Programme and Course Structure

Department of Mathematics & Data Science

Sharda School of Engineering & Science

Bachelor of Science (Data Science & Analytics)

Programme Code: SBR0308

Batch: 2026-30

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 accelerateentrepreneurship.
4. Seeking beyond boundaries.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

1.2 Vision and Mission of School

Vision of the School

Achieving academic excellence in the realm of basic and engineering sciences to address the global challenges and to become global leaders.

Mission of the School

1. To impart basic, advanced and transformative knowledge and skills in science and technology.
2. To strengthen capacity and capabilities in cutting-edge technology and research.
3. To nurture multidisciplinary research and entrepreneurship temperament for developing innovative solutions to global, societal and environmental challenges.
4. To foster multi-dimensional partnerships and collaborations for skill development and global employability.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

1.3 Vision and Mission of the Department

Vision of the Department

To become a globally recognized destination for education in mathematical sciences and research.

Mission of the Department

1. To develop mathematical skills in students and make them employable across a wide range of professions and promote interest in research.
2. To develop entrepreneurial skills in students by encouraging critical thinking, innovation, and interdisciplinary applications of mathematics, data science and statistics.
3. To develop skills for the applications of mathematics, statistics and data science in the various fields.

Core Values

1. Integrity
2. Leadership
3. Diversity
4. Community

Bachelor of Science (Data Science & Analytics)

1.4.1 Programme Educational Objectives (PEO's)

PEO1: To prepare professionals conversant with current and advanced technological tools to carry out Investigation, analysis and synthesis by identifying various compute-oriented solutions.

PEO2: To develop positive attitude and skills which enable them to become a multi facet personality.

PEO3: To prepare students in such a way so that they perform excellently in national label entrance examinations conducted by various well-known institution like IIT's/ central Universities/other academic institutes etc. to pursue their PG/MS/Dual PG and Ph.D. programs.

PEO4: To make them aware of effective machine learning and Artificial Intelligence based data analytics and inference required for Industrial Application.

PEO5: To inculcate passion for lifelong learning by introducing principles of group dynamics, public policies, environmental and societal context.

1.4.2 Programme Outcomes (PO's)

PO1. Complex Problem Solving: Solve different kinds of problems in familiar and non-familiar contexts and apply the learning to real-life situations.

PO2. Critical Thinking: Analyze and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.

PO3. Creativity: Demonstrate the ability to think 'out of the box' and generate solutions to complex problems in unfamiliar contexts by applying concepts of multidisciplinary and interdisciplinary.

PO4. Analytical reasoning/thinking: Evaluate the reliability and relevance of evidence.

PO5. Research-related skills: Demonstrate the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.

PO6. Communication Skills: Demonstrate the skills that enable them to express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.

PO7. Coordinating/collaborating with others: Demonstrate the ability to work effectively and respectfully with diverse teams using management skills to guide people to the right destination.

PO8. Digital and technological skills: Demonstrate the capability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data.

PO9. Value Inculcation: Instill integrity and identify ethical issues related to work, and follow ethical practices with or understand the perspective, experiences, or points of view of another individual or group, and to identify and understand other people's emotions.

PO10. Sustainability Growth: Demonstrate the capability to lead a diverse team or individual to accomplish and participate in community-engaged services/ activities for promoting the well-being of society to mitigating the effects of environmental degradation, climate change, and pollution.

PO11. Multidisciplinary Life-long learning: Comprehensive knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study in a broad multidisciplinary context by inculcating a healthy attitude to be a lifelong learner.

1.4.3 Mapping of PEOs with Mission Statements

PEO Statements	School Mission1	School Mission2	School Mission3	School Mission4
PEO1	3	3	2	2
PEO2	3	2	2	3
PEO3	3	3	2	3
PEO4	3	3	3	3
PEO5	3	2	3	3

1.4.4 Mapping of Programme Outcomes Vs Programme Educational Objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	**3**	**3**	**3**	**2**	**3**
PO2	**3**	**3**	**3**	**2**	**2**
PO3	**3**	**3**	**3**	**2**	**2**
PO4	**3**	**2**	**3**	**2**	**2**
PO5	**2**	**3**	**2**	**3**	**2**
PO6	**3**	**3**	**3**	**2**	**2**
PO7	**3**	**2**	**3**	**3**	**3**
PO8	**2**	**2**	**3**	**3**	**2**
PO9	**3**	**2**	**2**	**3**	**2**
PO10	**3**	**2**	**2**	**3**	**3**
PO11	**3**	**3**	**3**	**2**	**3**

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

Structure of UG Programme (Data Science & Analytics)

Table 3 : The Semester wise and Broad Course Category-wise distribution of credits of the Undergraduate Programme:2025-29

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)	
I	MSM101 (4) & DAT1101(3) +DAP1151(1) [8]	CMS102(3) [3]	MTT1101 (2) [2]	ARP101(2) [2]	VOM101(3) [3]	EVT1129 (2) [2]			40	First Minor Core is fixed course for each school.
II	MTT1202(3) + MTP1251(1) & CMS131(4) [8]	CMS132 (3) [3]		ARP102(2) [2]	VOM104(3) [3]	VAC110 (2) VAC120 (2) [4]				
	Students existing the programme after securing 40 credits will be awarded UG certificate in the relevant Discipline / Subject 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									VAC/SEC/Multidis/AEC can be taken from NPTEL
III	BDA217(3) + DAP2351 (2) & BDA313(5) [10]	BDA215 (3) [3]	AI3407 (2) [2]	Th-1(2) Indian Language [2]	VOM2305 (3) [3]			DAR2351 (0) [0]	80	Mandatory visit to Abhivyakti Wellness Clinic as Audit Course to be taken in any semester (Except 1st & final sem.)
IV	BDA202(4)+-BDA214(4) + DAP2452-(2) & BDA323(4) [14]	AI3408 (3) [3]		Community Connect-1(2) [2]				DAR2452 (1) [1]		On VAC Courses -Environment -Indian Knowledge System -Mulya Pravah
	Students existing the programme after securing 80 credits will be awarded UG Diploma in the relevant Discipline / Subject provided they secure additional 4 credits in skill based vocational courses offered during first year or second year summer term or Internship									
V	BDA303(4)+BDA322(4)+BDA318(4) + BDA216 (4)/ + DAP3551(2)+DAP3552(2) [20]							DAR3551(0) (Audit) [0]	120	{80+40=120} 3- Year UG Degree with single major or major with minor {120}
VI		BDA321(4) + BDA218 (3)+BDA270(1)+ AI3409(4) [12]	BDA325(3) [3]	ARP306 (2)/Foreign Language(2) [2]			INC001 (2)) [2]	DAR3652(1) [1]		
OR VI			Apprenticeship [20]					RBL4 -1(0) (Audit) [0]	20	
	OR									

				OR						
VII	MDA101(4)+ MDA102(4)+ STT4701 (4)+ STT4704 (4)+ DAP4754(1)+ DAP4755(1) STP4753(1)+ STP4752(1) [20]	**MDA203 (4) [4]							(24+20)	*should be take if not going to internship {120+40=160} 4- Year UG Degree (Honours) {160} Bachelor (Honors) in Faculty with single major
VIII		MDA117 [4] + MDA112 [4] [8]	MDA107(4) + MDA116(4) [8]					Project- DAR4856[4]	160	

OR VIII	MDA117 [4] [4]		Apprenticeship [20]						20	
									160	
				OR						
VII	MDA101(4)+ MDA102(4) + STT4701 (4)+ STT4704 (4) [16]	MDA203 [4]						DAR4757 (3) [3]		
VIII	MDA117 [4]	MDA112 [4]						DAR4858 (9) [9]		{120+40=160} 4- Year UG Degree (Honours with Research) {160} 1. Bachelor (Honours with Research) in Faculty with single major

No. of Courses
No. of Credits
Total Credits in Bucket

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
Term: 2601 (Semester-I)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL**			
1.	MSM101	Foundation Course in Mathematics	4	0	0	4	4	Basic Mathematics upto 10+2	CC Major
2.	DAT1101	Foundation of Data Science	3	0	0	3	3		CC Major
3.	CMS102	Descriptive Statistics	3	0	0	3	3	Basic Mathematics upto 10+2	(Minor)
4.	MTT1101	Programming for Problem Solving	2	0	0	2	2		Multi Dis (DSE)
5.	EVT1129	Environmental Education	2	0	0	2	2		VAC
	PRACTICALS								
6.	DAP1151	Foundation of Data Science Lab	0	0	2	2	1		CC Major
7.	ARP101	Communicative English-1	1	0	2	3	2		AEC
8.	VOM103	Essential Excel Skills for Business	0	0	6	6	3		SEC
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2602 (Semester-II)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	CMS131	Matrix Analysis and Linear Algebra	4	0	0	4	4	Pre-requisite MSM101	CC
2.	MTT1202	Principal of Data Structures	3	0	0	3	3		CC
3.	CMS132	Mathematical Expectations & Probability Distributions	3	0	0	3	3		Minor
4.	IKT1103	Indian Knowledge System	2	0	0	2	2		VAC
5.	IKT1104 (mulyapravaha)	Understanding India	2	0	0	2	2		VAC
	PRACTICALS								
6.	MTP1251	Principles of Data Structures Lab	0	0	2	2	1		CC
7.	SKP1020	Communicative Essentials-2	1	0	2	3	2		AEC
8.	VOM104	Advanced Excel Skills for Business	0	0	6	6	3	Pre-requisite VOM103	SEC
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2701 (Semester-III)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA217	Data Preparation and Data Cleaning	3	0	0	3	3		CC Major
2.	BDA313	Regression, Time Series, Forecasting and Index Numbers	4	0	2	6	5		CC Major
3.	BDA215	Operation Research	3	0	0	3	3		Minor
4.	IKT2202	General Hindi	2	0	0	2	2		AEC
	PRACTICALS								
5.	DAP2351	Data Preparation and Data Cleaning lab	0	0	4	4	2		CC Major
6.	AI3407	Prompt Engineering for AI and Data Science	0	0	4	4	2		DSE(Multi/Inter-discipli)
7.	VOM2305	Data Visualization with Tableau and Power BI	0	0	6	6	3		SEC
8.	DAR2351	Research Based Learning-I(RBL-1)	0	0	2	2	0		Research Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2702 (Semester-IV)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA202	Database Management Systems	4	0	0	4	4		CC
2.	BDA214	Sampling Theory	4	0	0	4	4		CC
3.	DAT2401	Multivariate Data Analysis & its Applications	4	0	0	4	4		CC
	Practicals								
4.	DAP2452	Sampling Lab	0	0	4	4	2(was 1)		CC
5.	AI3408	Supervised & Unsupervised Learning Techniques	0	0	6	6	3		Minor
6.	CCU108	Community Connect	0	0	2	2	2		AEC
7.	DAR2452	Research Based Learning-2(RBL-2)	0	0	2	2	1		Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2801 (Semester-V)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA303	Machine Learning	4	0	0	4	4		CC
2.	BDA322	Statistical Simulation	4	0	0	4	4		CC
3.	BDA318	Data Visualization	4	0	0	4	4		CC
4.	BDA216	Statistical Inference	4	0	0	4	4		CC
	Practicals								
5.	DAP3551	Machine Learning Lab	0	0	4	4	2(was 1)	Co-requisite BDA303	CC
6.	DAP3552	Statistical Simulation Lab	0	0	4	4	2(was 1)	Co-requisite BDA322	CC
7.	DAR3551	Research Based Learning-III (RBL-3)	0	0	0	0	0	Pre-requisite DAR2452	Research Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2802 (Semester-VI)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	BDA321	Non-Parametric Statistical Inference	4	0	0	4	4		Minor
2.	BDA218	Data Ware Housing and Data Mining	3	0	0	3	3		Minor
3.	BDA325	Deep Learning	3	0	0	3	3		DSE
	Practicals								
4.	BDA270	Data Ware Housing and Data Mining Lab	0	0	2	2	1	Co-requiste MSM312	Minor
5	AI3409	Advanced Machine Learning Techniques	0	0	8	8	4		Minor
6.	ARP306	Campus to Corporate	1	0	2	3	2	AEC	AEC
7.	INC001	Industry Connect	0	0	4	4	2		Project
8.	DAR3652	Research Based Learning-IV (RBL-4)	0	0	2	2	1	Pre-requisite DAR3551	Project
TOTAL CREDITS							**20**		

Department of Mathematics & Data Science
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Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2901 (Semester-VII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA101	Foundations of Data Science	4	0	0	4	4		CC
2.	MDA102	Mathematics for Machine Learning	4	0	0	4	4		CC
3.	STT4701	Distributions Theory	4	0	0	4	4		CC
4.	STT4704	Probability & Statistical Methods	4	0	0	4	4		CC
5.	MDA203*(remove because we did not give them a minor degree)	Soft Computing Techniques	4	0	0	4	4*		Minor
	Practical's								
6.	DAP4754	Data Science Lab	0	0	2	2	1	Co-requisite MDA101	CC
7.	DAP4755	Mathematics for Machine Learning Lab	0	0	2	2	1	Co-requisite MDA102	CC
8.	STP4753	Distributions Theory Lab	0	0	2	2	1	Co-requisite STT4701	CC
9.	STP4752	Statistical Methods Lab	0	0	2	2	1	Co-Requisite STT4704	CC
TOTAL CREDITS							**20/ *24**		

***Only for the students going for Apprenticeship & requires minor with major degree.**

***Credited Research Project/Dissertation:** Students of B.Sc. Data Science & Analytics have the option to choose a research project/dissertation of worth 12 credits (However student has to take 23 credits courses including 3 credits project in 7th semester and 17 credits courses including 9 credits project in 8th semester). This can be undertaken for those who secure 75% and above marks/CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a mathematics faculty member of the Sharda University. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded **B.Sc. (Hons. with Research) Data Science & Analytics.**

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2902 (Semester-VIII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6.VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA117	Computational Intelligence	4	0	0	4	4		Minor
2.	MDA104	Next Generation Databases	4	0	0	4	4		Minor
3.	MDA107	Advanced Big Data and Text Analytics	4	0	0	4	4		DSE
4.	MDA105	Regression Analysis and Predictive Models	4	0	0	4	4		DSE
	Practicals								
5.	DAR4856	Project	0	0	8	8	4		Project
TOTAL CREDITS							**20**		

OR

Department of Mathematics & Data Science
Sharda School of Engineering & Science
Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2901 (Semester-VII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA101	Foundations of Data Science	4	0	0	4	4		CC
2.	MDA102	Mathematics for Machine Learning	4	0	0	4	4		CC
3.	STT4701	Distributions Theory	4	0	0	4	4		CC
4.	STT4704	Probability & Statistical Methods	4	0	0	4	4		CC
5.	MDA203	Soft Computing Techniques	4	0	0	4	4		Minor
6.	DAR4757	Research Project-I	0	0	6	6	3		Project
TOTAL CREDITS							**23**		

Department of Mathematics & Data Science
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Bachelor of Science (Data Science & Analytics)
Batch: 2026-30
TERM: 2902 (Semester-VIII)

S. No.	Course Code	Course Name	Teaching Load				Credits	Pre-Requisite/ Co-Requisite	Type of Course: 1. CC; 2. DSE; 3. OPE; 4. SEC; 5. AEC; 6. VAC; 7.Project
	THEORY		**L**	**T**	**P**	**TOTAL (hrs)**			
1.	MDA117	Computational Intelligence	4	0	0	4	4		CC
2.	MDA112	Econometrics	4	0	0	4	4		CC
3.	DAR4858	Research Project-II	0	0	18	18	9		Project
TOTAL CREDITS							**17**		

***Credited Research Project/Dissertation:** Students of B.Sc. Data Science & Analytics have the option to choose a research project/dissertation of worth 12 credits (However student has to take 23 credits courses including 3 credits project in 7th semester and 17 credits courses including 9 credits project in 8th semester). This can be undertaken for those who secure 75% and above marks/CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a mathematics faculty member of the Sharda University. The students, who secure 160 credits, including 12 credits from a research project/dissertation, are awarded **B.Sc. (Hons. with Research) Data Science & Analytics.**

Bachelor of Science (Data Science & Analytics) Curriculum Credits Distribution

Sem	CC	DSE	MINOR	SEC	AEC	VAC	Project	Mathematics	Computer Science	Statistics
1	8	2	3	3	2	2	0	4	2	7
2	8	0	3	3	2	4	0	4	4	3
3	10	2	3	3	2	0	0	0	2	16
4	14	0	3	0	2	0	1	3	4	10
5	20	0	0	0	0	0	0	0	0	20
6	0	3	12	0	2	0	3	0	7	8
Total:	60	**7**	**24**	9	**10**	6	**4**	11	**19**	**64**
%	**50**	**5.84**	**20**	**7.5**	**8.4**	**5**	**3.3**	**9.16**	**15.8**	**53.3**
7	20	0	4*	0	0	0	0	0	6	14
8	0	8	8	0	0	0	4	0	3	16
Total:	80	**15**	**32**	9	**10**	6	**8**	**11**	**28**	**94**
%	**50**	**9.37**	**20**	**5.63**	**6.25**	**3.75**	**5**	**6.8**	**17.5**	**58.75**

COURSE ARTICULATION MATRIX

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MSM101	2.5	2.3	1.6	2.3	1.3	1.5	1.1	2.0	1.6	1.1	2.1
DAT1101	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
CMS102	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
MTT1101	3.0	2.3	1.6	2.3	1.3	1.5	1.1	2.0	1.6	1.1	2.1
EVT1129	3.0	3.0	2.0	1.0	3.0	1.0	1.0	3.0	3.0	2.0	2.0
DAP1151	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
ARP101	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		1.0
VOM103	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
CMS131	2.5	2.3	1.6	2.3	1.3	1.5	1.1	2.0	1.6	1.1	2.1
MTT1202	2.5	2.3	1.6	2.3	1.3	1.5	1.1	2.0	1.6	1.1	2.1
MTP1251	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
CMS132	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
VOM104	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
ARP102	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		
IKT1103	2.0			1.0	1.0		2.0	2.0	1.0		
IKT1104	2.0			1.0	1.0		2.0	2.0	1.0		
BDA217	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
BDA313	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
BDA215	1.0	2.0	2.3	2.1	1.0	1.0	1.0	2.0	3.0		1.0
DAP2351	1.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	1.0	1.0	3.0
AI3407	2.5	2.7	2.2	2.3	2.3	1.7	1.8	1.8	1.7	1.7	3
VOM2305	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
DAR2351	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
BDA202	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3
BDA214	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	3.0
BDA323	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	3.0
DAP2452	1.0	2.0	2.0	2.0	1.0	1.0	1.0	3.0	1.0		2.0
AI3408	2.0	1.0	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0	2.0
CCU108	1.0	2.0	2.0	3.0	3.0	2.0	3.0	3.0	3.0	2.0	1.0
DAR2452	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
BDA303	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0
BDA322	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	2.0
BDA318	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	2.0
BDA216	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	1.0
DAP3551	3.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0
DAP3552	3.0	2.0	2.0	2.0	2.7	1.0	1.0	3.0	1.0	2.0	3.0
DAR3551	3.0	2.0	2.0	2.0	2.7	1.0	1.0	3.0	1.0	2.0	3.0

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA321	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
BDA218	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
BDA325	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
BDA270	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
AI3409	2.0	1.0	2.0	2.0	1.0	3.0	1.0	3.0	1.0	1.5	2.0
ARP306			2.0	2.0		3.0	1.0	3.0	1.0		2.0
INC001	2.0	1.0	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0	2.0
DAR3652	3.0	2.0	2.0	2.0	2.7	1.0	1.0	3.0	1.0	2.0	3.0
MDA101	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA102	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
STT4701	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
STT4704	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA203*	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA155	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA158	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA117	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA101	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA102	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
STT4701	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
STT4704	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
MDA203	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2
DAR4858	3.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0

1. Slight (Low) ***2. Moderate (Medium)*** ***3. Substantial (High)***

Course Module

School: SSES		**Batch: 2026-30**
Programme: Bachelor of Science (Hons. /Hons. With Research) Data Science & Analytics		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	MSM101
2	Course Title	Foundation Course in Mathematics
3	Credits	4
4	Contact Hours(L-T-P)	4-0-0
	Course Status	CC
5	Course Objective	To familiarize students with the fundamental concepts of matrices, determinants, and methods for solving systems of linear equations. This course also aims to develop an understanding of the basic principles of set theory, coordinate geometry, complex numbers, and vector algebra.
6	Course Outcomes	CO1: Understand the fundamental concepts of set theory, relations, and functions, and apply them to solve mathematical problems (K2, K3). CO2: Understand the fundamental operations of matrices, and apply them to solve systems of linear equations using rank and inverse (K2, K3). CO3: Analyze the representation of complex numbers in the Argand plane and apply algebraic operations to solve problems involving complex numbers (K3, K4) CO4: Analyze and apply the concepts of the Cartesian coordinate system to solve geometric problems (K3, K4). CO5: Understand basic concepts of vector algebra and apply them to determine projections and area of geometric figures (K2, K3). CO6*:* Evaluate and apply vector triple products to analyze and solve geometric problems involving vectors in three-dimensional space (K3, K4, K5).
7	Course Description	This course provides an introduction to the fundamental concepts of mathematics. It aims to develop a basic understanding of matrices, complex numbers, coordinate geometry, set theory, and vector algebra. The course builds a strong mathematical foundation and enhances students' analytical and problem-solving skills required for further studies in mathematics and related disciplines.
8	Outline syllabus		CO Mapping
	Unit 1	Set Theory	
	A	Definition of set, types of sets, Union and intersection of sets, Venn diagram, De-Morgan's law.	CO1
	B	Relation and functions.	CO1
	C	Composite function and inverse function.	CO1
	Unit 2	Matrices	
	A	Matrices: types of matrices, addition, subtraction and multiplication of matrices, symmetric and skew symmetric matrix.	CO2
	B	Evaluation of determinants, Properties of determinants, Adjoint and Inverse of matrix.	CO2
	C	Rank of a matrix, Consistency of system of equations, Characteristic equation, Cayley -Hamilton theorem.	CO2
	Unit 3	Complex Numbers	
	A	Representation of complex number in Argand plane, Modulus and	CO3

		argument of complex number	
	B	Algebraic operations, De- Moivre's theorem	CO3
	C	Nth root of complex number, Euler's formula	CO3
	Unit 4	Co-ordinate geometry	
	A	Cartesian coordinate system, Distance between two points Equations of line in various forms	CO4
	B	Equation of circle in various forms, Equation of tangent and normal to the circle.	CO4
	C	Equation of ellipse, parabola and hyperbola	CO4
	Unit 5	Vector Algebra	
	A	Addition and subtraction of vectors and their geometric application.	CO5
	B	Scalar and vector product, their physical application, Projection of vector on another vector, area of triangle.	CO5
	C	Area of parallelogram and quadrilateral, Vector triple product.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA MSE ESE	
	Text book/s*	1. Kreyszig, E., "Advanced Engineering Mathematics", John Wiley & Sons Inc. 2. NCERT Mathematics, Class XI, XII, NCERT, New Delhi.	
	Other References	1. Jain, M.K., and Iyengar, S.R.K., "Advanced Engineering Mathematics", Narosa Publications.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MSM101.1	2	2	2	2	1	2	1	2	1	1	2
MSM101.2	2	2	2	2	2	1	2	2	3	1	2
MSM101.3	2	2	2	2	1	2	1	2	1	1	2
MSM101.4	3	2	1	2	1	2	1	2	1	1	2
MSM101.5	3	3	1	3	2	1	1	2	2	1	2
MSM101.6	3	3	2	3	1	1	1	2	2	2	3
Average	2.5	2.3	1.6	2.3	1.3	1.5	1.1	2.0	1.6	1.1	2.1

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	DAT1101	
2	Course Title	Foundation of Data Science	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	CC	
5	Course Objective	To make students familiar with Data Science concepts, tools, and techniques, and to develop their skills in data analysis, visualization, and basic Machine Learning through hands-on projects, preparing them for advanced studies and careers in the field.	
6	Course Outcomes	CO1: Understand the fundamental concepts of Data Science and its applications. (K2) CO2: Apply basic statistical techniques for data analysis. (K3) CO3: Analyze data preprocessing techniques. (K4) CO4: Understand the basics of Machine Learning techniques. (K2) CO5: Evaluate real data set using basic tools of Python (K5) CO6: Develop basic programming skills for data science (Python/R) (K6)	
7	Course Description	This course introduces the fundamental concepts, tools, and techniques of Data Science, including data analysis, preprocessing, visualization, and basic machine learning. It provides hands-on experience using Python/R for data handling and builds a foundation for real-world data-driven applications.	
8			
	Unit 1	Introduction to Data Science	
	A	Definition, scope, and evolution of Data Science, Real-world applications (Healthcare, Finance, Marketing, etc.), Overview of Big Data and its challenges	CO1
	B	Structured vs Unstructured Data, Data types (Numerical, Categorical, Time Series, Text Data), Overview of datasets	CO1
	C	Data Collection, Preprocessing, Analysis, Visualization, and Model Building.	CO1
	Unit 2	Measures of Central Tendency and Dispersion	
	A	Measures of Central Tendency (Mean, Median, Mode).	CO2
	B	Measures of Dispersion (Variance, Standard Deviation, Range).	CO2
	C	Scatter diagram, covariance, Correlation	CO2
	Unit 3	Data Cleaning & Manipulation in Python/R	
	A	Handling missing values, removing duplicates, and outliers. Data transformation (Normalization, Standardization).	CO3
	B	Working with NumPy and Pandas, Filtering, Sorting, Grouping, and Aggregation.	CO3
	C	Basics of Matplotlib and Seaborn. Types of Graphs: Bar Charts, Histograms, Box Plots, Scatter Plots, Line Graphs, Heat maps, and Pair Plots.	CO3
	Unit 4	Linear Regression and Classification Models	
	A	Understanding the Regression Equation, Assumptions of Linear Regression. Model Evaluation Metrics (MSE, RMSE, R^2).	CO4
	B	Decision Trees (Basic Concepts).	CO4

	C	K-Means Algorithm.	CO4
	Unit 5	Programming for Data Science	
	A	Basic Syntax, Data Types, and Operators, Control Structures (Loops & Conditional Statements). Functions and Modules.	CO5
	B	NumPy (Array Operations), Pandas (Data Frame Operations). Scikit-Learn (Basic ML Models).	CO5
	C	Problem Identification and Data Collection, Data Cleaning and Exploration, Model Selection and Implementation, Result Interpretation and Presentation.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: MTE : ETE:	
	Text book/s*	1. "Python for Data Analysis" by Wes McKinney 2. Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce	
	Other References	1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAT1101.1	2	2	3	2	2	2	2	3	2	3	3
DAT1101.2	3	2	3	3	2	2	2	2	2	3	2
DAT1101.3	3	3	2	3	2	2	2	2	2	2	2
DAT1101.4	2	2	3	2	2	2	2	2	2	2	3
DAT1101.5	3	3	2	3	3	2	2	3	2	2	2
DAT1101.6	3	2	2	2	2	2	2	3	2	2	2
Average	2.6	2.3	2.5	2.5	2.1	2	2	2.5	2.3	2.3	2.3

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	CMS102	
2	Course Title	Descriptive Statistics	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	OPE	
5	Course Objective	This course aims to introduce fundamental statistical concepts, logical reasoning, and analytical tools for analyzing and communicating quantitative data in verbal, graphical, symbolic, and numerical forms. It also familiarizes students with the concepts of probability, correlation, and regression, and enables them to represent and interpret data using various tables, charts, and graphical methods.	
6	Course Outcomes	CO1: Define methods of data collection, classification, tabulation, and graphical representation of data. (K1) CO2: Explain basic descriptive statistics and their properties (K2). CO3: Apply measures of central tendency, dispersion, moments, skewness, and kurtosis to analyze datasets. (K3) CO4: Analyze relationships between variables using correlation and regression techniques. (K4) CO5: Evaluate probability concepts and apply them to real-life decision problems. (K5) CO6 Interpret statistical results and communicate findings using appropriate statistical reasoning. (K6).	
7	Course Description	This is an introductory course in statistics. Students are introduced to the fundamental concepts involved in using sample data to make inferences about populations. Included are the study of measures of central tendency and dispersion, finite probability, statistical inferences from large and small samples, linear regression, and correlation.	
8	Outline syllabus		CO Mapping
	Unit 1	Data Presentation	
	A	Classification, tabulation, diagrammatic & graphical representation of groupeddata.	CO1
	B	Frequency distributions, cumulative frequency distributions	CO1
	C	Histogram, Ogives, frequency polygon, Tree and leaf diagram.	CO1
	Unit 2	Descriptive statistics	CO2
	A	Measures of central tendency – arithmetic mean, median, quartiles, mode, harmonicmean, geometric mean.	CO2
	B	Their properties, merits, and demerits	CO2
	C	Measures of dispersion, range, quartile deviation, mean deviation, standard deviation,and coefficient of variation.	CO2
	Unit 3	Moments, Skewness, Kurtosis	CO3
	A	Moments, Skewness, Measures of skewness: Karl Pearson's coefficient of skewness.	CO3
	B	Quartile, coefficient of skewness, Measure of skewness based on moments.	CO3
	C	Kurtosis, Measures of Kurtosis.	
	Unit 4	Correlation & Regression	CO4
	A	Bivariate data, principles of least squares, fitting of polynomial curves, and fitting ofcurves reducible to polynomial form.	CO4
	B	Correlation: Spearman's rank correlation, Partial and Multiple	CO4

		Correlation (only two independent variables case).	
	C	Regression lines.	
	Unit 5	Probability	CO5
	A	Probability: Introduction, random experiment, outcomes, sample space, events, various definitions of probability, laws of total and compound probability.	CO5
	B	Boole's inequality. Conditional probability, independence of events.	CO5
	C	Bayes theorem and its applications in real-life problems.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: ; MTE : ; ETE:	
	Text book/s*	1. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2. Rohatgi, V.K. "Introduction to Probability".	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CMS102.1	3	2	2	3	3	2	2	3	1	1	3
CMS102.2	3	2	2	3	3	2	2	3	1	1	3
CMS102.3	3	3	3	3	3	2	2	3	2	2	3
CMS102.4	3	3	3	3	3	2	2	3	2	2	3
CMS102.5	3	3	3	3	3	2	2	3	2	2	3
CMS102.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2026-30**	
Program: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester:1**	
1	Course Code	MTT1101	Course Name: Programming for problem solving
2	Course Title	Programming for problem solving	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	DSE	
5	Course Objective	1. Learn basic programming constructs –data types, decision structures, control structures in C 2. Learning logic aptitude programming in c language 3. Developing software in c programming	
6	Course Outcomes	CO1: Analyze a problem and represent its solution using algorithms, pseudo-code, and flowcharts. (K2, K3, K4). CO2: Apply fundamental concepts of C programming, including data types, operators, and control structures, to solve problems. (K2, K3, K4). CO3: Develop and implement programs using loops, functions, and arrays for structured problem-solving. (K1,K2). CO4: Utilize pointers and strings effectively to manage memory and text-based data processing. (K2, K3, K4). CO5: Implement user-defined data types, structures, and file handling techniques for data organization and storage. CO6: Design and develop optimized C programs to address real-world computational problems.	
7	Course Description	Programming for problem solving gives the Understanding of C programming and implement code from flowchart or algorithm	
8	Outline syllabus		CO Mapping
	Unit 1	Logic Building	
	A	Flowchart: Elements, Identifying and understanding input/ output, Branching and iteration in flowchart	CO1,
	B	Algorithm design: Problem solving approach(top down/bottom up approach)	CO1
	C	Pseudo Code : Representation of different construct, writing	CO1

		pseudo-code from algorithm and flowchart			
	Unit 2	Introduction to C Programming			
	A	Introduction to C programming language, Data types, Variables, Constants, Identifiers and keywords, Storage classes			CO2, CO6
	B	Operators and expressions, Types of Statements: Assignment, Control, jumping.			CO2, CO6
	C	Conditional statements: if, if-else, nested if-else, switch case, break, continue			CO2, CO6
	Unit 3	Loops and Arrays			
	A	Iterative Statements: while loop, for loop, and do-while loop			CO3, CO6
	B	Arrays: One dimensional: Declaration, Initialization (sorting, searching).			CO3, CO6
	C	Multidimensional arrays: Declaration, Initialization, Array manipulation (Matrix operations)			CO3, CO6
	Unit 4	Functions			
	A	Functions: Definition, Declaration/Prototyping and Calling,			CO4, CO6
	B	Types of functions, Parameter passing: Call by value, Call by reference.			CO4, CO6
	C	Passing and Returning Arrays from Functions, Recursive Functions.			CO4, CO6
	Unit 5	Pointers, String and Structures			
	A	Pointer: Introduction, declaration of pointer variables, Operations on pointers: Pointer arithmetic.			CO5, CO6
	B	String: Introduction, predefined string functions, Manipulation of text data.			CO5, CO6
	C	Structure and Unions: Introduction, Declaration, Difference, Application, Nested structure, self-referential structure.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	Kernighan, Brian, and Dennis Ritchie. *The C Programming Language*			
	Other References	1. B.S. Gottfried - Programming With C - Schaum's Outline Series - Tata McGraw Hill 2nd Edition - 2004.			

		2. E. Balagurusamy - Programming in ANSI C - Second Edition - Tata McGraw Hill- 1999.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MTT1101.1	3	3	2	2	2	1	2	2	2	2	2
MTT1101.2	2	3	3	2	2	1	2	2	2	2	2
MTT1101.3	2	2	2	3	2	1	2	2	2	2	2
MTT1101.4	2	3	2	2	2	1	2	2	2	2	2
MTT1101.5	3	3	2	2	2	1	2	2	2	2	2
MTT1101.6	3	3	2	3	2	1	2	2	2	2	2
Average	2.3	2.6	2.0	2.1	2	1.0	2	2	2	2	2.0

School: SSES		**Batch: 2026-30**
Program: (Hons. /Hons. With Research)		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	EVT1129
2	Course Title	Environmental Education
3	Credits	02
4	Contact Hours (L-T-P)	2-0-0
	Course Status	Compulsory
5	Course Objective	Enable students to learn the concepts, principles and importance of environmental science. Provide students an insight of various causes of natural resource depletion and its conservation. Provide detailed knowledge of causes, effects and control of different types of environmental pollution and its effect on climate change, global warming and ozone layer depletion. Provide knowledge of different methods of water conservation. Provide and enrich the students about sustainable practices and environmental management.
6	Course Outcomes	CO1.Develop a better understanding of the principles and scope of environmental science. CO2. Acquire to learn various pollution causes, effects and control and solid waste management. CO3. Interpret the effect of global warming and ozone layer depletion. CO4. Comprehend about various types of natural resources and its conservation. CO5. Develop a better understanding about sustainable practices and environmental management. CO6. Function effectively on overall understanding of various environmental components, its protection and 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 4. Sustainable and environmental protection
8	Outline syllabus		CO Mapping
	Unit 1	Humans and the Environment	
	A	The man-environment interaction: Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation.	CO1
	B	The Club of Rome- Limits to Growth; UN Conference on	CO1

		Human Environment 1972; World Commission on Environment and Development.			
	C	The concept of sustainable development; Rio Summit and subsequent international efforts.			CO1
	Unit 2	Natural Resources and Sustainable Development			
	A	Overview of natural resources: Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: forests, grasslands, wetlands, wildlife and aquatic, water resources.			CO2
	B	Renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy.			CO2
	C	Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells. Introduction to sustainable development: Sustainable Development Goals (SDGs).			CO2
	Unit 3	Environmental Issues: Local, Regional and Global			
	A	Environmental issues and scales: local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste.			CO3/CO6
	B	Land use and Land cover change: land degradation, deforestation, desertification, urbanization.			CO3/CO6
	C	Global change: Ozone layer depletion, Sources and impact on human health and ecosystems.			CO3/CO6
	Unit 4	Conservation of Biodiversity and Ecosystems			
	A	Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots.			CO4/CO6
	B	Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics forests, wetlands, grasslands, agriculture, coastal and marine			CO4/CO6
	C	Threats to biodiversity and ecosystems. Major conservation policies: in-situ and ex-situ conservation approaches.			CO4/CO6
	Unit 5	Climate Change: Impacts, Adaptation and Mitigation			
	A	Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events.			CO5/CO6
	B	Global warming effects, Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality.			CO5/CO6
	C	National and international policy instruments for mitigation, and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan.			CO5/CO6
	Mode of examination	Theory based survey			
	Weightage Distribution	CA	MSE	ESE	
		25%	25%	50%	
	Text book/s*	Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha, Pub: Orient Blackswan Pvt			

		Ltd	
	Other References	Environmental Science by G. Tyler Miller, JR. and Scott E. Spoolman; Broks/Cole.	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	3	1	1	3	3	2	2
CO2	3	3	2	1	3	1	1	3	3	2	2
CO3	3	3	2	1	3	1	1	3	3	2	2
CO4	3	3	2	1	3	1	1	3	3	2	2
CO5	3	3	2	1	3	1	1	3	3	2	2
CO6	3	3	2	1	3	1	1	3	3	2	2
Average											

1-Slight (Low) **2-Moderate (Medium)** **3-Substantial (High)**

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	DAP1151	
2	Course Title	Foundation of Data Science Lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	CC	
5	Course Objective	To introduce students to Python/R programming for data science and develop skills in data preprocessing, manipulation, visualization, and basic machine learning for analyzing real-world datasets.	
6	Course Outcomes	CO1: Define the basic concept of Python/R software. (K2) CO2: Explain the Python/R techniques for Data Preprocessing. (K2, K3) CO3: Apply the Filter, sort, group, aggregate, Merge and join etc. tools on the data set. (K2, K3) CO4: Analyze the different types of data visualization techniques. (K2, K4) CO5: Evaluate the linear regression using python/R software. (K4) CO6: Develop statistical model using python/R software. (K5).	
7	Course Description	This course introduces Python/R for data science, focusing on data preprocessing, manipulation, visualization, and basic machine learning techniques. It provides hands-on experience in analyzing datasets and building simple predictive models.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction to Python/R for Data Science	
	A, B, C	Install and set up Python/R environment (Anaconda, Jupyter Notebook, RStudio). Write basic Python/R scripts: Variables, Data Types, Operators, and Control Structures. Perform basic operations using NumPy (Python) or basic R functions.	CO1
	Unit 2	Data Cleaning and Preprocessing	
	A, B, C	Load a dataset (CSV/Excel) into Python/R.Handle missing values (imputation, removal).Remove duplicates and outliers. Normalize and standardize data	CO2
	Unit 3	Data Manipulation	
	A, B, C	Use Pandas (Python) or dplyr (R) for data manipulation. Filter, sort, group, and aggregate data.Merge and join datasets	CO3
	Unit 4	Data Visualization	
	A, B, C	Create basic plots using Matplotlib/Seaborn (Python) or ggplot2 (R):Bar charts, histograms, scatter plots, line graphs, box plots. Customize plots (titles, labels, legends)	CO4

	Unit 5	Introduction to Machine Learning	
	A, B, C	Implement Linear Regression using Scikit-Learn (Python) or caret (R). Evaluate models using metrics like MSE, RMSE, and R^2	CO5, CO6
	Mode of examination	Practical + Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. Python for Data Analysis by Wes McKinney 2. R for Data Science by Hadley Wickham and Garrett Grolemund 3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron	
	Other References	1. Data Visualization with Python and JavaScript by Kyran Dale 2. Data Wrangling with Python by Jacqueline Kazil and Katharine Jarmul	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
DAP1151.1	3	3	2	3	2	2	2	3	2	2	3
DAP1151.2	3	3	2	3	2	2	2	3	2	2	3
DAP1151.3	3	3	3	3	3	2	2	3	2	2	3
DAP1151.4	3	3	3	3	3	2	2	3	2	2	3
DAP1151.5	3	3	3	3	3	2	2	3	2	2	3
DAP1151.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	**ARP101**	
2	Course Title	**Communicative English-1**	
3	Credits	2	
4	Contact Hours(L-T-P)	1-0-2	
	Course Status	AEC	
5	Course Objective	To minimize the linguistic barriers that emerge in varied socio-linguistic environments through the use of English. Help students to understand different accents and standardize their existing English. Guide the students to hone their basic communication skills - listening, speaking, reading, and writing while also uplifting their perception of themselves, giving them self-confidence and building a positive attitude.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Develop a better understanding of advanced grammar rules and write grammatically correct sentences CO2: Acquire wide vocabulary and punctuation rules and learn strategies for error-free communication. CO3: Interpret texts, and pictures and improve both reading and writing skills which would help them in their academic as well as professional career CO4: Comprehend language and improve speaking skills in academic and social contexts CO5: Develop, share, and maximize new ideas with the concept of brainstorming and the documentation of key critical thoughts articulated towards preparing for a career based on their potential and availability of opportunities. CO6: Function effectively in multi-disciplinary teams through the knowledge of team work, Inter-personal relationships, conflict management, and leadership quality	
7	Course Description	The course is designed to equip students, who are at a very basic level of language comprehension, to communicate and work with ease in the varied work environment. The course begins with basic grammar structure and pronunciation patterns, leading up to apprehension of oneself through written and verbal expression as a first step towards greater employability.	
8			
	Unit 1	Sentence Structure	CO Mapping
	A	Subject Verb Agreement	CO1
	B	Parts of speech	CO1
	C	Writing well-formed sentences	CO1
	Unit 2	Vocabulary Building & Punctuation	
	A	Homonyms/ homophones, Synonyms/Antonyms	CO1, CO2
	B	Punctuation/ Spellings (Prefixes-suffixes/Unjumbled Words)	CO1, CO2
	C	Conjunctions/Compound Sentences	CO1, CO2
	Unit 3	Writing Skills	

	A	Picture Description – Student Group Activity	CO1
	B	Positive Thinking - Dead Poets Society-Full-length feature film - Paragraph Writing inculcating the positive attitude of a learner through the movie | SWOT Analysis – Know yourself	CO3
	C	Story Completion Exercise –Building positive attitude - The Man from Earth (Watching a Full-length Feature Film)	CO2, CO3
		Digital Literacy | Effective Use of Social Media	CO2, CO3
	Unit 4	Speaking Skill	CO3
	A	Self-introduction/Greeting/Meeting people – Self-branding	CO3
	B	Describing people and situations - To Sir with Love (Watching a Full-length Feature Film)	CO4
	C	Dialogues/conversations (Situation based Role Plays)	CO4
	Unit 5	Professional Skills | Career Skills	CO4
	A	Exploring Career Opportunities	CO4, CO5
	B	Brainstorming Techniques & Models	CO4, CO5
	C	Social and Cultural Etiquettes	CO4, CO5
	D	Internal Communication	CO4, CO5
	Unit 6	Leadership and Management Skills	
	A	Managerial Skills	CO4, CO5
	B	Entrepreneurial Skills	CO4, CO5
	Mode of examination	Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem-Solving Scenarios/GD/Simulations	
	Weightage Distribution	CA:30%; CE :30% ; ESE:40%	
	Text book/s*	Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication	
	Other References	Comfort, Jeremy (et.al). Speaking Effectively. Cambridge University Press	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
ARP101.1	1	2	2	2		1	1	3	1		1			
ARP101.2	1	2	3	2		1	1	3	1		1			
ARP101.3	1	2	2	2		1	1	3	1		1			
ARP101.4	1	2	2	2		1	1	3	1		1			
ARP101.5	1	2	2	2		1	1	3	1		1			
ARP101.6	1	2	2	2		1	1	3	1		1			
Average	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0		1.0			

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	VOM103	
2	Course Title	Essential Excel Skills for Business	
3	Credits	3	
4	Contact Hours(L-T-P)	0-0-6	
	Course Status	SEC	
5	Course Objective	This course aims to develop basic skills in using Excel for data entry, formatting, and calculations. It enables students to apply formulas and functions, create charts, and manage data effectively for practical applications.	
6	Course Outcomes	CO1: Recall essential navigational controls in Excel, data entry methods, and cell references. (K1) CO2: Explain formatting tools such as font formatting, borders, alignment, number formatting, and printing options. (K2) CO3: Apply formulas, functions, and formatting techniques to organize and process spreadsheet data. (K3) CO4: Analyze data using charts and manage multiple worksheets and workbooks for data integration. (K4) CO5: Evaluate and manipulate data using text functions, date functions, and logical operations for business applications. (K5) CO6: Create and manage advanced spreadsheet models using Named Ranges and integrated Excel features. (K6)	
7	Course Description	This course provides hands-on experience in Excel, covering data entry, formatting, formulas, and visualization. It also includes working with multiple worksheets, text and date functions, and named ranges to support efficient data analysis in real-world scenarios.	
8			
	Unit 1	Critical Core of Excel and Performing Calculations	
	A	Introduction, Taking Charge of Excel, Navigating and Selecting, View Options, Data Entry, Data Types, Editing and Deleting, Fill Handle, Copy and Paste, Templates.	CO1
	B	Formulas, Formulas in Context, Functions I: SUM and AUTOSUM.	CO1
	C	Functions II: AVERAGE, MIN and MAX, Absolute Cell References, Calculations across sheets.	CO1
	Unit 2	Formatting and Printing	
	A	Formatting, Borders, Alignment Tools, Format Painter, Number Formats, Styles, and Themes.	CO2
	B	Managing Rows and Columns, Finding and Replacing, Filtering, Sorting, Conditional Formatting.	CO2
	C	Print Preview, Orientation, Margins, Scale, Page Breaks, Print Titles, Headers, and Footers	CO2
	Unit 3	Charts	
	A	Basic Chart Types: Pie, Column, and Line Charts.	CO3
	B	Move and Resize Charts, Change Chart Style & Type.	CO3
	C	Modify Chart Elements.	CO3C
	Unit 4	Working with Multiple Worksheets & Workbooks	
	A	Multiple Worksheets, 3D Formulas, Linking Workbooks.	CO4

	B	Consolidating by Position, Consolidating by Category (Reference).	CO4
	C	Combining Text (CONCAT, &), Changing Text Case (UPPER, LOWER, PROPER).	CO4
	Unit 5	Named Ranges	
	A	Extracting Text (LEFT, MID, RIGHT), Finding Text (FIND),	CO5
	B	Date Calculations (NOW, TODAY, YEARFRAC).	CO5
	C	Introducing Named Ranges, Creating Named Ranges, Managing Named Ranges, Named Ranges in Formulas, Apply Names.	CO6
	Mode of examination	Practical	
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*	1. Michael Alexander, Excel® Dashboards & Reports for Dummies, John Wiley & Sons, Inc, ISBN: 978-1-119-07676-6, 2016.	
	Other References	1. Michael Alexander and Dick Kusleika, Excel 2016 Formulas, John Wiley & Sons, Inc, ISBN: 978-1-119-06786-3, 2016.	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
VOM103.1	3	3	2	3	2	2	2	3	2	2	3
VOM103.2	3	3	2	3	2	2	2	3	2	2	3
VOM103.3	3	3	3	3	3	2	2	3	2	2	3
VOM103.4	3	3	3	3	3	2	2	3	2	2	3
VOM103.5	3	3	3	3	3	2	2	3	2	2	3
VOM103.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

SEMESTER-2

Programme: Bachelor of Science (Hons./Hons. With Research) Data Science & Analytics		**Batch: 2026-30**	
Branch: Data Science & Analytics		**Academic Year: 2026-27**	
		Semester II	
1	Course Code	CMS131	
2	Course Title	Matrix Analysis and Linear Algebra	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	This course aims to provide fundamental knowledge of matrices, vector spaces, and linear transformations. It develops skills in solving systems of linear equations, understanding eigenvalues and eigenvectors, and applying matrix methods. The course also introduces concepts of orthogonality and inner product spaces, enabling students to analyze and solve problems in mathematics and related fields.	
6	Course Outcomes	CO1: Understand matrix operations and evaluate the rank and inverse of matrices using elementary transformations to analyze the consistency of systems of linear equations (K2, K4, K5). CO2: Analyze eigenvalues and eigenvectors of matrices and evaluate quadratic and bilinear forms using their matrix representations (K4, K5). CO3: Analyze vector spaces, subspaces, linear span, and linear independence to construct the basis of finite-dimensional vector spaces (K4, K6). CO4: Analyze and evaluate linear transformations by determining their range, kernel, rank, and nullity, and verify the Rank–Nullity Theorem (K4, K5). CO5: Apply linear operators and invertible linear transformations to determine their matrix representations and quadratic forms (K3, K5). CO6: Apply the concepts of inner product spaces to analyze orthogonality and construct orthonormal bases using the Gram–Schmidt process (K3, K4, K6).	
7	Course Description	This course covers the fundamental concepts of linear algebra, including matrix operations, rank, and solutions of linear systems. It introduces eigenvalues, eigenvectors, and matrix diagonalization, along with vector spaces, basis, and linear transformations. The course also explores quadratic forms, inner product spaces, and orthogonality, providing a foundation for applications in mathematics, science, and engineering.	
8	Outline syllabus		CO Mapping
	Unit 1	Matrix Analysis -I	
	A	Course introduction and properties of Matrices, Elementary row operations, Echelon form of a matrix.	CO1
	B	Rank of a Matrix, Normal form of a Matrix, Gauss-Jordan Method: Inverse of a Matrix by elementary operations.	CO1
	C	Application of Rank: System of linear homogeneous and non-homogeneous equations, Theorems on consistency of a system of linear equations.	CO1, CO2
	Unit 2	Matrix Analysis -II	
	A	Eigenvalues, Eigenvectors and characteristic equation of a matrix.	CO2
	B	Cayley Hamilton theorem and its application, Diagonalization.	CO2
	C	Quadratic forms, Matrix of a quadratic forms, Bilinear forms, Matrix of a bilinear forms.	CO2
	Unit 3	Vector space and Linear Transformations -I	

	A	Vector Space, Vector Subspaces and Linear Span, Linear Independence and Linear Dependence, Basic Results on Linear Independence.	CO3
	B	Basis of a Finite Dimensional Vector Space, Linear Transformations, Results on Linear Transformation.	CO3
	C	Range and Kernel of a Linear Transformation, Rank and Nullity, Rank-Nullity Theorem.	CO4
	Unit 4	Linear Transformations-II	
	A	Linear operators, Invertible Linear Transformations.	CO5
	B	Matrix of a Linear Transformation, Matrix of the sum and product of linear transformations.	CO5
	C	Linear transformation of a Quadratic Form and its theorems.	CO4, CO5
	Unit 5	Orthogonality	
	A	Inner Product Space (definition and examples), Cauchy- Schwartz inequality.	CO6
	B	Orthogonal and orthonormal vectors, Orthogonal and orthonormal bases	CO6
	C	Gram-Schmidt Process, Orthogonal and positive definite matrices.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA MSE ESE	
	Text book/s*	1.) Hoffman K & Kunze R, Linear Algebra, 2nd edition, Prentice Hall of India, 1975.	
	Other References	1.) Lipshutz S, Lipson M, Linear Algebra, 3rd edition, Schaum's Outline series, 2001.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CMS131.1	3	2	2	2	2	2	2	2	3	2	2
CMS131.2	2	3	2	3	2	1	2	3	2	2	2
CMS131.3	2	3	2	2	2	2	2	2	3	2	2
CMS131.4	2	3	2	3	2	2	2	3	2	2	2
CMS131.5	2	3	2	2	2	2	2	2	3	2	2
CMS131.6	3	2	2	3	2	2	2	3	2	2	2
Average	2.3	2.6	2.0	2.5	2.0	1.8	2.0	2.5	2.5	2.0	2.0

School		**SSES**	
Department:		**Department of Mathematics & Data Science**	
Program:		**B. Sc. Data Science & Analytics**	
Semester:		**II**	
1	Course Code	MTT1202	Course Name: Principal of Data Structures
2	Course Title	Principal of Data Structures	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	This course introduces the fundamental concepts of data structures using Python programming. It aims to develop problem-solving abilities and computational thinking by implementing common data structures such as arrays, stacks, queues, linked lists, trees, and graphs. The course focuses on applying Python-based techniques to design efficient algorithms and solve practical computational problems.	
6	Course Outcomes	After the completion of this course, students will be able to: CO1: Explain and apply basic operations on Python lists and arrays for storing and manipulating data. (K2, K3) CO2: Develop and implement Python programs for matrix and multidimensional data processing using lists.(K3) CO3: Apply stack and queue data structures using Python to solve real-life computational problems. (K3) CO4: Analyze and implement linked list data structures using Python for solving complex problems. (K4) CO5: Analyze and evaluate tree data structures and their applications in hierarchical data representation. (K5) CO6: Design and implement graph data structures and algorithms using Python for applications such as networks and data analysis. (K6)	
7	Course Description	The purpose of this course is to understand and use data structures that are backbone of computer science. A basic understanding of data structure topics is fundamental for work in computer science. In this course we will discover taking form arrays to stacks, queues, linked list, trees and graphs including searching and sorting.	
8	Outline syllabus		CO Mapping
	Unit 1	Arrays and Strings	
	A	Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays	CO1, CO6
	B	Pointer, Pointer to Structure, various Programs for Array and Pointer	CO1, CO6
	C	Strings. Introduction to Strings, Definition, Library Functions of Strings.	CO1, CO6
	Unit 2	Stacks and Queues	
	A	Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks	CO2, CO6
	B	Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.	CO2, CO6

	C	Representation of stacks & queues using linked, sequential and their applications.			CO2, CO6
	Unit 3	Linked list sorting and searching			
	A	Linked list, singly linked list, Circular linked list and doubly linked list, representation of linked list in memory			CO1,CO3, CO6
	B	Algorithms like insertion, deletion at beginning, middle and at the end of the linked list			CO1,CO3, CO6
	C	Various types of sorting like bubble sort, selection sort, insertion sort, quick sort, Merge Sort and searching like linear and binary search algorithms			CO1,CO3, CO6
	Unit 4	Introduction to Trees			
	A	Trees: Definition, Binary tree, Binary tree traversal: pre-order, in-order and post-order, Binary search tree.			CO4,CO5
	B	Binary search trees and operation like insertion deletion on binary search trees, AVL search trees with insertion deletion and rotation.			CO4,CO5
	C	M-way search trees, B-Trees and B+ Trees			CO4,CO5
	Unit 5	Graphs			
	A	Graphs: Definition and terminology, Representation of graphs and Types of Graphs.			CO4,CO5
	B	Traversing a graph: Breadth- First search, Depth first search and Implementation			CO4,CO5
	C	Minimum spanning trees by Prims Algorithms and Krushkal's Algorithm			CO4,CO5, CO6
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	A Common-Sense Guide to Data Structures and Algorithms, Second Edition: Level Up Your Core Programming Skills 2nd Edition Data Structures Through C (A Practical Approach) Paperback – 1 January 2016 by G.S. Baluja			
	Other References	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication			

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO)
1.	Apply the basic operations on arrays.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
2.	Construct complex programs like matrix implementations on arrays.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
3.	Apply the concept of stacks and queues in real life problem solving.	PO1,PO2,PO3,PO4,PO7,PO10,PSO1,PSO2
4.	Apply the concepts of data structure, like linked list to solve complex problems.	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2
5.	Solving the real-life problems based on trees.	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2
6.	Implementing the graphs and apply	PO1,PO2,PO3,PO4,PO5,PO7,PO10,PSO1,PSO2

	graph concept in computer networks.	

PO and PSO mapping with level of strength for Course Name: Principal of Data Structures

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	2	1	1	1	-	-	2		-	1	1	1
CO2	2	2	2	1	-	-	2	-	-	1	1	2
CO3	2	2	2	1	-	-	2	-	-	1	2	2
CO4	2	1	2	3	2	-	2	-	-	1	1	1
CO5	2	2	3	2	2	-	2	-	-	1	2	2
CO6	3	3	3	2	2	-	2	-	-	1	2	2
Average	2.16	1.8	2.16	1.67	2		2			1	1.5	1.67

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	CMS132	
2	Course Title	Mathematical Expectations & Probability Distributions	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Minor	
5	Course Objective	Uncertainty is ubiquitous and probability theory provides a rational description of uncertainty. There is a growing realization that randomness is an essential component in the modeling and analysis of a variety of systems. Probability has become an important conceptual framework of computer science, engineering, and physical and biological sciences. Several problems in computer engineering and other disciplines arise, which require probabilistic modeling. The complete specification of the model enquires statistical tools for the analysis of data and inference	
6	Course Outcomes	CO1Explain the fundamental concepts of probability, random variables, and mathematical expectation. (K2). CO2: Describe and analyze discrete probability distributions such as Bernoulli, Binomial, Poisson, Geometric, and Negative Binomial. (K2, K4). CO3: Apply continuous probability distributions and inequalities to solve statistical problems. (K3, K4) CO4: Analyze jointly distributed random variables and apply central limit theorem and covariance concepts. (K4). CO5: Evaluate probability models using Monte Carlo simulation and information theory concepts such as entropy. (K5) CO6: Interpret statistical results using exploratory data analysis and descriptive statistics. (K5).	
7	Course Description	This is an introductory course in probability. Axioms of probability, conditional probability and independence, Bayes theorem, and probability distributions.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Mathematical Expectation	
	A	Axioms of probability, conditional probability and independence, Bayes theorem,	CO1
	B	Random variables: discrete and continuous random variables, probability mass function (p.m.f), probability density function (p.d.f) and cumulative distribution function (c.d.f), Illustrations and properties of random variables.	CO1
	C	Mathematical Expectation: Expectation of single and bivariate random variables, properties of expectation, conditional expectation, and its properties. Moments and cumulants. Moment generating function, probability generating function.	CO1
	Unit 2	Discrete Random Variable	
	A	Random variables, distribution function, discrete random variable, expectation, variance	CO2
	B	Discrete distributions: Bernoulli and Binomial random variable, Poisson random variable, demerits	CO2
	C	Negative binomial random variable, Geometric random variable, and their properties, merits, and demerits	CO2
	Unit 3	Continuous Random Variable	
	A	Continuous random variable: the expectation of random variable, variance	CO3
	B	Continuous distributions: Uniform, Normal, Exponential, Gamma, and Cauchy, computing probabilities by conditioning, moment generating function, their properties, merits, and demerits.	CO3

	C	Markov inequality and Chebyshev's inequality.	CO3
	Unit 4	Jointly Distributed Random Variables	CO4
	A	Jointly distributed random variables, Independent random variable, the sum of independent random variable	CO4, CO5
	B	Central Limit Theorem, conditional distribution with example.	CO4, CO5
	C	Joint probability distribution, covariance, correlation coefficient.	
	Unit 5	Generation of Random Numbers	
	A	Generation of random numbers and elements of Monte Carlo simulation.	CO5, CO6
	B	Elements of information theory: entropy as a measure of randomness.	CO5, CO6
	C	Exploratory data analysis, types of data, frequency tables, descriptive measures, variability measures	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:%, MTE: %, ETE:%	
	Text book/s*	1.Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2.Rohatgi, V.K. Introduction to Probability.	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CMS132.1	3	2	2	3	3	2	2	3	1	1	3
CMS132.2	3	2	2	3	3	2	2	3	1	1	3
CMS132.3	3	3	3	3	3	2	2	3	2	2	3
CMS132.4	3	3	3	3	3	2	2	3	2	2	3
CMS132.5	3	3	3	3	3	2	2	3	2	2	3
CMS132.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2026-30**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	VAC110	
2	Course Title	Yoga for Holistic Health	
3	Credits	2	
4	Contact Hours(L-T-P)	2-0-0	
	Course Status	VAC	
5	Course Objective	To make the students familiar with the different practices of yoga, chantingand meditation techniques and learn the correct teaching skills.	
6	Course Outcomes	CO1: Recite the Vedic hymns given in traditional texts skillfully. CO2: Define the concept and principles of Yoga. CO3: Interpret and understand the loosening practices. CO4: Describe the knowledge about advance asanas. CO5: Make students aware of Yogic impact on the positive health and personality development. CO6: Learn primary level of Shatkarma, Pranayama & Dhyana	
7	Course Description		
8			
	Unit 1	Yoga Philosophy in traditional texts	
	A	Core Concepts of Hatha philosophy – Sapta Sadhana of Hatha Yoga	CO2, CO4, CO5, CO1
	B	Core concepts of Yoga darshana – Abhyasa Vairagya, Ishwara Pranidhana, Kriya Yoga, Ashtanga Yoga	CO1, CO2, CO4, CO5, CO6
	C	Core Concepts of Bhagawad Gita: Jnana Yoga, Dhyana Yoga, Karma Yoga, Bhakti Yoga	CO1, CO2, CO4, CO5, CO6
	Unit 2	Yoga ahaara, Dinacharya, Ritucharya, Introduction to Yoga therapy, Pioneer institutes of research in Yoga	
	A	Concept of Aahaara with relevance to modern lifestyle	CO3, CO4, CO5, CO6
	B	Dinacharya, Ritucharya in accordance with Swastha vritta	CO3, CO4, CO5, CO6
	C	Need for Yoga therapy, Pioneer Research Institutes in Yoga Therapy – Kaivalyadhama, SVYASA, Patanjali Yoga Peeth and their contributions in Yoga therapy	CO3, CO4, CO5,

			CO6
	Unit 3	Sukshma Vyayama, Surya Namaskara, Kapalabhati	
	A	Sukshma Vyayama and their health benefits (Bihar School of Yoga)	CO4, CO5, CO6
	B	Sukshma Vyayama and their health benefits (Swami Dhirendra Bramhachari)	CO4, CO5, CO6
	C	Surya Namaskara (Sun salutation) with mantra chanting (12 steps)	CO4, CO5, CO6
	Unit 4	Advanced Asana - all categories	
	A	Standing & Sitting - Trikonasana, Virabhadrasana I & II, Parvatasana, Yogamudrasana, Baddhakonasana, Ardhamastyendrasana, Navasanasa	CO4, CO5, CO6
	B	Supine and Prone: Setubandhasana, Jatharaparivartitasana, Dhanurasana, Chakrasana	CO4, CO5, CO6
	C	Balancing and Inverted: Trivikramasana, Virabhadrasana – III, Halasana, Shirshasana	CO4, CO5, CO6
	Unit 5	Shatkarma, Pranayama, Dhyana	
	A	Shatkarma - Kapalabhati, Agnisara, Bindu Trataka	CO1, CO4, CO5, CO6
	B	Bhastrika, Shitali, Sheetkari, Bhramari	CO1, CO4, CO5, CO6
	C	Dhyana: Yoga Nidra, Nadanusandhana	CO1, CO4, CO5, CO6
	Mode of examination	Theory and Practical	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	Sri Ananda: The Complete book of Yoga, Orient Course Backs, Delhi,2003.	
	Other References	1. Basavaraddi, I.V. & others: SHATKARMA: A Comprehensive description about Cleansing Process, MDNIY New Delhi, 2009 2. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009 3. Dr. Nagendra H R: Pranayama, The Art & Science, Swami Vivekananda Yoga Prakashan, Bangalore, 2005. 4. Swami Niranjanand: Asana Pranayama Mudra Bandha, Yoga Publication Trust, Munger Bihar. 5. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009 6. Swami Kuvalyananda: Pranayama, Kaivalyadhama, Lonavla, 2010 7. Swami Rama: Science of Breath, A Practical Guide, The Himalayan International Institute, Pennselvenia, 1998. 8. Swami Niranjanand Saraswati: Prana, Pranayama & Pranavidya, Yoga Publications Trust, Munger, Bihar, 2005	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
VAC110.1			2			1	1		2	2	1			
VAC110.2			2			1	1		2	2	1			
VAC110.3			2			1	1		2	2	1			
VAC110.4			2			1	1		2	2	1			
VAC110.5			2			1	1		2	2	1			
VAC110.6			2			1	1		2	2	1			
Average			**2.0**			**1.0**	**1.0**		**2.0**	**2.0**	**1.0**			

Branch: All UG Programmes		**Semester: II**	
	Course Code	**IKT1104**	
	Course Title	**Mulya Pravah**	
	Credits	**2**	
	Contact Hours	**2-0-0**	
	Course Type	**Values Added Course (VAC)**	
	Course Owner	**SSHSS**	
	Course Objective	1. To help the student see the need for developing a holistic perspective of life. 2. To sensitize the student about the scope of life, individual, family (inter-personal relationship), society and nature/existence with a corporeal understanding. 3. To strengthen self-reflection about life and human values. 4. To develop more confidence in virtues and commitment to learn and live with them.	

	Course Outcomes	CO1: Understand and articulate India's cultural legacy and human values, recognizing their role in preserving traditions CO2: Apply principles of professional ethics to distinguish ethical actions in diverse societal contexts. CO3: Analyze the relationship between constitutional, universal values, and holistic education to foster integrated citizenship. CO4: Demonstrate how skills and values together support a successful career. CO5: Develop guidelines to promote human values and ethical conduct among stakeholders in organisations. CO6: Embrace a global citizenship mindset, fostering inclusivity and the spirit of *Vasudhaiva Kutumbakam*.	

	Course Description	Human Values and Ethics are the bedrock for the formation of individuals, organisations, and societies. They orient people, organisations, and societies towards growth and development. These are developed through lifelong reflection, experience, and the environment in which one learns and grows. This curriculum can bring theoretical and experiential learning among the students so that they will really understand human values and their applications in everyday life. Bringing learning to reality through the outdoor experience encourages the evolution of values, such as teamwork, responsibility, and love for nature. These experiences support classroom teaching and help see the practical applicability of those ethical principles taught in class. Pedagogy includes class room and extra class room settings like library, nature walk, Yoga & Meditation Hall, Visit to Community organisation etc. for better delivery of content and optimal impressions of values in our future world citizens.		
	Unit 1	Introduction to Indian Culture and Civilisation		
	A	What is Bharatvarsha?	CO1	
	B	• Basics of Vedic Literature	CO1	
	C	• Role of Itihasa and Purana	CO1	
	Unit 2	Human Values and Indian Ethics		
	A	• Jainism: Five Mahavratas	CO2	
	B	• Buddhism: Panchsila	CO2	
	C	• Values (*Sanatan*), The Law of Karma & Nishkama Karma	CO2	
	Unit 3	Constitutional Values and Global Citizenship		
	A	• Values embedded in the Preamble of the Indian Constitution	CO3	
	B	• Sensibility and responsibility towards the global environment	CO3	
	C	• Understanding the Universal Human Values Loksangraha and Vasudhaiva Kutumbakam	CO3	
	Unit 4	**Values for Youth**		
	A	• Human Dignity, Rights, Duty & Responsibility	CO4	

	B	• Ethical Behaviour and Decision Making	CO4	
	C	• Value-led Virtuous Living	CO4	
	Unit 5	**Integrated Personality and Well-being**		
	A	The four antah-karanas (inner instruments), and Panch kosh (five sheaths)	CO5	
	B	Stress management: meditated personality and agitated personality (Manasa Vacha Karmana)	CO5; CO6	
	C	Physical, mental, social, and spiritual well-being	CO5; CO6	
	Mode of examination	Theory and Practical		
	Weightage Distribution	CA: 25%	MTE: 15%	ETE: 60%
	ReadingsText book/s*	• Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). *A foundation course in human values and professional ethics*. • Bilimoria, P., Prabhu, J., & Sharma, R. (Eds.). (2007). *Indian ethics: Classical traditions and contemporary challenges* (Vol. 1). Ashgate. • Sharma, C. (1996). *A critical survey of Indian philosophy* (9th ed.). Motilal Banarsidass • Easwaran, E. (Trans.). (2007). *The Bhagavad Gita* (2nd ed.). Nilgiri Press. • Sharma, I. C. (1999). *Ethical philosophies of India* (2nd d.). HarperCollins Publishers India.		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

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

School:		**SHARDA SCHOOL OF ENGINEERING & SCIENCE**				
Program:		**B.Sc. (Hons. /Hons. With Research)**				
Branch:		**Data Science & Analytics**				
Semester:		**II**				
1	**Course Code**	**MTP1251**				
2	**Course Title**	**Principal of Data Structures Lab**				
3	**Credits**	**1**				
4	**Contact Hours (L-T-P)**	**0-0-2**				
	Course Status	Compulsory				
5	Course Objective	To Develop arrays-based program to implement matrix To write program to implement stacks and queues Perform operation on various data structures like trees and graphs				
6	Course Outcomes	By the end of this course, the student will be able to: CO-1 Apply the basic operations on arrays (K2) CO-2 Construct complex programs like matrix implementations on arrays (K2) CO-3 Apply the concept of stacks and queues in real life problem solving (K3) CO-4. Apply the concepts of data structure, like linked list to solve complex problems (K4) CO-5. Solving the real-life problems based on trees (K5) CO-6 Implementing the graphs and apply graph concept in computer networks (K6)				
7	Course Description	An introduction design and implement data structures. Design and develop various program in lab like programs on stacks and queues, program on linked list like singly linked list and doubly linked list, program on trees and graphs.				
8	Outline syllabus				CO Mapping	
	Unit 1	Programs based on arrays				
		Write programs to implement the matrix operations			CO1, CO6	
	Unit 2	Programs based on stacks and queues				
		Programs to implement the stacks and queues operations			CO2, CO6	
	Unit 3	Programs based on linked list, searching and sorting				
		Programs to implement the linked list, searching and sorting			CO3, CO6	
	Unit 4	Programs based on Trees				
		Program to implement the trees like insertion, deletion of a node including tree traversal			CO4, CO6	
	Unit 5	Programs based on Graphs				
		Program to implement the graphs like Dijkstra algorithm, Prims algorithm and Kruskal's algorithm			CO5, CO6	
	Mode of examination	Jury/Practical/Viva				
	Weightage Distribution	CA	CE (Viva)	ESE		
		30%	30%	40%		

	Text book/s*	A Common-Sense Guide to Data Structures and Algorithms, Second Edition: Level Up Your Core Programming Skills 2nd Edition Data Structures Through C (A Practical Approach) Paperback – 1 January 2016 by G.S. Baluja		
	Other References	Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++" , PHI		
		Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication		

CO and PO Mapping

S. No.	Course Outcome	Program Outcomes (PO) & Program Specific Outcomes (PSO)
1.	CO-1 Apply the basic operations on arrays (K2)	PO1, PO3, PO4, PO8, PO9, PO10, PSO1
2.	CO-2 Construct complex programs like matrix implementations on arrays (K2)	PO1, PO2, PO3, PO4, PO8, PO9, PO10
3.	CO-3 Apply the concept of stacks and queues in real life problem solving (K3)	PO1, PO2, PO3, PO4, PO8, PO9, PO10
4.	CO-4. Apply the concepts of data structure, like linked list to solve complex problems (K4)	PO1, PO2, PO3, PO4, PO8, PO9, PO10, PSO1
5	CO-5. Solving the real-life problems based on trees (K5)	PO1, PO2, PO3, PO4, PO8, PO9, PO10, PSO1
6	CO-6 Implementing the graphs and apply graph concept in computer networks (K6)	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PSO1

PO and PSO mapping with level of strength for Course Name Principal of Data Structures lab (BOL204)

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

Average of non-zeros entry in following table (should be auto calculated).

Course Code/ Name	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2
Principal of Data Structures Lab	3	3	3	2.2	2	-	2	2.8	2	2	2	-

School: SSES		**Batch: 2026-30**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	SKP1020	
2	Course Title	Communicative Essentials-2	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
	Course Status	AEC	
5	Course Objective	To Develop LSRW skills through audio-visual language acquirement, creative writing, advanced speech et al and MTI Reduction with the aid of certain tools like texts, movies, and long and short essays.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Acquire Vision, Goals, and Strategies through Audio-visual Language Texts CO2: Synthesize complex concepts and present them in creative writing CO3:Develop MTI Reduction/Neutral Accent through Classroom Sessions & Practice CO4: Determine their role in achieving team success by defining strategies for effective communication with different people CO5: Realize their potential as human beings and conduct themselves properly in the ways of the world. CO6 Acquire satisfactory competency in the use of Quantitative aptitude and Logical Reasoning	
7	Course Description	The course takes the learnings from the previous semester to an advanced level of language learning and self-comprehension through the introduction of audio-visual aids as language enablers. It also leads learners to an advanced level of writing, reading, listening, and speaking abilities, while also reducing the usage of L1 to a minimum to increase employability chances.	
8			
	Unit 1	Acquiring Vision, Goals, and Strategies through Audio-visual Language Texts	
	A	Pursuit of Happiness / Goal Setting & Value Proposition in life	CO1
	B	12 Angry Men / Ethics & Principles	CO1
	C	The King's Speech / Mission statement in life | strategies & Action Plans in Life	CO1
	Unit 2	Creative Writing	CO2
	A	Story Reconstruction - Positive Thinking	CO2
	B	Theme-based Story Writing - Positive attitude	CO2
	C	Learning Diary Learning Log – Self-introspection	
	Unit 3	**Writing Skills 1**	CO3
	A	**Precis**	CO3
	B	**Paraphrasing**	CO3
	C	**Essays (Simple essays)**	
	Unit 4	MTI Reduction/Neutral Accent through Classroom Sessions & Practice	CO4
	A	Vowel, Consonant, sound correction, speech sounds, Monothongs, Diphthongs and Tripthongs	CO4
	B	Vowel Sound drills, Consonant Sound drills, Affricates and Fricative Sounds	CO4

	C	Speech Sounds | Speech Music| Tone | Volume| Diction |Syntax |Intonation | Syllable Stress |	CO4
	Unit 5	Gauging MTI Reduction Effectiveness through Free Speech	
	A	Jam sessions	CO4
	B	Extempore	
	C	Situation-based Role Play	CO5
	Unit 6	Leadership and Management Skills	
	A	Innovative Leadership and Design Thinking	CO5
	B	Ethics and Integrity	CO5
	Unit 7	Universal Human Values	
	A	Love & Compassion, Non-Violence & Truth	CO5
	B	Righteousness, Peace	CO6
	C	Service, Renunciation (Sacrifice)	CO6
	Unit 8	Introduction to Quantitative aptitude & Logical Reasoning	
	A	Analytical Reasoning & Puzzle Solving	CO6
	B	Number Systems and its Application in Solving Problems	CO6
	Mode of examination	Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem-Solving Scenarios/GD/Simulations	
	Weightage Distribution	30% CA , 30% CE and 40% ETE	
	Text book/s*	Wren, P.C.&Martin H. High English Grammar and Composition, S.Chand& Company Ltd, New Delhi.	
	Other References	Blum, M. Rosen. How to Build Better Vocabulary. London: Bloomsbury Publication Comfort, Jeremy(et.al). Speaking Effectively. Cambridge University Press. The Luncheon by W. Somerset Maugham - http://mistera.co.nf/files/sm_luncheon.pdf	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
ARP102.1	1	2	2	2		1	1	3	1					
ARP102.2	1	2	3	2		1	1	3	1					
ARP102.3	1	2	2	2		1	1	3	1					
ARP102.4	1	2	2	2		1	1	3	1					
ARP102.5	1	2	2	2		1	1	3	1					
ARP102.6	1	2	2	2		1	1	3	1					
Average	1.0	2.0	2.0	2.0		1.0	1.0	3.0	1.0					

School: SSES		**Batch: 2026-30**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: II**	
1	**Course Code**	**VOM104**	
2	**Course Title**	**Advanced Excel Skills for Business**	
3	**Credits**	**3**	
4	**Contact Hours (L-T-P)**	**0-0-6**	
	Course Status	**SEC**	
5	Course Objective	This course aims to develop advanced Excel skills for solving real-world business problems and improving data analysis capabilities. It also enables students to use advanced tools and functions in Excel, enhancing their employability and efficiency in data-driven tasks.	
6	Course Outcomes	CO1: Recall the use of functions like COUNTIFS to extract information from data, as well as create graphical and table representations of it. (K1) CO2: Explain pivot tables and gain skills to create interactive dashboards with pivot charts and slicers. (K2) CO3: Apply data validation through conditional logic and conditional format. (K3) CO4: Analyze functions like CHOOSE, VLOOKUP, INDEX, MATCH, and other dynamic lookups to find and display data from several sources. (K4) CO5: Evaluate errors, trace precedents and dependents, and resolve circular references. (K5) CO6: Create protected worksheets and workbooks. (K6)	
7	Course Description	This course provides hands-on training in advanced Excel features used in business analytics. It covers data summarization, advanced functions, pivot tables, dashboards, data validation, lookup techniques, and formula auditing. The course focuses on solving real-world problems and improving efficiency in data handling and reporting.	
8			
	Unit 1	Summarizing Data and Tables	
	A	COUNT functions, Counting with Criteria (COUNTIFS), Adding with Criteria (SUMIFS), Sparklines, Advanced Charting, Trendlines.	CO1
	B	Creating and Formatting Tables, Working with Tables, Sorting and Filtering in Tables	CO1
	C	Automation with Tables, Converting to Range, and Sub totaling	CO1
	Unit 2	Pivot Tables, Charts, and Slicers	
	A	Creating and Modifying a Pivot Table	CO2
	B	Value Field Settings, Sorting and Filtering a Pivot Table	CO2
	C	Reporting Filter Pages, Pivoting Charts, Pivoting Slicers	CO2
	Unit 3	Data Validation and Conditional Logic	
	A	Data Validation, Creating Drop-down Lists, Using Formulas in Data Validation	CO3
	B	Working with Data Validation, Advanced Conditional Formatting	CO3
	C	Logical Functions I: IF, Logical Functions II: AND, OR, Combining Logical Functions I: IF, AND, OR, Combining Logical Functions II: Nested Ifs, Handling Errors: IFERROR, IFNA	CO3
	Unit 4	Automating Lookups	
	A	Introduction to Lookups: CHOOSE	CO4

	B	Approximate Matches: Range VLOOKUP, Exact Matches: Exact Match VLOOKUP	CO4
	C	Finding a Position: MATCH, Dynamic Lookups: INDEX, MATCH	CO4
	Unit 5	Formula Auditing and Protection	
	A	Error Checking, Formula Calculation Options, Trace Precedents and Dependents	CO5
	B	Evaluate Formula, Watch Window	CO5
	C	Protecting Workbooks and Worksheets	CO6
	Mode of examination	Practical Based	
	Weightage Distribution	CA, CE: ESE:	
	Text book/s*	1. Michael Alexander, Excel® Dashboards & Reports for Dummies, John Wiley & Sons, Inc, ISBN: 978-1-119-07676-6, 2016.	
	Other References	1. Michael Alexander and Dick Kusleika, Excel 2016 Formulas, John Wiley & Sons, Inc, ISBN: 978-1-119-06786-3, 2016.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
VOM104.1	3	3	2	3	2	2	2	3	2	2	3
VOM104.2	3	3	2	3	2	2	2	3	2	2	3
VOM104.3	3	3	3	3	3	2	2	3	2	2	3
VOM104.4	3	3	3	3	3	2	2	3	2	2	3
VOM104.5	3	3	3	3	3	2	2	3	2	2	3
VOM104.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

SEMESTER-III

School: SSES		**Batch: 2026-230**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**BDA217**	
2	Course Title	**Data Preparation and Data Cleaning**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	CC	
5	Course Objective	To develop skills in data preparation, cleaning, and transformation, including handling dates, data structures, and text data for effective data analysis.	
6	Course Outcomes	CO1: Explain and apply techniques for preparing data including rearranging variables, removing variables, renaming variables, creating new variables, and categorizing continuous variables. **(K2, K3)** CO2: Apply methods for handling dates and times, removing duplicate observations, selecting subsets of data, sampling datasets, and sorting datasets. **(K3)** CO3: Analyze data cleaning processes and technical representation of data in statistical computing environments. **(K4)** CO4: Analyze different data structures used in data processing such as tabular data, matrices, databases, and time series. **(K4)** CO5: Explain character normalization, encoding conversion, Unicode normalization, character conversion, and transliteration techniques used in text processing. **(K2)** CO6: Evaluate and apply regular expressions and string processing techniques for approximate text matching and string similarity analysis. **(K5)**	
7	Course Description	This course focuses on data preparation and cleaning techniques, including data transformation, handling dates and structures, and text processing. It equips students with practical skills to manage and analyze real-world datasets.	
8			
	Unit 1		
	A	Preparing your data: Rearranging and removing variables, renaming variables, Variable classes, Calculating new numeric variables	CO1
	B	Dividing a continuous variable into categories, Working with factor variables	CO1
	C	Manipulating character variables: Concatenating character strings, extracting a substring, Searching a character variable.	CO1
	Unit 2		
	A	Working with dates and times, Adding and removing observations,	CO2
	B	Removing duplicate observations, Selecting a subset of the data,	CO2
	C	Selecting a random sample from a dataset, Sorting a dataset.	CO2
	Unit 3		
	A	Data Cleaning: The Statistical Value Chain, Raw Data, Input Data, Valid Data, Statistics, and Output.	CO3

	B	Technical Representation of Data: Numeric Data. Integers. Integers in R. Real Numbers. Double Precision Numbers. The Concept of Machine Precision. Consequences of Working with Floating Point Numbers, Dealing with the Consequences,	CO3
	C	Numeric Data in R. Text Data. Terminology and Encodings. Unicode. Textual Data in R: Objects of Class Character. Encoding in R. Reading. and Writing of Data with Non-Local Encoding. Detecting Encoding. Collation. and Sorting. Times and Dates. Time and Date Notation. Time and Date Storage in R. Time and Date Conversion in R, Leap Days, Time Zones, and Daylight-Saving Times.	CO3C
	Unit 4		
	A	Data Structure: Introduction, Tabular Data, data.frame, Databases, dplyr, Matrix Data, Time Series,	CO4
	B	Graph Data, Web Data, Web Scraping, Web API, Other Data, Tidying Tabular Data,	CO4
	C	Variable Per Column, Single Observation Stored in Multiple Tables.	CO4
	Unit 5		
	A	Cleaning Text Data: Character Normalization. Encoding Conversion and Unicode Normalization, Character Conversion and Transliteration,	CO5
	B	Pattern Matching with Regular. Expressions. Basic Regular Expressions. Practical Regular Expressions, Generating Regular Expressions in R,	CO5
	C	Common String Processing Tasks in R. Approximate Text Matching. String Metrics, String Metrics, and Approximate Text Matching in R.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE: 25%, ETE:75%	
	Text book/s*	1. Bad Data Handbook: Cleaning Up the Data So You Can Get Back to Work by Q. Ethan McCallum 2. Best Practices in Data Cleaning: A Complete Guide to Everything You Need to Do Before and After Collecting Your Data by Jason W Osborne	
	Other References	1. Data Wrangling with Python by Jacqueline Kazil 2. Principles of Data Wrangling: Practical Techniques for Data Preparation by Tye Rattenbury	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BDA217.1	3	2	2	3	3	2	2	3	1	1	3
BDA217.2	3	2	2	3	3	2	2	3	1	1	3
BDA217.3	3	3	3	3	3	2	2	3	2	2	3
BDA217.4	3	3	3	3	3	2	2	3	2	2	3
BDA217.5	3	3	3	3	3	2	2	3	2	2	3
BDA217.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		Batch: 2026-230	
Program: B.Sc.		Academic Year: 2027-28	
Branch: Data Science & Analytics		Semester: III	
1	Course Code	**BDA313**	
2	Course Title	**Regression, Time Series, Forecasting and Index Numbers**	
3	Credits	5	
4	Contact Hours (L-T-P)	4-0-2	
	Course Status	Compulsory	
5	Course Objective	The objective of the course is to explain basic concepts of regression, time series, forecasting and index numbers.	
6	Course Outcomes	CO1: Explain and illustrate the nature and uses of forecasts, some examples of time series, the forecasting process, resources for forecasting, statistics background for forecasting: graphical displays, numerical description of time series data (K2, K3) CO2: Describe how to evaluate least squares estimation in linear regression models, statistical inference in linear regression, prediction of new observations, model adequacy checking, model adequacy checking, generalized and weighted least squares, regression models for general time series data. (K6) CO3: Explain and illustrate first-order exponential smoothing, modeling time series data, second-order exponential smoothing, higher-order exponential smoothing. (K3, K6) CO4: Use forecasting: constant process, linear trend process and evaluate estimation of σ_e^2, adaptive updating of the discount factor, model assessment. (K3, K6) CO5: Describe autoregressive integrated moving average (arima) models. (K2) CO6: Explain and illustrate index numbers with application. (K6)	
7	Course Description	This course will cover the fundamental concepts of Regression, time series, forecasting and Index numbers.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Introduction to regression analysis, types of regression, Angle of two Regressions lines.	CO1
	B	Simple linear regression, Estimate by LSE.	CO1
	C	Fitting linear regression models (straight line, curve, exponential, algebraic), Application of regression analysis in Python /R.	CO1
	Unit 2		
	A	Multiple Linear regression, Properties. Assumptions of error term.	CO2
	B	Estimate of beta. Concept of Logistic regression. Some Applications. Coefficient of Determination.	CO2
	C	Generalized linear model. Assumptions and Applications, Application of Multiple linear regression analysis in Python /R.	CO2
	Unit 3		
	A	Introduction of Time series, Components of time series, Basic models of time series(Additive and multiplicative), Methods of measuring linear trends, Methods of measuring seasonal variation, Method of measuring cyclic variation.	CO3

	B	Exponential Smoothing Methods: First-Order Exponential Smoothing, Modeling Time Series Data, Second-Order Exponential Smoothing, Higher-Order Exponential Smoothing,			CO4
	C	Stationarity and Non-stationarity, ACF and PACF, Application of Time series analysis in Python/ R			CO4
	Unit 4				
	A	Moving Average (MA) Processes. Autoregressive (AR) process.			CO5
	B	Box-Jenkins test, ADF test, Autoregressive integrated moving average method (ARIMA)			CO5
	C	Introduction to Forecasting, Modelling seasonality and forecasting, Characterizing and modelling cycles, Application of AR, ARIMA model in Python/R.			CO5
	Unit 5				
	A	Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including			CO6
	B	Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers,			CO6
	C	Conversion of fixed based to chain-based index numbers and vice- versa. Consumer price index numbers, Application of Index number			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	1. Business Statistics: For Contemporary Decision Making, 7th Edition by Ken Black			
	Other References	1. Ken Black. Business Statistics: For Contemporary Decision Making. 7th Edition. 2. Wayne W. Daniel. Biostatistics: Basic Concepts and Methodology for Health Sciences. 3. B. S. Grewal. Higher Engineering Mathematics.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BDA313.1	3	2	2	3	3	2	2	3	1	1	3
BDA313.2	3	2	2	3	3	2	2	3	1	1	3
BDA313.3	3	3	3	3	3	2	2	3	2	2	3
BDA313.4	3	3	3	3	3	2	2	3	2	2	3
BDA313.5	3	3	3	3	3	2	2	3	2	2	3
BDA313.6	3	3	3	3	3	2	2	3	2	2	3
Average2	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2026-230**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**BDA215**	
2	Course Title	**Operations Research**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
0	Course Status	OPE	
5	Course Objective	This course aims to introduce students to the fundamental concepts of optimization and operations research, including linear and nonlinear programming techniques. It focuses on developing the ability to formulate and solve real-world optimization problems using methods such as simplex, duality, and dynamic programming.	
6	Course Outcomes	CO1: Explain the fundamental concepts of Linear Programming Problems (LPP) and Duality. **(K2)** CO2: Apply simplex method, dual simplex method, and integer programming techniques to solve optimization problems. **(K3)** CO3: Analyze transportation problems and nonlinear programming problems using appropriate optimization methods. **(K4)** CO4: Analyze unconstrained and constrained nonlinear optimization problems including Karush–Kuhn–Tucker (KKT) conditions. **(K4)** CO5: Evaluate optimization models for solving real-life decision-making problems. **(K5)** CO6: Design optimization solutions using dynamic programming and multi-objective decision-making techniques. **(K6)**	
7	Course Description	This course provides an introduction to operations research and its applications in decision-making. It covers linear programming, duality, integer programming, transportation problems, and nonlinear optimization techniques including KKT conditions. The course also explores dynamic programming and multi-objective decision-making to equip students with analytical tools for solving complex optimization problems.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Introduction to LPP, Graphical Method, and Simplex Method	
	A	Introduction to Optimization, Assumptions & Mathematical Modeling of LPP, Graphical Solution of L.P.P., Graphical Solution of LPP-I, Graphical Solution of LPP- II.	CO1
	B	Solution of L.P.P. by Simplex method, Revised Simplex Method, Introduction of Big M method, Algorithm of BIG-M method.	CO1
	C	Problems on BIG-M Method, Two Phase Method: Introduction and Two-Phase Method: Problem Solution.	CO1
	Unit 2	Duality Theory and Integer Programming	
	A	Special Cases of LPP, Degeneracy in LPP, Sensitivity Analysis- I, Sensitivity Analysis- II, and Problems on Sensitivity Analysis.	CO2
	B	Introduction to Duality Theory- I, Introduction to Duality Theory- II, Dual Simplex Method and Examples on Dual Simplex Method.	CO2
	C	Integer Linear Programming, IPP: Branch & B-Bound Method and Mixed Integer Programming Problem.	CO2

	Unit 3	Introduction to transportation problem and Some Solving Methods	
	A	Introduction to transportation problem-I, Transportation problem-II, Vogel Approximation method, optimal solution Generation for Transportation problem and Degeneracy in TP and problems.	CO3
	B	Introduction to Nonlinear Programming, Graphical Solution of NLP, and Types of NLP.	CO3
	C	One-dimensional unconstrained optimization, Region Elimination Technique-1, Region Elimination Technique-2, and Region Elimination Technique-3.	CO3
	Unit 4	NLP and Unconstrained optimization	
	A	Multivariate Unconstrained Optimization-1, Multivariate Unconstrained Optimization-2.	CO4
	B	NLP with Equality Constrained-1, NLP with Equality Constrained-2, Constrained NLP-1, and Constrained NLP 2.	CO4
	C	Constrained Optimization, Constrained Optimization, and KKT (Karush-Kuhn-Tucker conditions)	CO4
	Unit 5	Constrained optimization and Dynamic programming of LPP	
	A	Constrained Optimization, Constrained Optimization, and Feasible Direction.	CO5
	B	Penalty and barrier method, Penalty method, and Penalty and barrier method.	CO5
	C	Dynamic programming, Multi-Objective decision-making, and Multi-Attribute decision-making.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA: ; MTE: ; ETE:	
	Text book/s*	1. Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, Sultan Chand & Sons. 2. S. Chandra, Jayadeva, Aparna Mehra, Numerical Optimization with Applications, Narosa.	
	Other References	1 Hamdy A. Taha, Operations Research, An Introduction, 9th Edition, Pearson. 2. M.S. Bazarra, H.D. Sheral, and C.M. Shetty, Nonlinear Programming Theory and Algorithms.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA215.1	3	2	2	3	3	2	2	3	1	1	3
BDA215.2	3	2	2	3	3	2	2	3	1	1	3
BDA215.3	3	3	3	3	3	2	2	3	2	2	3
BDA215.4	3	3	3	3	3	2	2	3	2	2	3
BDA215.5	3	3	3	3	3	2	2	3	2	2	3
BDA215.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2026-230**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**DAP2351**	
2	Course Title	**Data Preparation and Data Cleaning Lab**	
3	Credits	2	
4	Contact Hours(L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	This course aims to provide practical knowledge of data preparation and cleaning techniques, including handling dates, data structures, and text data. It develops skills in identifying and resolving data quality issues using appropriate tools and methods.	
6	Course Outcomes	**CO1:** Define basic concepts of data preparation and data cleaning. **(K1)** **CO2:** Explain techniques for data preprocessing, including handling variables, dates, and missing data. **(K2)** **CO3:** Apply data cleaning and manipulation techniques such as filtering, sorting, and transforming datasets. **(K3)** **CO4:** Analyze data structures and identify data quality issues in datasets. **(K4)** **CO5:** Evaluate text processing techniques such as encoding, normalization, and error handling. **(K5)** **CO6:** Develop solutions using regular expressions and string processing techniques for data cleaning tasks. **(K6)**	
7	Course Description	This lab course focuses on hands-on implementation of data preparation and cleaning techniques. Students learn to handle missing data, preprocess datasets, manage data structures, and perform text processing using practical experiments to ensure data quality and reliability.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Lab. Experiment 1	
	A, B, C	Problem Related to Data Collection and Potential Sources of Error, Data cleaning.	CO1
	Unit 2	Lab. Experiment 2	
	A, B, C	Problem-based on identifying, preprocessing, including handling variables, analyzing, and resolving data issues.	CO2
	Unit 3	Lab. Experiment 3	
	A, B, C	Problem-based on handling missing data and ensuring the accuracy of record values, manipulation techniques such as filtering, sorting, and transforming dataset.	CO3
	Unit 4	Lab. Experiment 4	
	A, B, C	Problem-based on quality control procedure, and data Integration, as encoding, normalization, and error handling.	CO4
	Unit 5	Lab. Experiment 5	
	A, B, C	Problem-based on tools and techniques for data cleaning, string processing techniques for data cleaning tasks.	CO5, CO6
	Mode of examination	Practical + Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. Bad Data Handbook: Cleaning Up the Data So You Can Get Back to Work by Q. Ethan McCallum	

		2. Best Practices in Data Cleaning: A Complete Guide to Everything You Need to Do Before and After Collecting Your Data by Jason W Osborne	
	Other References	1. Data Wrangling with Python by Jacqueline Kazil 2. Principles of Data Wrangling: Practical Techniques for Data Preparation by Tye Rattenbury	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAP2351.1	3	3	2	3	2	2	2	3	2	2	3
DAP2351.2	3	3	2	3	2	2	2	3	2	2	3
DAP2351.3	3	3	3	3	3	2	2	3	2	2	3
DAP2351.4	3	3	3	3	3	2	2	3	2	2	3
DAP2351.5	3	3	3	3	3	2	2	3	2	2	3
DAP2351.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

School: SSES		Batch: 2026-30
Programme: UG		Current Academic Year: 2026-27
Branch: All UG Programmes		Semester: III
1	Course Code	IKT2202
2	Course Title	General HINDI
3	Credits	2
4	Contact Hours(L-T-P)	2-0-0
	Course Type	AEC
5	Course Objective	यह हिंदी भाषा कोर्स विद्यार्थियों को हिंदी की शब्दावली, व्याकरण, पठन समझ, अनुच्छेद लेखन और पत्र लेखन में दक्ष बनाने के लिए डिजाइन किया गया है। इस कोर्स के माध्यम से विद्यार्थियों को हिंदी भाषा की मूल संरचनाओं और उनके सही उपयोग की समझ प्रदान की जाएगी। विद्यार्थियों को हिंदी के विभिन्न पहलुओं को जानने और अभ्यास करने का अवसर मिलेगा, ताकि वे इस भाषा में निपुणता प्राप्त कर सकें। इस कोर्स के दौरान शब्दावली के विस्तार, व्याकरण की सही समझ, लेखन कौशल को सुधारने के लिए व्यावहारिक गतिविधियाँ और अभ्यास कराया जाएगा।
6	Course Outcomes	CO1 हिंदी भाषा की शब्दावली का विस्तार करना और सही संदर्भ में उनके उपयोग की क्षमता विकसित करना। CO2 हिंदी व्याकरण के मूल नियमों को समझना और उनका सही तरीके से उपयोग करना। CO3 पठन समझ के कौशल को बढाना और विभिन्न प्रकार की पाठ्य सामग्री को समझने में सक्षम बनाना। CO4 स्पष्ट और प्रभावी अनुच्छेद लेखन में महारत हासिल करना। CO5 विभिन्न प्रकार के पत्र लेखन, जैसे व्यक्तिगत, औपचारिक और आधिकारिक पत्र लेखन में दक्षता प्राप्त करना। CO6 विद्यार्थियों को हिंदी भाषा में संवाद और विचारों को सुसंगत और सुबोध तरीके से प्रस्तुत करने की क्षमता प्रदान करना।
7	Course Description	यह हिंदी भाषा कोर्स विद्यार्थियों को हिंदी शब्दावली, व्याकरण, पठन समझ, अनुच्छेद लेखन और पत्र लेखन में कुशल बनाने के लिए तैयार किया गया है। इस कोर्स में विद्यार्थियों को हिंदी भाषा की मूल संरचनाओं और उनके सही उपयोग का ज्ञान होगा। विद्यार्थियों को लेखन और पठन के विभिन्न कौशलों में सुधार करने का अवसर मिलेगा, जिससे वे इस भाषा में दक्षता प्राप्त कर सकेंगे। इस कोर्स के अंतर्गत विद्यार्थियों को हिंदी में प्रभावी और सटीक संवाद करने की क्षमता विकसित होगी। इसके अतिरिक्त, पाठ्यक्रम में हिंदी साहित्य की कविताएँ और कहानियाँ भी शामिल हैं, जो विद्यार्थियों

		को ऱाहहक्तत्यक दहष्टकोण ऱे हहिंदी भाषा को मंझने और आनिंद लेने का अिर प्रदान करेंगी।	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**हहिंदी भाषा, इसके हिहि और ध्वहियिं का सामान्य िररचय**	

	A	**हहिंदी भाषा का िररचय** • हहिंदी का इहतहार् और उत्पहि • भारत और हिश्व में हहिंदी का महत्व • हहिंदी की हिहभन्न बोहलयाँ और रूप	CO1, CO2
	B	**हहिंदी हिहि: देवनागरी** • देिनागरी हलहप का पररचय • स्वर (अ, आ, इ, ई, आहद) और व्यिंजन (क, ख, ग, घ, आहद) • मूल िणों की लेखन अभ्यार्	CO1, CO2
	C	**हहिंदी की ध्वहियाँ** • ध्वहनयोिं का उच्चारण और उनका रूप • मात्राओं का उच्चारण में भूहमका • हहिंदी उच्चारण के ऱामान्य हनयमोिं का पररचय	CO1, CO2

	Unit 2	**हलिंग, वचि, कारक, उिसगग/प्रत्यय**	
	A	**हहिंदी म हलिंग (हलिंग)** • पुक्तलिंग और स्त्रीहलिंग ऱिंज्ञाएँ • हलिंग पहचानने के हनयम • ऱिंज्ञा और हिशेषणोिं में हलिंग परिितसन	CO3, CO4, CO5
	B	**एकवचि और बहुवचि (एकवचि और बहुवचि)** • एकिचन और बहुिचन ऱिंज्ञाओं के हनमासण केहनयम • अऱामान्य बहुिचन रूप • हिशेषणोिं और उनके बहुिचन रूपोिं का प्रयोग	CO3, CO4, CO5

C	**उपसर्ग, प्रत्यय और कारक** • उपसर्ग और प्रत्यय का परिचय • कारक (प्रथम, द्वितीय, तृतीय, आदि) और उनका प्रयोग • शब्द निर्माण और अर्थ में उपसर्ग तथा प्रत्यय का महत्व	CO3, CO4, CO5
Unit 3	**मुहावरे, लोकोक्तियाँ और अपठित गद्यांश**	
A	**मुहावरे** • सामान्य मुहावरों की व्याख्या • मुहावरों का वाक्य में प्रयोग • विभिन्न संदर्भ के अनुसार मुहावरों का उपयोग	CO4, CO5, CO6
B	• हिंदी में लोकोक्ति का महत्व • सामान्य लोकोक्ति का अर्थ और उपयोग • लोकोक्तियों का जीवन में प्रासंगिकता	CO4, CO5, CO6
C	**अपठित गद्यांश** • अपठित गद्यांश के अध्ययन का उद्देश्य • गद्यांश के मुख्य विचारों को सरल भाषा में व्यक्त करना • उदाहरण के रूप में गद्यांश और संबंधित प्रश्नों का अभ्यास	CO4, CO5, CO6
Unit 4	**लेखन कौशल**	
A	• वाक्य शुद्धीकरण का अभ्यास। • सरल वाक्यों का अनुवाद सीखना • अनुवाद कौशल में सुधार।	CO4, CO5, CO6
	अनुच्छेद लेखन • अनुच्छेद लेखन का परिचय: संरचना और उद्देश्य • अनुच्छेदों के प्रकार (विवरणात्मक, कथात्मक, व्याख्यात्मक) • उदाहरणों के माध्यम से अभ्यास: स्पष्ट और संक्षिप्त अनुच्छेद लिखना	CO4, CO5, CO6

	C	ि◌त्र ि◌◌ोखे (ाऔचाररक और ाअ◌ौ◌ंचाररक) • ऑपचाररक पत्र लेखन का प्रारूप (जैर◌ं छुट्टी के हलए ाअ◌ेदन, हशकायत पत्र, आहद) • अनौपचाररक पत्र लेखन का प्रारूप (जैर◌ं हमत्र/परर◌ार को पत्र) • ऑपचाररक और अनौपचाररक पत्रा◌ं◌ं में अभ्यार		CO4, CO5, CO6
	Unit 5	गद, ि◌द और हिबिंध		
	A	• हगलू – महादेि◌ी ि◌मास • ईदगाह - मु◌ं◌शी प्रेमचिंद		CO4, CO5, CO6
	B	• 'पुष्प की अहभलाषा' – माखनलाल चतु◌ि◌ेदी • बीती हिभाि◌री जाग री – जयशिंकर प्र◌ाद • मेरा नया बचपन – र◌ुभद्रा कुमारी चौहान		CO4, CO5, CO6
	C	• जो दखकर भी नहीं◌ दखत (जीं◌नी) • स्वतंत्रता की ओर		CO4, CO5, CO6
	Mode of examination	Theory		
	Weightage Distribution	MTE	CA	ESE
		25	25	50

	Text book/s*	Gillu https://www.nios.ac.in/media/documents/sechincour/Chapter-3.pdf Birbal ki Khichdi https://ncert.nic.in/textbook/pdf/chve106.pdf Daan ka Hisaab https://ncert.nic.in/textbook/pdf/dhhn107.pdf Swatantrata ki Or https://ncert.nic.in/textbook/pdf/dhhn109.pdf Jo Dekhkar bhi nahin Dekhte https://docs.aglasem.com/view/3c740b90-2192-11ea-b695-02f21f5619c4#google_vignette https://gitaganga.org/books/prerak-kahaniya

COURSE ARTICULATION MATRIX

POs Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3
CO1	2	3	1	1	1	2	2	2	1	3	2
CO2	3	3	2	2	1	2	1	1	2	3	2
CO3	3	3	3	2	2	2	1	3	2	3	1
CO4	1	3	1	3	2	1	1	2	2	3	3
CO5	2	3	2	3	2	2	1	3	3	3	2
CO6	2	2	2	1	1	3	3	3	1	2	2

1- **Slight (Low)**
2- **Moderate (Medium)**
3- **Substantial (High)**

School: SSES		**Batch: 2026-30**	
Programme: B.Sc. (Hons./Hons. With Research) Mathematics		**Academic Year: 2027-28**	
Branch: Mathematics		**Semester: III**	
1	Course Code	**AI3407**	
2	Course Title	Prompt Engineering for AI and Data Science	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	DSE	
5	Course Objective	This course introduces the basics of AI prompting, including different types of prompts and how to structure them for better responses. Students will learn key techniques like providing context, refining prompts, and handling multi-turn conversations. The course also explores real-world applications in content creation, coding, and automated data analysis while addressing ethical considerations. By the end, students will be able to craft effective prompts and understand AI's role in various domains.	
6	Course Outcomes	CO1: Understand the basics of AI prompting and the importance of effective prompts (K2) . CO2: Apply prompt design techniques using clarity, context, constraints, and examples to avoid common prompting mistakes and improve AI-generated responses (K3). CO3: Analyze chain-of-thought, few-shot/zero-shot prompting, multi-turn strategies, and evaluate bias, ethics, and prompt debugging techniques (K4, K5). CO4: Analyze the applications of prompting across industries and the role of AI in education, research, and content generation (K4). CO5: Apply AI prompting techniques for data analysis, visualization, report generation, and decision-making support (K3). CO6: Design optimized prompts for various industries to explore emerging trends in AI prompting (K6).	
7	Course Description	This course provides a foundational understanding of AI prompting, teaching students how to effectively communicate with AI models to generate accurate and useful responses. It covers different types of prompts, key strategies for refining AI outputs, and advanced techniques like Chain-of-Thought prompting. Practical applications in content creation, coding, and business automation are explored, along with ethical considerations. By the end of the course, students will be able to craft effective prompts for various real-world scenarios.	
8		Outline syllabus	CO Mapping
	Unit 1	Introduction to Prompting	
	A	What is prompting and understanding AI models (GPT, LLMs, Transformers)	CO1

	B	Types of prompts (Instructional, Open-ended, Role-based), Basic prompt structures	CO1
	C	Importance of effective prompts	CO2
	Case Study	Using AI for Customer Support: How well-structured vs. poorly structured prompts impact AI responses in customer service chatbots.	
	Unit 2	Fundamentals of Effective Prompting	
	A	Clarity and specificity in prompts, Role of context and constraints	CO2
	B	Importance of examples in prompting	CO2
	C	Common mistakes in prompting	CO2
	Case Study	AI in Content Writing: How prompt refinement improves AI-generated articles, blog posts, and marketing copy.	
	Unit 3	Advanced Prompting Techniques	
	A	Chain-of-thought prompting (breaking down complex queries)	CO3
	B	Few-shot and zero-shot learning, Multi-turn conversation strategies	CO3
	C	Bias and ethical considerations in prompting, Prompt debugging techniques	CO3
	Case Study	AI for Code Generation: Comparing results of different prompts in generating Python/Java code using AI.	
	Unit 4	Domain-Specific Prompting	
	A	Prompting for different industries (Healthcare, Legal, Education, Marketing).	CO4
	B	AI-powered prompting to EDA, statistical queries, visualization, and report generation.	CO4
	C	Using AI for decision-making support, Fine-tuning AI responses for professional use.	CO5
	Case Study	AI in Education: How educators can use AI for generating lesson plans, quizzes, and explanations	
	Unit 5	Real-World Applications & Future of Prompting	
	A	AI-assisted research and writing	CO5
	B	Prompting in automation and AI agents, The role of prompt engineering in AI-driven products	CO6
	C	Future trends in AI prompting	CO6
	Case Study	*AI in Business Decision-Making:* How companies use AI-generated insights for market analysis and strategic planning	
	Mode of	Practical	

	examination				
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
AI3407.1	1	1	1	1	3	2	2	2	2	2	2
AI3407.2	3	2	2	2	3	2	2	3	2	2	2
AI3407.3	2	3	2	3	3	2	2	2	2	2	2
AI3407.4	2	1	2	1	2	2	2	2	2	2	2
AI3407.5	3	2	2	2	2	2	2	3	2	2	2
AI3407.6	3	3	3	2	2	2	2	3	2	2	3
Average	2.3	2.0	2.0	1.9	2.5	2.0	2.0	2.5	2.0	2.0	2.1

School: SSES		**Batch: 2025-29**	
Programme: (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**VOM2305**	
2	Course Title	***Data Visualization with Tableau and Power BI***	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	SEC	
5	Course Objective	This course aims to introduce the fundamentals of data visualization and Business Intelligence tools and develop skills in data preprocessing, transformation, and dashboard creation using Tableau and Power BI. It enables students to analyze data and design interactive dashboards for real-world business applications.	
6	Course Outcomes	CO1: Define the fundamental concepts of Business Intelligence and data visualization tools such as Tableau and Power BI **(K1)** CO2: Explain data connection, preprocessing, and transformation techniques in Tableau and Power BI. **(K2)** CO3: Apply data visualization techniques to create charts, reports, and dashboards. **(K3)** CO4: Analyze datasets using visualization tools to generate meaningful insights. **(K4)** CO5: Evaluate and optimize dashboards and reports for effective decision-making. **(K5)** CO6: Develop interactive and real-time BI dashboards using Tableau and Power BI for real-world applications. **(K6)**	
7	Course Description	This course introduces Business Intelligence and data visualization using Tableau and Power BI. It focuses on data connection, preprocessing, and transformation, along with creating interactive dashboards and reports. Students learn to analyze datasets, generate insights, and develop real-time visualization solutions for practical business applications.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Introduction to Tableau and Power BI	
	A	Install & Setup Tableau Public & Power BI	CO1
	B	Connecting to CSV, Excel, and SQL databases	CO1
	C	Understanding Data Models, Joins, and Relationships, Creating Basic Bar, Line, and Pie Charts	CO1
	Unit 2	Data Preprocessing & Transformation	
	A	Handling missing values and data types, Data cleaning with Power Query	CO2
	B	Creating calculated columns & measures	CO2
	C	Using Filters, Slicers, and Groups	CO2
	Unit 3	Advanced Visualizations & Dashboards	
	A	Creating Time Series and Trend Analysis	CO3
	B	Implementing Heatmaps, Maps, and Scatter Plots	CO3

	C	KPI indicators and Conditional Formatting, Designing an Interactive Dashboard	CO3
	Unit 4	Data Analysis & Storytelling	CO4
	A	Analyzing Business Performance using BI	CO4
	B	Forecasting and Clustering in Power BI	CO4
	C	Case Study: Sales & Customer Analytics/ Creating a Storyboard for Business Insights	CO5
	Unit 5	Report Publishing & Performance Optimization	
	A	Publishing Reports to Tableau Public & Power BI Service	CO5
	B	Performance Optimization Techniques in BI	CO6
	C	Scheduling Data Refresh in Power BI, Final Project – Creating a Full Business Dashboard	CO6
	Mode of examination	Practical Based	
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*	1. Murray, D. (2016). *Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software*. Wiley. ISBN: 9781119001195.	
	Other References	1. Lachev, M. (2021). *Applied Microsoft Power BI (5th Edition): Bring your data to life!*. Prologika Press. ISBN: 9781733046127.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
VOM2305.1	3	3	2	3	2	2	2	3	2	2	3
VOM2305.2	3	3	2	3	2	2	2	3	2	2	3
VOM2305.3	3	3	3	3	3	2	2	3	2	2	3
VOM2305.4	3	3	3	3	3	2	2	3	2	2	3
VOM2305.5	3	3	3	3	3	2	2	3	2	2	3
VOM2305.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. /Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: III**	
1	Course Code	**DAR2351**	
2	Course Title	**Research Based Learning-1**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Compulsory	
5	Course Objective	To familiarise students with basic concepts of software, i.e., MS Word and Latex for report writing, knowledge of a specific area of specialization and develop communication skills, especially in project writing and oral presentation.	
6	Course Outcomes	CO1: Understand the basics of software and programs used during research for effective writing and presentation. (K1) CO2: Demonstrate the knowledge of a program best suited for mathematics. (K2) CO3: Construct a deeper interest in mathematics and a taste for research. (K3) CO4: Examine the effective project title for research. (K4) CO5: Evaluate the problem and summarize research findings and present. (K5) CO6: Create a comprehensive literature review by collecting, organizing, and synthesizing relevant research studies on a specific topic. (K6)	
7	Course Description	This course introduces students to essential software tools, including **MS Word** and **Latex**, for effective report writing. It also provides in-depth knowledge in a chosen area of specialization while enhancing key communication skills. Emphasis is placed on preparing students to present their projects clearly and professionally, both in written reports and oral presentations.	
8			
	Unit 1	Introduction to Word	
		Introduction to the basics of fonts, alignments, layout and design. Inserting tables and images.	CO1
	Unit 2	Introduction to Latex	
		Students learn basic syntax and write equations. Learn to insert matrices, tables and images. Writing references.	CO2
	Unit 3	Information Collection and Feasibility Analysis of the Identified Problem	
		Students collect information from multiple sources and analyze the information in-depth, also checking the feasibility.	CO3
	Unit 4	Appropriateness of Problem Title	
		The title is clearly defined and the context for the research is provided.	CO4
	Unit 5	Literature Review of Problem Domain	CO5, CO6

	Mode of examination		
	Weightage Distribution	CA: 30%; CE: 30%; ESE: 40%	
	Text book/s*	C. R. Kothari, Research Methodology Methods & Techniques, Newage International Publishers, 2004.	
	Other References	P. Pruzan, Research Methodology, Springer 2016.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
DAR2351.1	2	2	3	3	2	2	1	3	1	2	3
DAR2351.2	2	2	1	2	2	1	1	3	1	2	3
DAR2351.3	3	3	2	1	2	1	1	1	1	2	3
DAR2351.4	2	3	2	3	3	1	1	1	1	2	3
DAR2351.5	3	3	2	3	3	2	1	2	1	2	3
DAR2351.6	3	3	2	3	3	2	1	2	1	2	3
Average	2.1	2.3	1.6	2.1	2.5	1.3	1.0	2.0	1.0	2.0	3

SEMESTER – IV

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA202**	
2	Course Title	**Database Management Systems**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	This course aims to provide a comprehensive understanding of database systems, including data models, database design, and query processing. It focuses on developing skills in relational algebra, SQL, and normalization, along with transaction management and concurrency control techniques, enabling students to design and manage efficient database systems.	
6	Course Outcomes	CO1: Define fundamental concepts of database systems, transactions, and data models. (K1) CO2: Explain database design concepts including ER diagrams, UML, and normalization techniques. (K2) CO3: Apply relational algebra and relational calculus for querying and manipulating data. (K3) CO4: Analyze constraints, views, and SQL queries for efficient database management. (K4) CO5: Evaluate transaction management techniques and concurrency control mechanisms. (K5) CO6: Design and develop database solutions incorporating SQL, normalization, and recovery mechanisms. (K6)	
7	Course Description	This course introduces the fundamental concepts of database systems, including data modeling, database design, relational algebra, and SQL. It also covers transaction management, concurrency control, and database recovery techniques. The course equips students with the skills to design, implement, and manage efficient and reliable database systems.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Introduction to Databases and Transactions and Data Models	
	A	What is a database system, purpose of the database system, what view of data, relational databases, database architecture.	CO1
	B	Transaction management, The importance of data models, Basic building blocks,	CO1
	C	Business rules, The evolution of data models, Degrees of data abstraction.	CO1
	Unit 2	Database Design, ER-Diagram, and Unified Modeling Language	
	A	Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas,	CO2
	B	Introduction to UML Relational database model: Logical view of data, keys, integrity rules.	CO2
	C	Relational Database design: features of good relational database design, atomic domain, and Normalization (1NF, 2NF, 3NF, BCNF).	CO2
	Unit 3	Relational Algebra and Calculus	
	A	Relational algebra: introduction, Selection, and projection, set operations, renaming, Joins, Division, syntax, semantics.	CO3
	B	Operators, grouping and ungrouping, relational comparison.	CO3

	C	Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.	CO3
	Unit 4	Constraints, Views, and SQL	
	A	What are constraints, types of constraints, and Integrity constraints?	CO4
	B	Views: Introduction to views, data independence, security, updates on views, and comparison between tables.	CO4
	C	Views SQL: data definition, aggregate function, Null Values, nested subqueries, Joined relations. Triggers.	CO4
	Unit 5	Transaction management and Concurrency control	
	A	Transaction management: ACID properties, serializability, and concurrency control,	CO5, CO6
	B	Lock-based concurrency control (2PL, Deadlocks), Time stamping methods.	CO5, CO6
	C	Optimistic methods, database recovery management.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1."Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill	
	Other References	1 "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer science Press. 2 "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**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**
BDA202.1	3	2	2	3	3	2	2	3	1	1	3	3	2	3
BDA202.2	3	2	2	3	3	2	2	3	1	1	3	3	2	3
BDA202.3	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA202.4	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA202.5	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA202.6	3	3	3	3	3	2	2	3	2	2	3	3	3	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0	3.0	2.7	**3**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA214**	
2	Course Title	**Sampling Theory**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	This course aims to provide a comprehensive understanding of sampling theory, including concepts of population and sample, sampling techniques, and estimation methods. It focuses on developing the ability to apply and evaluate sampling methods, estimate population parameters, and understand the role of official statistical systems in real-world data collection.	
6	Course Outcomes	CO1: Define the basic concepts of population, sample, and sampling methods. (K1) CO2: Explain different sampling techniques including simple random sampling with and without replacement. (K2) CO3: Apply estimation techniques for population parameters such as mean, total, and variance. (K3) CO4: Analyze stratified and systematic sampling methods and compare their efficiencies. (K4) CO5: Evaluate ratio and regression estimation methods and their variances in comparison with simple random sampling. (K5) CO6: Design sampling strategies and interpret data based on official statistical systems and real-world applications. (K6)	
7	Course Description	This course introduces the principles of sampling theory, including sampling techniques, estimation of population parameters, and variance analysis. It also covers stratified and systematic sampling, ratio and regression methods, and the role of official statistics in data collection and analysis.	
8			
	Unit 1	Simple random sampling	
	A	Concept of sample and population, complete enumeration versus sampling	CO1
	B	Sampling and non-sampling errors, requirements of a good sample,	CO1
	C	Simple random sampling with and without replacement.	CO2
	Unit 2	Estimation of population parameter	
	A	Estimates of the population mean, total, and proportion,	CO3
	B	Variances of these estimates	CO3
	C	Estimates of theses variances and sample size determination.	CO3
	Unit 3	Stratified random sampling	
	A	Stratified random sampling, estimates of the population mean, and total variances of these estimates.	CO4
	B	Proportional and optimum allocations and their comparison with SRS.	CO4
	C	Systematic Sampling, estimates of the population mean and total, variances of these estimates.	CO4
	Unit 4	Ration and regression method of estimation	
	A	Ratio and regression methods of estimation, estimates of the	CO5

		population mean and total (for SRS of large size),	
	B	Variances of these estimates and estimates of theses variances,	CO5
	C	Variances in terms of the correlation coefficient between X and Y for regression method and their comparison with SRS.	CO5
	Unit 5	Official Statistics	
	A	Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations.	CO6
	B	Principal publications containing data on the topics such as population, industry, and finance.	CO6
	C	Various official agencies are responsible for data collection and their main functions.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta 2. Cochran W.G (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.	
	Other References	1. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall 2. Guide to Current Indian Official Statistics, Central Statistical Organization, GOI, New Delhi.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
BDA214.1	2	2	2	3	3	2	2	3	1	1	3	3	2	2
BDA214.2	2	2	2	3	3	2	2	3	1	1	3	3	2	2
BDA214.3	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA214.4	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA214.5	3	3	3	3	3	2	2	3	2	2	3	3	3	3
BDA214.6	3	3	3	3	3	2	2	3	2	2	3	3	3	3
Average	2.7	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0	3.0	2.7	2.7

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**DAT2401**	
2	Course Title	Multivariate Data Analysis & its Applications	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	Familiarise students with the multivariate normal distribution, estimation of the mean vector and the covariance matrix, the distributions and uses of sample correlation coefficients, classification of observations, the distribution of the sample covariance matrix, and the sample generalized variance.	
6	Course Outcomes	CO1: Demonstrate knowledge and understanding of the multivariate normal distribution. (K2, K3) CO2: Demonstrate knowledge and understanding of the concept of estimation of the mean vector and the covariance matrix. (K2, K3) CO3: Apply the concepts of dimension reduction technique on real data set. (K3) CO4: Analyze the difference between Principal Components Analysis, Factor Analysis and Cluster Analysis techniques. (K4) CO5: Evaluate the different types of regressions in multivariate data. (K4, K5) CO6: Evaluate the analysis of variance for multivariate data. (K4, K5)	
7	Course Description	This module aims to provide an understanding of the multivariate normal distribution, estimation of the mean vector and the covariance matrix, the distributions and uses of sample correlation coefficients, classification of observations, the distribution of the sample covariance matrix, and the sample generalized variance.	
8			
	Unit 1		
	A	A brief review of Univariate and Bivariate distribution with their properties.	CO1
	B	Basic Multivariate Distribution: mean, variance, Covariance, correlation, and the linear combination of variables.	CO1
	C	The multivariate normal distribution, Mean Vectors, and Covariance Matrices. Application of Multivariate Distribution	CO1
	Unit 2		
	A	Multivariate normal distribution: maximum likelihood estimation, Wishart's distribution, Properties of Wishart distribution	CO2
	B	Hotelling's T2 and hypothesis testing for multivariate normal data. Inference from a single sample, Inference from two dependent samples Inference from two independent samples.	CO2
	C	Simple, Multiple, Partial, and Canonical correlations with their properties.	CO2
	Unit 3		
	A	Principal Components Analysis and derivation of principal components; PCA structural model; PCA on normal populations; bi-plots.	CO3
	B	Factor Analysis, Factor extraction Factor rotation, Factor scores Validation of factor analysis, Higher order factor analysis Q-type factor analysis	CO3, CO4

	C	Cluster Analysis, Types of clustering, Correlation, and distance, Partitioning methods, hierarchical clustering, K-means clustering, and their interpretation.	CO4
	Unit 4		
	A	Simple, Multiple, and Multivariate regression with their properties and applications	CO5
	B	Binary and multidimensional Logistic regression.	CO5
	C	Linear discriminant function analysis. Estimating linear discriminant functions and their properties.	CO5
	Unit 5		
	A	Analysis of variance and covariance. Difference between ANOVA and ANOCOVA	CO6
	B	Multivariate analysis of variance and Covariance.	CO6
	C	Concepts of correspondence analysis, chi-square distance and inertia, multiple correspondence analysis.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25% ESE:50%	
	Text book/s*	1. Johnson, R.A. and Wichern, D.W.: Applied Multivariate Statistical Analysis, Sixth Edition, Pearson Education India. 2. Hardle, W.K. and Hlavka, Z. Multivariate Statistics, Springer.	
	Other References	1. Anderson, T.W.: An Introduction to Multivariate Statistical Analysis, Third Edition, Wiley. 2. Härdle, W.K. and Simar, L. : Applied Multivariate Statistical Analysis, Springer.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
DAT2401.1	3	2	2	3	3	2	2	3	1	1	3
DAT2401_.2	3	2	2	3	3	2	2	3	1	1	3
DAT2401.3	3	3	3	3	3	2	2	3	2	2	3
DAT2401.4	3	3	3	3	3	2	2	3	2	2	3
DAT2401.5	3	3	3	3	3	2	2	3	2	2	3
DAT2401.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2026-30**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**DAP2452**	
2	Course Title	**Sampling Theory Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	This course aims to provide practical understanding of sampling theory concepts, including sampling techniques, estimation of population parameters, and comparison of different sampling methods. It focuses on developing hands-on skills to apply sampling procedures and analyze real-world data.	
6	Course Outcomes	**CO1:** Define the basic concepts of population, sample, and sampling techniques. **(K1)** **CO2:** Explain different sampling methods such as SRSWR, SRSWOR, and PPS sampling. **(K2)** **CO3:** Apply sampling techniques to estimate population parameters and compare sampling methods. **(K3)** **CO4:** Analyze stratified and systematic sampling methods and their efficiency in practical scenarios. **CO5:** Evaluate ratio, difference, and regression estimators for estimating population parameters. **CO6:** Design and implement sampling procedures for real-world datasets and interpret the results.	
7	Course Description	This lab course provides hands-on experience in sampling techniques such as simple random sampling, stratified sampling, and systematic sampling. It focuses on estimation of population parameters, comparison of sampling methods, and application of ratio and regression estimators. The course equips students with practical skills to analyze and interpret real-world data using sampling methods.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Lab. Experiment 1	
	A, B, C	Problem based on how to draw the sample from the population in SRSWR and SRSWOR and PPS sampling	CO1, CO2
	Unit 2	Lab. Experiment 2	
	A, B, C	Problem-based on simple random sampling and find that SRSWOR performs better than SRSWR and PPS sampling	CO1, CO3
	Unit 3	Lab. Experiment 3	
	A, B, C	Problem-based on stratified random sampling and applications of allocation techniques	CO1, CO4
	Unit 4	Lab. Experiment 4	
	A, B, C	Problem-based on systematic sampling and circular systematic sampling	CO1, CO5
	Unit 5	Lab. Experiment 5	
	A, B, C	Problem-based on ratio, difference and regression type estimator.	CO1, CO6

	Mode of examination	Practical+Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta 2. Cochran W.G (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.	
	Other References	1. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall 2. Guide to current Indian Official Statistics, Central Statistical Organization, GOI, New Delhi.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAP2452.1	2	2	2	2	1	1	1	3	2	2	3
DAP2452.2	2	2	3	2	2	2	1	3	2	2	3
DAP2452.3	3	3	2	2	2	2	1	3	2	2	3
DAP2452.4	3	3	2	2	2	2	1	3	2	2	3
DAP2452.5	3	3	2	2	2	2	1	3	2	2	3
DAP2452.6	3	3	2	2	2	2	1	3	2	2	3
Average	**2.7**	**2.7**	**2.0**	**2.0**	**1.8**	**1.8**	**1.0**	**3.0**	**2.0**	**2.0**	**3.0**

Programme: B.Sc.(Hons./Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**AI3408**	
2	Course Title	Supervised & Unsupervised Learning Techniques	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	Minor	
5	Course Objective	This course aims to introduce students to the fundamentals of data science by exploring both supervised and unsupervised learning techniques. It provides hands-on experience in data preprocessing, feature engineering, model training, evaluation, and optimization using Python. Students will develop programming and analytical skills, apply key mathematical concepts such as linear algebra, probability, and optimization, and gain insights into building effective machine learning models for real-world data science applications.	
6	Course Outcomes	**CO1:** Apply data preprocessing techniques using Python libraries (NumPy, Pandas, Scikit-learn) to prepare real-world datasets for exploratory data analysis and machine learning models (K3). **CO2:** Apply supervised and unsupervised machine learning algorithms such as Linear Regression, Logistic Regression, Decision Trees, Random Forest, SVM, and K-Means to analyze real-world datasets (K3, K4). **CO3:** Analyze the performance of machine learning model using evaluation metrics such as accuracy, precision, recall, F1-score, and cross-validation techniques (K4). **CO4:** Evaluate and improve machine learning models using hyperparameter tuning methods such as Grid Search and Randomized Search while addressing bias-variance tradeoff (K5). **CO5:** Understand advanced unsupervised learning techniques such as Hierarchical Clustering and Principal Component Analysis (PCA) for dimensionality reduction and data analysis (K2). **CO6:** Develop problem-solving skills using machine learning techniques in various domains such as predictive analytics, healthcare diagnosis, and fraud detection (K6).	
7	Course Description	This lab course covers the basics of supervised and unsupervised learning. Students will learn how to apply machine learning algorithms using Python. The lab focuses on hands-on experience with data preprocessing, model training, evaluation, and optimization, helping students understand machine learning concepts and solve real-world problems.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction to Machine Learning	
	A	Introduction to Python Libraries: NumPy, Pandas, Matplotlib, and Scikit-learn.	CO1

	B	Data Preprocessing Techniques: Handling missing values, feature scaling, and encoding categorical variables.			CO1
	C	Exploratory Data Analysis (EDA): Visualizing and understanding datasets using statistical methods.			CO2
	Unit 2	Supervised Learning Techniques			
	A	Implementing Linear Regression: Predicting house prices using a dataset.			CO2
	B	Logistic Regression: Classification of spam emails			CO2
	C	Decision Trees, Random Forest, Support Vector Machines (SVM).			CO3
	Unit 3	Unsupervised Learning Techniques			
	A	K-Means Clustering: Customer segmentation in retail data.			CO2
	B	Hierarchical Clustering: Clustering gene expression data.			CO3
	C	Principal Component Analysis (PCA): Dimensionality reduction of high-dimensional data.			CO4
	Unit 4	Model Evaluation and Optimization			
	A	Cross-validation and Model Performance Metrics: Accuracy, Precision, Recall, F1-score.			CO4
	B	Hyperparameter Tuning: Grid Search and Randomized Search.			CO4
	C	Bias-Variance Tradeoff: Understanding overfitting and underfitting in mode			CO5
	Unit 5	Applications of Supervised and Unsupervised Learning in Real-World Scenarios			
	A	Predictive analytics (e.g., stock price prediction, weather forecasting etc).			CO5
	B	Healthcare applications (e.g., disease classification, medical diagnosis, etc).			CO6
	C	Fraud detection in banking (e.g., credit card fraud detection). Case study discussions on ethical AI and bias in ML models.			CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*				
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

CO	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
AI3408.1	2	1	2	1	3	1	3	3	2	2	2	2	1	2
AI3408.2	3	2	2	2	3	1	2	3	1	2	2	3	2	2
AI3408.3	2	3	2	3	3	2	2	2	2	2	2	2	3	2
AI3408.4	2	3	2	3	2	2	3	2	2	2	2	2	3	2
AI3408.5	1	1	2	1	2	1	2	2	2	2	2	1	1	2
AI3408.6	3	3	2	2	2	2	3	3	2	2	3	3	3	2
Average	**2.1**	**2.1**	**2.0**	**2.0**	**2.5**	**1.5**	**2.5**	**2.5**	**1.8**	**2.0**	**2.7**	**2.1**	**2.1**	**2.0**

<table>
<tr><td colspan="2">School: SSES</td><td colspan="2">Batch: 2025-29</td></tr>
<tr><td colspan="2">Program: B.Sc. (Hons. / Hons. With Research)</td><td colspan="2">Academic Year: 2026-27</td></tr>
<tr><td colspan="2">Branch: Data Science & Analytics</td><td colspan="2">Semester: IV</td></tr>
<tr><td>1</td><td>Course Code</td><td colspan="2">CCU108</td></tr>
<tr><td>2</td><td>Course Title</td><td colspan="2">Community Connect</td></tr>
<tr><td>3</td><td>Credits</td><td colspan="2">2 Course Status: Training/Survey/Project</td></tr>
<tr><td>4</td><td>(L-T-P)</td><td colspan="2">(0-0-4)</td></tr>
<tr><td>5</td><td>Learning Hours</td><td colspan="2"><table><tr><td>Contact Hours</td><td>30</td></tr><tr><td>Project/Field Work</td><td>20</td></tr><tr><td>Assessment</td><td>00</td></tr><tr><td>Guided Study</td><td>10</td></tr><tr><td>Total hours</td><td>60</td></tr></table></td></tr>
<tr><td>6</td><td>Course Objectives</td><td colspan="2">1. Contribute to the holistic development of students by making them more aware of socially and economically disadvantaged communities and their specific issues
2. Provide richer context to classrooms, to make them more effective laboratories of learning by aligning them to social realities beyond textbooks
3. Provide scope to faculty members to align their teaching and research goals by giving them ample opportunity to carry out community-oriented projects
4. Ensure that the community connect programs provides benefits to communities in tangible ways so that they may feel perceptibly better off post the interaction and involvement of the Sharda academic community
5. Provide ample opportunity for Sharda University academic community to contribute effectively to society and nation building</td></tr>
<tr><td>7</td><td>Course Outcomes</td><td colspan="2">After completion of this course, students will be able to:
CO1: Students learn to be sensitive to the living challenges of disadvantaged communities.
CO2: Students learn to appreciate societal realities beyond textbooks and classrooms
CO3: Students learn to apply their knowledge via research, and training for community benefit
CO4: Students learn to work on socio-economic projects with teamwork and timely delivery
CO5: Students learn to engage with communities for meaningful contributions to society.
CO6: The survey will help to identify the gaps and create a plan to further improve the situation related to social problems prevailing in different sections of society and find the solution in a sustainable manner.</td></tr>
</table>

8	Theme	Major research themes: 1. *Survey and self-learning*: In this mode, students will make the survey, analyze data, and will extract results to correlate with their theoretical knowledge. E.g. Crops and animals, land holding, labor problems, medical problems of animals and humans, savage and sanitation situations, waste management, etc. 2. *Survey and solution providing*: In this mode, students will identify the common problems and will provide solutions/ educate the rural population. E.g. air and water pollution, the need for treatment, use of renewable (mainly solar) energy, electricity-saving devices, inefficiencies in the cropping system, animal husbandry, poultry, pest control, irrigation, machining in agriculture, etc. 3. *Survey and reporting*: In this mode, students will educate villagers and survey the ground-level status of various government schemes meant for rural development. The analyzed results will be reported to concerned agencies which will help them for taking necessary/corrective measures. E.g. Pradhan Mantri Jan Dhan Yojana, Pradhan Mantri MUDRA Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal pension Yojana, Pradhan Mantri Awas Yojana, Pradhan Mantri FasalBima Yojana, Swachh Bharat Abhiyan, Soil Health Card Scheme, Digital India, Skill India Program, BetiBachao, BetiPadhao Yojana, DeenDayal Upadhyaya Gram Jyoti Yojana, Shyama Prasad Mukherjee Rurban Mission, UJWAL Discom Assurance Yojana, PAHAL, Pradhan Mantri Awas Yojana-Gramin, Pradhan Mantri Yuva Yojana, Pradhan Mantri Jan Aushadhi Yojana, Pradhan Mantri KhanijKshetra Kalyan Yojana, Pradhan Mantri Suraksha Bima Yojana, UDAN scheme, DeenDayal Upadhyaya Grameen Kaushalya Yojana, Pradhan Mantri Sukanya Samriddhi Yojana, Sansad Adarsh Gram Yojana, Pradhan Mantri SurakshitMatritva Abhiyan, Pradhan Mantri RojgarProtsahan Yojana, Midday Meal Scheme, Pradhan Mantri Vaya Vandana Yojana, Pradhan Mantri Matritva Vandana Yojana, and Ayushman Bharat Yojana.
9.1	Guidelines for Faculty Members	It will be a group assignment. There should be no more than 10 students in each group. The faculty guide will guide the students and approve the project title and help the student in preparing the questionnaire and final report. The questionnaire should be well-designed and it should carry at least 20 questions (Including demographic questions). The faculty will guide the student to prepare the PPT. The topic of the research should be related to social, economical, or environmental issues concerning the common man. The report should contain 2,500 to 3,000 words and relevant charts, tables, and photographs.

		A plagiarism check of the report must. ETE will conduct out of 100, divided in three parts (i) 30 Marks for the report (ii) 30 Marks for the presentation (iii) 40 Marks for knowledge. The student should submit the report to CCC-Coordinator signed by the faculty guide by …… The students have to send the hard copy of the report and PPT, and then only they will be allowed for ETE.
9.2	Role of CCC-Coordinator	The CCC Coordinator will supervise the whole process and assign students to faculty members. 1. UG- B.Sc.-Semester VI - the students will be allocated to faculty member (mentors/faculty member) in odd term.
9.3	Layout of the Report	Abstract (250 words) a. Introduction b. Literature review(optional) c. Objective of the research d. Research Methodology e. Finding and discussion f. Conclusion and recommendation g. References,Note: Research report should base on primary data.
9.4	Guideline for Report Writing	Title Page: The following elements must be included: • Title of the article; • Name(s) and initial(s) of author(s), preferably with first names spelled out; • Affiliation(s) of author(s); • Name of the faculty guide and Co-guide Abstract: Each article is to be preceded by a succinct abstract, of up to 250 words, that highlights the objectives, methods, results, and conclusions of the paper. Text: Manuscripts should be submitted in Word. • Use a normal, plain font (e.g., 12-point Times Roman) for text. • Use italics for emphasis. • *Use the automatic page numbering function to number the pages.* • *Save your file in docx format* (Word 2007 or higher) or doc format (older Word versions) Reference list: The list of references should only include works that are cited in the text and that have been published or accepted for publication. The entries in the list should be in alphabetical order. Journal article Hamburger, C.: Quasimonotonicity, regularity and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura Appl. 169, 321–354 (1995) Article by DOI Sajti, C.L., Georgio, S., Khodorkovsky, V., Marine, W.: New nanohybrid materials for biophotonics. Appl. Phys. A (2007). doi:10.1007/s00339-007-4137-z Book Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra.

		Kluwer, Boston (1992) Book chapter Broy, M.: Software engineering — from auxiliary to key technologies. In: Broy, M., Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, Heidelberg (2002) Online document Cartwright, J.: Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1 (2007). Accessed 26 June 2007 Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see www.issn.org/2-22661-LTWA-online.php For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list. EndNote style (zip, 2 kB) Tables: All tables are to be numbered using Arabic numerals. Figure Numbering: All figures are to be numbered using Arabic numerals.
9.5	Format:	The report should be Spiral/ hardbound The Design of the Cover page to report will be given by the Coordinator- CCC Cover page, Acknowledgement, Content, Project report,Appendices
9.6	Important Dates:	Students should prepare questionnaire and get it approved by concern faculty member and submit the final questionnaire within ……to CCC-Coordinator. Students will complete their survey work within …….. and submit the same to concern faculty member. (Each group should complete 50 questionnaires) The student should show the 1st draft of the report to concern faculty member within …….. and submit the same to concern faculty member. Faculty members should give required inputs, so that students can improve their project work and make the final report submission on …….. The students should submit the hard copy and soft copy of the report to CCC-Coordinator signed by the faculty guide within ……. The students should submit the soft copy of the PPT to CCC-Coordinator signed by the faculty guide within ……. The final presentation will be organized on ……..
9.7	ETE	The students will be evaluated by panel of faculty members on the basis of their presentation on ……

10	Course Evaluation:30%	
10.01	Continuous Assessment	30%
	Questionnaire design	
	Report Writing	
10.02	ESE (PPT presentation)	40%

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
CCU108.1	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.2	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.3	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.4	1	2	2	3	3	2	3	3	3	2	1	2	2	3
CCU108.5	1	2	2	3	3	2	3	3	3	2	1	2	2	3

CCU108.6	1	2	2	3	3	2	3	3	3	2	1	2	2	3
Average	**1.0**	**2.0**	**2.0**	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**	**2.0**	**2.0**	**3.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**DAR2452**	
2	Course Title	**Research Based Learning-2**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Project (Audit-Qualifying)	
5	Course Objective	The primary objective of this research is to identify gaps in existing literature and formulate objectives to address them. It will select an appropriate methodology, develop a structured research plan, and assess the organization of research papers for clarity and coherence. Data will be collected and synthesized from multiple sources to generate meaningful insights supporting the study.	
6	Course Outcomes	CO1: Find the research gap for further understanding of the specific topic. (K2) CO2: Construct objectives related to the research problem. (K3) CO3: Analyse a clear methodology for the research. (K4) CO4: Develop an effective plan for the research procedure. (K3, K6) CO5: Evaluate the structure of the research paper. (K5) CO6: Construct data from various sources. (K6)	
7	Course Description	This course equips students with the skills to identify research gaps, formulate objectives, select appropriate methodologies, and develop structured research plans. It also covers evaluating research papers and synthesizing data from multiple sources to generate meaningful insights.	
8			
	Unit 1	Research Gap	CO1
		To find the research gaps in various research papers, to develop a theoretical framework and research questions	
	Unit 2	Formulation of Research Objectives	CO2
		To frame the objective of the research paper with the acquired knowledge to fill the research gap found	
	Unit 3	Methodology	CO3
		Clear description of methods, procedures and steps to be used for the research	
	Unit 4	Planning & Preliminary Results	CO4
		Detailed formulation of the flow of the research procedure	
	Unit 5	Data Collection	
		To collect data from primary and secondary sources	
			CO5, CO6

	Mode of examination		
	Weightage Distribution	CA, CE,=30%, ESE=40%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAR2452.1	2	3	1	3	2	1	1	2	1	1	2
DAR2452.2	2	3	2	2	2	2	1	1	1	1	2
DAR2452.3	3	2	1	3	3	1	1	2	2	1	2
DAR2452.4	3	2	3	2	2	2	3	2	1	2	2
DAR2452.5	2	3	1	3	2	2	1	1	2	1	2
DAR2452.6	3	2	2	2	3	2	2	3	2	2	3
Average	2.5	2.5	1.6	2.5	2.3	1.6	1.5	1.8	1.5	1.3	2.1

SEMESTER-V

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA303**	
2	Course Title	**Machine learning**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	The objective of this course is to introduce students to the fundamental concepts and techniques of machine learning. It aims to develop the ability to build, evaluate, and apply machine learning models for solving real-world problems using statistical, computational, and data-driven approaches.	
6	Course Outcomes	CO1: Define and recall fundamental concepts, terminology, and types of machine learning. (K1) CO2: Explain machine learning processes, evaluation metrics, and the working principles of supervised and unsupervised learning algorithms. (K2) CO3: Apply machine learning algorithms such as regression, classification, and decision trees to solve real-world problems. (K3) CO4: Analyze clustering and dimensionality reduction techniques such as K-means and PCA for pattern discovery and data interpretation. (K4) CO5: Evaluate the performance of machine learning models using appropriate metrics, validation techniques, and model selection methods. (K5) CO6: Design and implement machine learning solutions by selecting suitable models, tuning parameters, and integrating advanced techniques such as neural networks and probabilistic models. (K6)	
7	Course Description	This course provides introductory concepts of various machine learning techniques to students which will help to build the foundation for further understanding. This course also aims to provide details of various steps involved in the machine learning pipeline such as data collection, pre-processing, feature engineering, etc. This course also introduces popular tools used in the area of machine learning. This course mainly focused on Regression and Neural network-based Machine learning algorithms.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction to Machine Learning	
	A	Machine Learning Fundamentals –Types of Machine Learning - Supervised, Unsupervised, Reinforcement- The Machine Learning process.	CO1
	B	Terminologies in ML- Testing ML algorithms: Over fitting, Training, Testing and Validation Sets-Confusion matrix -Accuracy metrics-ROC Curve.	CO1
	C	Basic Statistics: Averages, Variance and Covariance, The Gaussian-The Bias-Variance trade off- Applications of Machine Learning.	CO1
	Unit 2		
	A	Regression: Linear Regression – Multivariate Regression analysis, Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression	CO2
	B	Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier.	CO2

	C	Decision Tree based methods for classification and Regression-Ensemble methods.	CO2
	Unit 3		
	A	Clustering- K-Means clustering, Hierarchical clustering.	CO3
	B	The Curse of Dimensionality –Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis	CO3
	C	The Internet, Business and Retail, Law Enforcement, Computing, Clustering models: How the K-means and PCA works, Calculating the number of clusters in a dataset.	CO3
	Unit 4		
	A	Perceptron- Multilayer perceptron- Back Propagation- Initialization, Training and Validation Support.	CO4
	B	Vector Machines (SVM) as a linear and non-linear classifier - Limitations of SVM	CO4
	C	Recognition of MNIST handwritten digits using Artificial Neural Network. Build an email spam classifier using SVM.	CO4
	Unit 5		
	A	Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models.	CO5
	B	Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning.	CO5
	C	Classify the given text segment as 'Positive' or 'Negative' statement using the Naive Bayes Classifier. Predict future stock price of a company using Monte Carlo Simulation.	CO6
	Mode of examination	Theory	
	Weightage Distribution		
	Text book/s*	1. Mitchell Tom, Machine Learning. McGraw Hill. 2. Dr. Nilesh Shelke, Dr. Gopal Sakarkar, Dr N V Choudhari, Introduction to Machine Learning, Ganu Prakashan.	
	Other References	1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction 2. Andreas C. Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA303.1	3	2	2	3	3	2	2	3	1	1	3
BDA303.2	3	2	2	3	3	2	2	3	1	1	3
BDA303.3	3	3	3	3	3	2	2	3	2	2	3
BDA303.4	3	3	3	3	3	2	2	3	2	2	3
BDA303.5	3	3	3	3	3	2	2	3	2	2	3
BDA303.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA322**	
2	Course Title	**Statistical Simulation**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	The objective of this course is to discuss students to the basic concepts of statistical simulation. It helps students learn how to generate random numbers, apply simulation techniques such as Monte Carlo methods, and use these methods to understand and solve real-world problems.	
6	Course Outcomes	CO1: Define and recall fundamental concepts of probability, statistics, and simulation modeling. (K1). CO2: Explain methods for generating random numbers and random variables from standard statistical distributions. (K2). CO3: Apply resampling techniques such as bootstrapping and jackknife for statistical estimation. (K3). CO4: Analyze simulation techniques including Monte Carlo and Markov Chain Monte Carlo (MCMC) methods for modeling complex systems. (K4). CO5: Evaluate simulation results and model performance using statistical validation and variance reduction techniques. (K5) CO6: Design and implement simulation models to study and solve real-world problems using computational and mathematical approaches. (K6)	
7	Course Description	This course introduces the fundamental concepts and techniques of statistical simulation and modeling. It covers random number generation, sampling from probability distributions, and simulation methods such as Monte Carlo and Markov Chain Monte Carlo (MCMC). The course also includes topics such as variance reduction techniques, statistical validation, and resampling methods. Students will learn to apply simulation techniques for modeling and analyzing real-world systems and solving complex problems using computational approaches.	
8	Outline syllabus		**CO Mapping**
	Unit 1		
	A	Review of R/Python.	CO1
	B	Random number generation: Inverse-transform; acceptance-rejection; transformations.	CO1
	C	Statistic simulations: generating random variables, simulating normal, gamma and beta random variables.	CO1
	Unit 2		
	A	Simulating multivariate distributions, MCMC methods.	CO2
	B	Gibbs sampler, simulating random fields, simulating stochastic process.	CO2
	C	Variance reduction technique: importance sampling for integration, control variates and antithetic variables.	CO2
	Unit 3		
	A	Bootstrapping; jackknife resampling.	CO3

	B	Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation.	CO3
	C	Bootstrapping in regression and sampling from finite populations.	CO3
	Unit 4		
	A	Simulating a non-homogeneous Poisson process.	CO4
	B	Optimization using Monte Carlo methods simulated annealing for optimization.	CO4
	C	Solving differential equations by Monte Carlo methods.	CO4
	Unit 5		
	A	Univariate density estimation; kernel smoothing multivariate density estimation	CO5, CO6
	B	Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization.	CO5, CO6
	C	EM (Expectation-Maximization) algorithm; simplex algorithm.	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution		
	Text book/s*	1. Fishman, G.S. Monte Carlo: Concepts, Algorithms and Applications. 2. Rubinstein, R.Y.: Simulation and the Monte Carlo Method.	
	Other References	1. Ross, S. M.: Simulation, Third Edition, Academic Press. 2. Efron, B. and Tibshirani. R.J.: An introduction to the Bootstrap.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
BDA322.1	3	2	2	3	3	2	2	3	1	1	2
BDA322.2	3	2	2	3	3	2	2	3	1	1	2
BDA322.3	3	3	3	3	3	2	2	3	2	2	3
BDA322.4	3	3	3	3	3	2	2	3	2	2	3
BDA322.5	3	3	3	3	3	2	2	3	2	2	3
BDA322.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	**2.8**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-2**	
Branch: Data Science & Analytics		**Semester: VI**	
1	**Course Code**	**BDA318**	
2	**Course Title**	**Data Visualization**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory (CC)	
5	Course Objective	The objective of this course is to discuss students to the basic concepts of data visualization and data analytics. It helps students learn how to present data effectively, use tools like Tableau, and understand data-driven decision making through visual storytelling and model interpretation.	
6	Course Outcomes	CO1: Define the basic concepts of data visualization and data-analytic thinking. (K1) CO2: Explain the data analytics process including data understanding, preparation, modeling, evaluation, and deployment. (K2) CO3: Apply storytelling techniques and basic machine learning models for data analysis and visualization. (K3) CO4: Analyze data using visualization tools such as Tableau and apply decision analytic thinking. (K4) CO5: Evaluate model performance using visualization techniques such as ROC curves, confusion matrix, and performance metrics. (K5) CO6: Design and develop effective data visualizations and clustering-based insights for real-world problems. (K6)	
7	Course Description	This course introduces the fundamental concepts of data visualization and data analytics. It focuses on storytelling with data, use of visualization tools such as Tableau, and techniques for analyzing and presenting data to support decision making.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Data-Analytic Thinking: The Ubiquity of Data Opportunities, Data Processing and “Big Data” From Big Data 1.0 to Big Data 2.0,	CO1
	B	Data and Data Science Capability as a Strategic Asset. From Business Problems to Data Mining Tasks: Business Understanding	CO1
	C	Data Understanding; Data Preparation; Modeling; Evaluation; Deployment. Analytic techniques and technologies.	CO2
	Unit 2		
	A	Story Telling with Data: Importance of context; Choosing an effective visual; Focus audience’s attention; Thinking like designer;	CO3
	B	Dissecting model visuals; Lessons in story telling; Putting it all together; Case studies.	CO3
	C	Introduction to Predictive Modeling: Linear Regression; Classification: Logistic, Regression, Support Vector Machines, Decision Trees.	CO3
	Unit 3		

	A	Data Visualization Using Tableau 1: Introduction to Tableau; Data Import and Management: Data import, Extract and live, Data	CO4

		management – Join, Data management – Relationship, Data Management – Replace; Data Type and Operation: Data type, Pivot and separate , Change type, Set and group, Hierarchy.	
	B	Decision Analytic Thinking: Targeting the Best Prospects for a Charity Mailing -The Expected Value Framework: Decomposing the Business Problem and Recomposing the Solution Pieces , A Brief Digression on Selection Bias;	CO4
	C	Churn Example Revisited with Even More Sophistication - The Expected Value Framework: Structuring a More Complicated Business Problem, Assessing the Influence of the Incentive; From an Expected Value Decomposition to a Data Science Solution.	CO4
	Unit 4		
	A	Fitting a Model to Data: What is a good model? -Overfitting , Generalization Evaluating Classifiers , Plain Accuracy and Its Problems , Confusion Matrix , Problems with Unbalanced Classes, Problems with Unequal Costs and Benefits ;	CO5
	B	Generalizing Beyond Classification - Using Expected Value to Frame Classifier Evaluation; Evaluation, Baseline Performance, and Implications for Investments in Data.	CO5
	C	Visualizing Model Performance: Ranking Instead of Classifying; Profit Curves; ROC Graphs and Curves; The Area Under the ROC Curve (AUC); Cumulative Response and Lift Curves; Example: Performance Analytics for Churn Modeling.	CO5
	Unit 5		
	A	Data Visualization Using Tableau 2: *f* Different types of data visualizations - Visual encoding , Bar chart and pie chart , Line chart ,Multiple chart and distribution , Highlight tables , Scatter plot and trend lines, Heat map, Geographic mapping ,Bullet graph , Gnatt chart , Data calendar , Circle view.	CO6
	B	Similarity, Neighbors, and Clusters: Similarity and Distance; Nearest-Neighbor Reasoning o Example: Whiskey Analytics, How Many Neighbors and How Much Influence? , Issues with Nearest-Neighbor Methods;	CO6
	C	Clustering - Hierarchical clustering Example: Whiskey Analytics, Nearest Neighbors Revisited: Clustering Around Centroids; Example: Clustering Business News Stories -Understanding the Results of Clustering; Stepping Back: Solving a Business Problem Versus Data Exploration.	CO6
	Mode of examination	Theory	
	Weightage	CA, MTE ETE	

	Distribution	25%	50%	
	Text book/s*	1. Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few 2. Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsky		
	Other References	1. The Accidental Analyst: Show Your Data Who's Boss" by Eileen and Stephen McDaniel		
	Mode of examination	Theory		
	Weightage Distribution	CA, MTE	ETE	
		%	%	
	Text book/s*	3. Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few 4. Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsky		
	Other References	2. The Accidental Analyst: Show Your Data Who's Boss" by Eileen and Stephen McDaniel		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
BDA318.1	3	2	2	3	3	2	2	3	1	1	2
BDA318.2	3	2	2	3	3	2	2	3	1	1	2
BDA318.3	3	3	3	3	3	2	2	3	2	2	3
BDA318.4	3	3	3	3	3	2	2	3	2	2	3
BDA318.5	3	3	3	3	3	2	2	3	2	2	3
BDA318.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	2.8

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**BDA216**	
2	Course Title	**Statistical Inference**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	CC	
5	Course Objective	The objective of this course is to introduce students to the fundamental concepts of statistical inference. It aims to develop the ability to analyze data, estimate parameters, test hypotheses, and interpret results using statistical methods.	
6	Course Outcomes	CO1: Define basic concepts of statistical analysis, regression, and correlation. (K1) CO2: Explain curve fitting methods such as polynomial and exponential models. (K2) CO3: Apply methods of estimation and properties of estimators in statistical problems. (K3) CO4: Analyze point and interval estimation techniques including confidence intervals. (K4) CO5: Evaluate hypotheses using statistical tests such as t-test and variance tests. (K5) CO6: Design and interpret statistical models using Z-test, F-test, chi-square test, and ANOVA techniques. (K6)	
7	Course Description	This course introduces the concepts of statistical inference, including estimation and hypothesis testing. It focuses on analyzing sample data to make decisions about populations using various statistical techniques.	
8	Outline syllabus		CO Mapping
	Unit 1		CO1
	A	Statistical analysis of descriptive statistics, the principle of least square, lines of regression, simple linear regression	CO1
	B	Coefficient of determination. Multiple linear regression, coefficient of multiple determination.	CO2
	C	Fitting of polynomials and exponential curves.	
	Unit 2		CO3
	A	Criteria for obtaining a good estimator: unbiasedness, consistency, efficiency, and sufficiency.	CO3
	B	Minimal sufficient statistic.	CO3
	C	Uniformly minimum variance unbiased estimator, complete statistic.	
	Unit 3		CO4
	A	Method of point estimation: Method of moments, maximum likelihood estimator, and its properties mean square error (MSE).	CO4
	B	Method of minimum chi-square, method of moments, Least square and their properties.	CO4
	C	Interval estimation: Confidence interval, construction of confidence intervals	
	Unit 4		CO5
	A	Null hypothesis, alternative hypothesis, type I error, type II error,	CO5

		level of significance, p-value, and power of the test.	
	B	Tests for mean based on normal distribution- one-sample t-test, two-sample t-test, paired-sample t-test.	CO5
	C	Tests for variance based on normal distribution- one-sample and two-sample problem	
	Unit 5		CO6
	A	The large sample size test: Z-test, F-test, and Chi-square test for goodness of fit.	CO6
	B	One-way and Two-way analysis of variance (ANOVA) techniques.	CO6
	C	Statistical analysis of descriptive statistics, the principle of least square, lines of regression, simple linear regression	CO6
	Mode of examination	Theory	
	Weightage Distribution		
	Text book/s*	1. Gupta, S.C. and Kapoor, V.K., "Fundamental of Mathematical Statistics".	
	Other References	1. Grewal, B.S, "Higher Engineering Mathematics". 2. Goon, A.M., Gupta, A.K. & Das Gupta. Fundamental of Statistics.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO **CO**	**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**
BDA216.1	3	3	2	2		1					1	1	1	1
BDA216.2	2	3	3	2		1					1	1	1	1
BDA216.3	2	2	2	3		1					1	1	1	1
BDA216.4	2	3	2	2		1					1	1	1	1
BDA216.5	3	3	2	2		1					1	1	1	1
BDA216.6	3	3	2	3		1					1	1	1	1
Average	**2.3**	**2.6**	**2.0**	**2.1**		**1.0**					**1.0**	**1.0**	**1.0**	**1.0**

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAP3551**	
2	Course Title	**Machine Learning Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	The objective of this course is to provide practical knowledge of machine learning algorithms. It aims to develop the ability to implement machine learning techniques using real-world datasets and programming tools.	
6	Course Outcomes	CO1: Identify and recall basic concepts of machine learning algorithms and tools. (K1) CO2: Explain the working of machine learning models and interpret their results. (K2) CO3: Apply machine learning algorithms such as regression, classification, and clustering on real-world datasets. (K3) CO4: Analyze data patterns and model performance using appropriate machine learning techniques. (K4) CO5: Evaluate machine learning models using validation techniques and performance metrics. (K5) CO6: Develop and implement machine learning solutions using programming tools and advanced techniques such as ensemble methods. (K6)	
7	Course Description	This course provides hands-on experience in implementing machine learning algorithms using real-world datasets. It focuses on supervised and unsupervised learning techniques and their practical applications.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A, B, C	Write a Program to load and view data set file. Perform exploratory data analysis (EDA) on a dataset using Python	CO1
		Write a program to implement simple linear regression using housing price prediction problem.	CO1
		Write a program to implement binary logistic regression using cancer identification problem.	CO1
	Unit 2		
	A, B, C	Write a program to implement gradient descent method for learning.	CO2
		Implement stochastic gradient descent (SGD) for large datasets.	CO2
		Write a program to implement regularized linear regression.	CO2
	Unit 3		
	A, B, C	Write a program to implement Support Vector Machine regression using suitable dataset. Implement XGBoost and LightGBM for classification and regression tasks.	CO3
		Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	CO3
		Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO3
	Unit 4		

	A, B, C	Write a program to implement K-Means clustering algorithm using an appropriate dataset.	CO4
		Write a program to implement K-Means clustering algorithm using an appropriate dataset	CO4
	Unit 5		
	A, B, C	Write a program to implement data split into training, cross validation and testing data.	CO5
		Implement an Ensemble approach by combining different models to solve time series based prediction problem.	CO6
		Conduct hypothesis testing using some statistical toolkit on appropriate problem.	CO6
	Mode of examination	Practical+Viva	
	Weightage Distribution		
	Text book/s*	1. Bishop, C.: Pattern Recognition and Machine Learning. Berlin: Springer-Verlag. 2. Ethem Alpaydin: Introduction to Machine Learning, 3rd Edition	
	Other References	1. Baldi, P. and Brunak, S. (2002). Bioinformatics: A Machine Learning Approach. Cambridge, MA: MIT Press. 2. https://www.toptal.com/machine-learning/ensemble-methodsmachine-learning.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	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
DAP3551.1	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.2	1	2	3	2	2	1	1	3	1	2	3	2	2	3
DAP3551.3	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.4	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.5	1	2	2	2	2	1	1	3	1	2	3	2	2	3
DAP3551.6	1	2	2	2	2	1	1	3	1	2	3	2	2	3
Average	1.0	2.0	2.0	2.0	2.0	1.0	1.0	3.0	1.0	2.0	3.0	2.0	2.0	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAP3552**	
2	Course Title	**Statistical Simulation Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	CC	
5	Course Objective	The objective of this course is to provide practical knowledge of statistical simulation techniques. It helps students learn how to generate random numbers, apply Monte Carlo methods, and use simulation tools to solve real-world problems.	
6	Course Outcomes	CO1: Identify and recall basic concepts of probability and statistical simulation (K1) CO2: Explain methods for generating random numbers and random variables from standard distributions. (K2) CO3: Apply resampling techniques such as bootstrapping and jackknife using computational tools. (K3) CO4: Analyze simulation methods such as Monte Carlo and Markov Chain Monte Carlo (MCMC) for modeling problems. (K4) CO5: Evaluate simulation results using statistical validation and variance reduction techniques. (K5) CO6: Develop and implement simulation models to study real-world systems using programming tools. (K6)	
7	Course Description	This course provides hands-on experience in statistical simulation using computational tools. It focuses on random number generation, Monte Carlo methods, and applying simulation techniques to analyze real-world problems.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	Lab. Experiment 1	
	A, B, C	Review of R/Python.	CO1
		Problem Based on Random number generation: Inverse-transform; acceptance-rejection; transformations.	CO1
		Problem Based on Statistic simulations: generating random variables, simulating normal, gamma and beta random variables.	CO1
	Unit 2	Lab. Experiment 2	
	A, B, C	Problem Based on Simulating multivariate distributions, MCMC methods.	CO2
		Problem Based on Gibbs sampler, simulating random fields, simulating stochastic process.	CO2
		Problem Based on Variance reduction technique: importance sampling for integration, control variates and antithetic variables.	CO2
	Unit 3	Lab. Experiment 2	
	A, B, C	Problem Based on Bootstrapping; jackknife resampling.	CO3
		Problem Based on Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation.	CO3
		Problem Based on Bootstrapping in regression and sampling from finite populations.	CO3
	Unit 4	Lab. Experiment 2	

	A, B, C	Problem Based on Simulating a non-homogeneous Poisson process.	CO4
		Problem Based on Optimization using Monte Carlo methods simulated annealing for optimization.	CO4
		Problem Based on Solving differential equations by Monte Carlo methods.	CO4
	Unit 5	Lab. Experiment 2	
	A, B, C	Problem Based on Univariate density estimation; kernel smoothing multivariate density estimation	CO5, CO6
		Problem Based on Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization.	CO5, CO6
		Problem Based on EM (Expectation-Maximization) algorithm; simplex algorithm.	CO5, CO6
	Mode of examination	Practical+Viva	
	Weightage Distribution	CA:30%; CE:30%; ESE:40%	
	Text book/s*	1.Fishman, G.S. Monte Carlo: Concepts, Algorithms and Applications. 2.Rubinstein, R.Y.: Simulation and the Monte Carlo Method.	
	Other References	1. Ross, S. M.: Simulation, Third Edition, Academic Press. 2. Efron, B. and Tibshirani. R.J.: An introduction to the Bootstrap.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAP3552.1	3	3	2	3	2	2	2	3	2	2	3
DAP3552.2	3	3	2	3	2	2	2	3	2	2	3
DAP3552.3	3	3	3	3	3	2	2	3	2	2	3
DAP3552.4	3	3	3	3	3	2	2	3	2	2	3
DAP3552.5	3	3	3	3	3	2	2	3	2	2	3
DAP3552.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons.)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: V**	
1	Course Code	**DAR3551**	
2	Course Title	**Research Based Learning-3**	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-0	
	Course Status	Project	
5	Course Objective	This course aims to develop research skills by guiding students through problem identification, data analysis, and model development. It focuses on applying theoretical concepts to real-world problems and enables students to interpret results and generate meaningful insights.	
6	Course Outcomes	**CO1:** Explain the fundamental concepts of research, including problem identification and literature review. **(K2)** **CO2:** Analyze real-world data through case studies to identify patterns and research insights. **(K4)** **CO3:** Apply theoretical concepts and frameworks to formulate and study research problems. **(K3)** **CO4:** Analyze and develop analytical or computational models based on research objectives. **(K4)** **CO5:** Evaluate research findings by interpreting data using appropriate models and techniques. **(K5)** **CO6:** Create a complete research study, including data analysis, interpretation, and recommendations. **(K6)**	
7	Course Description	This course provides hands-on experience in the research process, including problem formulation, data analysis, and model development. Students analyze real-world datasets, apply theoretical frameworks, and present findings with meaningful interpretations and conclusions.	
8			
	Unit 1	**Introduction**	
		Identification of research problem, Formulation of research objectives, Literature review and background study, Research methodology and scope	**CO1**
	Unit 2	**Case study**	
		Selection of real-world case study, Data collection and data sources ,Exploratory data analysis, Identification of patterns and issues	**CO2**
	Unit 3	**Conceptual Framework**	
		Theoretical understanding of the problem, Selection of appropriate models/techniques, Linking objectives with methodology ,Hypothesis formulation (if applicable)	**CO3**
	Unit 4	**Model Development**	
		Development of analytical/computational model, Implementation of selected techniques, Validation of model, Refinement based on objectives	**CO4**
	Unit 5	**Analysis and Finalisation**	
		Data analysis using developed model, Interpretation of results,	**CO5, CO6**

		Drawing conclusions, Recommendations and future scope, Preparation of report and presentation	
	Mode of examination		
	Weightage Distribution	CA, CE=30%, ESE:40%	
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
DAR3551.1	3	3	2	3	2	2	2	3	2	2	3
DAR3551.2	3	3	2	3	2	2	2	3	2	2	3
DAR3551.3	3	3	3	3	3	2	2	3	2	2	3
DAR3551.4	3	3	3	3	3	2	2	3	2	2	3
DAR3551.5	3	3	3	3	3	2	2	3	2	2	3
DAR3551.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

SEMESTER-VI

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	BDA321	
2	Course Title	Non-Parametric Statistical Inference	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	The objective of this course is to introduce students to the basic concepts of non-parametric statistical inference. It aims to develop the ability to apply non-parametric methods and order statistics for analyzing real-world data.	
6	Course Outcomes	CO1: Define basic concepts and types of non-parametric statistical methods. (K1) CO2: Explain different non-parametric tests such as sign test, rank sum test, and Kruskal-Walli's test. (K2) CO3: Apply non-parametric tests and estimators to analyze data. (K3) CO4: Analyze properties and results of non-parametric tests including correlation and randomness tests. (K4) CO5: Evaluate data using non-parametric methods such as Wilcoxon test, median test, and Kolmogorov-Smirnov test. (K5) CO6: Develop and interpret models using order statistics for real-life data analysis. (K6)	
7	Course Description	This course introduces the concepts of non-parametric statistical inference and order statistics. It focuses on applying non-parametric methods to analyze data and solve real-world problems.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Non-Parametric methods, Advantages and Disadvantages,	CO1
	B	Uses and application of non-parametric method,	CO1
	C	Type of non-parametric test,	CO1
	Unit 2		
	A	The sign test for paired data, One sample sign test,	CO2
	B	Ranked sum test, Manwhitney U test,	CO2
	C	Kruskalwali's test or H test,	CO2
	Unit 3		
	A	One sample run test, median test for randomness,	CO3
	B	Runs above and below the median, spearman rank correlation test	CO3, CO4
	C	Testing of hypothesis about rank correlation,	CO4
	Unit 4		
	A	Kolmogrov Smirnov test, Kendall test of Concordance	CO5
	B	Median test for two independent samples,	CO5

	C	Wilcoxon Signed rank test, The Matched pairs sign, test		CO5
	Unit 5			
	A	Introduction and application of order statistics, Distribution of Single Order Statistics,		CO6
	B	Joint distribution of two or more order statistics, Distribution of difference of two distinct order statistics.		CO6
	C	Distribution of Range, Distribution of Quartile and Distribution of median.		CO6
	Mode of examination	Theory		
	Weightage Distribution	CA, MTE	ETE	
	Text book/s*	1. Gibbons, J.D. & Chakraborti, S. (2010). Nonparametric Statistical Inference, 5th Edition. CRC Press. 2. Hollander, M., Wolfe, D. & Chicken, E. (2013). Nonparametric Statistical Methods, 3rd Edition. Wiley.		
	Other References	1. Bonnini, S., Corain, L., Marozzi, M. & Salmaso, L. (2014). Nonparametric Hypothesis Testing Rank and Permutation Methods with Applications in R. Wiley. 2. Sprent, P. & Smeeton, N.C. (2013). Applied Nonparametric Statistical Methods, 4th Edition. CRC Press.		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
BDA321.1	3	3	2	2	2	3	2	2	1	1
BDA321.2	2	3	3	3	3	2	1	2	2	2
BDA321.3	2	3	2	1	2	2	2	1	2	2
BDA321.4	2	2	2	3	2	2	1	2	2	2
BDA321.5	3	2	2	3	2	2	2	2	2	1
BDA321.6	3	3	2	2	3	3	2	2	2	2

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA218**	
2	Course Title	**Data Ware Housing & Data Mining**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Minor	
5	Course Objective	The objective of this course is to introduce students to the concepts of data warehousing and data mining. It aims to develop the ability to analyze data, apply data mining techniques, and understand business intelligence tools for decision making.	
6	Course Outcomes	CO1: Define the basic concepts and components of data warehousing and metadata. (K1) CO2: Explain business analysis methods, reporting tools, and OLAP concepts. (K2) CO3: Apply OLAP operations and data warehouse techniques for data analysis.. (K3) CO4: Analyze data mining functionalities, data preprocessing methods, and pattern discovery techniques. (K4) CO5: Evaluate classification techniques such as decision trees, Bayesian methods, and support vector machines. (K5) CO6: Develop clustering models and analyze trends in data mining for real-world applications. (K6)	
7	Course Description	This course introduces the concepts of data warehousing and data mining. It focuses on data analysis, OLAP operations, classification, clustering, and the use of data mining techniques for decision making.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Data Warehousing**	
	A	Data warehousing Components –Building a Data warehouse.	CO1
	B	Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support	CO1
	C	Data Extraction, Cleanup, and Transformation Tools - Metadata.	CO1
	Unit 2	**Business Analysis**	CO2, CO3
	A	Reporting and Query tools and Applications, Cognos Impromptu, Online Analytical Processing (OLAP).	CO3
	B	Multidimensional Data Model, OLAP Guideline Multidimensional versus Multirotational OLAP,	CO3
	C	Categories of Tools, OLAP Tools, and the Internet.	
	Unit 3	**Data Mining**	CO4
	A	Introduction, Data, Types of Data, Data Mining Functionalities,	CO4
	B	Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives,	CO4
	C	Integration of a Data Mining System with Data Warehouse Issues, Data Preprocessing	
	Unit 4	**Association Rule Mining and Classification**	CO5
	A	Mining Frequent Patterns, Associations and Correlations, Mining	CO5

		Methods, Mining various Kinds of Association Rules, Correlation Analysis,	
	B	Constraint-Based Association Mining Classification and Prediction, Basic Concepts, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation,	CO5
	C	Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, and Prediction.	
	Unit 5	**Clustering and Trends in Data Mining**	CO6
	A	Cluster Analysis, Types of Data, Categorization of Major Clustering Methods, K-means, Partitioning Methods, Hierarchical Methods,	CO6
	B	Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High Dimensional Data, Constraint, Based Cluster Analysis, and Outlier Analysis.	CO6
	C	Data Mining Applications. Apply data mining techniques and methods to large data sets, use data mining tools, and Compare and contrast the various classifiers.	
	Mode of examination	Theory	
	Weightage Distribution		
	Text book/s*	1. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw Hill 2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier.	
	Other References	1. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining", Person Education. 2. K.P. Soman, Shyam Diwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA218.1	3	2	2	3	3	2	2	3	1	1	3
BDA218.2	3	2	2	3	3	2	2	3	1	1	3
BDA218.3	3	3	3	3	3	2	2	3	2	2	3
BDA218.4	3	3	3	3	3	2	2	3	2	2	3
BDA218.5	3	3	3	3	3	2	2	3	2	2	3
BDA218.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**BDA325**	
2	Course Title	**Deep Learning**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	DSE	
5	Course Objective	The objective of this course is to introduce students to deep learning concepts and techniques. It aims to develop the ability to design, train, and apply deep learning models for solving real-world problems.	
6	Course Outcomes	CO1: Define the basic concepts of deep learning and neural networks. (K1) CO2: Explain optimization techniques, autoencoders, and dimensionality reduction methods. (K2) CO3: Apply deep learning techniques for training models and solving learning problems. (K3) CO4: Analyze deep learning architectures such as CNNs, RNNs, and attention models. (K4) CO5: Evaluate deep learning models using appropriate techniques, tools, and performance measures. (K5) CO6: Design and implement deep learning solutions for engineering and real-world applications. (K6)	
7	Course Description	This course introduces deep learning techniques and neural network models. It focuses on training, optimization, and application of deep learning methods such as CNNs, RNNs, and advanced architectures.	
8			
	Unit 1		
	A	History of Deep Learning, McCulloch Pitts Neuron.	CO1
	B	Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.	CO1
	C	Feed Forward Neural Networks, Back propagation.	CO1
	Unit 2		
	A	Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD.	CO2
	B	Principal Component Analysis and its interpretations, Singular Value Decomposition.	CO2
	C	Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders.	CO2
	Unit 3		
	A	Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Data set augmentation.	CO3
	B	Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.	CO3
	C	Learning Vectorial Representations Of Words.	CO3
	Unit 4		
	A	Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.	CO4
	B	Recurrent Neural Networks, Back propagation through time (BPTT),	CO4

		Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs.	
	C	Encoder Decoder Models, Attention Mechanism, Attention over images.	CO4
	Unit 5		
	A	Advanced Deep architectures: Recurrent Neural networks (RNNs), Generative Adversarial Networks (GANs).	CO5, CO6
	B	In-depth discussion of DL examples.	CO5, CO6
	C	Advanced topics, Recent papers, Influential papers: Visual Question Answering, Visual Dialog, Novel deep methods (Deep internal learning, Deep image prior).	CO5, CO6
	Mode of examination	Practical Based	
	Weightage Distribution		
	Text book/s*	1. Mahmoud Hassaballah, Ali Ismail Awad: Deep Learning in Computer Vision, Principles and Applications. 2. Dr.P.S. Jagadeesh Kumar, Prof. Thomas Binford, Dr. J. Ruby, J. Lepika. Modern Deep Learning and Advanced Computer Vision, A Perspective Approach.	
	Other References	1. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning Adaptive Computation and Machine Learning series", MIT Press. 2. Li Deng and Dong Yu "Deep Learning Methods and Applications", Foundations and Trends in Signal Processing.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA325.1	3	2	2	3	3	2	2	3	1	1	3
BDA325.2	3	2	2	3	3	2	2	3	1	1	3
BDA325.3	3	3	3	3	3	2	2	3	2	2	3
BDA325.4	3	3	3	3	3	2	2	3	2	2	3
BDA325.5	3	3	3	3	3	2	2	3	2	2	3
BDA325.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	2.7	2.7	3.0	3.0	2.0	2.0	3.0	1.7	1.7	3.0

School: SSES		**Batch: 2023-27**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2024-25**	
Branch: Data Science & Analytics		**Semester: IV**	
1	Course Code	**BDA270**	
2	Course Title	**Data Ware Housing & Data Mining Lab**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	CC	
5	Course Objective	The objective of this course is to provide practical knowledge of data warehousing and data mining techniques. It helps students learn how to use tools such as WEKA and R to analyze data and solve real-world problems.	
6	Course Outcomes	CO1: Identify basic concepts and tools of data warehousing and data mining. (K1) CO2: Explain data preprocessing techniques and dataset handling methods. (K2) CO3: Apply data mining techniques such as association rule mining on datasets. (K3) CO4: Analyze classification and regression models using algorithms such as decision trees and Naïve Bayes. (K4) CO5: Evaluate clustering techniques and model performance using different parameters. (K5) CO6: Develop data mining solutions using real-world datasets and tools. (K6)	
7	Course Description	This course provides hands-on experience in data warehousing and data mining using tools such as WEKA. It focuses on data preprocessing, classification, clustering, and association rule mining for real-world applications.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1	**Lab. Experiment 1**	
	A, B, C	Installation of WEKA Tool Creating new Arff File	CO1
	Unit 2	**Lab. Experiment 2**	
	A, B, C	Pre-Processes Techniques on Data Set Pre-process a given dataset based on Handling Missing Values	CO2
	Unit 3	**Lab. Experiment 3**	
	A, B, C	Generate Association Rules using the Apriori Algorithm Generating association rules using fp growth algorithm	CO3
	Unit 4	**Lab. Experiment 4**	
	A, B, C	Build a Decision Tree by using J48 algorithm Naïve bayes classification on a given data set	CO4
	Unit 5	**Lab. Experiment 5**	
	A, B, C	Applying k-means clustering on a given data set. Calculating Information gains measurs OLAP Cube and its different operations	CO5, CO6
	Mode of examination	Practical+Viva	
	Weightage Distribution		

	Text book/s*	1. Jiawei Han and M Kamber , Data Mining Concepts and Techniques, , Second Edition, Elsevier Publication.	
	Other References	1. Arun K. Pujari, Data Mining Techniques, University Press. 2. Vipin Kumar, Introduction to Data Mining Pang Ning Tan, Michael Steinbach, Addison Wesley.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BDA270.1	3	3	2	3	2	2	2	3	2	2	3
BDA270.2	3	3	2	3	2	2	2	3	2	2	3
BDA270.3	3	3	3	3	3	2	2	3	2	2	3
BDA270.4	3	3	3	3	3	2	2	3	2	2	3
BDA270.5	3	3	3	3	3	2	2	3	2	2	3
BDA270.6	3	3	3	3	3	2	2	3	2	2	3
Average	3.0	3.0	2.7	3.0	2.7	2.0	2.0	3.0	2.0	2.0	3.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons./Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**AI3409**	
2	Course Title	Advanced Machine Learning Techniques	
3	Credits	4	
4	Contact Hours (L-T-P)	0-0-8	
	Course Status	Minor	
5	Course Objective	To provide students with a strong understanding of advanced machine learning and its applications in data science through hands-on practice. This course covers reinforcement learning, neural networks, and deep learning models while incorporating essential mathematical concepts such as probability, linear algebra, and optimization. Students will explore techniques like feature engineering, model evaluation, and hyperparameter tuning to enhance machine learning model performance and apply them to real-world data science challenges.	
6	Course Outcomes	CO1: Understand and apply reinforcement learning techniques for data-driven decision-making problems (K2, K3). CO2: Apply reinforcement learning techniques such as Q-learning to solve decision-making problems in simulated environments (K3). CO3: Develop deep learning models using Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) (K6). CO4: Apply feature engineering techniques such as feature selection, feature scaling, and dimensionality reduction (PCA) to improve model performance on structured datasets. (K3) CO5: Evaluate machine learning models using appropriate metrics and techniques (K5). CO6: Analyze model interpretability using explainable AI techniques and examine ethical issues such as bias, fairness, and transparency in AI systems (K4).	
7	Course Description	This course explores reinforcement learning, neural networks, deep learning, and large language models (LLMs). It covers AI architectures, optimization techniques, real-world applications, ethical concerns, and future AI trends.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction to Reinforcement Learning	
	A	Basics of reinforcement learning (RL) – Agents, actions, rewards, environments.	CO1
	B	Q-learning and policy-based RL methods – Concept, advantages, and applications.	CO2
	C	Implement Q-learning in a simple environment (e.g., GridWorld), and train an agent using Deep Q-Networks (DQN) in OpenAI Gym.	CO2

	Unit 2	Neural Networks & Training	
	A	Structure of neural networks – Neurons, layers, weights, and activation functions.	CO3
	B	Backpropagation and optimization techniques (Gradient Descent, Adam).	CO3
	C	Implement a simple feedforward neural network in PyTorch, experiment with activation functions, and train/test on small datasets.	CO3
	Unit 3	Deep Learning Applications	
	A	Introduction to deep learning architectures – CNNs, RNNs, LSTMs, and their key differences from traditional ML.	CO4
	B	Applications of deep learning in real-world problems like image recognition, speech processing, and healthcare.	CO4
	C	Implement CNNs for image classification (e.g., MNIST, CIFAR-10) and train RNNs/LSTMs for text generation tasks.	CO4
	Unit 4	Feature Engineering & Model Evaluation	
	A	Basics of Feature Engineering – Importance of feature selection, feature scaling, and feature transformation (PCA).	CO5
	B	Model Evaluation Techniques – Accuracy, Precision, Recall, F1-score, and ROC curves.	CO5
	C	Implement feature engineering techniques and compare model performance using different evaluation metrics on a real-world dataset	CO5
	Unit 5	AI Ethics & Future Trends	
	A	Challenges in AI ethics – Bias, fairness, and transparency in machine learning models.	CO5
	B	AI interpretability – SHAP, LIME, and explainability techniques.	CO5
	C	Explore model interpretability using SHAP/LIME and evaluate AI safety concerns in real-world applications.	CO6
	Mode of examination	Practical	
	Weightage Distribution		
	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
AI3409.1	2	1	2	2	1	3	1	3	1	1	2
AI3409.2	2	1	2	2	1	3	1	3	1	2	2
AI3409.3	2	1	2	2	1	3	1	3	1	1	2
AI3409.4	2	1	2	2	1	3	1	3	1	2	2
AI3409.5	2	1	2	2	1	3	1	3	1	1	2
AI3409.6	2	1	2	2	1	3	1	3	1	2	2
Average	2	1	2.0	2.0	1	3.0	1.0	3.0	1.0	1.5	2.0

School: SSES		**Batch: 2025-2029**	
Program: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	ARP306	
2	Course Title	Campus to Corporate	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
	Course Status	**AEC**	
5	Course Objective	To enhance holistic development of students and improve their employability skills. Provide a 360-degree exposure to learning elements of Business English readiness program, behavioural traits, achieve softer communication levels and a positive self-branding along with augmenting numerical and altitudinal abilities. To up skill and upgrade students across varied industry needs to enhance employability skills. By the end of this semester, a will have entered the threshold of his/her 4th phase of employability enhancement and skill building activity exercise.	
6	Course Outcomes	After completion of this course, students will be able to: CO1: Develop a creative resume, cover letters, interpret job descriptions and interpret KRA and KPI statements and art of conflict management. (K1) CO2: Build negotiation skills to get maximum benefits from deals in practical life scenarios.(K2) CO3: Develop skills of personal branding to create a brand image and self-branding. (K3) CO4: Acquire higher level competency in use of logical and analytical reasoning such as direction sense, strong and weak arguments. (K4) CO5: Develop higher level strategic thinking and diverse mathematical concepts through building analogies, odd one out (K5) CO6: Demonstrate higher level quantitative aptitude such as average, ratio & proportions, mixtures & allegation for making business decisions. (K6)	
7	Course Description	This penultimate stage introduces the student to the basics of Human Resources. Allows the student to understand and interpret KRA | KPI and understand Job descriptions. A student also understands how to manage conflicts, brand himself/herself, understand relations and empathise others with level-4 of quant, aptitude and logical reasoning	
8	Outline syllabus – ARP 306		
	Unit 1	Ace the Interview	CO MAPPING
	A	HR Sensitization (Role Clarity | KRA | KPI | Understanding JD) | Conflict Management	CO1

	B	Negotiation Skills | Personal Branding	CO3, CO4
	C	Uploading & Curating Resumes in Job Portals, getting Your Resumes Noticed | Writing Cover Letters | Relationship Management	CO1, CO3
	Unit 2	Introduction to APTITUDE TRAINING- Reasoning- Logical/ Analytical	
	A	Sitting Arrangement & Venn Diagrams | Puzzles | Distribution | Selection	CO4
	B	Direction Sense | Statement & Conclusion | Strong & Weak Arguments	CO4
	C	Analogies, Odd One out | Cause & Effect	CO5
	Unit 3	Quantitative Aptitude	
	A	Average , Ratio & Proportions, Mixtures & Allegation	CO6
	B	Geometry-Lines, Angles & Triangles	CO6
	C	Problem of Ages | Data Sufficiency - L2	CO6
	Unit 4	Verbal Abilities-4	
	A	Antonyms and Synonyms	CO1
	B	Idioms and Phrases	CO2
	Unit 5	Problem Solving and Case Studies	
	A	Real time Case Study Solving Exercises	CO4
	B	Intra student Mock Situation Handling Exercises	CO4
	Evaluation Weightage	(CA)Class Assignment/Free Speech Exercises / JAM – 30% | CE:30% (ESE) Group Presentations/Mock Interviews(MIP's)/GD/ Reasoning, Quant & Aptitude– 40%	
	Text book/s*	Wiley's Quantitative Aptitude-P Anand | Quantum CAT – Arihant Publications | Quicker Maths- M. Tyra | Power of Positive Action (English, Paperback, Napoleon Hill) | Streets of Attitude (English, Paperback, Cary Fagan, Elizabeth Wilson) The 6 Pillars of self-esteem and awareness – Nathaniel Brandon | Goal Setting (English, Paperback, Wilson Dobson	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
ARP306.1			2	2		3	1	3	1		2
ARP306.2			3	2		3	1	3	1		2
ARP306.3			2	2		3	1	3	1		2
ARP306.4			2	2		3	1	3	1		2
ARP306.5			2	2		3	1	3	1		2
ARP306.6			2	2		3	1	3	1		2
Average			2.0	2.0		3.0	1.0	3.0	1.0		2.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	**INC001**	
2	Course Title	**Industry Connect**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Project	
5	Course Objective	The objective of this course is to provide students with industry exposure and practical experience. It helps students apply theoretical knowledge to real-world problems and develop professional skills such as teamwork, communication, and career planning.	
6	Course Outcomes	CO1: Identify basic industry practices, principles, and professional environments. (K1) CO2: Explain and understand real-world problems in an industry context. (K2) CO3: Apply theoretical knowledge and technical skills to solve industry-based problems. (K3) CO4: Analyze project requirements and develop solutions through teamwork. (K4) CO5: Evaluate project outcomes and demonstrate effective communication skills.(K5) CO6: Develop professional competencies and define career goals through industry experience. (K6)	
7	Course Description	The Internship aims to offer students the opportunity to apply their prior acquired knowledge in problem-solving. Students will acquire skills important for time management, discipline, self-learning, effective communication, and so on.	
8			
	Unit 1		
	A, B, C	Define objectives and conditions for the internship, ensuring students that it is related to the study path carried out at the University	CO1
	Unit 2		
	A, B, C	Problem Definition and identification, Team/Group formation, and Project Assignment. Finalizing the problem statement, and resource requirement, if any.	CO2
	Unit 3		
	A, B, C	The internship work plan is drawn up by developing teamwork and applying prior acquired knowledge in problem-solving.	CO3
	Unit 4		
	A, B, C	Demonstrate and execute Project with the team. Submission of the evaluation form and final report completed by the intern.	CO4
	Unit 5		
	A, B, C	Final evaluation form completed by the supervisor at the Host Organization and final presentation before the departmental committee.	CO5,CO6
	Mode of examination		
	Weightage Distribution		

	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
INC001.1		2	1	2	2	1	2	3	2	2	2
INC001.2		2	1	2	2	1	2	3	2	2	2
INC001.3		2	1	2	2	1	2	3	2	2	2
INC001.4		2	1	2	2	1	2	3	2	2	2
INC001.5		2	1	2	2	1	2	3	2	2	2
INC001.6		2	1	2	2	1	2	3	2	2	2
Average		2.0	1.0	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2027-28**	
Branch: Data Science & Analytics		**Semester: VI**	
1	Course Code	DAR3652	
2	Course Title	Research Based Learning-4	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Project (Audit-Qualifying)	
5	Course Objective	The objective of this course is to develop research skills in a specific area of data science. It helps students enhance their ability to conduct research, manage projects, and communicate findings effectively through reports and presentations.	
6	Course Outcomes	CO1: Define basic concepts and methods of research in data science. (K1) CO2: Explain research problems, literature review, and data collection methods. (K2) CO3: Apply research methodologies to analyze problems and collect relevant data. (K3) CO4: Analyze research problems and interpret findings systematically. (K4) CO5: Evaluate research outcomes and summarize results effectively. (K5) CO6: Develop research reports and present findings using appropriate tools and techniques. (K6)	
7	Course Description	This course focuses on developing research skills in data science. It involves problem identification, analysis, and presentation of research findings through reports and presentations.	
8			
	Unit 1	Overall Project Implementation	CO1
		Implementation of the model in the research work	
	Unit 2	Validity of Result, Assumption and System Model	CO1,CO2
		Validation of the model with assumptions and its results	
	Unit 3	Results and Expected Outcomes	CO3,CO4
		Outcomes of the results	
	Unit 4	Conclusion and Future Suggestions	CO4, CO5
		Conclusion of the results, future scope and recommendations	
	Unit 5	Report Writing and Submission	CO5, CO6
		Comprehensive research report writing and submission to the journal/book chapter/conference paper for publication	
	Mode of examination		
	Weightage Distribution	CA 30, CE:30%, ESE:40%	

	Text book/s*		
	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
DAR3652.1	3	2	2	2	2	2	2	3	2	2	3
DAR3652.2	3	3	2	3	2	2	2	3	2	2	3
DAR3652.3	3	2	2	3	2	2	2	3	2	2	3
DAR3652.4	3	3	2	3	2	2	2	3	2	2	3
DAR3652.5	3	2	2	3	2	2	2	3	2	2	3
DAR3652.6	3	2	3	3	2	2	2	3	2	2	3
Average	3	2.3	2.2	2.8	2	2	2	3.0	2	2	3

SEMESTER-VII

School: SSES	**Batch: 2026-28**
Program: M.Sc.	**Academic Year: 2026-27**
Branch: Data Science & Analytics	**Semester: I**
Course Code	MDA101
Course Title	Foundations of Data Science
Credits	4
Contact Hours (L-T-P)	4-0-0
Course Status	Compulsory
Course Objective	The course is aimed at building the fundamentals of data science. Imparting design thinking capability to build big data and developing design skills of models for big data problems. Gaining practical experience in programming tools for data sciences and also empowering students with tools and techniques used in data science.
Course Outcomes	CO1: Understand data science and its applications. (K2) CO2: Analyze the Exploratory Data Analysis using basic concepts of data science. (K4) CO3: Apply data science techniques to analyze data preprocessing and feature selection techniques. (K3, K4) CO4: Understand the concept of Python software. (K2) CO5: Evaluate and create basic Machine Learning Algorithms. (K5, K6) CO6: Evaluate the statistical measures using Python in a real-time environment.(K5)
Course Description	This course introduces the fundamental concepts of Data Science, including the data science lifecycle, exploratory data analysis (EDA), and data preprocessing techniques. It provides hands-on experience with Python for data manipulation and analysis. The course also covers basic data mining and machine learning concepts, enabling students to develop simple models and gain insights from data for real-world problem solving.

Outline syllabus		CO Mapping
Unit 1	Introduction	
A	Introduction-What is Data Science?	CO1
B	The steps in Doing Data Science-Skills needed to do Data Science storing data-combining bits into larger structures	CO1
C	The steps in Doing Data Science-Skills needed to identify Data Problems.	CO1
Unit 2	EDA	
A	Big Data and Data Science - Big Data Analytics, Business intelligence vs big data, big data frameworks,	CO2
B	Exploratory Data Analysis (EDA), statistical measures,	CO2
C	Basic tools (plots, graphs, and summary statistics) of EDA, Data Analytics Lifecycle, Discovery	CO2
Unit 3	Data Pre-processing and Feature Selection	
A	Data cleaning - Data integration - Data Reduction - Data Transformation and Data Discretization.	CO3
B	Feature Generation and Feature Selection, Feature Selection algorithms: Filters- Wrappers - Decision Trees - Random Forests	CO3
C	Descriptive statistics-Using Histograms to understand a distribution-Normal Distribution.	CO3, CO6
Unit 4	Basics of Python for Data Science	

A	Introduction to Python: Installation, syntax, data structures (lists, tuples, dictionaries).			CO4
B	Data manipulation using Pandas: Data Frames, handling missing values, basic operations.			CO4
C	Importing and working with data sources: CSV, Excel, Databases.			CO4, CO6
Unit 5	Basic Data Mining			
A	Data Mining Overview-Association Rule Mining.			CO5
B	Text Mining-Supervised and Unsupervised Learning.			CO5
C	Supervised Learning via Support Vector Machines- Support			CO5, CO6
Mode of examination	Theory			
Weightage Distribution	CA	MTE	ETE	
Text book/s*	1. Jeffrey S. Saltz, Jeffre M. Stanton, "AnIntroduction to Data Science", Sage Publications.			
Other References	1. Bernard Kolman, Robert C. Busby and SharonRoss (2004). Discrete Mathematical Structures, New Delhi: Prentice Hall 2. V. Bhuvaneswari, T. Devi, (2016). Big Data Analytics: A Practitioner's Approach, Bharathiar University			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA101.1	3	2	3	3	2	3	3	2	2
MDA101.2	3	2	3	3	2	3	2	2	2
MDA101.3	2	3	2	3	2	2	2	3	3
MDA101.4	2	3	3	3	2	2	3	3	3
MDA101.5	3	3	3	3	2	3	2	3	3
MDA101.6	3	3	3	3	2	3	2	3	3
Average	2.7	2.6	2.8	3.0	2.0	2.6	2.3	2.6	2.6

School: SSBSR		**Batch: 2026-28**	
Program: M.Sc.		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	MDA102	
2	Course Title	Mathematics for Machine Learning	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To enable the students to understand the concept of mathematics in machine learning.	
6	Course Outcomes	CO1: Explain the fundamental concepts of vectors, vector operations, dot product, cosine similarity, and systems of linear equations, and solve them using the Gauss Elimination method. (K2, K3) CO2: Analyze the properties of vector spaces, linear combinations, basis, norms, and orthogonal and orthonormal vectors. (K4) CO3: Apply appropriate techniques to determine the determinant, inverse, rank, nullity, and trace of matrices. Evaluate eigenvalues and eigenvectors and interpret their role in linear transformations and matrix decompositions. (K3,K5) CO4: Apply rules of differentiation and Principle Component Analysis. (K5) CO5: Apply rules of partial differentiation to analyze multivariable functions and their applications in data science problems. (K3, K4) CO6: Formulate and solve optimization problems using gradient vectors, Lagrange multipliers, and convex optimization techniques. (K6)	
7	Course Description	This course introduces the mathematical foundations required for data science applications. It covers vectors, vector spaces, and systems of linear equations, followed by matrix algebra, eigenvalues, and eigenvectors used in data analysis. The course also includes differentiation and partial differentiation of multivariable functions. Concepts of gradients and optimization techniques such as Lagrange multipliers are discussed. These topics provide the analytical basis for solving real-world data science and machine learning problems.	
8			CO Mapping
	Unit 1	Vector	
	A	Vectors, Scalars, Addition, Scalar multiplication.	CO1
	B	Dot product, vector projection, cosine similarity. Linear Independence,	CO1
	C	Linear Algebra-System of Linear equations, SolvingSystem of Linear equations.	CO1
	Unit 2	Basic Concept of Linear Algebra	
	A	Orthogonal vectors, normal and Orthonormal vectors.	CO2
	B	Vector norm, vector space, linear combination.	CO2
	C	Basis of vectors, Affine spaces.	CO2
	Unit 3	Matrices and Determinants	
	A	Matrices – Determinant, Identity matrix, Inverse of amatrix.	CO3
	B	The rank of a matrix, Nullity, trace of a matrix.	CO3
	C	Eigen values, Eigen vectors, Matrix decompositions.	CO3

	Unit 4	Derivatives			
	A	Differentiation, rules of differentiation, Derivatives, Scalar derivatives.			CO4
	B	Partial derivatives, Principle Component analysis – Concepts and properties.			CO4
	C	Dimensionality reduction with PCA			CO4
	Unit 5	Derivatives of Function			
	A	Differentiation of univariate functions, Partial differentiation, and gradients.			CO5
	B	Gradient of a vector-valued function. Gradient of matrices.			CO5
	C	Optimization using gradient functions, Constrained optimization, and Lagrange multipliers. Convex optimization.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020.			
	Other References	1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, (2014). 2. B. S.Grewal, Higher Engineering Mathematics, 38th Edition. Khanna Publications, (2005).			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA102.1	3	2	2	2	2	2	2	2	2
MDA102.2	3	2	3	2	1	2	2	2	2
MDA102.3	3	2	2	3	2	2	2	2	3
MDA102.4	3	2	3	3	1	2	2	2	3
MDA102.5	3	2	2	2	3	1	2	2	2
MDA102.6	3	2	3	3	3	2	2	2	3
Average	3.0	2.0	2.5	2.5	2.0	1.8	2.0	2.0	2.5

School: SSES		**Batch: 2026-28**	
Program: M.Sc.		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	STT4701	
2	Course Title	Distribution theory	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course develops a comprehensive understanding of probability distributions and their properties, and enables students to apply them in statistical modeling, inference, and real-world data analysis.	
6	Course Outcomes	CO1: Understand various univariate discrete probability distributions, and apply them to practical problems. (K2, K3) Demonstrate the univariate continuous probability distributions and apply their properties in statistical modeling. (K2, K3) CO3: Examine bivariate distributions and sampling distributions (Chi-square, t, F) and inspect their role in statistical inference. (K4) CO4: Compare the non-central and compound probability distributions and evaluate the effects of truncation in statistical models. (K4, K5) CO5: Interpret the order statistics, their distributions, recurrence relations, and associated statistical properties. (K5) CO6: Formulate and develop interrelationships among sampling distributions, truncation effects, and mixture distributions including finite mixtures and zero-modified distributions. (K6)	
7	Course Description	This course introduces probability distributions and their applications in statistical modeling and inference. It covers univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, focusing on analysis and practical application.	
8			CO Mapping
	Unit 1	Univariate Discrete Distributions	
	A	Discrete Uniform distribution, binomial, multinomial, Poisson distribution	CO1
	B	Negative binomial, geometric distribution	CO1
	C	Hyper geometric distribution, power series Distribution	CO1
	Unit 2	Univariate Continuous Distributions	
	A	Exponential, Gamma distribution and Lindley distribution	CO2
	B	Beta (1st kind and 2nd kind), Weibull, Cauchy distribution	CO2
	C	Normal and Log-normal distribution, Pareto and Rayleigh distribution	CO2
	Unit 3	Bivariate Distributions and Sampling Distributions	
	A	Derivation, properties, and applications of bivariate normal distribution	CO3
	B	Derivation, properties and applications of Chi-square, t and F-distributions and	CO3
	C	Interrelationship between sampling distribution.	CO3

	Unit 4	Non-central Distributions, Compound Distributions and Truncation			
	A	Non-central chi-square, t and F distributions			CO4
	B	Compound distribution- Neyman's Type A distribution, Polya-Eggenberger distribution, Inverse Polya-Eggenberger distribution			CO4
	C	Truncation of basic discrete and continuous distributions with their properties.			CO4, CO5
	Unit 5	Order Statistics and Mixture Distribution			
	A	Distributions of r-th order statistics, joint density of two order statistics, some special joint distributions resulting from order statistics			CO5
	B	Distribution of range and other systematic statistics, moments of order statistics, recurrence relations and identities for moments of order statistics from an arbitrary distribution			CO5, CO6
	C	Mixture distribution- finite mixture, zero-modified distributions, mixture of binomial distribution.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	1. Sheldon Ross; A First Course in Probability, Pearson, 2014. 2. Parimal Mukhopadhyay; An Introduction to the Theory of Probability, World scientific, 2012. 3. Irwin Miller, Marylee's Miller, John E. Freund's;Mathematical Statistics, Pearson, 2017			
	Other References	1. FetsjeBijma, Marianne Jonker and Aad van der Vaart; Introduction to Mathematical Statistics, Amsterdam University Press, 2018. 2. Krishnamoorthy, K., Handbook of Statistical Distributions with Applications, Chapman & Hall/CRC, 2006. 3. Rohatgi, V.K. and Ebsanes Saleh, A.K. Md., An introduction to Probability and Statistics, 2nd Ed.,John Wiley & Sons, 2002. 4. Shanmugam, R., Chattamvelli, R. Statistics forscientists and engineers, John Wiley, 2015.			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4701.1	3	2	2	3	2	3	3	2	1
STT4701.2	3	2	2	3	2	3	2	1	1
STT4701.3	3	2	2	3	2	2	2	1	1
STT4701.4	3	2	2	3	2	2	3	1	1
STT4701.5	3	2	2	3	2	3	2	2	1
STT4701.6	3	2	2	3	2	2	2	1	1
Average	3.0	2.0	2.0	3.0	2.0	2.5	2.3	1.3	1.0

School: SSES		**Batch: 2026-28**
Programme: Master of Science		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	STT4704
2	Course Title	Probability & Statistical Methods
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course status	Compulsory
5	Course Objectives	This course develops a strong foundation in descriptive statistics, probability theory, and statistical inference. It introduces probability spaces, random variables, probability distributions, generating functions, and hypothesis testing. The course also covers probability inequalities, laws of large numbers, and central limit theorems, equipping students with essential tools for statistical analysis and modeling.
6	Course Outcomes	CO1: Recall and explain descriptive statistics, measures of central tendency and dispersion, and basic set theory concepts used in probability. (K1, K2) CO2: Interpret, and summarize probability spaces, conditional probability, independence of events, and Bayes' theorem. (K2) CO3: Apply and utilize concepts of random variables, probability functions, mathematical expectation, and probability inequalities in solving statistical problems. (K3) CO4: Analyze and distinguish properties of bivariate random variables and derive marginal and conditional distributions. (K4) CO5: Evaluate and justify the use of generating functions and hypothesis testing procedures including Type I and Type II errors, level of significance, and power of tests. (K5) CO6: Formulate and develop statistical models using the laws of large numbers, probability inequalities, and central limit theorems for statistical inference and decision making. (K6)
7	Course Description	This course covers descriptive statistics, probability theory, random variables, probability distributions, generating functions, and hypothesis testing. It also explores laws of large numbers, probability inequalities, and central limit theorems for statistical analysis and decision-making.
8	Outline syllabus:	

UNIT1	Descriptive Statistics and Probability	CO Mapping
A	Representation of data (measures of central tendency).	CO1
B	Dispersion & other characteristics of data (mean deviation, variance, quartiles, Skewness and Kurtosis, Moments).	CO1
C	Classes of Sets, Fields, sigma-fields, minimal sigma-field, Borel field	CO1
UNIT 2	Probability: Basic Concepts and Conditional Probability	

A	Probability space, Basic terminologies and theorems on probability, theorem of total probability, theorems on compound probability	CO2
B	Independence of events, conditional probability	CO2
C	Bayes' Theorem and its applications	CO2
UNIT 3	Random Variables and Probability Functions	
A	Random Variable and its properties, mathematical expectation and inequalities involving random variables viz. Markov's, Holder's, Minkowski's, and Jenson's Inequalities	CO3
B	PDF, PMF, Distribution function	CO3
C	Bivariate random variables, Marginal and conditional distributions	CO4
UNIT 4	Generating Functions and Hypothesis	
A	Generating functions, probability generating function, moment generating function characteristic functions,	CO4
B	factorial moment generating functions, Uniqueness theorem.	CO5
C	Hypothesis testing, Type I and II error, Level of Significance, power of test, large and small sample test.	CO5
UNIT 5	The Laws of Large Numbers, Inequalities and Central limit Theorem	
A	Law of large numbers, Chebyshev's and Khinchin's weak law of large numbers, Kolmogorov's theorem, Strong law of large numbers.	CO6
B	Central limit theorem, De-Moivre's Laplace central limit theorem.	CO6
C	Statement of Lindeberg- Feller's central limit theorem.	CO6

	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics". Sultan Chand & sons.		
	Other references	1.Ash, Robert B. (2000). Probability and Measure Theory, Second Edition, Academic Press, New York. 2. Feller, W. (1985). Introduction to Probability Theory and its Applications, Wiley Eastern, New Delhi 3. Bhatt, B.R. (1999). Modern Probability Theory, 3rd Edition, New Age International Publishers.		

COURSE OUTCOMES PROGRAMMEME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4704.1	3	3	3	3	3	3	3	2	1
STT4704.2	3	2	3	3	2	3	2	1	2
STT4704.3	2	2	2	2	2	2	2	2	1
STT4704.4	2	2	1	2	2	2	3	1	1
STT4704.5	3	2	2	3	2	3	2	2	2
STT4704.6	3	2	1	3	2	2	2	1	2
Average	2.7	2.2	2.0	2.7	2.2	2.5	2.3	1.5	1.5

School: SSES		**Batch: 2025-29**	
Program: B.Sc. (Hons. /Hons. With research)		**Academic Year: 2028**	
Branch: Data Science & Analytics		**Semester: VII**	
1	Course Code	MDA203	
2	Course Title	Soft Computing Techniques	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course aims to introduce the fundamental concepts of soft computing techniques, including neural networks, fuzzy logic, and genetic algorithms. It focuses on developing the ability to analyze, design, and apply intelligent systems for solving complex real-world problems in data analysis and decision-making.	
6	Course Outcomes	CO1: Define the fundamental concepts of soft computing and artificial intelligence techniques. (K1) CO2: Explain different neural network architectures and their applications. (K2) CO3: Apply perceptron and counter-propagation network algorithms for problem-solving. (K3) CO4: Analyze fuzzy logic systems and fuzzy rule-based models. (K4) CO5: Evaluate genetic algorithms and their performance in optimization problems. (K5) CO6: Design intelligent systems using soft computing techniques for real-world applications. (K6)	
7	Course Description	This course covers the principles of soft computing, including neural networks, fuzzy logic, and genetic algorithms. It enables students to design intelligent systems and apply soft computing techniques for solving complex data-driven problems.	
8	Outline syllabus		CO Mapping
	Unit 1	Soft Computing & AI	
	A	Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing.	CO1
	B	Introduction, Various types of production systems, characteristics of production systems, breadth-first search, depth-first search techniques, other Search Techniques like hill Climbing, Best-first Search, A* algorithm, AO* Algorithms, and various types of control strategies.	CO1
	C	Knowledge representation issues,Prepositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.	CO1
	Unit 2	Neural Network	
	A	Structure and Function of a single neuron.	CO2
	B	Biological neuron, artificial neuron, the definition of ANN, Taxonomy of the neural net, Difference b/w ANN and the human brain.	CO2
	C	Characteristics and applications of AssNN, single layer network.	CO2

	Unit 3	Perceptron & Counter propagation network			
	A	Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN.			CO3
	B	Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.			CO3
	C	Architecture, functioning & characteristics of counter Propagation network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations, and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation, and training. Associative Memory.			CO3
	Unit 4	Fuzzy Logic & Fuzzy rule base system			
	A	Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations.			CO4
	B	Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.			CO4
	C	Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.			CO4
	Unit 5	Genetic algorithm			
	A	Fundamental, basic concepts, working principle, encoding, fitness function, and reproduction.			CO5
	B	Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA.			CO6
	C	Applications & advances in GA, Differences & similarities between GA & other traditional methods.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.			
	Other References	1. N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009. 3. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 4. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic, Theory & Applications, PHI Publication, 1st Edition, 2009. 5. Martin T Hagen, Neural Network Design, Nelson Candid, 2nd Edition, 2008.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MDA203.1	2	2	2	2	2	2	2	3	2	2	2
MDA203.2	2	3	2	3	2	2	2	3	2	2	2
MDA203.3	3	2	2	3	2	2	2	3	2	2	2
MDA203.4	3	3	2	3	2	2	2	3	2	2	2
MDA203.5	3	2	2	3	2	2	2	3	2	2	2
MDA203.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3	2	2	2.2

School: SSES		**Batch: 2026-28**			
Programme: M.Sc.		**Academic Year: 2026-27**			
Branch: Data Science & Analytics		**Semester: I**			
1	Course Code	DAP4754			
2	Course Title	Data Science Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in data science using Python, covering data handling, exploratory data analysis (EDA), preprocessing, and basic machine learning techniques.			
6	Course Outcomes	CO1: Understand basic Python concepts for data science. (K2) CO2: Develop the data visualization and EDA techniques using Python. (K3) CO3: Apply data preprocessing techniques like cleaning and transformation. (K3) CO4: Understand the different data sources and manage datasets. (K2) CO5: Analyze and evaluate the basic machine learning algorithms using Python. (K4, K5) CO6: Create simple web applications using Python. (K6)			
7	Course Description	This practical course focuses on implementing foundational data science techniques using Python. Students will work with real-world datasets to perform exploratory analysis, data preprocessing, statistical modeling, and machine learning.			
8	Outline syllabus				CO Mapping
	Unit 1	Introduction to Python and Data Science			
	A, B, C	Python basics, installation, and libraries (NumPy, Pandas). Handling datasets and understanding the data science workflow.			CO1
	Unit 2	Exploratory Data Analysis (EDA) in Python			
	A, B, C	Summary statistics, histograms, boxplots, scatter plots. Understanding data patterns and relationships.			CO2
	Unit 3	Data Preprocessing and Feature Selection in Python			
	A, B, C	Handling missing values and outliers. Feature selection techniques (Decision Trees, Wrappers, Filters).			CO3
	Unit 4	Working with Data Sources			
	A, B, C	Importing and manipulating data from CSV, Excel, and databases. Using Python for data retrieval.			CO4
	Unit 5	Data Mining and Machine Learning			
	A, B, C	Basic supervised and unsupervised learning (Association, Regression, Clustering).			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
	Text book	Mount, J., & Zumel, N. (2019). Practical data science with R. Simon and Schuster.			
	Other References	Boschetti, A., & Massaron, L. (2016). Python data science essentials. Packt Publishing Ltd.			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAP4754.1	2	3	2	2	2	3	3	1	2
DAP4754.2	2	3	2	2	2	3	2	1	2
DAP4754.3	2	3	2	2	2	2	2	2	2
DAP4754.4	2	3	2	2	2	2	3	2	2
DAP4754.5	2	3	2	2	2	3	2	2	2
DAP4754.6	2	3	2	2	2	2	2	2	2
Average	2	3	2	2	2	2.5	2.3	1.6	2

School: SSES		**Batch: 2026-28**			
Programme: M.Sc.		**Academic Year: 2026-27**			
Branch: Data Science & Analytics		**Semester: I**			
1	Course Code	DAP4755			
2	Course Title	Mathematics for Machine Learning Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in implementing sampling techniques using R/Python. Students will learn to draw samples, compute estimators, perform survey analysis, and apply statistical sampling methods to real datasets.			
6	Course Outcomes	CO1: Recall the basic sampling techniques such as simple random sampling and stratified sampling using R/Python. (K1) CO2: Demonstrate the Probability Proportional to Size (PPS) sampling techniques using statistical software. (K2) CO3: Experiment with ratio and regression estimation methods and evaluate their efficiency. (K3, K4) CO4: Examine the advanced sampling techniques such as two-phase, cluster, and systematic sampling using R/Python. (K4) CO5: Interpret randomized response techniques such as Warner's and Simmons' models. (K5) CO6: Estimates errors in surveys and interpret results from randomized response techniques. (K6)			
7	Course Description	Introduce basic concepts of Python environment and provide students with a general understanding of Python for solving the data analytics based problem. Equip students with the skills to apply Python concepts and analytical tools to analyze data analytics problem and handle real-world issues related to vectors and matrices.			
8	Outline syllabus				CO Mapping
	Unit 1	Vector Operations and Spaces			
	A,B,C	Implementing vector operations, Dot product, scalar multiplication, and cosine similarity. Solving systems of linear equations using Gauss elimination and NumPy functions.			CO1
	Unit 2	Linear Algebra Concepts			
	A,B,C	Working with orthogonal, normal, and orthonormal vectors. Computing vector norms, basis vectors, and affine spaces.			CO2
	Unit 3	Matrices and Determinants			
	A,B,C	Implementing matrix operations: Addition, multiplication, inverse, and rank. Computing determinants, eigenvalues, and eigenvectors using NumPy.			CO3
	Unit 4	Differentiation and PCA			
	A,B,C	Implementing differentiation and partial derivatives using SymPy. Performing Principal Component Analysis (PCA) for dimensionality reduction.			CO4
	Unit 5	Optimization and Gradient Functions			
	A,B,C	Computing gradients of scalar and vector functions using Autograd. Implementing constrained optimization using Lagrange multipliers. Applying convex optimization techniques in machine learning problems.			CO5, CO6
	Mode of examinatic	Practical			
	Weightage Distribu	CA	CE	ESE	

	Text book	Scheaffer, R. L., Mendenhall, W., Ott, L., & Gerow, K. (1990). *Elementary survey sampling* (Vol. 501). California: Duxbury Press.			
	Other References	Särndal, C. E., Swensson, B., & Wretman, J. (2003). *Model assisted survey sam* Springer Science & Business Media.			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
DAP4755.1	2	3	2	1	2	3	3	2	2
DAP4755.2	2	3	2	2	2	3	2	2	2
DAP4755.3	2	3	2	2	2	2	2	2	2
DAP4755.4	2	3	2	2	3	2	3	2	2
DAP4755.5	2	3	2	2	3	3	2	2	2
DAP4755.6	2	3	2	2	3	2	2	2	2
Average	2	3	2	1.8	2.5	2.5	2.3	2	2

School: SSES		**Batch: 2026-28**
Program: M.Sc.		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	STP4753

2	Course Title	Distribution Theory Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	To provide hands-on experience in solving probability and statistical distribution problems using computational tools such as R or Python, with applications to real-world datasets.			
6	Course Outcomes	CO1: Recall the basic probability concepts using computational tools. (K1) CO2: Illustrate and visualize probability distributions and density functions. (K2) CO3: Interview with expectations, variances, and moment generating functions using statistical software. (K3) CO4: Implement various types of generating functions in statistical analysis. (K4) CO5: Evaluate sampling distributions and perform hypothesis testing using statistical software and simulation techniques. (K5) CO6: Formulate probability models to analyze real-world datasets and interpret statistical results on hypothesis. (K5, K6)			
7	Course Description	This practical course reinforces the theoretical foundations of probability theory and distributions through computational simulations and data analysis. Students will use programming tools such as R or Python to implement probability models, derive distributions, and perform hypothesis testing.			
8	Outline syllabus				CO Mapping
	Unit 1	Basic Probability Concepts and Random Variables			
		Problem based on conditional probability and Bayes' theorem using real-world data. Also, Visualization of probability distributions (discrete and continuous)			CO1 CO2
	Unit 2	Expectations and Inequalities			
		Problem based on expectation, variance, and covariance of random variables, Conditional expectation and variance calculations. Verification of probability inequalities (Markov, Chebyshev, etc.) using data			CO2, CO3
	Unit 3	Generating Functions and Discrete Distributions			
		Problem based on moment generating functions and probability generating functions. Simulating and analyzing discrete distributions (Bernoulli, Binomial, Poisson, etc.)			CO3, CO4
	Unit 4	Continuous Distributions			
		Problem based on Simulation and visualization of continuous distributions (Normal, Exponential, Gamma, Beta, etc.)			CO4,CO5
	Unit 5	Sampling Distributions and Hypothesis Testing			
		Problem based on Sampling distribution of sample mean and proportion Performing hypothesis tests using t, F, and chi-square distributions. Real-life case studies involving hypothesis testing			CO5, CO6
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*	Severini, T. A. (2005). *Elements of distribution theory* (No. 17). Cambridge University Press.			
	Other References	Tattar, P. N. (2017). *Statistical Application Development with R and Python*. Packt Publishing Ltd.			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STP4753.1	2	3	2	2	2	3	3	1	2
STP4753.2	2	3	2	2	2	3	2	1	2
STP4753.3	2	3	2	2	2	2	2	2	2
STP4753.4	2	3	2	2	2	2	3	2	2
STP4753.5	2	3	2	2	2	3	2	2	2
STP4753.6	2	3	2	2	2	2	2	2	2
Average	2	3	2	2	2	2.5	2.3	1.6	2

School: SSES		**Batch: 2026-28**
Program: M.Sc.		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	STP4752
2	Course Title	Statistical Methods Lab
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
	Course Status	Compulsory
5	Course Objective	To provide hands-on experience in solving statistical and probability-related problems using computational tools and real-life data applications.
6	Course	After the completion of this course, students will be able to:

	Outcomes	CO1: Apply descriptive statistical measures and probability concepts using computational tools. (K3) CO2: Analyze correlation, regression, and curve fitting techniques using statistical software. (K4) CO3: Apply regression models and evaluate their effectiveness using real datasets. (K3, K5) CO4: Analyze hypothesis testing using various parametric and non-parametric tests. (K4) CO5: Analyze the Central Limit Theorem and Law of Large Numbers using computational methods. (K4) CO6: Apply and Evaluate design of experiments and ANOVA techniques in statistical data analysis. (K3, K5)			
7	Course Description	This practical course reinforces theoretical concepts of descriptive statistics, probability, correlation, regression, hypothesis testing, and design of experiments through computational simulations and data analysis. Students will use programming tools such as R or Python to implement statistical models and analyze real-world datasets.			
8	Outline syllabus				CO Mapping
	Unit 1	Descriptive Statistics and Probability			CO1
	A, B, C	Problem Based on Descriptive Statistics and Probability using R or Python			
	Unit 2	Correlation, Regression, and Curve Fitting			CO2,CO3
	A, B, C	Problem Based on correlation, regression and curve fitting using R or Python			
	Unit 3	Testing of Hypothesis			CO4
	A, B, C	Practical problems on hypothesis testing using parametric and non-parametric tests in R or Python.			
	Unit 4	Design of Experiments			CO5
	A, B, C	Practical problems on analysis of variance (ANOVA) using R or Python.			
	Unit 5	CLT and Law of large number			CO6
	A, B, C	Simulation-based problems illustrating the Central Limit Theorem and Law of Large Numbers using R or Python.			
	Mode of examination	Practical			
	Weightage Distribution	CA	CE	ESE	
		30%	30%	40%	
	Text book/s*	• Introduction to Probability and Statistics by S.C. Gupta & V.K. Kapoor • Probability and Statistical Inference by Robert V. Hogg & Elliot A. Tanis			
	Other References	• Introduction to Probability Models by Sheldon M. Ross • Computational Probability and Statistics using R/Python (Online Resources)			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STP4752.1	2	3	2	2	2	2	2	1	2
STP4752.2	2	3	2	3	3	2	2	2	2
STP4752.3	2	3	2	2	2	2	2	1	2
STP4752.4	2	3	3	3	3	2	2	2	2
STP4752.5	2	3	3	2	2	2	2	1	2
STP4752.6	2	3	3	3	3	2	2	2	2
Average	2	3	2.5	2.5	2.5	2	2	1.5	2

SEMESTER – VIII

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	MDA117	
2	Course Title	Computational Intelligence	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	This course aims to provide a strong foundation in computational intelligence, including search techniques, reasoning, machine learning, and natural language processing. It focuses on developing problem-solving abilities using intelligent systems and applying these techniques to real-world applications.	
6	Course Outcomes	CO1: Define the fundamental concepts and techniques of computational intelligence. (K1) CO2: Explain intelligent computational techniques including logic, knowledge representation, and reasoning. (K2) CO3: Apply intelligent techniques such as search algorithms and inference methods to solve problems. (K3) CO4: Analyze advanced concepts including fuzzy logic, neural networks, and reasoning systems. (K4) CO5: Evaluate machine learning models and probabilistic reasoning techniques for decision-making. (K5) CO6: Design intelligent systems integrating computational intelligence techniques for real-world applications. (K6)	
7	Course Description	This course introduces computational intelligence concepts such as search algorithms, reasoning systems, machine learning, and natural language processing. It enables students to design intelligent systems for solving complex real-world problems.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Introduction to Artificial Intelligence-Search-Heuristic	CO1,
	B	Search A* algorithm Game Playing Alpha Beta Pruning Expert systems	CO1,
	C	Inference Rules Forward Chaining and Backward Chaining Genetic Algorithms	CO1,
	Unit 2		
	A	Proposition Logic First Order Predicate Logic Unification Forward Chaining	CO2
	B	Backward Chaining Resolution Knowledge Representation Ontological Engineering Categories and Objects	CO2
	C	Event Mental Events and Mental Objects Reasoning Systems for Categories Reasoning with Default Information Prolog Programming.	CO3
	Unit 3		

	A	Non-monotonic reasoning-Fuzzy	CO4
	B	Logic Fuzzy rules fuzzy inference Temporal Logic	CO4
	C	Temporal Reasoning Neural Networks Neuro Fuzzy Inference.	CO4
	Unit 4		
	A	Probability basics - Bayes Rule and its Applications Bayesian Networks Exact and Approximate Inference in Bayesian Networks Hidden Markov Models Forms of Learning	CO5
	B	Supervised Learning - Learning Decision Trees – Regression and Classification with Linear Models - Artificial Neural Networks –	CO5
	C	Nonparametric Models Support Vector Machines Statistical Learning, Learning with Complete Data Learning with Hidden Variables- The EM Algorithm Reinforcement Learning.	CO5
	Unit 5		
	A	Natural language processing-Morphological Analysis Syntax analysis	CO6
	B	Semantic Analysis All applications Language Models Information Retrieval Information	CO6
	C	Extraction Machine Translation Machine Learning Symbol Based Machine Learning: Connectionist Machine Learning.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA , MTE , ESE	
	Text book/s*	1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach‖, Third Edition, Pearson Education / Prentice Hall of India. 2. Elaine Rich and Kevin Knight, Artificial Intelligence‖, Third Edition, Tata McGraw- Hill.	
	Other References	1. Patrick H. Winston. "Artificial Intelligence", Third edition, Pearson Edition. 2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems‖, PHI.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MDA117.1	2	2	2	2	2	2	2	3	2	2	2
MDA117.2	2	3	2	3	2	2	2	3	2	2	2
MDA117.3	3	2	2	3	2	2	2	3	2	2	2
MDA117.4	3	3	2	3	2	2	2	3	2	2	2
MDA117.5	3	2	2	3	2	2	2	3	2	2	2
MDA117.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSES		**Batch: 2025-29**	
Program: B.Sc.(Hons. / Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	**MDA104**	
2	Course Title	**Next Generation Databases**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course aims to introduce the concepts of next-generation databases, including NoSQL, distributed, and columnar database systems. It focuses on understanding data models, scalability, and consistency in big data environments, enabling students to design and use modern database solutions for real-world applications.	
6	Course Outcomes	CO1: Define the fundamental concepts of Big Data and NoSQL databases. (K1) CO2: Explain the relationship between Big Data technologies and NoSQL database systems. (K2) CO3: Apply different NoSQL database models (document, column, graph) for data storage and analysis. (K3) CO4: Analyze distributed database architectures and consistency models in NoSQL systems. (K4) CO5: Evaluate different data models and database technologies for specific application requirements. (K5) CO6: Design scalable and efficient database solutions using modern NoSQL and distributed database technologies. (K6)	
7	Course Description	This course covers NoSQL databases, distributed database systems, and modern data models used in big data environments. It emphasizes database architectures, consistency models, and real-world applications of next-generation databases.	
8			**CO Mapping**
	Unit 1	Introduction to Databases and Big Data Evolution	
	A	Database Revolutions- system Architecture-Relational Database. Database Design-Data Storage-Transaction Management.	CO1
	B	Data warehouse and Data Mining-Information Retrieval. Big-Data Revolution-CAP Theorem.	CO1
	C	Birth of NoSQL-Document Database—XML Databases. JSON Document Databases-Graph Databases.Probability and Random variables	CO1
	Unit 2	Fundamentals of NoSQL and Big Data Systems	
	A	Big-Data Revolution-CAP Theorem.	CO2
	B	Birth of NoSQL-Document Database—XML Databases.	CO2
	C	JSON Document Databases-Graph Databases.	CO2
	Unit 3	Columnar and In-Memory Databases	
	A	ColumnDatabases-Data Warehousing Schemes- Columnar	CO3

		Alternative-Sybase IQ-C-Store.			
	B	Vertica-Column Database Architectures-SSD and In-Memory Databases.			CO3
	C	In-Memory Databases-Berkeley Analytics Data Stack and Spark.			CO3, CO6
	Unit 4	Distributed Database Systems and Consistency Models			
	A	Distributed Database Patterns-Distributed Relational Databases-Non-relational Distributed Databases.			CO4
	B	MongoDB Sharing and Replication-HBase-Cassandra- Consistency Models.			CO4
	C	Types of Consistency-Consistency MongoDB - HBase Consistency-Cassandra Consistency.			CO4, CO6
	Unit 5	Advanced Data Models and Emerging Database Technologies			
	A	Data Models and Storage-SQL-NoSQLAP Is-Return SQL-Advance Databases-Postgre SQL.			CO5
	B	Riak-CouchDB-NEO4J-Redis-Future, Databases- Revolution Revisited-Counter revolutionaries-Oracle HQ.			CO5
	C	Other Convergent Databases-Disruptive Database Technologies.			CO5, CO6
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		%	%	%	
	Text book/s*	1. Abraham Silberschatz, Henry F. Korth, S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill.			
	Other References	1. Guy Harrison, "Next Generation Databases",A Press, 2015. 2. Eric Redmond, Jim R Wilson, "Seven Databasesin Seven Weeks", LLC. 2012. 3. Dan Sullivan, "NoSQL for Mere Mortals",Addison-Wesley, 2015. 4. Adam Fowler, "NoSQL for Dummies", John			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
MDA104.1	2	2	2	2	2	2	2	3	2	2	2
MDA104.2	2	3	2	3	2	2	2	3	2	2	2
MDA104.3	3	2	2	3	2	2	2	3	2	2	2
MDA104.4	3	3	2	3	2	2	2	3	2	2	2
MDA104.5	3	2	2	3	2	2	2	3	2	2	2
MDA104.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSES		**Batch: 2023-25**	
Program: M.Sc.		**Academic Year: 2023-24**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	MDA107	
2	Course Title	Advanced Big Data and Text Analytics	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course aims to provide insight into the concepts of Natural Language Processing and its applications. This course helps the students to implement NLP applications using deep learning algorithms. This course helps to understand various word/text representation algorithms.	
6	Course Outcomes	CO1: Understand Big data techniques and their applications. (K2) CO2: Apply Big data techniques for Time series forecasting in real world data set. (K3) CO3: Apply sampling techniques in Data Stream and Analyze the Data Mining Stream. (K3, K4) CO4: Evaluate the different NLP applications using Machine Learning/Deep learning algorithms. (K4, K5) CO5: Evaluate different deep learning models to analyze real-time NLP problems. (K4, K5) CO6: Create an intelligent systems using text analysis techniques. (K6)	
7	Course Description	A PG-level course in Soft Computing Techniques to Improve Big Data Analysis solutions is to strengthen the dialogue between the statistics and soft computing research communities.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Introduction to Big Data: Introduction to Big Data,Big Data characteristics	CO1
	B	Types of Big Data, Structured Data, Unstructured Data, and semi–Structured Data.	CO1
	C	Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	CO1
	Unit 2		
	A	The Big Data Analytics and Big Data Analytics Techniques: Optimization techniques, Dimensionality Reduction techniques.	CO2
	B	Time series Forecasting, Social Media Mining, and Social Network Analysis, and its Application.	CO2
	C	Data analysis techniques like Discriminant Analysis and Cluster Analysis.	CO2
	Unit 3		
	A	Mining Data Streams: The Stream Data Model: A Data Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.	CO3
	B	Sampling Data in a Stream: Obtaining a Representative Sample, The General Sampling Problem, Varying the Sample Size. Filtering Streams: The Bloom Filter Analysis.	CO3
	C	Counting Distinct Elements in a Stream: The Count-Distinct	CO3

		Problem, The Flajolet -Martin Algorithm, Combining Estimates, Space Requirements Counting Ones in a Window: The Cost of Exact Counts.			
	Unit 4				
	A	Introduction to Natural Language Processing Words Regular Expressions N-grams Language modelling Part of Speech.			CO4
	B	Tagging Named Entity Recognition Syntactic and Semantic Parsing-Morphological Analysis			CO4
	C	Text Representation and Transformation-Vector space models Bag of Words Term Frequency Inverse Document Frequency Word Vector representations: Word2vec, GloVe, FastText, BERT-Topic Modelling			CO4
	Unit 5				
	A	Neural language models - Recurrent Neural Network - Long Short-Term Memory Networks			CO5
	B	Encoder decoder architecture - Attention Mechanism - Transformer networks			CO6
	C	Text classification-Sentiment Analysis-Neural Machine Translation - Question answering - Text summarization			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	1. S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2.S, Rajasekaran& G.A. VijayalakshmiPai, Neural Networks, 3. Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.			
	Other References	1.N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 3. Martin T Hagen, Neural Network Design, Nelson Candad, 2nd Edition, 2008.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
MDA107.1	2	2	2	2	2	2	2	3	2	2	2
MDA107.2	2	3	2	3	2	2	2	3	2	2	2
MDA107.3	3	2	2	3	2	2	2	3	2	2	2
MDA107.4	3	3	2	3	2	2	2	3	2	2	2
MDA107.5	3	2	2	3	2	2	2	3	2	2	2
MDA107.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSES		**Batch: 2026-28**	
Program: M.Sc.		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: II**	
1	Course Code	MDA105	
2	Course Title	Regression Analysis and Predictive Models	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	DSE	
5	Course Objective	The objective of this course is to equip students with statistical techniques required to understand and perform regression analysis and predictive modeling.	
6	Course Outcomes	**CO1: Understand the concepts of correlation and simple linear regression. (K2)** **CO2: Apply multiple regression techniques and perform hypothesis testing for regression coefficients. (K3)** **CO3: Analyze regression models using residual diagnostics, outlier detection methods, and model adequacy tests. (K4)** **CO4: Apply logistic regression and analyze generalized linear models for modeling categorical response variables. (K3, K4)** **CO5: Evaluate predictive models using statistical and machine learning approaches such as decision trees, clustering, and Bayesian networks. (K5)** **CO6: Create predictive models for real datasets using regression and classification techniques. (K6)**	
7	Course Description	This postgraduate course introduces the theory and applications of regression analysis and predictive modeling. Topics include correlation analysis, simple and multiple linear regression, logistic regression, generalized linear models, model diagnostics, and machine learning-based predictive methods. Students will learn to construct, analyze, and interpret regression models and apply predictive techniques to real-world datasets.	
8	Outline syllabus		CO Mapping
	Unit 1	Correlation and Simple linear regression	
	A	Correlation, Types of Correlation, Rank Correlation, Simple linear regression model. Least- squares estimation of parameters. Hypothesis testing on the slope and intercept.	CO1
	B	Interval estimation in simple linear regression. Coefficient of determination. Estimation by maximum likelihood.	CO1
	C	Properties of BLUEs and the residual sum of squares under normality, Gauss-Markov Model.	CO1

	Unit 2	Multiple linear regression			
	A	Multiple linear regression: Multiple linear regression models. Estimation of the model parameters. Hypothesis testing in multiple linear regression. Confidence intervals in multiple regression. Coefficient of determination and Adjusted R2.			CO2
	B	Properties of least square estimator, confidence intervals for mean, regression coefficients and prediction in multiple regression, collinearity			CO2
	C	Inverse regression, two-phase linear regression, inclusion of qualitative variable as regressors, multiple and partial correlations.			CO2
	Unit 3	Logistic regression and Model Adequacy			
	A	Logistic Regression: Introduction, Linear predictor and link functions, logit, probit, odds ratio, the test of hypothesis. Discriminant Analysis.			CO3
	B	Model Adequacy: Checking of linearity between study and explanatory variable, Residual Analysis, Detection and treatment of outliers, Residual plots.			CO3
	C	The PRESS statistic. Outlier test based on Studentized Residual (R-student). Test for lack of fit of the regression model.			CO3
	Unit 4	Generalized Linear models and Logistic Regression			
	A	Basic concept of generalized linear models.			CO4
	B	Logit transformation, maximum likelihood estimation			CO4
	C	Tests of hypothesis: Wald test, likelihood ratio (LR) test, score test, test for overall regression			CO4
	Unit 5	Machine Learning & Regression			
	A	Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID.			CO5
	B	Bayesian Networks (Naïve Bayes) , Linear Regression, Cox Regression, and Association rules, Clustering (K-means and Hierarchical clustering)			CO5
	C	Decision trees, Logistic regression, Discriminant analysis, Support vector machine.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	Johnston, J. (1984). Econometric Methods, McGraw Hill Kogakusha Ltd.			
	Other References	Draper, N. R., and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third edition.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MDA105.1	2	2	2	2	2	2	2	3	2	2	2
MDA105.2	2	3	2	3	2	2	2	3	2	2	2
MDA105.3	3	2	2	3	2	2	2	3	2	2	2
MDA105.4	3	3	2	3	2	2	2	3	2	2	2
MDA105.5	3	2	2	3	2	2	2	3	2	2	2
MDA105.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSES	**Batch: 2025-27**
Program: B.Sc. (Hons. With Research)	**Academic Year: 2025-26**
Branch: Data Science & Analytics	**Semester: VIII**
Course Code	**DAR4856**
Course Title	**Project**
Credits	4
Contact Hours (L-T-P)	0-0-8
Course Status	Compulsory
Course Objective	This course aims to develop research and project development skills in Data Science by guiding students through problem identification, literature review, data collection, analysis, and reporting. It focuses on applying analytical and computational techniques to solve real-world problems and communicate findings effectively.
Course Outcomes	CO1: Define and identify a research problem and formulate objectives. (K1) CO2: Explain literature review methods and assess project feasibility. (K2) CO3: Apply data collection, organization, and preprocessing techniques. (K3) CO4: Analyze data to identify patterns, trends, and relationships. (K4) CO5: Evaluate project methodologies and develop a structured project proposal. (K5) CO6: Create and present a complete project report with findings and recommendations. (K6)
Course Description	This course provides hands-on experience in data science project development, including problem formulation, data collection, analysis, and reporting. It enables students to apply learned concepts to real-world problems and present structured project outcomes.

Outline syllabus		CO Mapping
Unit 1	Project Planning and Problem Identification	
A	Selection of a topic and defining project scope	CO1
B	Literature review and feasibility analysis	CO1
C	Setting research objectives and expected outcomes	CO1
Unit 2	Data Collection and Organization	
A	Identifying sources of data	CO2
B	Collection, structuring, and documentation of data	CO2
C	Handling and managing missing or inconsistent data	CO2
Unit 3	Initial Data Analysis	
A	Exploring data characteristics	CO3
B	Identifying trends, patterns, and correlations	CO3
C	Generating preliminary insights	CO3
Unit 4	Project Proposal Development	
A	Outlining project methodology and approach	CO4
B	Identifying evaluation criteria	CO4
C	Addressing potential challenges and limitations	CO4
Unit 5	Presentation and Review	
A	Structuring and formatting the proposal	CO5

B	Preparing visual and written reports			CO6
C	Presenting and refining based on feedback			CO6
Mode of examination				
Weightage Distribution	CA	CE	ETE	
	30%	30%	40%	
Text book/s*	• The Data Science Handbook – Carl Shan, Henry Wang, William Chen, and Max Song • Practical Research: Planning and Design – Paul D. Leedy and Jeanne Ellis Ormrod			
Other References	• Exploratory Data Analysis with Python – John W. Tukey • The Craft of Research – Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams			

COURSE OUTCOMES– PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
DAR4856.1	3	2	2	2	2	2	2	3	2	2	3
DAR4856.2	3	3	2	3	2	2	2	3	2	2	3
DAR4856.3	3	2	2	3	2	2	2	3	2	2	3
DAR4856.4	3	3	2	3	2	2	2	3	2	2	3
DAR4856.5	3	2	2	3	2	2	2	3	2	2	3
DAR4856.6	3	2	3	3	2	2	2	3	2	2	3
Average	3	2.3	2.2	2.8	2	2	2	3.0	2	2	3

(OR)

SEMESTER-VII

School: SSES	**Batch: 2026-28**
Program: M.Sc.	**Academic Year: 2026-27**
Branch: Data Science & Analytics	**Semester: I**
Course Code	MDA101
Course Title	Foundations of Data Science
Credits	4
Contact Hours (L-T-P)	4-0-0
Course Status	Compulsory
Course Objective	The course is aimed at building the fundamentals of data science. Imparting design thinking capability to build big data and developing design skills of models for big data problems. Gaining practical experience in programming tools for data sciences and also empowering students with tools and techniques used in data science.
Course Outcomes	CO1: Understand data science and its applications. (K2) CO2: Analyze the Exploratory Data Analysis using basic concepts of data science. (K4) CO3: Apply data science techniques to analyze data preprocessing and feature selection techniques. (K3, K4) CO4: Understand the concept of Python software. (K2) CO5: Evaluate and create basic Machine Learning Algorithms. (K5, K6) CO6: Evaluate the statistical measures using Python in a real-time environment.(K5)
Course Description	This course introduces the fundamental concepts of Data Science, including the data science lifecycle, exploratory data analysis (EDA), and data preprocessing techniques. It provides hands-on experience with Python for data manipulation and analysis. The course also covers basic data mining and machine learning concepts, enabling students to develop simple models and gain insights from data for real-world problem solving.

Outline syllabus		CO Mapping
Unit 1	Introduction	
A	Introduction-What is Data Science?	CO1
B	The steps in Doing Data Science-Skills needed to do Data Science storing data-combining bits into larger structures	CO1
C	The steps in Doing Data Science-Skills needed to identify Data Problems.	CO1
Unit 2	EDA	
A	Big Data and Data Science - Big Data Analytics, Business intelligence vs big data, big data frameworks,	CO2
B	Exploratory Data Analysis (EDA), statistical measures,	CO2
C	Basic tools (plots, graphs, and summary statistics) of EDA, Data Analytics Lifecycle, Discovery	CO2
Unit 3	Data Pre-processing and Feature Selection	
A	Data cleaning - Data integration - Data Reduction - Data Transformation and Data Discretization.	CO3
B	Feature Generation and Feature Selection, Feature Selection algorithms: Filters- Wrappers - Decision Trees -	CO3

	Random Forests	
C	Descriptive statistics-Using Histograms to understand a distribution-Normal Distribution.	CO3, CO6
Unit 4	Basics of Python for Data Science	
A	Introduction to Python: Installation, syntax, data structures (lists, tuples, dictionaries).	CO4
B	Data manipulation using Pandas: Data Frames, handling missing values, basic operations.	CO4
C	Importing and working with data sources: CSV, Excel, Databases.	CO4, CO6
Unit 5	Basic Data Mining	
A	Data Mining Overview-Association Rule Mining.	CO5
B	Text Mining-Supervised and Unsupervised Learning.	CO5
C	Supervised Learning via Support Vector Machines- Support	CO5, CO6
Mode of examination	Theory	
Weightage Distribution	CA / MTE / ETE	
Text book/s*	1. Jeffrey S. Saltz, Jeffre M. Stanton, "AnIntroduction to Data Science", Sage Publications.	
Other References	3. Bernard Kolman, Robert C. Busby and SharonRoss (2004). Discrete Mathematical Structures, New Delhi: Prentice Hall 4. V. Bhuvaneswari, T. Devi, (2016). Big Data Analytics: A Practitioner's Approach, Bharathiar University	

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA101.1	3	2	3	3	2	3	3	2	2
MDA101.2	3	2	3	3	2	3	2	2	2
MDA101.3	2	3	2	3	2	2	2	3	3
MDA101.4	2	3	3	3	2	2	3	3	3
MDA101.5	3	3	3	3	2	3	2	3	3
MDA101.6	3	3	3	3	2	3	2	3	3
Average	2.7	2.6	2.8	3.0	2.0	2.6	2.3	2.6	2.6

School: SSBSR		**Batch: 2026-28**	
Program: M.Sc.		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	MDA102	
2	Course Title	Mathematics for Machine Learning	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	To enable the students to understand the concept of mathematics in machine learning.	
6	Course Outcomes	CO1: Explain the fundamental concepts of vectors, vector operations, dot product, cosine similarity, and systems of linear equations, and solve them using the Gauss Elimination method. (K2, K3) CO2: Analyze the properties of vector spaces, linear combinations, basis, norms, and orthogonal and orthonormal vectors. (K4) CO3: Apply appropriate techniques to determine the determinant, inverse, rank, nullity, and trace of matrices. Evaluate eigenvalues and eigenvectors and interpret their role in linear transformations and matrix decompositions. (K3,K5) CO4: Apply rules of differentiation and Principle Component Analysis. (K5) CO5: Apply rules of partial differentiation to analyze multivariable functions and their applications in data science problems. (K3, K4) CO6: Formulate and solve optimization problems using gradient vectors, Lagrange multipliers, and convex optimization techniques. (K6)	
7	Course Description	This course introduces the mathematical foundations required for data science applications. It covers vectors, vector spaces, and systems of linear equations, followed by matrix algebra, eigenvalues, and eigenvectors used in data analysis. The course also includes differentiation and partial differentiation of multivariable functions. Concepts of gradients and optimization techniques such as Lagrange multipliers are discussed. These topics provide the analytical basis for solving real-world data science and machine learning problems.	
8			CO Mapping
	Unit 1	Vector	
	A	Vectors, Scalars, Addition, Scalar multiplication.	CO1
	B	Dot product, vector projection, cosine similarity. Linear Independence,	CO1
	C	Linear Algebra-System of Linear equations, SolvingSystem of Linear equations.	CO1
	Unit 2	Basic Concept of Linear Algebra	
	A	Orthogonal vectors, normal and Orthonormal vectors.	CO2
	B	Vector norm, vector space, linear combination.	CO2
	C	Basis of vectors, Affine spaces.	CO2
	Unit 3	Matrices and Determinants	

	A	Matrices – Determinant, Identity matrix, Inverse of amatrix.			CO3
	B	The rank of a matrix, Nullity, trace of a matrix.			CO3
	C	Eigen values, Eigen vectors, Matrix decompositions.			CO3
	Unit 4	Derivatives			
	A	Differentiation, rules of differentiation, Derivatives, Scalar derivatives.			CO4
	B	Partial derivatives, Principle Component analysis – Concepts and properties.			CO4
	C	Dimensionality reduction with PCA			CO4
	Unit 5	Derivatives of Function			
	A	Differentiation of univariate functions, Partial differentiation, and gradients.			CO5
	B	Gradient of a vector-valued function. Gradient of matrices.			CO5
	C	Optimization using gradient functions, Constrained optimization, and Lagrange multipliers. Convex optimization.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020.			
	Other References	1. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th} Edition, John Wiley & Sons, (2014). 2. B. S.Grewal, Higher Engineering Mathematics, 38th Edition. Khanna Publications, (2005).			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
MDA102.1	3	2	2	2	2	2	2	2	2
MDA102.2	3	2	3	2	1	2	2	2	2
MDA102.3	3	2	2	3	2	2	2	2	3
MDA102.4	3	2	3	3	1	2	2	2	3
MDA102.5	3	2	2	2	3	1	2	2	2
MDA102.6	3	2	3	3	3	2	2	2	3
Average	3.0	2.0	2.5	2.5	2.0	1.8	2.0	2.0	2.5

School: SSES		**Batch: 2026-28**	
Program: M.Sc.		**Academic Year: 2026-27**	
Branch: Data Science & Analytics		**Semester: I**	
1	Course Code	STT4701	
2	Course Title	Distribution theory	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	This course develops a comprehensive understanding of probability distributions and their properties, and enables students to apply them in statistical modeling, inference, and real-world data analysis.	
6	Course Outcomes	CO1: Understand various univariate discrete probability distributions, and apply them to practical problems. (K2, K3) Demonstrate the univariate continuous probability distributions and apply their properties in statistical modeling. (K2, K3) CO3: Examine bivariate distributions and sampling distributions (Chi-square, t, F) and inspect their role in statistical inference. (K4) CO4: Compare the non-central and compound probability distributions and evaluate the effects of truncation in statistical models. (K4, K5) CO5: Interpret the order statistics, their distributions, recurrence relations, and associated statistical properties. (K5) CO6: Formulate and develop interrelationships among sampling distributions, truncation effects, and mixture distributions including finite mixtures and zero-modified distributions. (K6)	
7	Course Description	This course introduces probability distributions and their applications in statistical modeling and inference. It covers univariate, bivariate, sampling, non-central, and mixture distributions, along with truncation and order statistics, focusing on analysis and practical application.	
8			CO Mapping
	Unit 1	Univariate Discrete Distributions	
	A	Discrete Uniform distribution, binomial, multinomial, Poisson distribution	CO1
	B	Negative binomial, geometric distribution	CO1
	C	Hyper geometric distribution, power series Distribution	CO1
	Unit 2	Univariate Continuous Distributions	
	A	Exponential, Gamma distribution and Lindley distribution	CO2
	B	Beta (1st kind and 2nd kind), Weibull, Cauchy distribution	CO2
	C	Normal and Log-normal distribution, Pareto and Rayleigh distribution	CO2
	Unit 3	Bivariate Distributions and Sampling Distributions	

	A	Derivation, properties, and applications of bivariate normal distribution			CO3
	B	Derivation, properties and applications of Chi-square, t and F-distributions and			CO3
	C	Interrelationship between sampling distribution.			CO3
	Unit 4	Non-central Distributions, Compound Distributions and Truncation			
	A	Non-central chi-square, t and F distributions			CO4
	B	Compound distribution- Neyman's Type A distribution, Polya-Eggenberger distribution, Inverse Polya-Eggenberger distribution			CO4
	C	Truncation of basic discrete and continuous distributions with their properties.			CO4, CO5
	Unit 5	Order Statistics and Mixture Distribution			
	A	Distributions of r-th order statistics, joint density of two order statistics, some special joint distributions resulting from order statistics			CO5
	B	Distribution of range and other systematic statistics, moments of order statistics, recurrence relations and identities for moments of order statistics from an arbitrary distribution			CO5, CO6
	C	Mixture distribution- finite mixture, zero-modified distributions, mixture of binomial distribution.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
	Text book/s*	4. Sheldon Ross; A First Course in Probability, Pearson, 2014. 5. Parimal Mukhopadhyay; An Introduction to the Theory of Probability, World scientific, 2012. 6. Irwin Miller, Marylee's Miller, John E. Freund's;Mathematical Statistics, Pearson, 2017			
	Other References	5. FetsjeBijma, Marianne Jonker and Aad van der Vaart; Introduction to Mathematical Statistics, Amsterdam University Press, 2018. 6. Krishnamoorthy, K., Handbook of Statistical Distributions with Applications, Chapman & Hall/CRC, 2006. 7. Rohatgi, V.K. and Ebsanes Saleh, A.K. Md., An introduction to Probability and Statistics, 2nd Ed.,John Wiley & Sons, 2002. 8. Shanmugam, R., Chattamvelli, R. Statistics forscientists and engineers, John Wiley, 2015.			

COURSE OUTCOMES PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4701.1	3	2	2	3	2	3	3	2	1
STT4701.2	3	2	2	3	2	3	2	1	1

STT4701.3	3	2	2	3	2	2	2	1	1
STT4701.4	3	2	2	3	2	2	3	1	1
STT4701.5	3	2	2	3	2	3	2	2	1
STT4701.6	3	2	2	3	2	2	2	1	1
Average	3.0	2.0	2.0	3.0	2.0	2.5	2.3	1.3	1.0

School: SSES		**Batch: 2026-28**
Programme: Master of Science		**Academic Year: 2026-27**
Branch: Data Science & Analytics		**Semester: I**
1	Course Code	STT4704
2	Course Title	Probability & Statistical Methods
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course status	Compulsory
5	Course Objectives	This course develops a strong foundation in descriptive statistics, probability theory, and statistical inference. It introduces probability spaces, random variables, probability distributions, generating functions, and hypothesis testing. The course also covers probability inequalities, laws of large numbers, and central limit theorems, equipping students with essential tools for statistical analysis and modeling.
6	Course Outcomes	CO1: Recall and explain descriptive statistics, measures of central tendency and dispersion, and basic set theory concepts used in probability. (K1, K2) CO2: Interpret, and summarize probability spaces, conditional probability, independence of events, and Bayes' theorem. (K2) CO3: Apply and utilize concepts of random variables, probability functions, mathematical expectation, and probability inequalities in solving statistical problems. (K3) CO4: Analyze and distinguish properties of bivariate random variables and derive marginal and conditional distributions. (K4) CO5: Evaluate and justify the use of generating functions and hypothesis testing procedures including Type I and Type II errors, level of significance, and power of tests. (K5) CO6: Formulate and develop statistical models using the laws of large numbers, probability inequalities, and central limit theorems for statistical

		inference and decision making. (K6)
7	Course Description	This course covers descriptive statistics, probability theory, random variables, probability distributions, generating functions, and hypothesis testing. It also explores laws of large numbers, probability inequalities, and central limit theorems for statistical analysis and decision-making.
8	Outline syllabus:	

UNIT1	Descriptive Statistics and Probability	CO Mapping
A	Representation of data (measures of central tendency).	CO1
B	Dispersion & other characteristics of data (mean deviation, variance, quartiles, Skewness and Kurtosis, Moments).	CO1
C	Classes of Sets, Fields, sigma-fields, minimal sigma-field, Borel field	CO1
UNIT 2	Probability: Basic Concepts and Conditional Probability	
A	Probability space, Basic terminologies and theorems on probability, theorem of total probability, theorems on compound probability	CO2
B	Independence of events, conditional probability	CO2
C	Bayes' Theorem and its applications	CO2
UNIT 3	Random Variables and Probability Functions	
A	Random Variable and its properties, mathematical expectation and inequalities involving random variables viz. Markov's, Holder's, Minkowski's, and Jenson's Inequalities	CO3
B	PDF, PMF, Distribution function	CO3
C	Bivariate random variables, Marginal and conditional distributions	CO4
UNIT 4	Generating Functions and Hypothesis	
A	Generating functions, probability generating function, moment generating function characteristic functions,	CO4
B	factorial moment generating functions, Uniqueness theorem.	CO5
C	Hypothesis testing, Type I and II error, Level of Significance, power of test, large	CO5

	and small sample test.			
UNIT 5	The Laws of Large Numbers, Inequalities and Central limit Theorem			
A	Law of large numbers, Chebyshev's and Khinchin's weak law of large numbers, Kolmogorov's theorem, Strong law of large numbers.			CO6
B	Central limit theorem, De-Moivre's Laplace central limit theorem.			CO6
C	Statement of Lindeberg- Feller's central limit theorem.			CO6
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics". Sultan Chand & sons.		
	Other references	1.Ash, Robert B. (2000). Probability and Measure Theory, Second Edition, Academic Press, New York. 2. Feller, W. (1985). Introduction to Probability Theory and its Applications, Wiley Eastern, New Delhi 3. Bhatt, B.R. (1999). Modern Probability Theory, 3rd Edition, New Age International Publishers.		

COURSE OUTCOMES PROGRAMMEME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
STT4704.1	3	3	3	3	3	3	3	2	1
STT4704.2	3	2	3	3	2	3	2	1	2
STT4704.3	2	2	2	2	2	2	2	2	1
STT4704.4	2	2	1	2	2	2	3	1	1
STT4704.5	3	2	2	3	2	3	2	2	2
STT4704.6	3	2	1	3	2	2	2	1	2
Average	2.7	2.2	2.0	2.7	2.2	2.5	2.3	1.5	1.5

School: SSES		**Batch: 2025-29**
Program: B.Sc. (Hons. /Hons. With research)		**Academic Year: 2028**
Branch: Data Science & Analytics		**Semester: VII**
1	Course Code	MDA203
2	Course Title	Soft Computing Techniques
3	Credits	4
4	Contact Hours	4-0-0

	(L-T-P)		
	Course Status	Compulsory	
5	Course Objective	This course aims to introduce the fundamental concepts of soft computing techniques, including neural networks, fuzzy logic, and genetic algorithms. It focuses on developing the ability to analyze, design, and apply intelligent systems for solving complex real-world problems in data analysis and decision-making.	
6	Course Outcomes	CO1: Define the fundamental concepts of soft computing and artificial intelligence techniques. (K1) CO2: Explain different neural network architectures and their applications. (K2) CO3: Apply perceptron and counter-propagation network algorithms for problem-solving. (K3) CO4: Analyze fuzzy logic systems and fuzzy rule-based models. (K4) CO5: Evaluate genetic algorithms and their performance in optimization problems. (K5) CO6: Design intelligent systems using soft computing techniques for real-world applications. (K6)	
7	Course Description	This course covers the principles of soft computing, including neural networks, fuzzy logic, and genetic algorithms. It enables students to design intelligent systems and apply soft computing techniques for solving complex data-driven problems.	
8	Outline syllabus		CO Mapping
	Unit 1	Soft Computing & AI	
	A	Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing.	CO1
	B	Introduction, Various types of production systems, characteristics of production systems, breadth-first search, depth-first search techniques, other Search Techniques like hill Climbing, Best-first Search, A* algorithm, AO* Algorithms, and various types of control strategies.	CO1
	C	Knowledge representation issues,Prepositional and predicate logic, monotonic and non-monotonic reasoning, forward Reasoning, backward reasoning, Weak & Strong Slot & filler structures, NLP.	CO1
	Unit 2	Neural Network	
	A	Structure and Function of a single neuron.	CO2
	B	Biological neuron, artificial neuron, the definition of ANN, Taxonomy of the neural net, Difference b/w ANN and the human brain.	CO2
	C	Characteristics and applications of AssNN, single layer network.	CO2
	Unit 3	Perceptron & Counter propagation network	
	A	Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE, AI v/s ANN.	CO3
	B	Introduction of MLP, different activation functions, Error back propagation algorithm, derivation of BBPA, momentum, limitation, characteristics and application of EBPA.	CO3
	C	Architecture, functioning & characteristics of counter Propagation	CO3

		network, Hop field/ Recurrent network, configuration, stability constraints, associative memory, and characteristics, limitations, and applications. Hopfield v/s Boltzman machine. Adaptive Resonance Theory: Architecture, classifications, Implementation, and training. Associative Memory.			
	Unit 4	Fuzzy Logic & Fuzzy rule base system			
	A	Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations.			CO4
	B	Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions.			CO4
	C	Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.			CO4
	Unit 5	Genetic algorithm			
	A	Fundamental, basic concepts, working principle, encoding, fitness function, and reproduction.			CO5
	B	Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA.			CO6
	C	Applications & advances in GA, Differences & similarities between GA & other traditional methods.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	
	Text book/s*	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011. 2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 1st Edition, 2009.			
	Other References	1. N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998. 2. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009. 3. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012. 4. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic, Theory & Applications, PHI Publication, 1st Edition, 2009. 5. Martin T Hagen, Neural Network Design, Nelson Candid, 2nd Edition, 2008.			

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MDA203.1	2	2	2	2	2	2	2	3	2	2	2
MDA203.2	2	3	2	3	2	2	2	3	2	2	2
MDA203.3	3	2	2	3	2	2	2	3	2	2	2
MDA203.4	3	3	2	3	2	2	2	3	2	2	2
MDA203.5	3	2	2	3	2	2	2	3	2	2	2
MDA203.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3	2	2	2.2

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. Hons. With Research		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VII**	
1	Course Code	**DAR4757**	
2	Course Title	Research Project- I	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
	Course Status	Project	
5	Course Objective	• Develop foundational research skills in identifying, formulating, and planning a mathematical, statistical and data science related research problem. • Strengthen initial academic writing and literature review skills.	
6	Course Outcomes	CO1: Identify a relevant research problem in data science and formulate clear research objectives. (K2, K4) CO2: Conduct a preliminary literature review and establish the basic theoretical framework. (K4, K5) CO3: Develop a basic proposal and timeline for the full dissertation. (K5) CO4**:** Develop effective project organizational skills. (K5) CO5. Discuss the ethical dimensions of your research and	

		obtain appropriate ethical approval if needed. (K5) CO6. Plan a research article of the findings in an appropriate manner. (K6)			
7	Course Description	This course introduces students to the research process through identification of a research topic, preliminary literature review, and proposal writing. It lays the foundation for advanced research in the subsequent semester.			
8	Outline syllabus				CO Achievement
	Unit1	Introduction to Research and Problem Identification			
		Understanding research in statistics and data science, identifying potential problems, Formulating objectives and scope			CO1
	Unit2	Literature Review and Theoretical Orientation			
		Techniques for literature search, Review and synthesis of previous work, Conceptual framework formation			CO1, CO2
	Unit3	Proposal Development			
		Structuring a research proposal, Methodology outline, Planning and timeline			CO2, CO3
	Unit4	Data Collection and Analysis			
		Execute data collection strategies as per the research design, where applicable, Employ advanced and appropriate statistical and data science techniques for thorough data analysis, Interpret and contextualize the analytical results with respect to the research questions and the established theoretical framework.			CO3, CO4
	Unit 5	Dissertation Writing and Defense			
		Structuring and writing the Research paper, Adhering to academic writing standards and citation styles , Preparing for and delivering the dissertation defense			CO5, CO6
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	CE	ETE	
		30%	30%	40%	
	Text book/s*	-			

	Other References		

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
DAR4757.1	3	2	2	2	2	2	2	3	2	2	3
DAR4757.2	3	3	2	3	2	2	2	3	2	2	3
DAR4757.3	3	2	2	3	2	2	2	3	2	2	3
DAR4757.4	3	3	2	3	2	2	2	3	2	2	3
DAR4757.5	3	2	2	3	2	2	2	3	2	2	3
DAR4757.6	3	2	3	3	2	2	2	3	2	2	3
Average	3	2.3	2.2	2.8	2	2	2	3.0	2	2	3

OR

SEMESTER-VIII

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. (Hons. / Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	MDA117	
2	Course Title	Computational Intelligence	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Minor	
5	Course Objective	To provide a strong foundation on fundamental concepts in Computational Intelligence. To enable Problem-solving through various searching techniques.	
6	Course Outcomes	CO1: Provide a basic exposition to the goals and methods of Computational Intelligence. CO2: Study of the design of intelligent computational techniques. CO3: Apply the Intelligent techniques for problem solving CO4: Improve problem solving skills using the acquired knowledge in the areas of reasoning, natural language understanding, computer vision, automatic programming and machine learning. CO5: Learn about the advance concept of AI CO6: Explain computable functions, predicates, forward and backward reasoning	
7	Course Description	To apply these techniques in applications which involve perception, reasoning and learning. To apply Computational Intelligence techniques for information retrieval. To apply Computational Intelligence techniques primarily for machine learning.	
8	**Outline syllabus**		**CO Mapping**
	Unit 1		
	A	Introduction to Artificial Intelligence-Search-Heuristic	CO1,
	B	Search A* algorithm Game Playing Alpha Beta Pruning Expert systems	CO1,
	C	Inference Rules Forward Chaining and Backward Chaining Genetic Algorithms	CO1,
	Unit 2		
	A	Proposition Logic First Order Predicate Logic Unification Forward Chaining	CO2
	B	Backward Chaining Resolution Knowledge Representation Ontological Engineering Categories and Objects	CO2
	C	Event Mental Events and Mental Objects Reasoning Systems for Categories Reasoning with Default Information Prolog Programming.	CO3
	Unit 3		

	A	Non-monotonic reasoning-Fuzzy	CO4
	B	Logic Fuzzy rules fuzzy inference Temporal Logic	CO4
	C	Temporal Reasoning Neural Networks Neuro Fuzzy Inference.	CO4
	Unit 4		
	A	Probability basics - Bayes Rule and its Applications Bayesian Networks Exact and Approximate Inference in Bayesian Networks Hidden Markov Models Forms of Learning	CO5
	B	Supervised Learning - Learning Decision Trees – Regression and Classification with Linear Models - Artificial Neural Networks –	CO5
	C	Nonparametric Models Support Vector Machines Statistical Learning, Learning with Complete Data Learning with Hidden Variables- The EM Algorithm Reinforcement Learning.	CO5
	Unit 5		
	A	Natural language processing-Morphological Analysis Syntax analysis	CO6
	B	Semantic Analysis All applications Language Models Information Retrieval Information	CO6
	C	Extraction Machine Translation Machine Learning Symbol Based Machine Learning: Connectionist Machine Learning.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ESE:75%	
	Text book/s*	1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach‖, Third Edition, Pearson Education / Prentice Hall of India. 2. Elaine Rich and Kevin Knight, Artificial Intelligence‖, Third Edition, Tata McGraw- Hill.	
	Other References	1. Patrick H. Winston. "Artificial Intelligence", Third edition, Pearson Edition. 2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems‖, PHI.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MDA117.1	2	2	2	2	2	2	2	3	2	2	2
MDA117.2	2	3	2	3	2	2	2	3	2	2	2
MDA117.3	3	2	2	3	2	2	2	3	2	2	2
MDA117.4	3	3	2	3	2	2	2	3	2	2	2
MDA117.5	3	2	2	3	2	2	2	3	2	2	2
MDA117.6	3	2	3	3	2	2	2	3	2	2	3

Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSEs		**Batch: 2025-29**	
Programme: B.Sc. (Hons./ Hons. With Research)		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	MDA112	
2	Course Title	Econometrics	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	DSE	
5	Course Objective	This course aims to develop a strong foundation in econometric methods, focusing on regression analysis and its applications in economics and data science. It equips students with the ability to analyze economic data, test hypotheses, and build predictive models for decision-making and forecasting.	
6	Course Outcomes	CO1: Define the fundamental concepts of regression analysis and econometric models. (K1) CO2: Explain the theoretical properties of estimators and hypothesis testing in regression models. (K2) CO3: Apply econometric techniques using statistical tools and software for data analysis. (K3) CO4: Analyze regression models by diagnosing issues such as multicollinearity, heteroscedasticity, and autocorrelation. (K4) CO5: Evaluate advanced econometric methods and models for economic analysis and forecasting. (K5) CO6: Design and develop econometric models for real-world data-driven decision-making. (K6)	
7	Course Description	This course introduces econometric techniques including regression analysis, hypothesis testing, and model building. It enables students to analyze economic data, validate assumptions, and develop models for forecasting and decision-making.	
8			
	Unit 1	Fundamentals of Econometrics and Regression Models	
	A	Introduction to econometrics. A review of least squares and maximum likelihood estimation methods of parameters in the classical linear regression model and their properties.	CO1
	B	Generalized least squares estimation and prediction, construction of confidence regions.	CO1
	C	Tests of hypotheses, use of dummy variables, and seasonal adjustment.	CO1
	Unit 2	Regression Models and Violations of Assumptions	
	A	Regression analysis under linear restrictions, restricted least squares estimation method and its properties.	CO2

	B	Problem of Multicollinearity, its implications, and tools for handling the problem.	CO2
	C	Ridge regression. Heteroscedasticity, consequences, and tests for it.	CO2
	Unit 3	Advanced Estimation and Autocorrelation Analysis	
	A	Estimation procedures under heteroscedastic disturbances, Bartlett's test, Breusch Pagan test, and Goldfelf Quandt test.	CO3
	B	Autocorrelation, sources, and consequences.	CO3
	C	Autoregressive process tests for autocorrelation.	CO4
	Unit 4	Advanced Econometric Models and Techniques	
	A	Durbin Watson test. Asymptotic theory and regressors.	CO5
	B	Instrumental variable estimation, errors in variables.	CO5
	C	Simultaneous equations model, the problem of identification, a necessary and sufficient condition for the identifiability of parameters in a structural equation.	CO5
	Unit 5	Estimation Methods and Model Applications	
	A	Ordinary least squares, indirect least squares.	CO6
	B	Two-stage least square.	CO6
	C	Limited information maximum likelihood method.	CO6
	Mode of examination	Theory	
	Weightage Distribution	CA:25%; MTE:25%, ETE:50%	
	Text book/s*	1.Gujrati, D.N. & Porter, D.C.: Basic Econometrics, 6th Edition. McGraw Hill. 2. Maddala, G.S. & Lahiri, K.: Introduction to Econometrics, 4th Edition. Wiley.	
	Other References	1. Greene, W.H.: Econometric Analysis, 7th Edition. Pearson. 2. Studenmund, A.H. &Johnson, B.K.: Using Econometrics: A Practical Guide, 7th Edition. Pearson.	

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
MDA112.1	2	2	2	2	2	2	2	3	2	2	2
MDA112.2	2	3	2	3	2	2	2	3	2	2	2
MDA112.3	3	2	2	3	2	2	2	3	2	2	2
MDA112.4	3	3	2	3	2	2	2	3	2	2	2
MDA112.5	3	2	2	3	2	2	2	3	2	2	2
MDA112.6	3	2	3	3	2	2	2	3	2	2	3
Average	2.7	2.3	2.2	2.8	2	2	2	3.0	2	2	2.2

School: SSES		**Batch: 2025-29**	
Programme: B.Sc. Hons. /Hons.With Research		**Academic Year: 2028-29**	
Branch: Data Science & Analytics		**Semester: VIII**	
1	Course Code	DAR4858	
2	Course Title	Research Project- II	
3	Credits	9	
4	Contact Hours (L-T-P)	0-0-18	
	Course Status	Project	
5	Course Objective	This course aims to develop advanced research skills in data science by enabling students to conduct independent and original research. It focuses on applying statistical and computational techniques, strengthening academic writing, and enhancing presentation skills through dissertation preparation and defense.	
6	Course Outcomes	CO1: Analyze research problems using theoretical and data-driven approaches. (K4) CO2: Evaluate and apply advanced data science and statistical techniques to solve research problems. (K5) CO3: Develop a well-structured and comprehensive research dissertation. (K6) CO4: Present and defend research findings effectively using appropriate communication tools. (K6) CO5: Evaluate ethical considerations and ensure compliance with research standards. (K5) CO6: Design and prepare a research article suitable for publication. (K6)	
7	Course Description	This course involves conducting in-depth research, applying advanced data analysis techniques, and preparing a comprehensive dissertation. Students present and defend their work while adhering to academic and ethical research standards.	
8	Outline syllabus		CO Achievement
	Unit 1	Advanced Research Methodology and Data Collection	
		Application of research methodologies, Data acquisition (theoretical, computational, empirical), Refinement of research design	CO1
	Unit2	Data Analysis and Interpretation	CO1, CO2
		Application of analytical and statistical methods	
		Interpretation of results, Drawing conclusions and	

		implications			
	Unit 3	Advanced Data Modeling and Validation			CO2, CO3
		Implementation of advanced data science models Model validation and performance evaluation, Linking results with research objectives			
	Unit 4	Dissertation Development			CO3, CO4
		Structuring and writing the dissertation, Academic writing standards and referencing, Preparation for presentation			
	Unit5	Research Communication and Publication			CO5,CO6
		Ethical considerations in research, Preparation of research article/paper, Final presentation and Défense			
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	CE	ETE	
		30%	30%	40%	
	Text book/s*	-			
	Other References				

COURSE OUTCOMES – PROGRAMME OUTCOMES MAPPING TABLE

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
DAR4858.1	3	2	2	2	2	2	2	3	2	2	3
DAR4858.2	3	3	2	3	2	2	2	3	2	2	3
DAR4858.3	3	2	2	3	2	2	2	3	2	2	3
DAR4858.4	3	3	2	3	2	2	2	3	2	2	3
DAR4858.5	3	2	2	3	2	2	2	3	2	2	3
DAR4858.6	3	2	3	3	2	2	2	3	2	2	3
Average	3	2.3	2.2	2.8	2	2	2	3.0	2	2	3