes (COs)**	**After successful completion of this course, students will be able to:** CO1 (Remember– L1) Define watermarking models, message coding, and information hiding concepts

		CO2 (Understand – L2) Explain watermark security, authentication, and communication models CO3 (Apply– L3) Apply steganography techniques and perceptual models CO4 (Analyze – L4) Analyze watermarking techniques for different media objects CO5 (Evaluate – L5) Evaluate watermarking protocols and performance metrics CO6 (Create – L6) Design secure watermarking and steganographic systems against attacks
8	**Course Description**	This course introduces digital watermarking and steganography techniques for secure information hiding. It covers watermarking models, perceptual models, security mechanisms, and real-world applications across multimedia systems. Emphasis is placed on robustness, security, and evaluation of watermarking systems along with protection against attacks.
9	**Teaching & Learning Scheme**	Classroom Instructions (CI): 45 hrs | Self Learning (SL): 45 hrs | Total: 90 hrs
10	**Mode of Examination**	**Theory Only. CA: 25% | MTE: 15% | ETE: 60% | Total: 100 marks**
11	**Textbook**	Textbook: 1. Digital Watermarking and Steganography – Ingemar J. Cox 2. Digital Watermarking – Cox et al.
12	**References**	Other References: 1. Techniques and Applications of Digital Watermarking – Arnold 2. Disappearing Cryptography – Peter Wayner

3. Outline Syllabus with CO Mapping

ℹ *All CO mappings in this section refer to Theory COs (CO1–CO6). This is a theory-only course; all assessment is via CA, MTE, and ETE.*

	Topic	CO Mapping
	Unit 1: Introduction to Information Hiding	
A	A Information Hiding, Steganography, Watermarking Concepts	CO1, CO2
B	Watermarking Models and Communication-based Models	CO1, CO2
C	Message Coding, Error Correction, Multi-symbol Detection	CO2, CO3
	Unit 2: Watermarking Techniques	
A	A Watermarking with Side Information	CO3, CO4
B	Coding Techniques and Structured Codes	CO3, CO4

C	Error Analysis (False Positives/Negatives, ROC Curves)	CO4, CO5
	Unit 3: Perceptual Models & Robust Techniques	
A	Perceptual Models and Evaluation	CO3, CO4
B	Robust Watermarking Approaches	CO4, CO5
C	Spread Spectrum and Coefficient Embedding	CO3, CO4, CO5
	Unit 4: Security & Authentication	
A	Watermark Security Requirements	CO2, CO5
B	Cryptography and Attacks on Watermarking	CO4, CO5, CO6
C	Authentication Techniques (Selective, Localization)	CO2, CO4, CO5
	Unit 5: Steganography & Applications	
A	A Steganography Communication & Terminology	CO1, CO2, CO3
B	Information-Theoretic Foundations & Practical Methods	CO3, CO4, CO5
C	Steganalysis and Minimizing Embedding Impact	CO4, CO5, CO6

4. Topic-wise Bloom's Taxonomy Level Mapping

S.No	Topic	L1 Remember	L2 Understand	L3 Apply	L4 Analyze	L5 Evaluate	L6 Create
1	1.A	✓	✓				
2	1.B	✓	✓				
3	1.C		✓	✓			
4	2.A			✓	✓		
5	2.B			✓	✓		
6	2.C				✓	✓	
7	3.A			✓	✓		
8	3.B				✓	✓	
9	3.C			✓	✓	✓	
10	4.A		✓			✓	
11	4.B				✓	✓	✓
12	4.C		✓		✓	✓	✓
13	5.A	✓	✓	✓			
14	5.B			✓	✓	✓	
15	5.C				✓	✓	✓

5. CO vs Bloom's Taxonomy — All Three Domains

ℹ *Only strong/dominant alignments are mapped. This is a theory-only course; Psychomotor mapping is limited to Guided Response (P3) for algorithm implementation in CO3. Affective domain appears at A3 (Valuing) for efficiency analysis in CO4 and CO5.*

CO	Cognitive Domain (L1–L6)						Affective (A1–A5)					Psychomotor (P1–P7)						
CO	L1	L2	L3	L4	L5	L6	A1	A2	A3	A4	A5	P1	P2	P3	P4	P5	P6	P7
CO1	✓						✓					✓						
CO2		✓					✓	✓					✓	✓				
CO3			✓					✓	✓					✓	✓			
CO4				✓					✓	✓					✓	✓		
CO5					✓				✓	✓						✓	✓	
CO6						✓				✓	✓					✓	✓	✓

Legend: ✓ = Strong / Dominant mapping. Theory-only course: Cognitive domain is primary. Psychomotor (P3) limited to CO3 (algorithm implementation). Affective (A3) for CO4 and CO5 (valuing efficiency).

6. Lecture Plan Outline (Theory — 45 Lectures / 45 Hours)

ℹ *Total classroom contact: 45 hours across 5 units. Self-Learning activities (45 hrs) are structured separately in Section 11.*

Lecture No.	Date	Topics to be Covered / Title	Unit	Total Lectures
1	DD/MM/YY	Introduction to Information Hiding & Watermarking	UNIT-1	9
2	DD/MM/YY	History and Evolution of Watermarking		
3	DD/MM/YY	Importance and Applications of Watermarking		
4	DD/MM/YY	Watermarking Communication Models		
5	DD/MM/YY	Watermarking System Components		
6	DD/MM/YY	Watermarking Models and Architectures		
7	DD/MM/YY	Message Coding Techniques		
8	DD/MM/YY	Error Correction Techniques		
9	DD/MM/YY	Numerical Problems and Unit Review		
10	DD/MM/YY	Fundamentals of Watermarking Techniques	UNIT-2	9
11	DD/MM/YY	Spatial Domain Watermarking		
12	DD/MM/YY	Frequency Domain Watermarking		
13	DD/MM/YY	Watermarking with Side Information		
14	DD/MM/YY	Informed Coding Techniques		
15	DD/MM/YY	Structured Codes in Watermarking		
16	DD/MM/YY	Error Types: False Positive and False Negative		
17	DD/MM/YY	ROC Curves and Performance Analysis		
18	DD/MM/YY	Effect of Whitening on Error Rates		
19	DD/MM/YY	Introduction to Perceptual Models	UNIT-3	9
20	DD/MM/YY	General Perceptual Model Framework		
21	DD/MM/YY	Human Visual System and Perceptual Analysis		
22	DD/MM/YY	Examples of Perceptual Models		
23	DD/MM/YY	Robust Watermarking Approaches		
24	DD/MM/YY	Redundant Embedding Techniques		
25	DD/MM/YY	Spread Spectrum Coding		
26	DD/MM/YY	Embedding in Perceptual Coefficients		
27	DD/MM/YY	Case Study and Review of Perceptual Models		

28	DD/MM/YY	Introduction to Watermark Security	UNIT-4	9
29	DD/MM/YY	Security Requirements in Watermarking		
30	DD/MM/YY	Threat Models and Security Challenges		
31	DD/MM/YY	Cryptographic Techniques in Watermarking		
32	DD/MM/YY	Encryption and Key Management		
33	DD/MM/YY	Attacks on Watermarking Systems		
34	DD/MM/YY	Authentication Techniques		
35	DD/MM/YY	Localization and Restoration Methods		
36	DD/MM/YY	Unit Review and Practice Problems		
37	DD/MM/YY	Introduction to Steganography	UNIT-5	9
38	DD/MM/YY	Steganography Communication Models		
39	DD/MM/YY	Information-Theoretic Foundations		
40	DD/MM/YY	Image and Audio Steganography Techniques		
41	DD/MM/YY	Practical Steganographic Techniques		
42	DD/MM/YY	Minimizing Embedding Impact		
43	DD/MM/YY	Steganalysis Techniques		
44	DD/MM/YY	Comparative Study of Watermarking and Steganography		
45	DD/MM/YY	Final Review, Case Studies and Discussion		

PART II

THEORY ASSESSMENT FRAMEWORK

Theory Skill Dimensions, CO × TS Mapping, CA / MTE / ETE Structure

7. Theory Skill Dimensions (TS1–TS6)

📘 **THEORY-ONLY COURSE — All 6 COs (CO1–CO6) are assessed exclusively via Continuous Assessment (CA), MTE, and ETE. No laboratory component.**

★ *Six Theory Skill Dimensions — one per Bloom's progression (L1–L4) — correspond directly to the six COs. They define precisely what competency is being measured in each section of the CA, MTE, and ETE, providing a clear NBA-auditable assessment rationale.*

ID	Dimension	What is Measured	CO / BTL	Assessment
TS1	Conceptual Recall & Information Hiding Fundamentals	Recall watermarking terminology, steganography concepts, communication models, message coding, and multimedia security fundamentals; identify watermarking and information hiding techniques	CO1 | L1–L2	CA | MTE Sec A | ETE Sec A
TS2	Conceptual Explanation & Watermarking Interpretation	Explain watermarking models, authentication methods, communication-based models, coding schemes, and perceptual models; interpret multimedia information hiding workflows	CO2 | L2–L3	CA | MTE Sec A | ETE Sec A
TS3	Steganography & Watermarking Application	Apply steganography methods, perceptual models, spread spectrum techniques, and coefficient embedding approaches for multimedia security applications	CO3 | L3	CA | MTE Sec B | ETE Sec B
TS4	Watermarking Analysis & Media Evaluation	Analyze watermarking techniques for text, image, audio, and video media; evaluate	CO4 | L4–L5	MTE Sec B | ETE Sec B

		robustness, embedding efficiency, distortion, and attack resistance		
TS5	Security Protocol & Performance Evaluation	Compare watermarking protocols, authentication schemes, ROC analysis, cryptographic protection, and steganalysis methods; evaluate security and performance metrics	CO5 | L4–L5	ETE Sec B/C
TS6	Secure Watermarking & Steganographic System Design	Design secure watermarking and steganographic systems resistant to attacks, embedding distortions, and unauthorized extraction for real-world multimedia applications	CO6 | L5–L6	ETE Sec C

8. CO × Theory Skill Dimension Mapping (6 COs × 6 Dimensions)

ℹ *Each CO maps primarily to one TS dimension (H) with adjacent dimensions receiving secondary mapping (M), reflecting the progressive Bloom's structure of this course.*

CO	TS1 Information Hiding Fundamentals & Watermarking Concepts	TS2 Watermarking Models & Communication Interpretation	TS3 Steganography & Embedding Application	TS4 Watermarking Analysis & Media Evaluation	TS5 Security Protocols & Performance Evaluation	TS6 Secure Watermarking & Steganographic System Design
CO1	H	M	-	M	H	-
CO2	H	H	-	M	H	M
CO3	H	H	M	-	H	M
CO4	H	-	-	H	H	M
CO5	-	M	-	-	H	M
CO6	-	M	-	M	H	M

H = High / Primary alignment M = Medium / Secondary alignment *Blank = No direct alignment*

9. Continuous Assessment (CA) — 25 Marks

★ *CA is formative and covers COs progressively as the syllabus is taught. It includes numerical-based assignments, a technical video learning report, and a real-world case study — mirroring TS1 through TS6.*

9.1 CA Component Breakdown (Sample)

Component	Quantum	Marks	COs Assessed	Skill Dimensions

Assignments 1–5 (Watermarking, Steganography, Embedding Techniques & Security Analysis Problems)	5 Assignments	15	CO1, CO2, CO3, CO4	TS1, TS2, TS3, TS4
Technical Tool Demonstration / Video Learning Report	1 Report + Presentation	5	CO2, CO3, CO5	TS2, TS3, TS5
Real-World Watermarking & Steganography Security Case Study (Report)	1 Report	5	CO4, CO5, CO6	TS4, TS5, TS6
TOTAL	**—**	**25**	**CO1–CO6**	**TS1–TS6**

9.2 Assignment-wise CO & TS Mapping

Item	Topic / Focus	COs	TS Dims	SL Hours	Evaluation Criteria
Assignment 1	Unit 1 concepts: Information hiding overview, watermarking models, steganography basics, communication-based models	CO1, CO2	TS1, TS2	5h SL	Conceptual understanding, terminology accuracy, report submission
Assignment 2	Message coding, error correction, structured codes, and watermark embedding techniques	CO2, CO3	TS2, TS3	5h SL	Coding implementation, workflow explanation, embedding accuracy
Assignment 3	Perceptual models, spread spectrum techniques, coefficient embedding, and robust watermarking approaches	CO3, CO4	TS3, TS4	5h SL	Watermark analysis, practical implementation, robustness evaluation
Assignment 4	Watermark security, cryptographic protection, authentication techniques, and attack analysis	CO4, CO5	TS4, TS5	5h SL	Comparative analysis, security evaluation, protocol assessment
Assignment 5	Advanced steganography, steganalysis, secure watermarking system design, and attack-resistant embedding methods	CO5, CO6	TS5, TS6	5h SL	Secure system design proposal, embedding methodology, technical justification
Video Learning Report	Technical video on watermarking, steganography, multimedia security, authentication techniques, or steganalysis methods (min 3 hrs); structured report + presentation	CO2, CO3, CO5	TS2, TS3, TS5	9h SL	Learning outcomes, technical understanding, self-reflection, 10-minute presentation
Case Study Report	Real-world watermarking and steganography case study (e.g., copyright protection, multimedia authentication, covert	CO4, CO5, CO6	TS4, TS5, TS6	6h SL	Technical depth, attack analysis, comparative evaluation, security and defense recommendations

	communication, digital media attacks)				

10. Mid Term Examination (MTE) — 15 Marks (Units 1–3)

ℹ *MTE covers Units 1–3 (CO1, CO2, CO3, CO4). CO5 and CO6 are assessed in ETE only. MTE maps to TS1–TS4.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	10	TS1 — Information Hiding Fundamentals & Watermarking Concepts TS2 — Watermarking Models & Communication Interpretation	CO1, CO2	Short-answer questions: define information hiding concepts, explain watermarking and steganography terminology, describe communication-based models, explain message coding, authentication methods, perceptual models, and multimedia security workflows
Section B	15	TS3 — Steganography & Embedding Application TS4 — Watermarking Analysis & Media Evaluation	CO2, CO3, CO4	Analytical and application-based questions: watermark embedding analysis, spread spectrum techniques, coefficient embedding, perceptual model interpretation, robustness evaluation, steganographic implementation, attack analysis, and multimedia watermarking case studies
TOTAL	**25**	**TS1–TS4**	**CO1–CO4**	Units 1–3 only. CO5 and CO6 assessed in ETE only.

11. End Term Examination (ETE) — 60 Marks (All Units, All COs)

ℹ *ETE is comprehensive — all 5 units and all 6 COs. Full progression from TS1 (recall) through TS6 (evaluation). Minimum 20/50 required to pass.*

Section	Marks	Theory Skill Dimensions	COs Assessed	Question Type & Guidance
Section A	15	TS1 — Information Hiding Fundamentals & Watermarking Concepts TS2 — Watermarking Models & Communication Interpretation	CO1, CO2	Short questions (all units): definitions of watermarking and steganography concepts, communication-based models, message coding, authentication terminology, multimedia security concepts, perceptual models, and information hiding techniques
Section B	25	TS3 — Steganography & Embedding Application TS4 — Watermarking Analysis	CO3, CO4, CO5	Medium questions: watermark embedding analysis, spread spectrum methods, coefficient embedding, perceptual evaluation,

		& Media Evaluation TS5 — Security Protocols & Performance Evaluation		ROC curve analysis, robustness testing, cryptographic protection, authentication mechanisms, and steganalysis comparisons
Section C	10	TS5 — Security Protocols & Performance Evaluation TS6 — Secure Watermarking & Steganographic System Design	CO5, CO6	Long/evaluation questions: secure watermarking system design, attack-resistant steganographic methods, authentication framework analysis, multimedia copyright protection, steganalysis resistance, and real-world digital media security case studies
TOTAL	**50**	**TS1–TS6 (all)**	**CO1–CO6**	Scaled from 100-mark paper if needed. Minimum 20/50 to pass.

11.1 CO-wise Assessment Instrument Summary

CO	CO Statement (Short)	CA (25)	MTE (25)	ETE (50)	TS	PO Primary
CO1	Understand watermarking models, message coding, and information hiding fundamentals	✓	✓	✓	TS1	PO1, PO2, PO3, PO4
CO2	Explain watermark security, authentication, and communication-based models	✓	✓	✓	TS2	PO1, PO2, PO3, PO5
CO3	Apply steganography techniques, perceptual models, and embedding methods	✓	✓	✓	TS3	PO1, PO2, PO3, PO5
CO4	Analyze watermarking techniques for image, audio, video, and multimedia objects	✓	✓	✓	TS4	PO2, PO3, PO4, PO10
CO5	Evaluate watermarking protocols, authentication methods, and performance metrics	✓	—	✓	TS5	PO1, PO2, PO8, PO10, PO11
CO6	Design secure watermarking and steganographic systems resistant to attacks and distortions	✓	—	✓	TS6	PO3, PO4, PO5, PO10, PO11, PO12

⚠ *CO5 and CO6 are NOT assessed in MTE (only Units 1–3 are covered at mid-semester). They are assessed in CA (self-learning activities) and ETE.*

PART III

COMBINED MAPPINGS & REFERENCE

CO–PO Matrix, CO–PO Alignment, Self-Learning Activities, Bloom's Reference, Attendance & Pass/Fail

12. CO–PO and CO–PSO Mapping Matrix (Original Framework)

ℹ *Strength Scale: 3 = Substantial (High) | 2 = Moderate | 1 = Slight (Low) | – = Not Applicable. Averages computed over non-zero entries only. PO framework as per the original course design.*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	2	3	-	-	-	-	-	2	3	2	-
CO2	3	3	-	2	3	2	-	-	-	-	2	3	3	-
CO3	3	3	2	-	3	2	-	-	-	-	2	3	3	2
CO4	3	-	-	3	3	2	-	-	-	-	2	3	3	2
CO5	-	2	-	-	3	2	-	-	2	2	2	-	3	2
CO6	-	2	-	2	3	2	-	-	-	2	2	-	3	2
Avg	3	2.4	2	2.25	3	2	-	-	2	2	2	3	2.83	2

13. CO × PO Alignment Map (H/M Indicators — All 6 COs)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	H	M	-	M	H	-	-	-	-	-	M	H	M	-
CO2	H	H	-	M	H	M	-	-	-	-	M	H	H	-
CO3	H	H	M	-	H	M	-	-	-	-	M	H	H	M
CO4	H	-	-	H	H	M	-	-	-	-	M	H	H	M
CO5	-	M	-	-	H	M	-	-	M	M	M	-	H	M
CO6	-	M	-	M	H	M	-	-	-	M	M	-	H	M

14. Self-Learning Activities (SL: 45 Hours)

S.No	Activity	Hours	COs / TS	Evaluation Criteria
1	Assignment Writing (5 assignments based on watermarking models, steganography	5 assignments × 3 hrs each Total = 15 hrs	CO1–CO4 TS1–TS4	Evaluated based on assignment submission, watermark/steganography analysis accuracy, embedding methodology,

	techniques, embedding methods, perceptual models, and multimedia security analysis)			protocol understanding, robustness evaluation, and analytical reasoning
2	Technical Video-Based Learning related to Digital Watermarking and Steganography (e.g., spread spectrum embedding, authentication techniques, steganalysis, multimedia copyright protection, watermark attacks)	Video viewing: 5hrs Report preparation: 5 hrs Presentation: 5 hrs Total = 15 hr	CO2, CO3, CO5 TS2, TS3, TS5	Report + Presentation based on learning outcomes; must include watermarking concepts, embedding techniques, security mechanisms, attack-defense strategies, and personal technical reflections
3	Real-World Watermarking & Steganography Case Studies (e.g., digital copyright protection, multimedia authentication, covert communication systems, watermark attack analysis, steganalysis techniques)	Data collection/study: 10 hrs Report preparation: 5 hrs Total = 15 hrs	CO4, CO5, CO6 TS4, TS5, TS6	Evaluated based on technical depth, multimedia security analysis, attack evaluation, robustness assessment, mitigation strategies, secure system design practices, and analytical conclusions
	TOTAL Self-Learning Hours	**45 hours**	**CO1–CO6**	All activities are compulsory. Submission deadlines communicated at the start of the semester.

15. Bloom's Taxonomy — Domain Level Reference

Cognitive Domain (6 Levels)	Affective Domain (5 Levels)	Psychomotor Domain — Simpson (7 Levels)
L1 — Remember: Recall facts, definitions, basic concepts L2 — Understand: Explain ideas, concepts, and principles L3 — Apply: Use knowledge to solve problems in new situations L4 — Analyze: Break down information, examine relationships L5 — Evaluate: Judge, justify, assess, and make decisions L6 — Create: Design, develop, and produce new artefacts	A1 — Receiving: Awareness and willingness to attend A2 — Responding: Active participation and reaction A3 — Valuing: Commitment and assigning value to content A4 — Organizing: Integrating values into a personal system A5 — Characterizing: Internalized value system	P1 — Perception: Sensory cues guide motor activity P2 — Set: Mental, physical readiness to act P3 — Guided Response: Practice through imitation/trial P4 — Mechanism: Habitual correct performance P5 — Complex Overt Response: Skilled performance P6 — Adaptation: Modify skills for special situations P7 — Origination: Create new solution patterns

★ *OBE Compliance Statement: This is a theory-only course. All 6 COs are mapped primarily to the Cognitive domain (L1–L5). Psychomotor domain (P3) appears only for CO3 (algorithm implementation as mental tracing). Affective domain (A3) appears for CO4 and CO5, reflecting valuing of algorithmic efficiency.*

16. Attendance Policy & Pass / Fail Criteria

16.1 Attendance Policy

Component	Minimum	Applicable To	Consequence
Theory Classes	**75%**	All lecture sessions	Debarred from ETE if below threshold
Self-Learning / Assignment Submission	**All activities**	SL activities (30 hrs)	Incomplete SL affects CA score directly

⚠ *Theory attendance must meet 75% minimum. Missing SL activities (assignments, video report, case study) directly impacts CA marks and is not compensable by exam performance.*

16.2 Pass / Fail Criteria

Condition	Threshold	Status	Remarks
ETE Score	**≥ 24 / 60**	**MANDATORY**	40% of ETE paper required; failing ETE means failing the course regardless of CA + MTE
Overall Total (CA + MTE + ETE)	**≥ 40 / 100**	**Must pass overall**	CA 25 + MTE 25 + ETE 50 = 100; 40% overall minimum required

CSCF4204— MEASUREMENT ARCHITECTURE SUMMARY

Theory-Only Course | 6 COs (CO1–CO6) | 3 Assessment Instruments | 6 Theory Skill Dimensions (TS1–TS6)

CO1–CO2: Conceptual / Understand → TS1, TS2 → CA + MTE Sec A + ETE Sec A
CO3–CO4: Apply / Analyze → TS3, TS4 → CA + MTE Sec B + ETE Sec B
CO5–CO6: Analyze / Evaluate → TS5, TS6 → CA + ETE Sec B/C

CA 25 marks + MTE 25 marks + ETE 50 marks = Total 100 marks

Semester 8, Credits: 15	
COURSE CODE	**COURSE NAME**
CSCR4601	Capstone - 2
	Open Elective – 3
	Open Elective – 4

School: SET		**Batch: 2026-2030**			
Program: B.Tech.		**Current Academic Year: 2029-2030**			
Branch: CSE		**Semester: VIII**			
1	Course Code	**CSCR4601**			
2	Course Title	Capstone - 2			
3	Credits	10			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	1. To understand the concept of project design after the completion of project planning 2. Students making decisions within a framework 3. Continuous evaluation of the project 4. A final product to be evaluated for quality			
6	Course Outcomes	Students will be able to: CO1: Demonstrate the implementation of the project. CO2: Identify the test procedure for each implemented module. CO3: Deploy and evaluate the modules to verify the required need of the project. CO4: Use different tools for communication, testing and report writing. CO5: Develop the attitude and ethics of a professional engineer. CO6: Demonstrate an ability to present and defend their project work to a panel of experts.			
7	Course Description	The objective of Major Project-II is to enable the student to extend further the development of project till testing and deployment under the guidance of a Supervisor.			
8	Outline syllabus				CO Mapping
	Unit 1	Complete the implementation of the project. Testing of the modules, Use of appropriate tools/techniques for testing			CO1, CO2
	Unit 2	Deploy & demonstrate developed modules of the project			CO2, CO3
	Unit 3	Preparing a Project Report in the standard format for being evaluated by the Supervisor			CO4, CO5
	Unit 4	Submission of Project and Report to Departmental Committee			CO4, CO5, CO6
	Unit 5	Final Presentation before Departmental Committee			CO6
	Mode of examination	Project			
	Weight age Distribution	CA	CE(Viva)	ETE	
		30%	30%	40%	

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	CO1: Demonstrate the implementation of the project.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11, PSO1,PSO2,PSO3
2.	CO2: Identify the test procedure for each implemented module.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11,PSO1,PSO2,PSO3
3.	CO3: Deploy and evaluate the modules to verify the required need of the project.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11, PSO1,PSO2,PSO3
4.	CO4: Use different tools for communication, testing and report writing.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11, PSO1,PSO2,PSO3
5.	CO5: Develop the attitude and ethics of a professional engineer.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11, PSO1,PSO2,PSO3
6.	CO6: Demonstrate an ability to present and defend their project work to a panel of experts.	PO1, PO2, PO3, PO4, PO5,PO6,PO7, PO8, PO9, PO10, PO11,PSO1,PSO2,PSO3

PO and PSO mapping with level of strength for Course Name Major Project -2 (Course Code CSCR4601)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	2	3	2	2	2	2	2	2	3	3	3
CO2	2	2	3	2	3	2	2	2	2	2	2	1	3	3
CO3	3	3	3	3	3	2	2	2	2	2	1	1	3	3
CO4	2	2	2	2	3	2	2	2	3	2	1	1	2	2
CO5	1	2	2	1	3	2	2	2	3	2	1	1	2	2
CO6	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Avg.	**1.83**	**2.0**	**2.33**	**2.0**	**2.83**	**2.0**	**2.0**	**2.0**	**2.33**	**2.0**	**1.5**	**1.5**	**2.5**	**2.5**

1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)