School of Basic Sciences and Research
Department of Life Science

Program Structure: Three Year UP HigherEducation for Food Science and Technology Discipline

AY: 2021-22 Onwards

1. Standard Structure of the Program at University Level

1.1 Vision, Mission and Core Values of the University

Vision of the University

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

Mission of the University

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

Creative Campaign can be TEDs: This is guiding principle for promotion and wide circulation among various stakeholders.
Guidelines: Similar Mnemonics can be designed by schools.

Core Values

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

Note: Detailed Mission Statements of University can be used for developing Mission Statements of Schools/ Departments.

1.2 Vision and Mission of the School

Vision of the School

Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish centre of excellence for ecologically and socially innovative research.**
4. **To strengthen inter-institutional and industrial collaboration forskill development and global employability.**

1.3 Vision and Mission of Department

Vision of the Department

To acquire and impart knowledge of Food Science and Technology so as to build capacity for addressing current global challenges

Mission of the Department

1. To train and transform students into technical researchers/ professionals who are able to integrate theoretical knowledge and analytical skills in diverse areas of Food Science.

2. To make students and faculties updated with advance techniques and to introduce the students to dynamic environment of food science.

3. To conduct cutting-edge interdisciplinary research.

4. Introduction of various skill development and entrepreneurship courses to enhance the employability and providing opportunities for industry academia collaboration.

1.4 Programme Educational Objectives (PEO)

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO1: The graduate students will understand of various food preservation techniques and concepts and phenomena in the minds of students through theoretical and practical knowledge.
PEO2: Graduate students will upgraded with new discoveries in Food Science and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.
PEO3: Graduate students will be taught various Food Standards and techniques as well as applications of these techniques for betterment of society and environment.
PEO4: Graduate students will industry- or academia-ready by developing independent thinking, good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.
PEO5: Graduate students will understand interdisciplinary nature of research in Food Sciences/Food Safety by assigning them different research projects/ case studies/presentations.

1.4.1 Map PEOs with Mission Statements:

PEO Statements	**School Mission 1**	**School Mission 2**	**School Mission 3**	**School Mission 4**
PEO1	3	2	-	-
PEO2	3	2	2	-
PEO3	3	3	2	1
PEO4	2	3	2	2
PEO5	3	2	2	2

1.4.1.1 Map PEOs with Department Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1	3	1	1	1
PEO2	3	2	2	-
PEO3	2	2	2	2
PEO4	3	-	2	2
PEO5	3	2	3	2

1.4.2 Program Outcomes (PO's)

PO1: Knowledge: Students will develop a sound understanding the Food Preserve Techniques and processes.

PO2: Skill Set Development: The student will be skilled in various Food Quality Analysis techniques that will enhance the employability of the students.

PO3: Oral Communication and Scientific Writing: The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report and reviews) content.

PO4: Environment and Sustainable Development: Student will be able to realize the effect of human malpractices on environment and the need and importance of sustainable development.

PO5: Ethics, Independent Thinking and Team Work: The students will develop professional ethics and also gain knowledge about various ethical issues associated with Food Science and Technology. Students will learn to think and analyze a problem independently while at the same time realizing the importance of team work in carrying out successful research/ projects/ presentations.

1.4.3. Mapping of Program Outcome Vs Program Educational Objectives

Mapping	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	2	2	2
PO2	3	2	2	3	2
PO3	1	1	-	3	2
PO4	1	2	3	-	2
PO5	1	2	-	3	2

B. Program Structure

1. TITLE: Three Year UP Higher Education Program Structure for Food Science and Technology Discipline

2. DURATION OF THE COURSE: 3 Years

3. YEAR OF IMPLIMENTATION

This syllabus will be implemented for the session academic year 2021-22 onwards.

4. PREAMBLE

Total Credits- 150

Minimum credit required for multiple entry and exit:

Total credit of the 03 year UG Program for year wise multiple entry and exit	01st Year	50
	02nd Year	100
	03rd Year	150

Total Number of Semesters – 06 (Two

semesters per year)

Total Number of Theory subjects - 27

Total number of practical: 22

Vocational Course: 4

Co-Curricular Course: 6

Internship: 01

Research Project: 01

Community Connect: 01

BSc Food Science and Technology Course Structure

Year	Semester	Course Codes from UPHE	Course Code	Paper Title	Theory /Practical	Credits
1st	I		BFS101	Fundamental of Food Technology	Theory	4
			BFS102	Food Biomolecules	Theory	4
				Chemistry - I (L)	Theory	4
				Vocational Course	Practical	3
		Z010101T	COC101	Food, Nutrition and Hygeine	Theory/Practical	2
			BFP101	Food Technology Lab	Practical	2
			BFP102	Food Biomolecules Lab	Practical	2
				Chemistry Lab - I	Practical	2
				Total Credits		**23**
	II		BFS201	Processing Technology of Cereals, Pulses Legumes and Oilseeds	Theory	4
			BFS202	Technology of Fruits and Vegetables	Theory	4
				Chemistry - II (L)	Theory	4
				Physics – I (L)	Theory	4
				Vocational Course	Practical	3
		Z020201	COC201	First aid and Health	Theory/Practical	2
			BFP201	Processing Technology of Cereals, Pulses Legumes and Oilseeds Lab	Practical	2
			BFP202	Technology of Fruits and Vegetables Lab	Practical	2
				Chemistry Lab - II	Practical	2
				Total Credits		**27**
2nd	III		BFS301	Food Chemistry	Theory	4
			BFS302	Unit Operations in Food Processing	Theory	4
				Chemistry - III (L)	Theory	4
				Vocational course	Practical	3
		Z030301	COC301	Human Values and Environmental Studies	Theory/Practical	2
			BFP301	Food Chemistry and Food Processing Lab	Practical	2
			BFP302	Food Engineering Lab	Practical	2
				Chemistry Lab - III	Practical	2
				Total Credits		**23**
			BFS401	Dairy Technology	Theory	4
			BFS402	Technology of Meat, Poultry and Sea Foods	Theory	4
				Chemistry - IV (L)	Theory	4

	IV			Physics – II (L)	Theory	4
				Vocational Course	Practical	3
		Z040401	COC401	Physical Education end Yoga	Theory/Practical	2
			BFP401	Dairy Technology Lab	Practical	2
			BFP402	Technology of Animal Foods Lab	Practical	2
				Chemistry Lab - IV	Practical	2
				Total Credits		**27**
3rd	V		BFS501	Food Microbiology	Theory	4
			BFS502	Principles of Food Preservation	Theory	4
			BFS503	Waste Management in Food Industries	Theory	4
			BFS504	Food Engineering	Theory	4
		Z050501	COC501	Analytic Ability and Digital Awareness	Theory/Practical	2
			CUC501	Community Connect	Practical	2
			BFP503	Summer internship of term IV (1) (Will be done after 4th Sem.)	Practical	1
			BFP501	Food Microbiology Lab	Practical	2
			BFP502	Food Preservation Lab	Practical	2
				Total Credits		**25**
	VI		BFS601	Food Biotechnology	Theory	4
			BFS602	Research Methodology in Food Science	Theory	4
			BFS603	Food Safety and Regulations	Theory	4
			BFS604	Food Enzymology		4
				Communication Skills and Personality Development	Theory	2
			BFP601	Food Biotechnology Lab	Practical	2
			BFP602	Research Methodology Lab	Practical	2
			BFP603	Research Project	Project	3
				Total Credits		**25**

Semester wise subjects as per NEP							
					Credit		(Min.-Max.Total Credits) After completion{Minimum Credits} [Max Duration in years]
No.		**Course Name**	**Subject**	**Theory/Practical**	**Total**	**Min. - Max.of the semester/ year**	
1	**Semester 1**	Fundamental of Food Technology	Major I	Theory	04	23-29	(50-52) {46} [4] **Certificate Course in Faculty**
2		Food Technology Lab	Major I	Practical	02		
3		Food Biomolecules	Major II	Theory	04		
4		Food Biomolecules Lab	Major II	Practical	02		
5		Chemistry – I (L)	Major III	Theory	04		
6		Chemistry Lab - I	Major III	Practical	02		
7		Vocational	Vocational	Practical	03		
8		Food, Nutrition and Hygiene	Co-curricular	Theory	02		
		Total credit			**23**		
1	**Semester 2**	Processing Technology of Cereals, Pulses, Legumes and Oilseeds	Major I	Theory	04	23-29	
2		Processing Technology of Cereals, Pulses, Legumes and Oilseeds Lab	Major I	Practical	02		
3		Technology of Fruits and Vegetables	Major II	Theory	04		
4		Technology of Fruits and Vegetables Lab	Major II	Practical	02		
5		Chemistry – II (L)	Major III	Theory	04		
6		Chemistry Lab - II	Major III	Practical	02		
7		Physics – I (L)	Minor/ Elective	Theory	04		
8		Vocational Course	Vocational	Practical	03		
9		Health and Hygiene	Co-curricular	Theory	02		
		Total Credit			**27**		
1	**Semester 3**	Food Chemistry	Major I	Theory	04	23-29	
2		Food Chemistry and Food Processing Lab	Major I	Practical	02		
3		Unit Operations in Food Processing	Major II	Theory	04		

4		Food Engineering Lab	Major II	Practical	02		100-104 {92} [7] **Diploma in Faculty**
5		Chemistry - III (L)	Major III	Theory	04		
6		Chemistry Lab - III	Major III	Practical	02		
7		Vocational course	Vocational	Practical	03		
8		Physical Education and Yoga	Co-curricular	Theory	02		
		Total Credit			**23**		
1	**Semester 4**	Dairy Technology	Major I	Theory	04	23-29	
2		Dairy Technology Lab	Major I	Practical	02		
3		Technology of Meat, Poultry and Sea Foods	Major II	Theory	04		
4		Technology of Animal Foods Lab	Major II	Practical	02		
5		Chemistry - IV (L)	Major III	Theory	04		
6		Chemistry Lab - IV	Major III	Practical	02		
7		Physics – II (L)	Minor/ Elective	Theory	04		
8		Vocational Course	Vocational	Practical	03		
9		Human Values and Environmental Studies	Co-curricular	Theory	02		
		Total Credit			**27**		
1	**Semester 5**	Food Microbiology	Major I	Theory	4	25	(150-154) {138) [10] **Bachelor in Faculty**
2		Waste Management in Food Industries	Major I	Theory	4		
3		Food Microbiology Lab	Major I	Practical	2		
4		Principles of Food Preservation	Major II	Theory	4		
5		Food Engineering	Major II	Theory	4		
6		Food Preservation Lab	Major II	Practical	2		
7		Analytic Ability and Digital Awareness	Co-curricular	Theory	2		
8		Community Connect	Survey/Project	Practical	2		
9		Summer internship of term IV (1) (Will be done after 4th Sem.)	Industrial Training	Practical	1		
		Total Credits			**25**		
1	**Semester 6**	Food Biotechnology	Major I	Theory	4	25	
2		Food Safety and Regulations	Major I	Theory	4		
3		Food Biotechnology Lab	Major I	Practical	2		
4		Research Methodology in Food Science	Major II	Theory	4		

5		Food Enzymology	Major II	Theory	4		
6		Research Methodology Lab	Major II	Practical	2		
7		Communication Skills and Personality Development	Co-curricular	Theory	2		
8		Research Project	IndustrialTraining/ Survey/ Project	Project	3		
		Total Credits			**25**		
1	**Semester 7**	Bakery, Confectionary and Extruded Products	Major I	Theory	4	26-32	(206-212) {194} [12] **Bachelor research in faculty**
2		Bakery, Confectionary and Extruded Products Lab	Major I	Practical	4		
3		Technology of Spices and Functional Food	Major I	Theory	4		
4		Food Quality Analysis	Major I	Theory	4		
5		IPR in Food Industry	Major I	Theory	4		
6		Research Project	IndustrialTraining/ Survey/ Project	Project	6		
		Total Credits			**26**		
1	**Semester 8**	Food Toxicology	Major I	Theory	4	26-32	
2		Food Toxicology Lab	Major I	Practical	4		
3		Fermentation Technology	Major I	Theory	4		
4		Food Packaging	Major I	Theory	4		
5		Nutrition Biochemistry	Major I	Theory	4		
6		Physics – III (L)	Minor/Elective	Theory	4		
7		Research Project	IndustrialTraining/ Survey/ Project	Theory	6		
		Total credit			**30**		

Three years UG programme structure of Food Science and Technology as per UP Higher Education

		Subject I	Subject II	Subject III	Subject IV	Vocational	Co- Curricular	Industrial Training/ Survey/ Project		
		Major	Major	Major	Minor/ Elective	Minor	Minor	Major	Credits	
		Credits 4 + 2	Credits 4 + 2	Credits 4 + 2	Credits 4	Credits 3	Credits 2	Credits		{Minimum Credits} [Max Duration in years]
Year	**Sem.**	**Own Faculty**	**Own Faculty**	**Any Faculty**	**Other Department/ Faculty**	**Vocational Faculty**	**Co- Curricular Course**	**Inter/Intra Faculty related to Main Subjects**	**Total**	
1	I	Fundamental of Food Technology (L)	Food Biomolecules (L)	Chemistry - I (L)		As per choice of student	Food, Nutrition and Hygiene		23	(50) {46} [4] Certificate Course
		Food Technology Lab (P)	Food Biomolecules Lab (P)	Chemistry Lab - I (P)						
	II	Processing Technology of Cereals, Pulses, Legumes and Oilseeds (L)	Technology of Fruits and Vegetables (L)	Chemistry - II (L)	Physics – I (L)	As per choice of student	Health and Hygiene		27	
		Processing Technology of Cereals, Pulses, Legumes and Oilseeds Lab (P)	Technology of Fruits and Vegetables Lab (P)	Chemistry Lab - II (P)						
2	III	Food Chemistry	Unit Operations in Food Processing	Chemistry - III (L)		As per choice of student	Physical Education and Yoga		23	(100) {96} [7] Diploma
		Food Chemistry and Food Processing Lab	Food Engineering Lab	Chemistry Lab – III (P)						
	IV	Dairy Technology	Technology of Meat, Poultry and Sea Foods	Chemistry - IV (L)	Physics – II (L)	As per choice of student	Human values and Environmental Studies		27	
		Dairy Technology Lab	Technology of Animal Foods Lab	Chemistry Lab - IV (P)						
	V	Food Microbiology	Principles of Food Preservation				Analytical Abilityand	Community Connect (2) +	25	
		Waste Management in Food Industries	Food Engineering							

3		Food Microbiology Lab	Food Preservation Lab				Digital awareness	Summer internship of term IV (1)		(150) {146} [10] Degree in Bachelor of Science
	VI	Food Biotechnology	Research Methodology in Food Science				Communication Skills and Personality Development	Research Project	25	
		Food Safety and Regulations	Food Enzymology							
		Food Biotechnology Lab	Research Methodology Lab							

Programme/Class: Certificate	**Year:** First	**Semester:** I
Subject: Food Science and Technology		
Course Code:	**Course Title:** Fundamental of Food Technology	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Discuss historical development of food science, technology, and the effects of processing on foods.
- CO2: Explain the processing of cereals, pulses, milk and meat products.
- CO3: Explain the thermal and non-thermal methods of food processing.
- CO4: Define potential applications of processing and preservation in food technology.
- CO5: Discuss use of microbes in food industries.
- CO6: Explain the processing, nutritional values and packaging of food product.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**General Introduction** • Historical development of Food Science and Technology • Evolution of Food Processing • Introduction to various branches of Food Science and Technology	**8**
II	**Introduction to Plant and Animal derived foods** • Classification, processing and nutritional value: Plant derived: Cereals, pulses, fruits, vegetables • Classification, processing and nutritional value: fats and oils; Animal derived: Meat, poultry, fish, milk and milk products • Beneficial microbes in Food	**15**
III	**Introduction to Food processing and preservation** • Minimal processing of foods with thermal and non thermal methods; Ohmic heating and High Pressure processing; Freezing, drying and dehydration and irradiation procedures • Safety criteria in minimally processed foods • Minimal processing in practice fruits and vegetables, seafood-effect on quality, Future developments	**15**

IV	**Introduction to Food packaging** • Objectives of packaging • flexible packaging • Brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods	**10**
V	**Properties of the packaging materials** • Use of low density polyethylene, ethylene acrylic acid, ethylene methacrylic acid, ionomers • High density polyethylene, polypropylene, polyvinyl chloride, polyvinylidene chloride, ethylene vinyl alcohol, polystyrene Polyethylene terephthalate or nylon, ethylene vinylacetate for food packaging • Polyethylene terephthalate or nylon, ethylene vinyl acetate for food packaging	**12**

Suggested Readings:

1. Manay, S. & Shadaksharaswami, M., Foods: Facts and Principles, NewAge Publishers, 2004
2. B. Srilakshmi, Food science, New AgePublishers,2002
3. Essentials of Food & Nutrition by Swaminathan, Vol.1 & 2 (2012)
4. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** I
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Biomolecules	

Course outcomes:

After successfully completion of this course, students will be able to:

- CO1; Summarize structural chemistry and general properties of lipids
- CO2: Distinguish the structure, classification and significance of carbohydrates
- CO3: Analyze the structure and properties of amino acids and proteins
- CO4: Evaluate the structure of nucleosides and nucleotides and stability of DNA backbone
- CO5: Illustrate the biosynthesis of purines and pyrimidines and structure as well as properties of DNA and RNA
- CO6: Summarize the structure, properties and significance of biological macromolecules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Lipids** • Structure and chemistry of fatty acids • Saturated and unsaturated fatty acids • General properties and structures of phospholipids, sphingolipids and cholesterol	**10**
II	**Carbohydrates** • Carbohydrate classification, Monosaccharides; D- and L-designation, Open chain and cyclic structures • Structure and biological importance of disaccharides • Structural polysaccharides and storage polysaccharides	**15**
III	**Proteins** • Amino Acids • Classification, Structure and Properties; Proteins: Primary, Secondary structure • Tertiary and Quaternary Structure; Biological functions of proteins	**15**
IV	**Nucleic Acids** • Nature of nucleic acids, Structure of purines and pyrimidines • Nucleosides and Nucleotides • Stability and formation of phosphodiester linkage	**10**
V	**Structure of DNA** • Biosynthesis of purines and pyrimidines • Structure of DNA and RNA • Watson-Crick model, Types of DNA	**10**

Suggested Readings:

1. Nelson D.L., and Cox M.M., *Lehninger Principles of Biochemistry, 6th Edition.* W. H. Freeman (2012).
2. Berg J.M., Tymoczko J.L., and Stryer L., *Biochemistry, 7th Edition.* W. H. Freeman(2010).
3. Voet D., and Voet J.G., *Biochemistry, 4th Edition.* Wiley (2010).

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** I
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Technology Lab	

Course outcomes:

After successful completion of this course, students will be able to:

- CO1: Demonstrate common food testing techniques.
- CO2: Explain the importance of testing procedures for cereal and related products.
- CO3: Analyze and evaluate the quality assessment of milk.
- CO4: Explain the importance of various chemicals preservatives in preservation.
- CO5: Discuss the macronutrient constituents of food products.
- CO6: Analyze the nutritional constituents of different food products.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-3

Unit	Topic	Total No. of Practical (10)
I	Practical based on effect of heat and pH on colorand texture of green vegetables	**2**
II	Practical related to estimation of gluten content present in a different samples	**2**
III	Practical related to evaluation of milk products	**2**
IV	Practical related to development of different types of fruit and vegetable based products	**2**
V	Practical related to estimation of carbohydrates in different food samples	**2**

Suggested Readings:

1. FSSAI Manual for Analysis for Food Products.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** I
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Biomolecules Lab	

Course outcomes:

After successfully completion of this course students will be able to:

- CO1: Identify the food containing starch.
- CO2: Identify the food containing carbohydrate/sugar.
- CO3: Identify the presence of fat and protein in food products.
- CO4: Estimate the moisture and ash content of food products.
- CO5: Compare the different food products on the basis of nutrients.
- CO6: Explain the principles of nutrition science.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-3

Unit	Topic	Total No. of Practical (10)
I	Practical related to carbohydrate.	**2**
II	Practical related to presence of protein.	**2**
III	Practical related to presence of fat.	**2**
IV	Practical related to moisture and ash content.	**2**
V	Practical related to comparison of different food products.	**2**

Suggested Readings:

1. Bevier, I. (1914). *Food and Nutrition Laboratory Manual*. Boston: Whitcomb & Barrows.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** II
Subject: Food Science and Technology		
Course Code:	**Course Title:** Technology of Cereals, Pulses and Oilseeds	

Course outcomes:

After successfully completion of this course, students will be able to:

- CO1: Explain the structural, nutritional and processing importance of wheat grain.
- CO2: Discuss physicochemical properties of rice grain and importance of parboiling based on its advantages and disadvantages.
- CO3: Explain other important cereals and their processing aspects
- CO4: Describe about processing of various pulses
- CO5: Discuss about oilseeds as well as processing of vegetable oils and fats.
- CO6: Discuss the nutritional composition and processing of cereals, legumes and oilseeds.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Wheat** Introduction, Structure and composition to cereals, pulses and oilseeds. Wheat types, physicochemical characteristics, milling of wheat, quality of flour and flour treatment. Additives used in bakery products -bleaching agents and flour improvers. Bakery products :bread, biscuits, cakes, extruded products (noodles and pasta)	**15**
II	**Rice** Physicochemical characteristics, Rice Milling; Parboiling of rice- traditional methods and their drawbacks. CFTRI process of parboiling. Properties of parboiled rice. Changes during parboiling. Advantages and disadvantages of parboiling. By-products of rice milling. Rice aging and rice based processed products.	**15**

III	**Minor cereals** Barley, Oats, Sorghum and Millets processing and their important products. Corn milling wet and dry method; Corn products: corn starch, flakes, and hydrolyzed syrups, corn flour, corn oil and baby corn.	**10**
IV	**Pulses** Types and processing of Legumes (Pulses) Storage and cooking losses, sprouting of legumes for nutritional benefits. Antinutritional factors in legumes and methods of removal.	**10**
V	**Oilseeds** Processing- oil extraction/expression and solvent extraction. Refining of crude oil- degumming, bleaching, deodorizations. Preparation of protein concentrates and isolates and their use in high protein foods. Hydrogenation and Interesterification, Shortening-introduction, manufacturing and uses of shortening, types of shortening. Margarine.	**10**

Suggested Readings:

1. Chakraverty, A. 1988. Postharvest Technology of Cereals, Pulses and oilseeds. Oxford and IBH, New Delhi.
2. Kent, N.L. 1983. Technology of Cereals. 3rd Edn. Pergamon Press, Oxford, UK.
3. Salunkhe, D. and Despande, S.S(2001) Foods of Plant origin : Production, Technology & Human
4. Nutrition An AVI Publications, New York.
5. Pomeranz, Y. 1987. Modern Cereal Science and Technology. VCH Pub., New York.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** II
Subject: Food Science and Technology		
Course Code:	**Course Title:** Technology of Fruits and Vegetables	

Course outcomes:

After successfully completion of this course, students will be able to:

- **CO1:** Understand the importance, canning and need of preservation for fruits and vegetables.
- **CO2:** Understand the processing and preservation of fruit juices.
- **CO3:** Understand the industrial method of making jam, jellies and marmalades.
- **CO4:** Understand the making of pickles, chutneys, sauces with processingof tomatoes and their various products.
- **CO5:** Understand the drying and dehydration methods of fruits andvegetables.
- **CO6:** Understand the processing technology of fruits and vegetables

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Introduction** • Importance of fruits and vegetable; history and need of preservation; Reasons of spoilage • Method of preservation; Canning and bottling of fruits and vegetables; process of canning; factors affecting the process-time and temperature • Lacquering syrups and brines for canning; spoilage in canned foods, containers of packing.	**15**
II	**Fruit Beverages and products** • Processing of fruit juices • Preservation of fruit juices (pasteurization, chemically preserved with sugars, freezing, drying, tetra packing, carbonation) • Processing of squashes, cordials, nectors, concentrates and powder.	**15**
III	**Jams, jellies and marmalades** • Jam: Constituents, selection of fruits, processing & Technology • Jelly: Essential constituents (Role of pectin, ratio); Theory of jelly formation, Processing; defects in jelly • Marmalade: Types, processing & technology, defects.	**10**
IV	**Pickles , chutneys and sauces** • Processing and types of pickles and chutney ;causes of spoilage; • Tomato products: Selection of tomatoes, pulping • Processing of tomato juice; tomato puree; paste, ketchup; sauce and soup	**10**
V	**Dehydration of foods and vegetables** • Sun drying & mechanical dehydration • Process variation for fruits and vegetables • Effects of dehydration on fruits and vegetables (Merits	**10**

	/Demerits); packing and storage.	

Suggested Readings:

1. Girdharilal, Siddappaa, G.S and Tandon, G.L., Preservation of Fruits & Vegetables, ICAR, New Delhi,1998
2. Manay, S. & Shadaksharaswami, M., Foods: Facts and Principles, New Age Publishers, 2004

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** II
Subject: Food Science and Technology		
Course Code:	**Course Title:** Processing Technology of Cereals, Pulses Legumes and Oilseeds Lab	

Course outcomes:

The student at the completion of the course will be able to:

- CO1- Understand the importance of testing procedures for cereal and related products.
- CO2- Identify the adulteration in cereals grains and legumes.
- CO3- Determination of acid and saponification value of oilseeds products.
- CO4- Experiment on dehulling and milling of cereals and legumes.
- CO5- Analysis of nutritional composition of cereal, legumes and related products
- CO6- Development of cereal and legumes based food products.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Practical (10)
I	**Importance of testing procedures for cereal and related products** • Determination of physicochemical properties of cereals and legumes.	**2**

II	**Identify the adulteration in cereals grains and legumes** • Determination of foreign matter in food grains. • Detection of *kesari* dal powder (*Lathyrus sativus*) in *Besan*.	**2**
III	**Determination of acid and saponification value of oilseeds** • Determination of saponification value in oilseeds Products. • Determination of acid value in mustard oil.	**2**
IV	**Dehulling and milling of cereals and legumes** • Principles and methods of dehulling • Dal milling process and visit to dal mill industry.	**2**
V	**Nutritional analysis of cereal, legumes and related products** • Estimate the crude fiber in cereal grains/legumes and related products • Estimation of fat content in cereal/legumes and related products.	**2**
VI	**Production of cereal and legumes based food products** • Production of fermented products from cereals/legumes • Production of soymilk	**2**

Suggested Readings:

1. Serna-Saldivar, S. O. (2012). *Cereal grains: Laboratory Reference and Procedures Manual*. CRC Press.
2. Nielsen, S. S. (Ed.). (2003). *Food Analysis Laboratory Manual* (p. 557). New York: Kluwer Academic/Plenum Publishers.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** First	**Semester:** II
Subject: Food Science and Technology		
Course Code:	**Course Title:** Technology of Fruits and Vegetables Lab	

Course outcomes:

After successfully completion of this course students will be able to:

- CO1: Demonstrate common post-harvest management and grading techniques.
- CO2: Explain the importance of various chemicals preservatives inpreservation.
- CO3: Understand basic techniques used in the estimation of lycopene.
- CO4: Discuss the importance of microbiological analysis in fruits andvegetables.
- CO5: Identify the importance of the chemical composition of different varieties of fruits and vegetables intended for processing and processing conditions to the composition and properties of the product.
- CO6: Analyze the nutrient constituents of fruits and vegetables

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Practical (10)
I	Practical based on post-harvest management and grading of foods.	**2**
II	Practical related to preservation of fruits by different methods.	**2**
III	Practical related to estimation of lycopene.	**2**
IV	Practical related to oxidative rancidity.	**2**
V	Practical related to development of value added new product.	**2**

Suggested Readings:

1. Laboratory Manual in Food Preservation by Marion L. Fields, Avi Publishing Co Inc.; New edition (December 1983).

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	2	2	2	3
CO5	3	2	2	2	2	2
CO6	3	2	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester:** III
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Chemistry	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Comprehend the basic chemistry concept of carbohydrates, proteins and fat.
- CO2: Develop idea for chemistry of gums, polysaccharides for industrial purpose.
- CO3: Different parameters use to evaluate carbohydrates, proteins and fat.
- CO4: Describe the concept of carbohydrate, as well as the identification of various anti-nutritional factors found in foods.
- CO5: Differentiation among enzymes and enzyme activity
- CO6: Recognize the importance of food chemistry in food.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Carbohydrates** • Scope, Introduction, Definition and Importance of Food Chemistry • Carbohydrates: Chemistry, classification, function • Chemical and physical properties of carbohydrates, pentosans, mannans and galactans, pectic substances, gums, types of fibers, celluloses, hemicelluloses, soluble fibers, insoluble fibers and their important functions	**8**
II	**Proteins and Amino acids** • Types, chemical, physical and functional properties, gel formation • Protein denaturation, Milk, Meat and Egg proteins: caseins, whey proteins, Colostrums, elastin, meat tenderness and muscle proteins • Egg white proteins and egg yolk, Collagen	**15**
III	**Lipids (oil and fats)** • Classification, Physico-chemical properties, Functions, Oxidation of Oils and Fats • Chemistry, Functions and Application of Emulsifiers, Antioxidants, Stabilizers and Additives • Chemistry and functional properties of pigments and flavour compounds (flavonoids)	**15**
IV	**Anti-nutritional factors of foods** • Enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor	**10**

	• Flatulence causing sugars, phytolectins and Allergens, toxic constituents • Important chemical changes during storage and cooking of foods (plant and animal foods)	
V	**Enzymes and starches** • Modified starches, resistant starches • Gelatinization of starches, alpha amylase and beta amylase • Enzymatic and non-enzymatic browning, reactions of aldehydes and ketones with amino compounds, caramelization, oxidative changes of polyphenols and their applications.	**12**

Suggested Readings:

1. Meyer, L.H. (1998) Food Chemistry, Van Nostrand, Reinhold Company Publication, New york, London.
2. Pomeranz, Y and Meloon, R. (1995) Food Analysis: Theory and Practice, Westport, An AVI Publication, New York, Sydney, Toronto.
3. Fennema, R.O (1997) Food Chemistry, Second Edition, Food Science & Technology series, Marcel Dekker, INC., New York

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester:** III
Subject: Food Science and Technology		
Course Code:	**Course Title:** Unit Operations in Food Processing	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Identify cleaning methods and material handling systems for foods
- CO2: Describe size reduction and mixing unit operation of foods
- CO3: Apply different methods of filtrations and expressions of foods
- CO4: Describe high temperature preservation operations for foods
- CO5: Understand Low temperature preservation unit operations
- CO6: To have broader idea to the student about unit operations in food processing

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Design and Layout of food plant** • Design and layout of food plants; Important considerations for designing of food plants; Construction and design; Types of layout	**8**
II	**Units and Dimensions** • Dimensions – Primary and Secondary; Engineering Units – Base Units, Derived Units and supplementary Units; • System – State of a system, • extensive and intensive properties; Density – Solid, Particle and Bulk density; Phase diagram of water	**15**
III	**Fluid flow in food processing** • Liquid Transport Systems– Pipes and Pumps; PUMPS-Definition, classification, positive displacement and centrifugal pumps • factors affecting choice of a pump • Properties of liquids - Density, Pressure, Surface tension and Viscosity, Laminar and turbulent fluid • The Continuity equation; Reynold's number	**15**
IV	**Thermodynamics and equilibrium** • Conservation of mass- conservation of mass for an open system and a closed system • Thermodynamics – laws of thermodynamics, Equation of state and Perfect Gas Law • Energy – potential and kinetic energy • Energy balance for a closed system and an open system, total energy balance	**10**
V	**Energy in Unit processes** • Generation of steam – Steam Generation System, Steam Tables, Steam Utilization; • Fuel utilization –Systems, Mass and energy balance analysis	**12**

	,Burner efficiency; • Electric Power Utilization – Electric Terms and Units, Ohm's Law, Electric Circuits, Electric Motors, Electric Controls and Lighting	

Suggested Readings:

1. Dincer, I. Heat Transfer Food Cooling Applications. Taylor and Francis Publishers, USA.
2. Heldman, D.R. and Lund, D.B. Handbook of Food Engineering 2nd edition. CRC press, Newyork, 2007.
3. Singh, R.P. Introduction to Food Engineering 3rd edition. Academic Press, London. 2004.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester:** III
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Chemistry and Food processing Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: To educate the students on the significance, purpose and principle of Food Chemistry
- CO2: To estimate total carbohydrates, protein, starch, ash, moisture content from different food samples
- CO3: To estimate reducing and non-reducing sugars from different food samples
- CO4: To understand the method for determination of pH and acidity from different food samples.
- CO5: To understand preparation of Primary and Secondary solutions.
- CO6: To understand method of estimation of ascorbic acid in food samples

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)

I	**General Laboratory Principles and Practices** • Practical experience with laboratory equipment related to food processing. • Cleaning of lab glassware and work areas	**10**
II	**Determining the nutritional composition of foods** • Estimation of proximate constituents in a given food sample • Determination of the starch content of food. • Estimation of reducing and non-reducing sugars using a standard protocol	**15**
III	**Estimation of physicochemical properties of foods** • Determination of pH and water activity in various food samples • Determining the acidity of a given food sample	**10**
IV	**Preparation of solutions**. • Preparation of Primary and Secondary solutions. • Preparation of Normal, Moral and diluted solution.	**15**
V	**Analysis of ascorbic acid and fat quality** • To comprehend the method of estimating ascorbic acid in food samples • To calculate saponification value and percent free fatty acids.	**10**

Suggested Readings:

1. Serna-Saldivar, S. O. (2012). Cereal Grains: Laboratory Reference and Procedures Manual. CRC Press.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester:** III
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Engineering Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand the fundamentals of food science and food process engineering.
- CO2: Understanding the concepts of drying and osmotic dehydration in depth.
- CO3: Utilization of some thermal/non-thermal techniques for different food commodities.
- CO4: Understand the physical properties of food materials.
- CO5: Describe the engineering properties of food materials.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)
I	• To get hands on experience on various aspects of food science and food process engineering. • Determination of cooking properties of parboiled and raw rice.	**10**
II	• Determination of rehydration ratio of dehydrated foods. • Experiment on osmotic dehydration of foods	**10**
III	• Blanching and Freezing of Foods. • Microwave heating of foods.	**10**
IV	• Determination of colour of food material • Determination of Texture properties of food products. • Evaluation of Rheological properties of foods	**15**
V	• Calculation of bulk density • Estimation of True density • To determine the Surface area • To determine the Porosity	**15**

Suggested Readings:

1. Singh, R. Paul and Heldman, R. Dennis.2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London.
2. Kessler, H.G.1981. Food engineering and dairy technology. Verlag A. Kessler, Freising.

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2

CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester: I**V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Dairy Technology	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Discuss milk and its nutritional value and apply total quality management systems into processes.
- CO2: Analyze the manufacturing aspects of various dairy products.
- CO3: Explain the importance of utilization and manufacturing of dairy waste products.
- CO4: Understand the importance of fortification and enrichment in dairy based nutraceuticals.
- CO5: Explain key functions in production steps, standards and defects of various dairy products.
- CO6: Review potential applications and efficiency of various equipment used in dairy products processing.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	**Topic**	**Total No. of Lectures (60)**
I	**Technology of milk and dairy products** • Introduction, Composition and Processing of milk; Pasteurisation, sterilization, HTST and UHT processes • TQM in Dairy Industry, In-plant cleaning system.	**8**
II	**Manufacturing of dairy products** • Manufacture of condensed milk, milk powder, cheese, ice-cream, butter, ghee, malted products, evaporated and dried products, their evaluation and quality parameters, • Defects encountered during production, packaging and storage.	**15**
III	**Substitutes for milk and milk products** • Casein and caseinates, lactose, whey protein concentrates and isolates, milk co precipitates, and other by-products.	**15**

IV	**Fortification and enrichment** • Technology of baby foods, weaning foods, therapeutic foods; • Fortification and enrichment of milk products.	**10**
V	**Traditional dairy products processing** • Milk confections such as *yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi* etc.	**12**

Suggested Readings:

1. Dey, S. 1994. Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
2. Aneja *et al.* 2002. Technology of Indian Milk Products. Dairy India Publ. De S.1980. Outlines of Dairy Technology. Oxford Univ. Press.
3. Walstra et al. 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester: I**V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Technology of Meat, Poultry and Sea Foods	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand the current scenario of meat and poultry industry in India.
- CO2: Learn the glossary of live market terms for animals and birds.
- CO3: Understand the processing of meat, poultry and sea foods.
- CO4: Grasp knowledge of factors affecting meat quality and different preservation techniques.
- CO5: Value-addition to poultry and fish by-products.
- CO6: To learn the overall objective of meat Industry.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0		
Unit	**Topic**	**Total No. of Lectures (60)**
I	**Introduction** • Livestock and poultry population in India, • Development of meat and poultry industry in India and its need in nation's economy, • Glossary of live market terms for animals and birds.	**8**
II	**Meat preservation and quality** • Effects of feed, breed and environment on production of meat animals and their quality • Meat Quality-color, flavor, texture, Water-Holding Capacity(WHC), • Preservation of meat Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing	**15**
III	**Slaughtering and Carcass Processing** • Modern abattoirs, typical layout and features, Ante-mortem handling and design of handling facilities • Hoisting rail and traveling pulley system; stunning methods; steps in slaughtering and dressing; offal handling and inspection • Operational factors affecting meat quality; effects of processing on meat tenderization; abattoir equipment and utilities.	**15**
IV	**Processing of Poultry Products** • Poultry industry in India; measuring the yields and quality characteristics of poultry products, Microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation; • Poultry meat processing operations, equipment used – Defeathering, bleeding, scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, • By products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.	**10**
V	**Fish and other Marine Products Processing** • Commercially important marine products from India; product export and its sustenance; Basic biochemistry and microbiology; • Preservation of postharvest fish freshness; transportation in refrigerated vehicles; deodorization of transport systems; design of refrigerated and insulated trucks; Grading and	**12**

	preservation of shell fish; • Pickling and preparation of fish protein concentrate, fish oil and other by-products.	

Suggested Readings:

1. Forrest JC. 1975. Principles of Meat Science. Freeman
2. Govindan TK. 1985. Fish Processing Technology.
3. IBH. Hui YH. 2001. Meat Science and Applications. Marcel Dekker.
4. Kerry J. et al. 2002. Meat Processing. Woodhead Publ. CRC Press. Levie A. 1984.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester: I**V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Dairy Technology Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Discuss milk and its nutritional value.
- CO2: Evaluate an overview of the major macro and micronutrients relevant to human health available in milk.
- CO3: Manufacturing and processing of various milk products
- CO4: Analysis of milk safety and microbial spoilage
- CO5: Application of Total Quality Management Systems into processes.
- CO6: Understand processing conditions for different dairy products.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)

I	• Plateform Tests of milk (COB, MBR Test, Alcohol Test, Sediment Test) • Determination of SNF Content in Milk.	**8**
II	• Determination of milk protein content • Determination of Fat content in Milk and Milk Products	**15**
III	• Development of Yogurt and cheese • Development of Soy Tofu	**15**
IV	• Determination of Titratable Acidity in Milk • Determination of Overrun in Icecream	**10**
V	• Analysis of Adulteration in Milk and Milk products • Quality Testing of Butter oil / Ghee	**12**

Suggested Readings:

1. Ramesh C. Chandan: Dairy-based Ingredients, Eagan Press, 1997
2. Sukumar De: Outlines of Dairy Technology, Oxford University Press, 1980
3. Aneja, Mathur, Chandan & A.K.Bannerji: Technology of Indian Milk Products: Dairy India Publication

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Second	**Semester: I**V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Technology of Animal Foods Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Identify the quality parameters of egg.
- CO2: Understand basic techniques to preserve meat and meat products.
- CO3: Explain the importance of Crude fiber in daily life and how to analyses it from animal feed.
- CO4: Understand how to prepare standard solution and able to explain normality and Molarity.
- CO5: Analyze the microbial quality of meat and milk.

- CO6: Estimation of physical properties of the animal products and industrial visit.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)
I	• Determination of external and internal quality of poultry egg. • To study the effect of time, temp on co-agulation properties of egg.	**8**
II	• Preparation of different types of meat products using different methods of preservation. • Preservation and evaluation of different egg products	**15**
III	• Practical related to fibre content of meat Estimation of total fibre content of meat • Practical related to solution preparation	**15**
IV	• Estimation of bacterial numbers in a given sample of meat • Estimation of yeast and mould numbers in a given sample of meat • Determination of microbiological quality of milk of MBR test.	**10**
V	• Water holding capacity and colour of different meat type • Moisture and protein content of different meat type • Visit to meat, fish and poultry processing industries.	**12**

Suggested Readings:

1) Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3) Pearson & Gillet Processed Meats,3 Ed, CBS Publication, New Delhi, 1997
4) Shai Barbut,Poultry Products Processing,CRC Press 2005
5) Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2

CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Microbiology	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Identify microbes associated with food, their classification and factors affecting their growth
- CO2: Describe fermented foods and their microflora
- CO3: Compare food spoilage in different classes of food
- CO4: Examine and detect food-borne pathogens
- CO5: Recognize microbial destruction methods
- CO6: Develop an overall idea of food-borne microbes involved in beneficial and harmful activities and methods of influencing their growth and survival

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Microorganisms of Food** • History of Food Microbiology • Microorganisms associated with foods. Bacteria, fungi, viruses, protozoa, toxic algae. Microbial grouping in practice. • Extrinsic and Intrinsic Factors affecting Microbial Growth.	**8**
II	**Fermented and microbial foods** • Fermented and microbial foods: Fermented Milk and milk products, Single cell protein, Fermented fruits and vegetables, Fermented fish, Fermented meats • Fermented beverages- Beer, Vinegar and Wine • Concept of Probiotics and health benefits	**15**
III	**Food Spoilage** • Spoilage of different foods types- Cereal and its products, • Vegetables, fruits, and its products, • Milk and its products, meat and meat products, poultry, fish and sea foods and Drinking water.	**15**
IV	**Diagnosis** • Detection of food-borne organisms and diseases, • Concept of Metabolically injured organisms their	**10**

	examination, • Bioassays for detecting microbes	
V	**Destruction of microorganisms** • Principles underlying the destruction of microorganisms, • Destruction of microorganisms by physical and chemical methods, Heating process, Irradiation, Low temperature storage, Chemical preservatives, High-pressure processing, Control of water activity.	**12**

Suggested Readings:

1. Frazier, W. C. and Westhoff, D. C. (2007) Food Microbiology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Adams, M. R. and Moss, M. O. (2005) Food Microbiology (Second edition).Royal Society of Chemistry Publication, Cambridge.
3. Jay, J.M. (2008) Modern Food Microbiology (Sixth Edition). Aspen Publishers, Inc. Gaithersburg, Maryland.
4. Ray, B. (2005) Fundamental food microbiology (Third edition). CRC Press, New York, Washington.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Principles of Food Preservation	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand the principles and methods of food preservation, thermal processing equipment and calculate adequacy of heat treatment.
- CO2: Demonstrate the principles, technology, industrial methods and application of preservation by low temperature

- CO3: Understand the principles, technology, industrial methods and application of preservation by moisture removal
- CO4: Understand the principles, technology, industrial methods and application of preservation by irradiation and membrane technology
- CO5: Understand the uses and effects of chemical preservatives in food Industry with principle, mechanism and application of various novel techniques in food preservation
- CO6: Understand the various conventional and novel food preservation techniques

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Principles of preservation** • Scope and importance of food processing, Historical developments in food processing. • `Types of foods and causes of food spoilage. • Principles and methods of preservation. Heat preservation and processing, heat resistance of microorganisms, thermal death curve, D, F and Z value, types of heat treatments and effects on foods, Canning of foods, cans and container types, spoilage of canned foods, heat penetration.	**8**
II	**Cold preservation** • Cold preservation and processing • Requirement of refrigeration and Freezing, Difference between refrigeration and freezing, effect of low temperature on fresh food, storage changes in food during refrigerated storage. • Freezing and frozen storage, Slow and quick freezing, Freezing curves, Freezing methods, factors determining freezing rate, changes in food during freezing, Frozen food storage.	**15**
III	**Moisture reduction in Preservation** • Drying, Dehydration and concentration, Sun drying and solar dehydration, Drying methods Drying curves, and type of dryers • Food concentration, Methods of concentration of fruit juices, Liquid food concentrates, Changes in food during dehydration and concentration. • Water activity; Role of water activity in food preservation, Intermediate moisture foods (IMF), Principles, characteristics, advantages and problems of IM foods	**15**
IV	**Irradiation** • Food Irradiation, Use of ionization radiations in food preservation, Sources, Units, effects, limitations, dose determination, safety and wholesomeness of irradiated	**10**

	foods, • Food irradiation techniques and recent applications of irradiation in food preservation. • Chemical Preservation, Uses and effects of class I and class II preservatives in foods, membrane technology	
V	**Novel Techniques in Food Preservation** • Hydrostatic pressure, dielectric heating, microwave processing, • Hurdle technology- Properties, mechanism of heating, Application in food processing and its effects on nutrients.	**12**

Suggested Readings:

1. Norman, N.P and Joseph, H.H. (1997). Food Science, Fifth edition, CBS Publication, New Delhi.
2. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
3. B. Srilakshmi, (2002).Food science, New Age Publishers,
4. Kalia M. and Sangita, S. (1996): Food Preservation and Processing, First edition, Kalyani Publishers, New Delhi.
5. Sivasankar, B. (2002): Food Processing and Preservation, Prentice Hall of India Pvt. Ltd., New Delhi.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Waste Management in Food Industries	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Comprehend the basic concept of waste and types.
- CO2: Waste Disposal method. Recognize the importance and utility of
- waste from food Industry

- CO3: Treatment of plant waste by physical, chemical and biological methods, Effluent treatment plants, Use of waste and waste water. Various hazards and their control measures.
- CO4: Types, availability and utilization of by-products of cereals, legumes & oilseeds, Utilization of by-products from food processing Industries.
- CO5: Status and utilization of dairy by-products. Industrial waste management
- CO6: Case study.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Introduction:** Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.	**8**
II	Treatment methods for liquid wastes, Treatment methods from food process industries; Design of activated sludge process, Rotating biological contactors, Trickling filters, UASB, Biogas plant.	**15**
III	Treatment methods of solid wastes, Biological composting, drying and incineration; Design of solid waste, management system: Landfill digester, Vermicomposting pit.	**15**
IV	Bio filters and bio clarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by different methods.	**10**
V	Case studies ,Cane Sugar waste, molasses for alcohol, baggasse for paper pulp, chemicals, bioethanol, cogeneration	**12**

Suggested Readings:

1.Handbook of Waste management and co-product recovery in Food Processing – Vol.1- Keith Waldron
2. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
3. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
4. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd. 4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2

CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Engineering	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Design the plant layout.
- CO2: Calculate the various engineering units and engineering properties of foods.
- CO3: Design and understand the liquid transport system according to flow behavior of food.
- CO4: Calculate and understand the conservation of mass, law of thermodynamics and energy balance of the system.
- CO5: Understand the steam generation system, fuel utilization system and various laws for electrical energy.
- CO6: Understand the engineering approach in food industry.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Design and Layout of food plant** • Design and layout of food plants; Important considerations for designing of food plants; Construction and design; Types of layout	**8**
II	**Units and Dimensions** • Dimensions – Primary and Secondary ; Engineering Units – Base Units, Derived Units and supplementary Units; System – State of a system, extensive and intensive properties; Density – Solid, Particle and Bulk density; Phase diagram of water	**15**
III	**Fluid flow in food processing** • Liquid Transport Systems – Pipes and Pumps; PUMPS-Definition, classification, positive displacement and centrifugal pumps, factors affecting choice of a pump; Properties of liquids - Density, Pressure, Surface tension and Viscosity ; laminar and turbulent fluid; The	**15**

	Continuity equation; Reynold's number	
IV	**Thermodynamics and equilibrium** • Conservation of mass- conservation of mass for an open system and a closed system; Thermodynamics – laws of thermodynamics, Equation of state and Perfect Gas Law; Energy – potential and kinetic energy Energy balance for a closed system and an open system, total energy balance.	**10**
V	**Energy in Unit processes** • Generation of steam – Steam Generation System, Steam Tables, Steam Utilization ; Fuel utilization –Systems ,Mass and energy balance analysis ,Burner efficiency; Electric Power Utilization – Electric Terms and Units, Ohm's Law, Electric Circuits, Electric Motors, Electric Controls and Lighting.	**12**

Suggested Readings:

1. Dincer, I. Heat Transfer Food Cooling Applications. Taylor and Francis Publishers, USA.
2. Heldman, D.R. and Lund, D.B. Handbook of Food Engineering 2nd edition. CRC press, Newyork, 2007.
3. Singh, R.P. Introduction to Food Engineering 3rd edition. Academic Press, London. 2004.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Microbiology Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Demonstrate common aseptic techniques used in microbiology Laboratory
- CO2: Illustrate the ubiquitous nature of microorganisms and how they can be isolated for study
- CO3: Describe basic principles of food microbiology and media preparation
- CO4: Understand basic techniques used in the observation and identification of microorganisms
- CO5: Recognize various bio-techniques in the enumeration of different compounds
- CO6: Development of various food products via microbial fermentation

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)
I	• Introduction to basic microbiology Laboratory Practices and Equipment's • Cleaning and Sterilization of glassware's	**8**
II	• Study of Compound Microscope • Cultivation and sub-culturing of microbes	**15**
III	• Staining Techniques • Preparation of nutrient media	**15**
IV	• Standard Plate Count Method • Yeast and Mould Count Method • Estimation of Coliforms Count	**10**
V	• Microscopic examination of microorganisms in food products • Biotechnology and Industrial production of food products	**12**

Suggested Readings:

1. Dubey, R. C., & Maheshwari, D. K. (2012). *Practical Microbiology*. S. Chand Pvt. Limited.

2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. Microbiology. (1993). Tata McGrow Hill publication, New Delhi, India.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1

CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** V
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Preservation Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand the principles and methods of food preservation, thermal processing equipment and calculate adequacy of heat treatment.
- CO2: Demonstrate the principles, technology, industrial methods and application of preservation by low temperature.
- CO3: Understand the principles, technology, industrial methods and application of preservation by moisture removal.
- CO4: Understand the principles, technology, industrial methods and application of preservation by irradiation and membrane technology.
- CO5: Understand the uses and effects of chemical preservatives in food Industry with principle, mechanism and application of various novel techniques in food preservation
- CO6: Understand the various conventional and novel food preservation techniques

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)
I	• To study the various processing steps involved in food preservation. • Principle and working of various food processing equipment's • To check the adequacy of Blanching process	**8**
II	• Osmotic concentration/dehydration of certain fruits and vegetables. • Extension of shelf life/ preservation of foods by use of low temperature. • Preservation of foods by Freezing	**15**

III	• Preservation and processing of certain vegetables by drying and dehydration • To study the concept of Asepsis and sterilization • Processing and preservation of Peas by use of high temperature.	**15**
IV	• Preservation of fruit pulp with the help of Chemical preservatives • Determination of pH of different foods using pH meter.	**10**
V	• Preservation of food via Pickling/ Salting/fermentation • Use of technology for minimal processing for preservation of fresh foods • Food preservation using novel processing technique	**12**

Suggested Readings:

1. B. Srilakshmi, Food science, New Age Publishers, 2002
2. Meyer, Food Chemistry, New Age, 2004
3. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title: Food Biotechnology**	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand the basic principles, application, safety, regulations and food authentication methods of food biotechnology.
- CO2: Understand fundamentals of downstream processing and biosensors in food industry
- CO3: Understand natural control of micro-organism and production with control of Aflatoxin
- CO4: Understand all about GMOs and Protein Engineering applications in food industry
- CO5: Understand the biotechnology and industrial production of different food product
- CO6: Biotechnology is tool for various quality measurements in food products like PCR, Immunological methods and DNA based methods. Biotechnology offers various purification operations for food products. Fermented food products manufacturing are based on biotechnology.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Food Biotechnology** • Introduction to Food Biotechnology, basic principles of Gene technology and its application in food industry. Food safety and biotechnology- Impact of Biotechnology on foods. Real time PCR based methods	**8**
II	**Downstream processing** • Principle and types of downstream processing of food products, General types and stages in downstream processing, Bacterial starter culture, Methods of inoculation, media preparation, Slurry processing and product isolation. Biosensors types and applications in food processing.	**15**
III	**Industrial Application** • Biotechnology and industrial production of enzymes, beer, wine, amino acids, organic acids, vitamins, baker's yeast, brewer's yeast and single cell protein.	**15**
IV	• **Other Applications of Bio-Technology** • Applications of bacteriocins in food systems. Various Fermentative Products .Other applications.	**10**

V	**GMO** • Transgenic plants and animals: Current status of transgenic Plants and animals, methods, concept, risks regulation and application, Ethical issues. Protein engineering in Food technology –objectives, methods, limitations and applications (e.g. Lactobacillus, β-galactosidase, nisin and Glucose isomerase).	**12**

Suggested Readings:

1. VK Joshi and Ashok Pandey (1999). Biotechnology- Food fermentation, Volume 1&2 Educational publishers and Distributors.
2. Tombs, M.P. (1991). Biotechnology in Food Industry, Open University Press, Milton Keynes
3. Lee, B.H. (1996). Fundamentals of Food Biotechnology, VCH Publishers.
4. Schwartzberg, A & Rao (1990). Biotechnology & Food Process Engineering.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title:** Research Methodology in Food Science	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Familiarization of various research concepts in food Science
- CO2: Knowledge in formulating research design, hypothesis and and selecting the research problem
- CO3: Identify and discuss the concepts and procedure of sampling, data collection.

- CO4: Identify , explain compare and prepare the key element of a research proposal and report
- CO5: Knowledge of data interpretation and data analysis.
- CO6: Demonstrate the knowledge of research process, research design and complete research hypothesis in research methodology.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Basics of Research in Food Science** • Exploration, Description, Explanation, Scientific method and research, Research Designs – Experimental and Observational, Quantitative and Qualitative approaches Conceptualization and Measurement, Variables, concepts and measurement.	**8**
II	**Sampling & Tools** • Role of sampling in research, Types of sampling, Research Tools and Techniques, Validity and reliability, Interviewing and observational methods	**15**
III	**The Research Process** • Defining the problem, research questions, objectives, hypotheses, Review of related literature and originality in writing, Planning the research, Subjects context and ethics, Methodology and tools, Citation formats: in medical sciences, social sciences	**15**
IV	**Sampling Process** • Exercise in sampling, random number table. Exercise in designing tools and their analysis: interview, questionnaire. 3. Data collection process: conducting interviews, FGDs (FOCUS GROUP DISCUSSION).	**10**
V	**Data Collection** • Levels of measurement, Units of analysis, Case Studies. Results Interpretation	**12**

Suggested Readings:

1) Kumar, R. (2005) Research Methodology: A Step by Step Guide for Beginners. Sage Publications, New Delhi.
2) Kerlinger F. N. and Lee, H.B. (2000) Foundations of Behavioural Research 4th Ed. Harcourt College Publishers
3) Kothari, C. R. (2008) Research Methodology: Methods and Techniques 2nd Ed. New Age International Pvt Ltd, New Delhi.
4) Black, J.A. & Champion, D. J. (1976) Methods and Issues in Social Research. New York: John Wiley and Sons.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Safety and Regulation	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understand general principles of food safety and hygiene.
- CO2: Apply the food safety regulations
- CO3: Recognize the national food laws.
- CO4: Understand the role of international bodied dealingin standardization
- CO5: Recognize current concerns for food safety
- CO6: Prepare for working in food industry and other food laws governing bodies.

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**General Principles for Food Safety and Hygiene** • Principles of food safety and quality –Food Safety System - Quality attributes- Total Quality Management. Introduction to Risk Analysis, Risk Management, Risk Assessment, Risk Communication,CCP, Principles and Implementation of HACCP. Traceability and authentication, Certification and quality assurance**.**	**8**
II	**General Principles for Food Safety Regulation** • The Structure of Food Law, Food Regulation, Laws and Regulations to Prevent Adulteration and Cross Contamination, Microbial Contamination, Hygienic Practice, Chemical and Environmental Contamination, Food Additives, Labelling.	**15**
III	**National Standards** • PFA, FPO, MMPO, MPO, AGMARK, BIS, Environment and Pollution Control Board, Trends in Food Standardization, An Overview and structure of 9001:2000/2008, Clause wise Interpretation of ISO 9001:2000, An overview and Structure of 22000:2005.	**15**
IV	**International Bodies Dealing in Standardization** • International Standardization Organization (ISO), Joint FAO/WHO Food Standards Program. Codex Alimentarius Commission (CAC), Other International Organizations Active in Food Standard Harmonization. Advantages of Utilizing International Standards**.**	**10**
V	**Recent Concerns** • Packaging, Product labelling and Nutritional labelling, Organic foods, Newer approaches to food safety	**12**

Suggested Readings:

1. Lawley, R., Curtis L. and Davis, J. The Food Safety Hazard Guidebook, RSC publishing, 2004

2. De Vries. Food Safety and Toxicity, CRC, New York, 1997

3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985 4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Enzymology	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Comprehend the basic chemistry concept of enzymes and their role.
- CO2: Develop idea for chemistry of enzymes action on food.
- CO3: Different parameters use to evaluate enzyme activity in carbohydrates, proteins and fat.
- CO4: Various enzymes and their role in food. Enzymes as Additives. Differentiation among enzymes and enzyme activity.
- CO5: Recognize the importance and utility of Food enzyme chemistry in food. Basic understanding chemistry with food.
- CO6: Food enzymes used in food preservation and chemicals

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 4-0-0

Unit	Topic	Total No. of Lectures (60)
I	**Enzymes** • Classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases,	**8**

	lipases) used in food industry and their downstream processing.	
II	**Enzymes in processing of food** • Role of enzymes in baking (fungal α-amylase for bread making; maltogenic α-amylases for anti-staling; xylanses and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes); enzymes in meat processing (meat tenderization) and egg processing.	**15**
III	**Role of enzymes in fruit juices** • Liquefaction, clarification, peeling, debittering, decolourization); Enzymes in brewing: Enzymes in malting and mashing, Enzymes for process improvement, starch- haze removal. Other food applications of enzymes: protein cross-linking and oil degumming enzymatic approach to tailor- made fats.	**15**
IV	**Enzyme processing for flavours** • Enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides; flavours from hydrolyzed animal/vegetable protein. Role of enzymes in cheese making, whey processing.	**10**
V	**Other applications** • Enzymes for production of protein hydrolysates and bioactive peptides, maltodextrins and corn syrup solids (liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup), fructose and fructo-oligosaccharides. Enzyme safety and regulations: Safe handling of enzymes, possible health effects & control technology, regulations of enzyme products.	**12**

Suggested Readings:

1. A Wiley- Inter Science Publ. Kruger JE. et al. 1987. Enzymes and their Role in Cereal Technology. American Association of Cereal Chemists Inc.
2. Nagodawithana T & Reed G. 1993. Enzymes in Food Processing. Academic Press. Tucker GA & Woods LFJ. 1991. Enzymes in Food Processing.
3. Whitehurst R & Law B. 2002. Enzymes in Food Technology. Blackwell Publ.
4. Handbook of Food Enzymology Ed. by John R. Whitaker, Marcel Dekker, 2003
5. Enzymes in Industry; Product & Applications Ed. by Wolfgang Aehle, Wiley-VCH, 2004

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title:** Food Biotechnology Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Describe the basic biotechnology tool and techniques
- CO2: Recognize the method used for isolation and purification of nucleic acid
- CO3: Understanding the gel electrophoresis and molecular size determination concept
- CO4:Understanding the importance of quantification of protein
- CO5: Detailed study of assay (ELISA)
- CO6: Describe the biotechnology techniques in details

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of Lectures (60)
I	• Food biotechnology techniques (Basic lab procedures, equipment's, safety and food sampling and storage) • Bioinformatics (Food pathogens related -genes, marker and single nucleotide polymorphism (SNP) analysis using online tools)	**8**
II	• Genomic DNA isolation and purification from food samples • Spectrophotometric determination (DNA quantification and purity) Primer designing & Polymerase Chain Reaction (PCR)	**15**

III	• Agarose gel electrophoresis of DNA RFLP & DNA Molecular Size Determination	**15**
IV	• Quantitative determination of Total proteins by Bradford method • Protein Molecular weight Determination	**10**
V	• SDS- Polyacrylamide slab gel electrophoresis Enzyme linked immunosorbent assay (ELISA)	**12**

Suggested Readings:

1. Smith, S. (2010). *Food Biotechnology: Practical Manual*. Deakin University.
2. Gutiérrez-López, G. F. (2003). *Food science and food biotechnology*. CRC press.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2

Programme/Class: Certificate	**Year:** Third	**Semester:** VI
Subject: Food Science and Technology		
Course Code:	**Course Title:** Research Methodology Lab	

Course outcomes:

After successful completion of this course students will be able to:

- CO1: Understanding the principles and methods of scientific research
- CO2: Acquire the knowledge of approved methodology in the conduct of scientific research
- CO3: Acquire the knowledge about presentation of research data.
- CO4: Understanding of the application of statistics to derive scientific results
- CO5: Familiarize students with descriptive statistics
- CO6 Familiarize students with statistical methods for data analysis

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:** 0-0-4

Unit	Topic	Total No. of

		Lectures (60)
I	• Significance, Purpose and Types of Research • Ethics in Research, Plagiarism • Research Design	**8**
II	• Sampling Methods and Scaling Techniques • Research Tools and Methodology of Data Collection	**15**
III	• Tabulation of Research Data • Graphical Presentation of Data – use of Excel and Statistical Software	**15**
IV	• Measures of Central Tendency – Mean, Mode • Measures of Variability – Range, Variance, Standard Deviation and Standard Error	**10**
V	• Measures of Relationships– Correlation and Regression Analysis • Measures of Shape – Skewness, Kurtosis	**12**

Suggested Readings

1. Krishnan V. 2011. Statistics for Beginners. Atlantic Publishers and Distributors (P) Ltd.
2. Jackson SL. 2012. Research Methods and Statistics: A Critical Thinking Approach. Fourth Edition. Wadsworth Cengage Learning.

Course Articulation Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	1
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2
CO6	3	2	2	2	2