

PERIYAR UNIVERSITY

SALEM-636011



Syllabus for

B.Sc. FOOD TECHNOLOGY

(SEMESTER PATTERN)

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(For Candidates admitted in the Colleges affiliated to
Periyar University from 2026 – 2027 onwards)

REGULATIONS

1. Preamble:

B.Sc. Food Technology curriculum has been structured in compliance with UGC Model curriculum and TANSCH guidelines. Core courses address the science of food, food chemistry, food engineering, food processing and food preservation, food safety and quality assurance, food innovation, food packaging, technology of cereals, pulses, oilseeds, fruits, vegetables, egg, milk, fleshy foods, spices and condiments and food entrepreneurship. The programme empowers the capacity of the students as per the job role specific requirements of food industries.

2. Eligibility for Admission

Candidates for admission to the first year of the Degree of B.Sc. Food Technology shall be required to have passed the Higher Secondary Examinations conducted by the Government of Tamil Nadu or any other equivalent examination.

As per Government Order (2020-2021) G.O.(1D) No.110, Higher Education (G1) Department, dated 18.07.2020.

☐ **ELIGIBILITY: 1.General Stream:** Chemistry with Science subjects like Biology/ Home Science/Botany and Zoology/Computer Science/Computer Applications/Microbiology/Food Service Management/Nutrition and Dietetics

☐ **2.Vocational Stream:** Agriculture/Home Science/Engineering and Technology

Eligibility will be updated as per the Tamilnadu G.O.thereafter.

3. Eligibility for the Award of the Degree

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than three academic years, passed the examinations of all the six semesters prescribed.

4. Courses of Study

The main parts of the study for Bachelor Degree shall consist of the following:

PART-I: Tamil / Other languages

PART-II: English

PART -III: Core Courses, Elective Courses and Allied Courses

PART-IV: SEC*/ NMEC**/Value Education/Disaster Management/Health and Wellness / EVS/ Extension Activities: NSS, NCC, Sports, YRC and other /Internship/Naan Mudhalvan

*Skilled Enhancement Course ** Non- Major Elective

5.Examinations

There shall be six examinations by adhering semester pattern - two in the first year, two in the second year and two in the third year. Candidates failing in any subject / subjects will be permitted to appear for such failed courses at subsequent examinations. The Syllabus has been divided into six semesters. Examinations for I, III and V semesters will be held in November/ December and for II, IV and VI semesters will be held in April / May.

Requirement to appear for the examination: A candidate shall be permitted to appear for the university examinations for any semester (practical/theory) if he / she secure not less than 75% of attendance in the number of working days during the semester.

6. Passing Minimum

A candidate who secures not less than 40% in the End Semester Examination (ESE) and 40% marks in the ESE and Continuous Internal Assessment (CIA) put together in any course of Part I, II, III & IV shall be declared to have passed the Examination in the course (Theory or Practical).

7. Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class. All other successful candidates shall be declared to have passed in the Second Class. Candidates who obtain 75% of the marks in the aggregate shall be declared to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance. Candidates who pass all the examinations (Part I, II, III& IV) prescribed for the course in the **FIRST APPEARANCE ITSELF ALONE** is eligible for ranking.

8. Maximum Duration for the completion of the programme

The maximum duration for completion of the UG Programme shall not exceed twelve semesters (6 years).

9. Commencement of this Regulation:

These regulations shall take effect from the academic year 2026-2027, i.e. for students who are to be admitted to the first year of the B.Sc Food Technology Programme during the academic year 2026-2027 and thereafter.

10. Pattern of Question Paper (All Courses)

The following is the model question paper pattern for B.Sc. Food Technology

Time: 3Hours

Maximum :75Marks

Part A: 15 x1 =15 (Multiple Choice) (Three questions from each unit)

Part B: 2x5= 10(Any Two questions) (One question from each unit)

Part C: 5 x 10 = 50 (One question from each unit with internal choice)

11. Evaluation Pattern for Continuous Internal Assessment (CIA)

11 -A THEORY PAPERS

External Assessment (EA)	Internal Assessment (IA)
75 Marks	25 Marks

Component	Time	Total Marks	IA marks
Test I	2hours	50	10
Test II	2hours	50	10
Assignment (minimum2)/Seminar/Problem Based Activity		10	05
		Total	25

PASS PERCENTAGE (THEORY)

Passing minimum (Internal Assessment) 40%	10marks
Passing minimum (External Assessment) 40%	30marks
Total	40marks

11 - B. PRACTICALS

External Assessment (EA)	Internal Assessment (IA)
60 Marks	40 Marks

Component	Time	Total Marks	IA Marks
Practical Test I	3hours	50	15
Practical Test II	3hours	50	15
Record/Filled in Manual			05
Attendance/Performance Evaluation of the Experiments during the Conduct of the Course			05
Total			40

PROJECT EVALUATION

External Assessment (EA)	Internal Assessment (IA)
75 Marks	25 Marks

PASS PERCENTAGE

Passing minimum (Internal Assessment) 40%	16marks
Passing minimum (External Assessment) 40%	24marks
Total	40marks

PROGRAMME OUTCOMES

PO 1 (Knowledge)

Master fundamental principles of food science, food engineering, and processing technologies. Apply scientific knowledge to ensure food quality, safety, and sustainability. Stay updated with emerging developments in food technology and innovation.

PO 2 (Communication)

Communicate scientific and technical information effectively to industry professionals and consumers. Prepare clear reports, documentation, and presentations related to food production and quality assurance. Demonstrate professional and ethical communication skills.

PO 3 (Critical Thinking)

Analyze food processing operations and quality parameters systematically. Evaluate scientific evidence to solve food-related challenges. Make informed decisions based on technical and regulatory requirements.

PO 4 (Problem Solving)

Identify issues related to food processing, preservation, packaging, and storage. Develop practical and innovative solutions for improving food quality and shelf life. Address industrial and societal challenges through scientific approaches.

PO 5 (Modern Tools)

Utilize modern analytical instruments, laboratory techniques, and digital technologies in food processing and quality control. Apply software tools and automation technologies in food industries. Leverage emerging technologies to enhance productivity and food safety.

PO 6 (Research)

Conduct scientific investigations related to food composition, processing, and product development. Apply statistical and experimental methods for generating reliable data. Contribute to innovations and advancements in food science and technology.

PO 7 (Teamwork)

Collaborate effectively with multidisciplinary teams in food industries, research organizations, and regulatory agencies. Demonstrate leadership skills in managing food production and quality assurance activities. Work responsibly in diverse professional environments.

PO 8 (Ethics)

Adhere to professional ethics and food safety regulations. Ensure consumer protection through responsible manufacturing practices. Promote environmental sustainability and social responsibility in food production systems.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Food Processing and Preservation

Apply principles of food chemistry, microbiology, and engineering to process, preserve, and store food products while maintaining nutritional quality, safety, and shelf life through appropriate technologies and quality control measures.

PSO 2: Food Quality Assurance and Safety Management

Implement food safety systems, HACCP principles, GMP, GHP, and national and international regulatory standards to ensure quality, hygiene, and consumer safety throughout food production and distribution processes.

PSO 3: Food Product Development and Innovation

Develop value-added and functional food products using modern food processing technologies and scientific approaches to improve nutritional quality, sensory characteristics, consumer acceptance, and sustainability while promoting innovation in the food industry.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids. The mapping is based on the revised Bloom's Taxonomy Verbs

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

professional progression.

K1 (Remember)

Recall basic terminology, concepts, and facts related to food chemistry, food microbiology, food engineering, and food processing operations.

K2 (Understand)

Explain scientific principles underlying food composition, preservation methods, packaging systems, and quality attributes of food products.

K3 (Apply)

Apply knowledge and laboratory techniques to food analysis, quality evaluation, processing operations, and food safety practices.

K4 (Analyze)

Analyze food processing parameters, microbial interactions, packaging systems, and quality control data to identify factors affecting product quality and shelf life.

K5 (Evaluate)

Assess the effectiveness of food processing methods, food safety management systems, quality assurance procedures, and industrial operations based on scientific and regulatory standards.

K6 (Create)

Design and develop innovative food products, functional foods, packaging systems, and sustainable processing technologies to address consumer needs and industry challenges.

Teaching Methods

- Lectures
- Group discussions
- Case studies
- Workshops
- Field visits
- Practical demonstrations
- Student seminars

Credits Distribution for UG Programmes

Sem I	C	H	Sem II	C	H	Sem III	C	H	Sem IV	C	H	Sem V	C	H	Sem VI	C	H
Part I Language –Tamil	3	6	Part I Language Tamil	3	6	Part I Language –Tamil	3	6	Part I Language –Tamil	3	6	Part III Core Theory 5	4	5	Part III Core Course 9	5	6
Part II English	3	6	Part II English	3	4	Part II English	3	6	Part II English	3	6	Part III Core Theory 6	4	5	Part III Core Course 10	4	5
Part III Core Theory 1	5	5	Part.III Core Theory 2	5	4	Part.III Core Theory 3	5	5	Part.III Core Theory 4	4	4	Part III Core Theory 7	4	5	Part.III Core Practical 5	3	3
Part III Core Practical 1	4	3	Part.III Core Practical 2	3	3	Part III Core Practical 3	3	3	Part.III Core Practical 4	3	3	Part.III Core Theory 8	4	4	Part III Core Project 1	3	4
Part III Allied Theory 1	4	4	Part.III Allied Theory 2	4	4	Part.III Allied Theory 3	4	4	Part.III Allied Theory 4	4	4	Part. III Elective Theory 1	4	4	Part III Elective Course 2	4	4
Part III Allied practical 1	-	3	Part.III Allied Practical 1	3	3	Part.III Allied Practical 2	3	3	Part.III Allied Practical 3	3	3	Part.IV SEC 2	2	3	Part.III Elective Course 3	4	4
Part.IV NME 1	2	2	Part.IV NME 2	2	2	Part.IV NMSDC	2	2	Part.IV SEC 1	2	2	Part.IV Internship	2	-	Part.IV SEC 3	2	2
VE 1	1	1	Part.IV DM	1	2	Part.IV HW	1	1	Part.IV NMSDC	2	2	Part.IV EVS	2	2	Part.IV NMSDC	2	2
-	-	-	Part.IV NMSDC	2	2	-	-	-	-	-	-	Part.IV NMSDC	2	2	Part.IV EA	1	-
	22	30		26	30		24	30		24	30		28	30		28	30

Total –152 Credits

C-credits **H- Hours** **NME-Non- Major Elective** **SEC-Skill Enhancement Course**
VE- Value Education **DM- Disaster Management** **NMSDC- Naan Mudhalvan** **EA- Extension Activity**
HW- Health and Wellness **EVS –Environmental Studies**

Total Papers- 50 (45+5 NMSDC)

Part -I	Total Papers	Part-II	Total Papers	Part-III	Total Papers		Part-IV	Total Papers	Total
Language Tamil	4	Language English	4	Core	16	10 (Theory) 5 (Practical) 1 (Project)	NME	2	26
				Allied	7	4 (Theory) 3 (Practical)	SEC 2-Theory 1-Practical	3	10
				Elective	3	3 (Theory)	VE	1	4
							DM	1	1
							HW	1	1
							Internship	1	1
							NMSDC	5	5
							EVS	1	1
							Extn	1	1
Total	4		4		26			16	50

CREDITS DISTRIBUTION

Part	Total Papers	Total Credits
I	4	12
II	4	12
III	26	100
IV	16	28
Total	50	152

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	15	15	14	20	23	100
Part IV	3	5	3	4	8	5	28
Total	22	26	24	24	28	28	152

List of Elective papers (Colleges can choose any one of the paper as electives)**Elective –I**

1. Food Quality and Control (or)
2. Food Safety and Standard

Elective-II

1. Convenience Foods (or)
2. Novel Food Technology

Elective-III

1. Basics in Research Methodology (or)
2. Food Toxicology

Allied Subjects

1. SEM I & II Chemistry I & II with Practical I (End Semester)
2. SEM III- Food Microbiology with Practical
3. SEM IV- Food Biotechnology with Practical

##Naan Mudhalvan– Courses - External 25 marks will be assessed by Industry and Internal Marks will be offered by respective course teacher.

Naan Mudhalvan re-appearing students –Alternate SKILL papers are arranged.

Course of Study and Scheme of Examination													
S.No	SEM	Paper Code	Part	Course Group	Paper Type	Subject Title	C	H W	E H	IM	EM	Total Marks	Page No
1	I		I	Foundation	Theory	Tamil/ Other	3	6	3	25	75	100	
2	I		II	Foundation	Theory	English	3	6	3	25	75	100	
3	I		III	Core	Theory	Food Chemistry	5	5	3	25	75	100	16
4	I		III	Core	Practical	Food Chemistry Practical	4	3	3	40	60	100	18
5	I		III	Allied	Theory	Chemistry I	4	4	3	25	75	100	
6	I		III	Allied	Practical	Chemistry Practical - I	-	3	-	-	-	-	
7	I		IV	NME 1	Theory	Food Preservation (other departments)	2	2	3	25	75	100	20
8	I		IV	VE 1	Theory	Value Education	1	1	3	25	75	100	
9	II		I	Foundation	Theory	Tamil/ Other	3	6	3	25	75	100	
10	II		II	Foundation	Theory	English	3	6	3	25	75	100	
11	II		III	Core	Theory	Technology of Food Preservation	5	4	3	25	75	100	22
12	II		III	Core	Practical	Technology of Food Preservation Practical	3	3	3	40	60	100	24
13	II		III	Allied	Theory	Chemistry II	4	3	3	25	75	100	
14	II		III	Allied	Practical	Chemistry Practical II	3	2	3	40	60	100	
15	II		IV	NME 2	Theory	Food Safety and Sanitation (other departments)	2	2	3	25	75	100	26
16	II		IV	DM	Theory	Disaster Management	1	2	3	25	75	100	
17	II		IV	NMSDC	Theory	Overview of English Communication	2	2	3	25	75	100	
18	III		I	Foundation	Theory	Tamil/ Other	3	6	3	25	75	100	
19	III		II	Foundation	Theory	English	3	6	3	25	75	100	
20	III		III	Core	Theory	Unit Operation in Food Processing	5	4	3	25	75	100	28

21	III		III	Core	Practical	Unit Operation in Food Processing Practical	3	3	3	40	60	100	30
22	III		III	Allied	Theory	Food Microbiology	3	3	3	25	75	100	32
23	III		III	Allied	Practical	Food Microbiology Practical	3	3	3	40	60	100	34
	III		IV	SEC 1	Theory	Food Additives and Contaminants	2	2	3	25	75	100	36
24	III		IV	NMSDC	Theory		2	2	3	25	75	100	
25	III		IV	H W	Report	Health and Wellness	1	2	Commended/Highly commend				
26	IV		I	Foundation	Theory	Tamil/ Other	3	6	3	25	75	100	
27	IV		II	Foundation	Theory	English	3	6	3	25	75	100	
28	IV		III	Core	Theory	Processing Technology of Cereals	5	4	3	25	75	100	38
29	IV		III	Core	Practical	Processing Technology of Cereals Practical	5	2	3	40	60	100	40
30	IV		III	Allied	Theory	Food Biotechnology	3	3	3	25	75	100	42
31	IV		III	Allied	Practical	Food Biotechnology Practical	1	2	3	40	60	100	44
	IV		III	Elective 1		1.Food Quality and Control 2.Food Safety and Standard	3	3	3	25	75	100	46 48
32	IV		IV	SEC 2	Theory	Food Product Development	2	2	3	25	75	100	50
33	IV		IV	NMSDC	Theory		2	2	3	25	75	100	
34	V		III	Core	Theory	Processing Technology of Legumes and Oil Seeds	5	6	3	25	75	100	52
35	V		III	Core	Theory	Processing Technology of Dairy	5	6	3	25	75	100	54
36	V		III	Core	Theory	Processing Technology of Legumes and Oil Seeds Practical	5	3	3	25	75	100	56
38	V		III	Elective 2	Theory	1.Convenience Foods	3	5	3	25	75	100	60

						2. Novel Food Technology								62
39	V		IV	SEC 3	Theory	Food Packaging and Labeling	2	2	3	40	60	100		64
40	V		IV	Internship	Training Report	Summer vacation at the end of IV semester activity	2	-	Commended/Highly commend					
41	V		IV	EVS	Theory	Environmental Studies	2	2	3	25	75	100		
42	V		IV	NMSDC	Theory		2	2	3	25	75	100		
43	VI		III	Core	Theory	Processing Technology of Sea Foods and Freshly Foods	5	7	3	25	75	100		66
44	VI		III	Core	Theory	Processing Technology of Fruits and Vegetables	5	7	3	25	75	100		68
45	VI			Core	Practical	Processing Technology of Fruits and Vegetables Practical	3	3	3	25	75	100		70
46	VI		III	Core	Project	Project Viva-Voce	4	4	3	40	60	100		72
47	VI		III	Core	Theory	Functional Foods and Nutraceuticals	4	6	3	25	75	100		74
48	VI		III	Elective 3	Theory	1. Basics in Research Methodology 2.Food Toxicology	4	5	3	25	75	100		76 78
50	VI		IV	NMSDC	Theory	Employability Skill	2	2	3	25	75	100		
51	VI		IV	EA	-	Extension activity	1	-	-	-	-	-		
C-Credits					HW-Hours per Week			EH-Exam Hours						
IM –Internal Marks					EM-External Marks									

❖ **Naan Mudhalvan Paper - Arrear Students – Re-Exam - NMSDC Syllabus (Semesters – II, III, IV, V & VI) Page No: 80 - 84**

***Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

B.Sc. FOOD TECHNOLOGY (Semester Wise Structure)

FIRST YEAR**SEMESTER – I**

Part	Semester I	Course Name	Credit	Hours	Internal	External	Total
I	Language	Tamil/ /Other Languages	3	6	25	75	100
II	Language	English	3	6	25	75	100
III	Core Course1	Food Chemistry	5	5	25	75	100
III	Core Course 2	Food Chemistry Practical	4	3	40	60	100
III	Allied1	Chemistry-I	4	4	25	75	100
III	Allied 2	Chemistry Practical I	-	3	-	-	-
IV	NMEC	Food Preservation (other departments)	2	2	25	75	100
IV	VE	Value Education	1	1	25	75	100
			22	30	230	570	800

SEMESTER – II

Part	Semester II	Course Name	Credit	Hours	Internal	External	Total
I	Language	Tamil/ /Other Languages	3	6	25	75	100
II	Language	English	3	6	25	75	100
III	Core Course 3	Technology of Food Preservation	5	4	25	75	100
III	Core Course 4	Technology of Food Preservation Practical	3	3	40	60	100
III	Allied 3	Chemistry-II	4	3	25	75	100
III	Allied 4	Chemistry Practical II	3	2	40	60	100
IV	NMEC	Food Safety and Sanitation (other departments)	2	2	25	75	100
IV	DM	Disaster Management	1	2	25	75	100
		NMSDC	2	2	25	75	100
			26	30	255	645	900

SECOND YEAR

SEMESTER - III

Part	Semester III	Course Name	Credit	Hours	Internal	External	Total
I	Language	Tamil/ /Other Languages	3	6	25	75	100
II	Language	English	3	6	25	75	100
III	Core Course 5	Unit Operation in Food Processing	5	4	25	75	100
III	Core Course 6	Unit Operation in Food Processing Practical	3	3	40	60	100
III	Allied 5	Food Microbiology	3	3	25	75	100
III	Allied 6	Food Microbiology Practical	1	2	40	60	100
IV	SEC 1	Food Additives and Contaminants	2	2	25	75	100
IV		Health and Wellness	1	2	25	75	100
		NMSDC	2	2	25	75	100
			23	30	255	645	900

SEMESTER - IV

Part	Semester IV	Course Name	Credit	Hours	Internal	External	Total
I	Language	Tamil/ /Other Languages	3	6	25	75	100
II	Language	English	3	6	25	75	100
III	Core Course 7	Processing Technology of Cereals	5	4	25	75	100
III	Core Course 8	Processing Technology of Cereals Practical	5	2	40	60	100
III	Allied 7	Food Biotechnology	3	3	25	75	100
III	Allied 8	Food Biotechnology Practical	1	2	40	60	100
III	Elective 1	1.Food Quality and Control 2.Food Safety and Standard	3	3	25	75	100
IV	SEC 2	Food Product Development	2	2	25	75	100
		NMSDC	2	2	25	75	100
			27	30	255	645	900

*Internship - 15 day's (Summer Vacation)

THIRD YEAR

SEMESTER - V

Part	Semester V	Course Name	Credit	Hours	Internal	External	Total
III	Core Course 9	Processing Technology of Legumes and Oil Seeds	5	6	25	75	100
III	Core Course 10	Processing Technology of Dairy	5	6	25	75	100
III	Core Course 11	Processing Technology of Legumes and Oil Seeds Practical	5	3	40	60	100
III	Elective 2	1.Convenience Foods 2. Novel Food Technology	3	5	25	75	100
IV	SEC 3	Food Packaging and Labeling	2	2	25	75	100
IV	Internship	Summer Internship/Industrial Training	2	-	-	-	-
IV	EVS	Environment Studies	2	2	25	75	100
		NMSDC	2	2	25	75	100
			26	26	190	510	700

SEMESTER - VI

Part	Semester VI	Course Name	Credit	Hours	Internal	External	Total
III	Core Course 12	Processing Technology of Sea Foods and Fleshly Foods	5	7	25	75	100
III	Core Course 13	Processing Technology of Fruits and Vegetables	5	7	25	75	100
III	Core Course 14	Processing Technology of Fruits and Vegetables Practical	3	3	40	60	100
III	Core Project	Project Viva-Voce	4	4	40	60	100
III	Core Course 15	Functional Foods and Nutraceuticals	4	6	25	75	100
III	Elective 3	1. Basics in Research Methodology 2.Food Toxicology	4	5	25	75	100
IV	EA	Extension Activity	1	-	-	-	-
		NMSDC	2	2	25	75	100
			28	34	205	495	700

SYLLABUS

Course Objectives

- To introduce the fundamental concepts of food chemistry and food constituents.
- To understand the structure, properties and functions of water, carbohydrates, proteins and lipids.
- To develop knowledge on chemical changes occurring during food processing and storage.

UNIT I : Introduction to Food Chemistry and Water

Food Chemistry: Definition, scope and importance of food chemistry, Composition of foods, Major and minor food constituents, Functions of food constituents

Water in Foods: Structure and properties of water, Types of water in foods (free and bound water), Water activity (aw) and its significance, Moisture content and food quality, Role of water in food preservation and spoilage.

UNIT II : Carbohydrates: Introduction and Classification-Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides.

Starch: Structure and composition, Gelatinization, Retrogradation, Modified starches, Resistant starch.

Dietary Fibre: Types and functions, Importance in human health.

Functional Properties: Sweetness, Caramelization, Crystallization.

UNIT III : Proteins and Lipids: Proteins, Structure and classification, Amino acids, Essential and non-essential amino acids, Functional properties, Denaturation and coagulation

Lipids: Classification of lipids, Fatty acids, Saturated and unsaturated fats, Physical and chemical properties

Lipid Deterioration: Hydrolytic rancidity, Oxidative rancidity, Prevention of rancidity

UNIT IV : Vitamins and Minerals

Vitamins: Classification, Fat-soluble vitamins (A, D, E and K), Water-soluble vitamins (B-complex and C), Functions, sources and deficiency disorders.

Minerals: Macro minerals, Micro minerals, Functions and food sources, Effect of processing on mineral availability.

UNIT V : Pigments, Flavours, Enzymes and Phytochemicals

Food Pigments: Chlorophyll, Carotenoids, Anthocyanins, Myoglobin

Flavour Compounds: Natural flavours, Artificial flavours, Flavour enhancement

Enzymes: Classification and functions, Enzymatic browning, Non-enzymatic browning

Phytochemicals: Polyphenols, Flavonoids, Antioxidants, Health benefits

TEXT BOOKS:

- 1.Fennema, O.R. (2017). Food Chemistry, 5th Edition, CRC Press.
- 2.deMan, J.M. (2018). Principles of Food Chemistry, 4th Edition, Springer.
- 3.Belitz, H.D., Grosch, W. & Schieberle, P. (2009). Food Chemistry, 4th Edition, Springer.
- 4.Potter, N.N. & Hotchkiss, J.H. (2012). Food Science, 5th Edition, Springer.
- 5.Srilakshmi, B. (2022). Food Science, New Age International.

REFERENCE BOOKS

- 1.Cheung, P.C.K. & Mehta, B.M. (2015). Handbook of Food Chemistry, Springer.
- 2.Hui, Y.H. (2006). Handbook of Food Science, Technology and Engineering, CRC Press.

COURSE OUTCOMES

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

CO	Course Outcomes	K LEVELS
CO1	Recall the basic concepts and constituents of food chemistry.	K1
CO2	Explain the structure, properties and functions of water, carbohydrates, proteins and lipids.	K2
CO3	Apply food chemistry principles in food processing and quality evaluation.	K3
CO4	Analyze the chemical changes occurring during food preparation, processing and storage.	K4
CO5	Evaluate the role of vitamins, minerals, pigments, enzymes and phytochemicals in food quality and nutrition.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	0	1	1	1	3	1	0
CO2	3	1	2	1	0	2	1	1	3	2	1
CO3	3	0	3	2	1	2	1	1	3	2	1
CO4	3	1	3	2	2	2	2	1	2	3	2
CO5	3	1	3	0	2	3	2	1	2	2	3

Semester I	Core Practical - FOOD CHEMISTRY PRACTICAL
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LIST OF EXPERIMENTS

1. Laboratory safety practices and handling of glassware.
2. Determination of pH of food samples.
3. Determination of titratable acidity in food products.
4. Determination of moisture content by hot air oven method.
5. Determination of total solids in food samples.
6. Qualitative tests for carbohydrates.
7. Estimation of reducing sugars.
8. Identification of starch and study of gelatinization.
8. Qualitative tests for proteins.
9. Determination of protein content by Kjeldahl method (Demonstration).
10. Determination of crude fat by Soxhlet extraction method (Demonstration).
11. Determination of peroxide value of edible oils.
12. Determination of ash content in food samples.
13. Detection of common food adulterants in food products.
14. Sensory evaluation of food products.

TEXT BOOKS:

1. Sadasivam, S. and Manickam, A. (2020). Biochemical Methods, 4th Edition, New Age International Publishers, New Delhi.
2. Nielsen, S.S. (2017). Food Analysis Laboratory Manual, 3rd Edition, Springer, New York.
3. Ranganna, S. (2015). Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2nd Edition, Tata McGraw-Hill Publishing Company, New Delhi.
4. Srivastava, R.P. and Kumar, S. (2018). Fruit and Vegetable Preservation: Principles and Practices, International Book Distributing Co., Lucknow.

REFERENCE BOOKS

1. AOAC International (2019). Official Methods of Analysis, 21st Edition, Association of Official Analytical Chemists, Washington D.C.
2. Pomeranz, Y. and Meloan, C.E. (2013). Food Analysis: Theory and Practice, CBS Publishers and Distributors, New Delhi.
3. Srilakshmi, B. (2022). Food Science, 8th Edition, New Age International Publishers, New Delhi.
4. Fennema, O.R. (2017). Food Chemistry, 5th Edition, CRC Press, Boca Raton.

COURSE OUTCOMES

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

CO	Course Outcomes	K LEVELS
CO1	Identify laboratory equipment, reagents and safety procedures used in food chemistry analysis.	K3
CO2	Explain the principles involved in the analysis of food constituents.	K2
CO3	Make use of basic analytical methods for determining moisture, carbohydrates, proteins and lipids in foods.	K3
CO4	Analyze experimental observations and interpret analytical results.	K4
CO5	Evaluate food quality parameters and prepare laboratory records scientifically.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	1	1	1	3	2	0
CO2	3	1	3	2	3	2	1	1	3	3	0
CO3	3	1	3	2	3	2	2	1	3	3	1
CO4	3	2	3	3	3	2	2	1	2	3	2
CO5	3	2	3	3	3	3	2	1	2	2	3

Semester I	NME 1- FOOD PRESERVATION (OTHER MAJORS)
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UNIT I : Introduction to Food Preservation

Food Spoilage - Definition, causes, and microorganisms involved in spoilage of bread, fruits and vegetables, meat, fish, egg, milk, juices and pickles. Classification of foods based on shelf life

Food preservation - Definition, principles and importance, classification–bactericidal and bacteriostatic methods.

UNIT II

Preservation by high temperature: Methods used blanching, pasteurization, sterilization, UHT processing, canning, extraction cooking, dielectric heating, Dehydration.

UNIT III

Preservation by low temperature: Methods commonly used-refrigeration, freezing, dehydro-freezing-advantages and limitations

UNIT IV

Preservation by drying and non-thermal treatments

Preservation by drying, concentration and evaporation: Sun drying, tray or tunnel drying, spray drying, drum drying, freeze drying, fluidized bed drying; advantages and disadvantages.

UNIT V

Preservation by other methods and Food packaging

Preservation by addition of sugar, salt, chemicals, smoking. Irradiation Food additives used in preservation: Definition, types and functions, and safety aspects; permissible limits of preservatives in fruit and vegetable products.

Food packaging-types, advantages and is advantages; Food labeling- types and nutritional information

REFERENCES:

- 1.Arthey.D and Ashurst,P.R (1996), Fruit processing, Blackie academic and professional. London.
- 2.Fellows, P.J(2016): Food Processing Technology: Principles and Practice,2ndedition, CRC Wood head publishing Ltd, Cambridge.
- 3.Gould.G.W (1995),New methods of food preservation. Blackie academic and professional. London.
- 4.ManayS and Shadaksharaswamy.M (2008) Food Facts and Principles, New Age International Publishers, New Delhi.
5. Rahman MS (2020) Hand book of Food Preservation CRC Press, USA
6. Srilakshmi.B(2017) Food Science, New Age International Publications, NewDelhi.
7. Suganthi.V and Subaratinam.R(2021) Text book on Food preservation, Dipti Press (OPC) Pvt. Ltd, Chennai.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	Description	K LEVELS
CO1	Explain the causes of food spoilage, microorganisms involved, and principles of food preservation.	K2
CO2	Describe high-temperature preservation methods such as blanching, pasteurization, sterilization, UHT processing, and canning.	K1
CO3	Apply low-temperature preservation techniques including refrigeration, freezing, and dehydro-freezing.	K3
CO4	Determine the drying and non-thermal preservation methods and Evaluate their advantages and limitations.	K3 K5
CO5	Examine the preservation by sugar, salt, chemicals, smoking, irradiation, food additives, packaging, and food labeling.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	0
CO2	3	1	2	2	1	1	1	1	3	2	1
CO3	3	1	3	2	2	1	2	1	3	2	1
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	2	2	2	1	3	3	3

Semester II	Core Theory - TECHNOLOGY OF FOOD PRESERVATION
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Course Objectives

- Understand the principles of food preservation and food spoilage.
- Explain the role of microorganisms in food deterioration and preservation.
- Describe preservation methods based on temperature, moisture control, and irradiation.
- Evaluate conventional and emerging food preservation technologies.

UNIT I

Principles of Food Preservation; Importance and objectives of food preservation, Food spoilage and shelf life, Microorganisms associated with foods: bacteria, yeasts, molds, Factors affecting microbial growth: temperature, pH, water activity, nutrients, oxygen, Growth curve of microorganisms, Food infection and food intoxication, Classification of foods based on pH and perish ability.

UNIT II

Preservation by Low Temperature: Principles of refrigeration, Cold storage and refrigerated storage, Principles of freezing, Freezing curve, Types of freezing: slow, quick, blast, plate, cryogenic, Changes during freezing and frozen storage, Thawing methods and quality changes

UNIT III

Preservation by High Temperature: Principles of thermal processing, Blanching, Pasteurization, Sterilization and commercial sterilization, Canning technology, Thermal death time, D-value and Z-value (basic concepts).

UNIT IV

Preservation by Moisture Control: Drying and dehydration, Principles of heat and mass transfer, Drying curve, Factors affecting drying rate, Types of dryers used in food industry Evaporation: principles and applications, Types of evaporators used in food industry

UNIT V

Food Irradiation and Emerging Technologies: Principles of food irradiation, Sources and units of radiation, Mechanism of action, Applications of irradiation, Cold sterilization Introduction to High Pressure Processing (HPP), Pulsed Electric Field (PEF), Ozonation.

REFERENCES:

1. Food Processing Technology, Woodhead Publishing, Latest Edition.
2. Food Science, CBS Publishers & Distributors, Latest Edition.
3. Fundamentals of Food Process Engineering, Springer Publications, Latest Edition.
4. Introduction to Food Engineering, Academic Press, Latest Edition.
5. Food Preservation Techniques, Woodhead Publishing, Latest Edition.
6. Handbook of Food Preservation, CRC Press, Latest Edition.
7. Food Processing and Preservation, New Age International Publishers.
8. Essentials of Food Science, Springer Publications.

COURSE OUTCOMES

On successful completion of the course, the students will be able to:

CO	Course Outcomes	K LEVELS
CO1	Explain the principles of food preservation and food spoilage.	K2
CO2	Describe the microorganisms and factors affecting their growth in foods.	K2
CO3	Apply low and high temperature preservation techniques.	K3
CO4	Analyze the drying, dehydration, and evaporation processes.	K4
CO5	Evaluate the food irradiation and modern preservation technologies.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	0
CO2	3	1	2	2	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	1
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	2	2	2	1	3	3	3

Semester II	Core Practical – TECHNOLOGY OF FOOD PRESERVATION PRACTICAL
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Course Objectives

1. Familiarize students with preservation techniques used in food processing.
2. Develop skills in preparation of preserved food products.
3. Apply preservation principles in food product development.

List of Experiments

1. Study of refrigeration and cold storage conditions.
2. Freezing and thawing of food materials.
3. Preparation of fruit squash.
4. Preparation of fruit syrup.
5. Preparation of jam.
6. Preparation of jelly.
7. Preparation of marmalade.
8. Preparation of pickle.
9. Preparation of tomato ketchup/sauce.
10. Drying of fruits and vegetables.
11. Determination of moisture content before and after drying.
12. Study of different food dryers and evaporators.
13. Canning of fruits or vegetables.
14. Shelf-life evaluation of preserved foods.

Industrial visit to cold storage/food preservation unit and submission of report.

REFERENCES:

1. P.J. Fellows – Food Processing Technology: Principles and Practice.
2. Norman N. Potter & Joseph H. Hotchkiss – Food Science.
3. Romeo T. Toledo – Fundamentals of Food Process Engineering.
4. G. Subbulakshmi & Udipi – Food Processing and Preservation.
5. Sivasankar – Food Processing and Preservation.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	Course Outcomes	K LEVELS
CO1	Demonstrate preparation of preserved food products.	K2
CO2	Illustrate the thermal and low-temperature preservation operations.	K3
CO3	Explain the quality parameters of preserved foods.	K1
CO4	Analyze the effect of preservation methods on food quality.	K4
CO5	Evaluate shelf life and storage stability of food products.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	0
CO2	3	1	2	2	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	1
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	2	2	2	1	3	3	3

Semester II	NME 2– FOOD SAFETY AND SANITATION (OTHER MAJOR)
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Course Objectives

- To provide basic knowledge on food safety and food hygiene.
- To familiarize students with food safety regulations and standards.
- To promote safe food practices for consumer health and well-being.

UNIT I

Introduction to Food Safety - Concept and importance of food safety, Food quality and food safety, Safe food and healthy food, Causes of food spoilage, Food safety concerns in daily life, Farm-to-fork concept.

UNIT II

Food Contamination and Food-Borne Diseases - Food contamination: physical, chemical and biological hazards, Sources of contamination, Food adulteration and its effects, Food-borne diseases: causes, symptoms and prevention, Common food poisoning microorganisms, Prevention of food-borne illnesses

UNIT III

Personal Hygiene and Food Sanitation - Importance of personal hygiene, Hygienic food handling practices, Hand washing and personal cleanliness, Sanitation of food premises, Cleaning and disinfection, Waste disposal and pest control

UNIT IV

Safe Food Storage and Handling - Principles of food storage, Storage of perishable and non-perishable foods, Refrigeration and freezing, Safe cooking practices, Food packaging and labeling; Consumer awareness in food purchasing.

UNIT V

Food Safety Standards and Consumer Protection - Introduction to food laws, Role of FSSAI, Food standards and regulations, Food labels and nutritional information, Consumer rights and, responsibilities, Recent trends in food safety.

TEXT BOOKS

- 1.Srilakshmi, B. (2022). Food Science, New Age International Publishers.
- 2.Marriott, N.G. and Gravani, R.B. (2021). Principles of Food Sanitation, Springer.
- 3.Jay, J.M., Loessner, M.J. and Golden, D.A. (2019). Modern Food Microbiology, Springer.

REFERENCE BOOKS

- 1.Adams, M.R. and Moss, M.O. (2018). Food Microbiology, Royal Society of Chemistry.
- 2.Frazier, W.C. and Westhoff, D.C. (2017). Food Microbiology, McGraw Hill.
- 3.Food Safety and Standards Authority of India (FSSAI). Food Safety Training Manuals.

COURSE OUTCOME

On successful completion of the course, the students will be able to

CO	Course Outcomes	K LEVELS
CO1	Recall the basic concepts of food safety and sanitation.	K1
CO2	Explain the causes and consequences of food contamination and food-borne diseases.	K2
CO3	Apply hygienic practices in food handling and storage	K3
CO4	Analyze food safety risks in day-to-day life.	K4
CO5	Evaluate food safety information and consumer protection measures.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	2	2	3	0
CO2	3	1	2	1	1	1	1	2	2	3	0
CO3	3	1	3	2	1	1	2	2	3	3	1
CO4	3	2	3	3	2	1	2	3	3	3	1
CO5	3	2	3	3	3	2	2	3	3	3	2

Semester III	Core Theory – UNIT OPERATIONS IN FOOD PROCESSING
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Learning Objectives

To enable the students to:

- Understand the fundamental principles of unit operations used in food processing industries.
- Analyze the operation and performance of food processing equipment.
- Evaluate emerging technologies, including Artificial Intelligence, in food process optimization and automation.

UNIT I

Introduction to Food Processing

Introduction to Food Processing Industries: Definition and importance of unit processing, Classification of Unit Operations, Process and process flow chart, Physical Properties of Food Preliminary unit operations - Cleaning, washing, sanitation, Sorting, Grading,

UNIT II

Size Reduction and Mixing

Size Reduction – benefits, classification, designation of the fineness of ground material, principles of Heat Transfer: Conduction: Convection and Radiation, Heat Exchangers, Size Reduction Operations, Conveying Systems in Food Industries. Different types of mills and impactors, cutting machines.

UNIT III

Mass Transfer Operations

Fundamentals of Mass Transfer: Drying and Dehydration: Distillation and Extraction, Absorption and Adsorption: Membrane Separation Processes, Osmotic Dehydration

UNIT IV

Mechanical and Separation Operations

Principles of separation and classification, separation methods; screening , types of screens sedimentation, Flow in Food Processing: Mixing and Agitation: Filtration, Centrifugation: Sedimentation, Homogenization and Emulsification

UNIT V

Artificial Intelligence and Emerging Technologies in Food Processing

Introduction to Artificial Intelligence in Food Processing: Machine Learning Applications in Food Manufacturing: AI-Based Quality Inspection and Defect Detection: Predictive Maintenance of Food Processing Equipment: Smart Sensors, IoT, and Automated Process Control: Future Trends in Industry 4.0 for Food Processing.

TEXT BOOKS

1. Unit Operations of Agricultural Processing – K. M. Sahay and K.K.Singh, Vikas Publishing House.
2. Introduction to Food Engineering – Academic Press.
3. Food Process Engineering and Technology – Academic Press.
4. Food Processing Technology: Principles and Practice – Woodhead Publishing.

REFERENCE BOOKS

1. Unit Operations in Food Processing.
2. Transport Processes and Unit Operations.
3. Food Engineering Fundamentals.
4. Handbook of Food Engineering.

E – LEARNING RESOURCES

1. [Institute of Food Technologists \(IFT\)](#)
2. [International Association for Food Protection \(IAFP\)](#)
3. [United States Department of Agriculture \(USDA\)](#)
4. [Food Safety and Standards Authority of India \(FSSAI\)](#)

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	Corse outcome	K LEVEL
CO1	Explain the principles and applications of various unit operations involved in food processing.	K2
CO2	Analyze heat and mass transfer processes and their role in food preservation and quality maintenance	K4
CO3	Select suitable mechanical and separation operations for specific food processing requirements.	K1
CO4	Evaluate the performance of food processing equipment and optimize processing parameters.	K5
CO5	Apply Artificial Intelligence and emerging digital technologies for process monitoring, quality control, and automation in food industries.	K3

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	0
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	1
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester III	Core Practical - UNIT OPERATIONS IN FOOD PROCESSING PRACTICALS
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Learning Objectives

Enable Students to

- Understand the principles and operation of equipment used in food processing industries.
- Analyze process parameters and evaluate the efficiency of food processing operations.
- Develop skills in handling, maintenance, and troubleshooting of food processing equipment.

LIST OF PRACTICAL EXPERIMENTS

1. Study of material handling equipment used in food industries.
2. Determination of particle size distribution using sieve analysis.
3. Performance evaluation of size reduction equipment (grinder/pulverizer).
4. Verifying flow rates and pressure drops through pipes and valves.
5. Experiments analyzing the efficiency of plate or shell and tube heat exchangers.
6. Plotting Thermal Death time (TDT) curves and calculate the values to ensure commercial sterility.
7. Determination of drying characteristics and drying rate of food materials.
8. Study of moisture content determination by oven drying method
9. Extraction of natural pigments/flavors from food materials.
10. Study of homogenization and emulsion stability.
11. AI-assisted quality evaluation using image analysis of food products.
12. Demonstration of smart sensors and automated process monitoring systems in food processing.

TEXT BOOKS

1. Unit Operations of Agricultural Processing, Vikas Publishing House.
2. Introduction to Food Engineering, Academic Press.
3. Food Process Engineering and Technology, Academic Press.
4. Food Processing Technology: Principles and Practice, Woodhead Publishing.

REFERENCE BOOKS

1. Unit Operations in Food Processing.
2. Transport Processes and Unit Operations.
3. Handbook of Food Engineering.
4. Food Engineering Fundamentals.
5. Food Engineering Practice.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	COURSE OUTCOME	K LEVEL
CO1	Demonstrate the operation and working principles of food processing equipment used in various unit operations.	K2
CO2	Experiments related with heat transfer, mass transfer, and mechanical operations and interpret the results are analysed.	K3
CO3	Analyze processing parameters and evaluate the performance and efficiency of food processing systems.	K4
CO4	Select and List out the experimental skills for quality control, process optimization, and equipment maintenance.	K1
CO5	Assess the digital tools, smart sensors, and Artificial Intelligence techniques for monitoring and improving food processing operations.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	1	1	1	3	1	0
CO2	3	1	3	2	3	1	2	1	3	2	1
CO3	3	1	3	2	3	1	2	1	3	2	1
CO4	3	2	3	3	3	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester III	Allied Theory – FOOD MICROBIOLOGY
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Learning Objectives

- Apply microbiological principles in food preservation, processing, and quality assurance.
- Evaluate food safety hazards and microbiological standards in food production and distribution systems.
- Utilize modern microbiological techniques and emerging technologies for food quality control and food safety management.

Unit I: Introduction and Scope

History and development of food microbiology. Beneficial microbes, Parameters affecting microbial growth: Intrinsic factors (pH, nutrient content, a_w water activity) and Extrinsic factors (temperature, humidity, atmosphere). Factors affecting microbial growth.

Unit II: Food Spoilage and Contamination

Contamination, spoilage, and preservation of plant-based foods (fruits, vegetables, juices, legumes, cereals, and nuts).

Spoilage of animal-based and processed foods (meat, poultry, fish, and dairy products, bakery products).

Unit III: Foodborne Diseases and Intoxication,

Food infections (Salmonellosis, E. coli, Shigellosis, Listeriosis).

Food intoxications (Staphylococcus, Clostridium). Fungal toxins (mycotoxins, aflatoxins).

Pathogenesis and symptoms of food borne illnesses.

Unit IV: Beneficial Microorganisms and Fermentation

Role of microbes (Bacteria, Yeasts, molds in fermented foods (curd, cheese, sauerkraut, bread, alcoholic beverages and soy-based foods).

Prebiotics – Probiotics – Health benefits, Gut microbiome, and Industrial production of fermented beverages and vinegar, Production of single-cell proteins and probiotics.

Unit V: Food Preservation and Quality Control

Principles of food preservation (high temperatures, low temperatures, irradiation, and chemical preservatives).

Detection Methods – Conventional culture techniques, microscopic analysis and rapid methods (PCR, ELISA, Immunological assays), Microbiological evaluation and standards, Food safety management systems and regulations: Introduction to HACCP, FDA, and FSSAI guidelines

References

Text Books

1. **Frazier, W. C., & Westhoff, D. C. (2013).** *Food Microbiology* (5th Edition). New Delhi: Tata McGraw-Hill Education Pvt. Ltd. ISBN: 978-0070701868.
2. **Jay, J. M., Loessner, M. J., & Golden, D. A. (2005).** *Modern Food Microbiology* (7th Edition). New York: Springer Science & Business Media. ISBN: 978-0387231805.
3. **Adams, M. R., & Moss, M. O. (2015).** *Food Microbiology* (4th Edition). Cambridge, United Kingdom: Royal Society of Chemistry. ISBN: 978-1782625022.
4. **Banwart, G. J. (2012).** *Basic Food Microbiology* (2nd Edition). New York: Springer. ISBN: 978-1461576119.

Reference Books

1. **Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (2019).***Food Microbiology: Fundamentals and Frontiers* (5th Edition). Washington, DC: ASM Press.ISBN: 978-1555819979.
2. **Montville, T. J., Matthews, K. R., & Kniel, K. E. (2017).***Food Microbiology: An Introduction* (4th Edition). Washington, DC: ASM Press.ISBN: 978-1555819979.
3. **Ray, B., & Bhunia, A. K. (2013).***Fundamental Food Microbiology* (5th Edition). Boca Raton, Florida: CRC Press.ISBN: 978-1466509389.
4. **Tortora, G. J., Funke, B. R., & Case, C. L. (2021).***Microbiology: An Introduction* (13th Edition). Pearson Education.ISBN: 978-0134605187.
5. **Prescott, L. M., Harley, J. P., & Klein, D. A. (2017).***Prescott's Microbiology* (10th Edition). McGraw-Hill Education.ISBN: 978-1259281591.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	COURSE OUTCOME	K LEVEL
CO1	Describe the classification, structure, growth, and metabolism of microorganisms relevant to food systems.	K1
CO2	Differentiate beneficial and harmful microorganisms involved in food fermentation, spoilage, and foodborne infections.	K2
CO3	Apply microbiological methods for the detection, enumeration, and control of microorganisms in foods.	K3
CO4	Analyze the principles of food preservation and food safety measures used to prevent microbial contamination.	K4
CO5	Evaluate microbiological quality assurance systems and emerging technologies used in food safety monitoring and management.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	1	2	3	0
CO2	3	1	2	1	1	2	1	2	2	3	0
CO3	3	1	3	2	2	2	2	2	3	3	1
CO4	3	2	3	3	2	2	2	2	3	3	1
CO5	3	2	3	3	2	3	2	2	3	3	2

Semester III	Allied Practical – FOOD MICROBIOLOGY PRACTICAL
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Learning Objectives

- Develop laboratory skills for the isolation, cultivation, identification, and enumeration of food microorganisms.
- Perform microbiological analyses to assess the quality and safety of food products.
- Apply aseptic techniques and standard microbiological methods for food quality control and food safety evaluation.

Practical Exercises

1. Staining techniques for microbes (bacteria, yeasts, molds, fungi).
2. Serial dilution and standard plate count method.
3. Determination of Total Viable Count (TVC) in food samples.
4. Enumeration of yeast and molds in food products.
5. Water quality testing.
6. Detection of coliforms using MPN technique.
7. Isolation and identification of common food spoilage microorganisms.
8. Detection of microbial contamination in processed foods.
9. Preparation and microbiological evaluation of fermented food products.
10. Assessment of microbial quality of fermented milk products.
11. Demonstration of rapid microbial detection methods and digital colony counting systems.

Text Books

1. Frazier, W. C., & Westhoff, D. C. (2013). *Food Microbiology* (5th Edition). New Delhi: Tata McGraw-Hill Education Pvt. Ltd. ISBN: 978-0070701868.
2. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). *Modern Food Microbiology* (7th Edition). New York: Springer Science & Business Media. ISBN: 978-0387231805.
3. Adams, M. R., & Moss, M. O. (2015). *Food Microbiology* (4th Edition). Cambridge, UK: Royal Society of Chemistry. ISBN: 978-1782625022.
4. Banwart, G. J. (2012). *Basic Food Microbiology* (2nd Edition). New York: Springer. ISBN: 978-1461576119.

Reference Books

1. Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (2019). *Food Microbiology: Fundamentals and Frontiers* (5th Edition). Washington, DC: ASM Press. ISBN: 978-1555819979.
2. Ray, B., & Bhunia, A. K. (2013). *Fundamental Food Microbiology* (5th Edition). Boca Raton, Florida: CRC Press. ISBN: 978-1466509389.
3. Montville, T. J., Matthews, K. R., & Kniel, K. E. (2017). *Food Microbiology: An Introduction* (4th Edition). ASM Press. ISBN: 978-1555819979.
4. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). *Prescott's Microbiology* (10th Edition). McGraw-Hill Education. ISBN: 978-1259281591.
5. Cappuccino, J. G., & Welsh, C. T. (2020). *Microbiology: A Laboratory Manual* (12th Edition). Pearson Education. ISBN: 978-0135188993.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

CO	COURSE OUTCOME	K LEVEL
CO1	Demonstrate laboratory safety procedures, aseptic techniques, and sterilization methods used in food microbiology laboratories.	K1
CO2	Examine to Perform staining, microscopic observation, and identification of microorganisms associated with food systems.	K4
CO3	Apply standard microbiological methods for isolation, enumeration, and analysis of microorganisms in food samples.	K3
CO4	Evaluate microbiological quality and safety of foods, water, and food processing environments using laboratory techniques.	K5
CO5	Interpret microbiological data and assess the role of microorganisms in food fermentation, spoilage, and food safety management.	K2

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	2	1	1	2	3	0
CO2	3	1	3	2	3	2	2	2	2	3	0
CO3	3	1	3	2	3	3	2	2	3	3	1
CO4	3	2	3	3	3	3	2	2	3	3	1
CO5	3	2	3	3	3	3	2	2	3	3	2

Semester III	SEC 1 – FOOD ADDITIVES AND CONTAMINANTS
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Learning Objectives

- Understand the classification, functions, and applications of food additives used in food processing and preservation.
- Identify various food contaminants and evaluate their impact on food quality, safety, and public health.
- Apply food safety regulations and quality control measures related to food additives and contaminants.

UNIT I: Introduction to Food Additives

Definition, classification, and functions of food additives: History and significance of food additives: Types of food additives: Natural and synthetic additives: Regulatory aspects of food additives: Safety evaluation and acceptable daily intake (ADI).

UNIT II: Preservatives, Antioxidants, and Sweeteners

Food preservatives: Types and applications, Antioxidants and their role in food preservation: Natural and artificial sweeteners: Flavor enhancers and flavoring agents: Regulations governing the use of preservatives and sweeteners

UNIT III: Colorants, Emulsifiers, and Stabilizers

Natural and synthetic food colors: Emulsifiers and stabilizers: Thickening and gelling agents: Anti-caking agents and humectants: Applications in processed foods

UNIT IV: Food Contaminants and Their Sources

Definition and classification of food contaminants: Biological contaminants: Bacteria, viruses, molds, and toxins: Chemical contaminants: Pesticide residues, heavy metals, veterinary drug residues: Physical contaminants in foods: Environmental contamination and food safety concerns

UNIT V: Food Safety Regulations and Emerging Issues

Food safety standards and regulations: Risk assessment and risk management of contaminants: Detection and monitoring of food contaminants: Food labeling requirements related to additives: Emerging contaminants and consumer awareness

Text Books

1. **Branen, A. L., Davidson, P. M., Salminen, S., & Thorngate, J. H. (2001).** *Food Additives* (2nd Edition). New York: Marcel Dekker Inc. ISBN: 978-0824709348.
2. **Madhavi, D. L., Deshpande, S. S., & Salunkhe, D. K. (1996).** *Food Antioxidants: Technological, Toxicological and Health Perspectives*. New York: Marcel Dekker Inc. ISBN: 978-0824793521.
3. **Shibamoto, T., & Bjeldanes, L. F. (2009).** *Introduction to Food Toxicology* (2nd Edition) Burlington, Massachusetts: Academic Press. ISBN: 978-0123742862.
4. **Belitz, H. D., Grosch, W., & Schieberle, P. (2009).** *Food Chemistry* (4th Edition). Berlin: Springer-Verlag. ISBN: 978-3540699337.

Reference Books

1. **Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017).** *Fennema's Food Chemistry* (5th Edition). Boca Raton, Florida: CRC Press. ISBN: 978-1493923431.

2. **Bhat, R. V., & Rao, B. S. N. (2001).***Food Safety in Food Security and Food Trade*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
3. **Watson, D. H. (2001).***Food Chemical Safety: Contaminants*. Cambridge, United Kingdom: Woodhead Publishing. ISBN: 978-1855736075.
4. **Rees, N., Watson, D., & Levesque, A. (2000).***Food Chemical Safety Volume 2: Additives*. Cambridge, United Kingdom: Woodhead Publishing.
5. **Motarjemi, Y., Moy, G., & Todd, E. (2014).***Encyclopedia of Food Safety*(Volumes 1–5). London: Academic Press. ISBN: 978-0123786125.

COURSE OUTCOMES

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the classification, functions, and applications of food additives used in food processing.	K1
CO2	Differentiate various food additives and evaluate their technological and nutritional significance.	K2
CO3	Identify biological, chemical, and physical contaminants and their sources in food systems.	K3
CO4	Assess the impact of food contaminants on food quality, safety, and public health.	K5
CO5	Apply food safety regulations and quality assurance measures related to food additives and contaminants.	K3

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	2	2	3	0
CO2	3	1	2	1	1	1	1	2	2	3	1
CO3	3	1	3	2	2	1	2	2	3	3	1
CO4	3	2	3	3	3	2	2	3	3	3	2
CO5	3	2	3	3	3	2	2	3	3	3	2

Semester IV	Core Theory- PROCESSING TECHNOLOGY OF CEREALS
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Learning Objectives

To enable the students to:

- Understand the structure, composition, quality characteristics, and processing principles of major cereals and millets.
- Apply various cereal processing technologies for the production of value-added cereal-based products
- Evaluate quality, safety, storage, packaging, and recent technological advancements in cereal processing industries.

UNIT I

Introduction to Cereals and Millets

Classification and importance of cereals and millets, Structure and composition of cereal grains, Physical and chemical properties of cereals, Structure, composition and nutritive value of cereal grains such as wheat, maize, barley, sorghum, millets, oats and rye, Quality characteristics and grading of cereals.

UNIT II

Primary Processing of Cereals

Cleaning, grading, sorting, and conditioning, De-husking and milling of rice, Wheat milling technology and flour production, Corn milling (dry and wet milling), Parboiling of rice and its effects on quality. Effect of processing on nutritive value of cereals, changes in physiochemical properties of cereal starch due to processing.

UNIT III

Secondary Processing and Value Addition

By products of cereal processing and its utilization, breakfast cereals, and extrusion changes in physiochemical properties of cereal starch due to processing, Changes in physiochemical properties of protein due to processing.

Storage of cereal grains and its product and the changes in quality. Production of semolina, flour, starch, malt, and cereal flakes, Extrusion cooking technology, Breakfast cereals and ready-to-eat products, Instant mixes and convenience foods, Traditional cereal-based foods and processing techniques

UNIT IV

Quality Evaluation, Storage and Packaging

Quality parameters of cereal products, Functional properties of cereal flours, Storage behavior of cereals and cereal products, Packaging materials and methods, Prevention of post-harvest losses and pest management

UNIT V

Advanced Processing Technologies and Industrial Applications

Novel processing technologies in cereal industries, Fortification and enrichment of cereal products, Development of functional and nutraceutical cereal foods, Automation in cereal processing industries, Recent trends and future prospects in cereal processing.

Text Books

1. Kent, N.L. and Evers, A.D. (2018). **Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture** (5th Edition). Woodhead Publishing, Cambridge, UK.

- 2.Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V. and Ramaswamy, H.S. (2013). **Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea and Spices**. CRC Press, Boca Raton, Florida, USA.
- 3.Lorenz, K.J. and Kulp, K. (1991). **Handbook of Cereal Science and Technology**. Marcel Dekker Inc., New York, USA.

Reference Books

- 1.Kulp, K. and Ponte, J.G. (2000). **Handbook of Cereal Science and Technology** (2nd Edition). CRC Press, Boca Raton, Florida, USA.
- 2.Owens, G. (2001). **Cereals Processing Technology**. Woodhead Publishing Ltd., Cambridge,UK.
- 3.Hoseney, R.C. (1998). **Principles of Cereal Science and Technology** (2nd Edition). American Association of Cereal Chemists (AACC), Minnesota, USA.
- 4.Matz, S.A. (1991). **The Chemistry and Technology of Cereals as Food and Feed** (2nd Edition). AVI Publishing Company, Connecticut, USA.
- 5.Samuel, A. Matz (1996). **Snack Food Technology**. Springer Publications, USA.

COURSE OUTCOMES

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the structure, composition, nutritional value, and quality characteristics of cereals and millets	K1
CO2	Demonstrate knowledge of primary cereal processing operations such as cleaning, grading, milling, and parboiling.	K2
CO3	Apply secondary processing technologies for the development of value-added cereal products.	K3
CO4	Evaluate quality, storage stability, packaging requirements, and safety aspects of cereal products.	K5
CO5	Analyze modern processing technologies, fortification strategies, and emerging trends in cereal processing industries	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	1
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	2
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester IV	Core Practical- PROCESSING TECHNOLOGY OF CEREALS PRACTICALS
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Learning Objectives

- Perform various cereal processing operations such as cleaning, grading, milling, and value addition using standard laboratory and pilot-scale equipment.
- Analyze the physical, chemical, and quality characteristics of cereals and cereal-based products using appropriate testing methods.
- Develop and evaluate value-added cereal products while understanding quality control, packaging, and storage practices.

Practical Exercises

1. Identification of rice, wheat, maize, barley, oats, sorghum, and millets.
2. Determination of physical properties of cereal grains - grain dimensions, shape, and size, Measurement of bulk density and true density, Determination of thousand-kernel weight, Grain grading and quality assessment.
3. Cleaning and grading of cereal grains - Conditioning and tempering of grains,
4. Rice dehusking and polishing studies.
5. Milling characteristics of wheat and maize - Determination of milling yield, Calculation of milling efficiency and yield.
6. Determination of Moisture determination in cereals and flours - Water absorption capacity.
7. Evaluation of flour quality characteristics, flour particle size distribution, Functional properties of cereal flours - Sensory evaluation techniques in all cereals.
8. Preparation of cereal flakes - Development of ready-to-eat cereal products.
9. Preparation of extruded cereal products, Preparation of millet-based snacks,
10. Development of traditional cereal-based foods - Formulation of fortified cereal mixes.
11. Packaging of cereal products using different materials.
12. Quality control testing of packaged cereal products.
13. Shelf-life assessment of cereal products.

Text Books

1. Kent, N.L. and Evers, A.D. (2018). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture (5th Edition). Woodhead Publishing, Cambridge, UK.
2. Owens, G. (2001). Cereals Processing Technology. Woodhead Publishing Limited, Cambridge, United Kingdom.
3. Hoseney, R.C. (1998). Principles of Cereal Science and Technology (2nd Edition). American Association of Cereal Chemists, Minnesota, USA.

Reference Books

1. Kulp, K. and Ponte, J.G. (2000). Handbook of Cereal Science and Technology (2nd Edition). CRC Press, Boca Raton, Florida, USA.
2. Lorenz, K.J. and Kulp, K. (1991). Handbook of Cereal Science and Technology. Marcel Dekker Inc., New York, USA.
3. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V. and Ramaswamy, H.S. (2013). Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea and Spices. CRC Press, USA.
4. Matz, S.A. (1991). The Chemistry and Technology of Cereals as Food and Feed (2nd Edition). AVI Publishing Company, Connecticut, USA.
5. Pomeranz, Y. (1988). Wheat: Chemistry and Technology (3rd Edition). American Association of Cereal Chemists, Minnesota, USA.

COURSE OUTCOMES

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

CO	COURSE OUTCOME	K LEVEL
CO1	Identify and evaluate the physical characteristics and quality attributes of cereals and millets.	K3
CO2	Demonstrate the Perform primary cereal processing operations including cleaning, grading, dehusking, and milling.	K2
CO3	Analyze functional and quality properties of cereal flours and cereal-based products and List out.	K4 K1
CO4	Develop and evaluate value-added cereal products using appropriate processing techniques.	K3 K5
CO5	Apply packaging, storage, and quality control methods for maintaining the quality and safety of cereal products.	K3

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	1	1	1	3	1	1
CO2	3	1	3	2	3	1	2	1	3	2	1
CO3	3	1	3	2	3	2	2	1	3	2	2
CO4	3	2	3	3	3	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester IV	Allied Theory- FOOD BIOTECHNOLOGY
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Learning Objectives

- Understand the principles of biotechnology and their applications in food processing, preservation, and product development.
- Apply biotechnological tools and techniques for improving food quality, safety, nutrition, and shelf life.
- Evaluate the role of genetic engineering, microbial biotechnology, and novel biotechnological innovations in the food industry.

Unit -I

Introduction to food biotechnology

Introduction to food biotechnology and related industries; Definition, scope, and importance of food biotechnology, History and development of biotechnology, Basic concepts of molecular biology, Cell structure and functions, Applications of biotechnology in the food industry.

Unit-II

Microbial Biotechnology in Food Processing

Industrially important microorganisms, Microbial growth and fermentation principles, Starter cultures in food processing, Production of fermented foods and beverages, Probiotics and prebiotics in food systems, Probiotics: Production & importance of probiotics.

Unit -III

Fermented foods, and Cheese production technologies; Fermented foods of India: dairy products, cereal and legume foods, vegetables/fruits, meat and fish; Aseptic packaging of foods: sterilization techniques of packaging materials; Methods for the microbiological examination of foods. Advantages/ functions and disadvantages associated with packaging of foods.

Unit-IV

Nutraceuticals and functional foods, transgenic plant foods: carbohydrates, proteins, vitamins nutritional quality improvement of the food crops by genetic engineering, safety of GM food crops. Dietary supplements; Single cell Protein (SCP) production, mushrooms production technology, large scale production of algae and yeast.

Unit-V

Enzymes Technology And Emerging Trends

Classification and characteristics of enzymes, Enzyme production and immobilization Applications of enzymes in food processing, Enzymes in dairy, bakery, beverage, and starch industries, Biotechnological improvement of food quality, Nanobiotechnology in food system, Biotechnology for food safety and quality assurance, Biosensors in food analysis, Future prospects of food biotechnology.

Text Books

1. Bielecki, S. and Tramper, J. (Eds.) (2014). Food Biotechnology. Elsevier Academic Press, Amsterdam, Netherlands.
2. Kalidas Shetty, Gopinadhan Paliyath, Alan Pometto and Robert Levin (2006). Food Biotechnology (2nd Edition). CRC Press, Boca Raton, Florida, USA.
3. Ramesh C. Ray and Didier Montet (2017). Microorganisms and Fermentation of Traditional Foods. CRC Press, Taylor & Francis Group, USA.

Reference Books

- 1.Joshi, V.K. and Pandey, A. (2009). Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Educational Publishers and Distributors, New Delhi, India.
- 2.Waites, M.J., Morgan, N.L., Rockey, J.S. and Higon, G. (2013). Industrial Microbiology: An Introduction (2nd Edition). Wiley-Blackwell, United Kingdom.
- 3.Prescott, L.M., Harley, J.P. and Klein, D.A. (2017). Microbiology (10th Edition). McGraw-Hill Education, New York, USA.
- 4.Crueger, W. and Crueger, A. (2017). Biotechnology: A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi, India.
- 5.Stanbury, P.F., Whitaker, A. and Hall, S.J. (2016). Principles of Fermentation Technology (3rd Edition). Butterworth-Heinemann, Elsevier, Oxford, UK.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the basic concepts, principles, and applications of biotechnology in food systems	K1
CO2	Describe the role of microorganisms and fermentation technologies in food production and preservation.	K2
CO3	Apply genetic engineering and recombinant DNA techniques in food biotechnology applications.	K3
CO4	Evaluate the importance of enzymes and biotechnological interventions in food processing industries.	K4
CO5	Analyze emerging trends and innovations in food biotechnology for sustainable food production and safety.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	1	2	1	3
CO2	3	1	2	1	1	2	1	1	2	2	3
CO3	3	1	3	2	2	2	2	1	2	2	3
CO4	3	2	3	3	2	3	2	2	3	2	3
CO5	3	2	3	3	3	3	2	2	3	2	3

Semester IV	Allied Practical- FOOD BIOTECHNOLOGY PRACTICAL
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Learning Objectives

- Develop skills in handling microorganisms, fermentation processes, and

biotechnological techniques used in food industries.

- Perform laboratory experiments related to microbial cultivation, enzyme applications, and food biotechnology analysis.
- Apply biotechnology principles for improving food quality, safety, preservation, and value-added food production.

List of Experiments

1. Isolation and identification of food microorganisms - Isolation of bacteria, yeast, and molds from food sources.
2. Preparation of nutrient broth, nutrient agar, and selective media, Media sterilization using autoclave.
3. Determination of sugar fermentation by microorganisms, Gas production studies
4. Preparation of fermented food products – Bread fermentation and dough development studies, probiotics and prebiotics in food products
5. Preparation of curd/yogurt using starter cultures,
6. Determination of microbial quality of yogurt and fermented beverages,
7. Enzyme activity assays in food systems- Amylase activity determination. Effect of temperature and pH on enzyme activity, Sterilization techniques and aseptic practices.
8. Pure Culture Techniques - Streak plate, spread plate, and pour plate methods, Maintenance of pure cultures.
9. Enumeration of Microorganisms - Simple staining, Gram staining of bacterial cultures, Standard Plate Count (SPC) of food samples, Calculation of microbial load.
10. Monitoring microbial growth phases using spectrophotometric methods.
11. Screening microorganisms for enzyme production
12. Isolation of *Lactobacillus* spp. from fermented foods, Assessment of probiotic characteristics
13. Case study on genetically modified foods and biosafety regulations.
14. Literature review on recent advances in food biotechnology.

Text Books

1. Cappuccino, J.G. and Welsh, C.T. (2017). Microbiology: A Laboratory Manual (11th Edition). Pearson Education, New York, USA.
2. Benson, H.J. (2015). Microbiological Applications: Laboratory Manual in General Microbiology (14th Edition). McGraw-Hill Education, New York, USA.
3. Harley, J.P. (2016). Laboratory Exercises in Microbiology (10th Edition). McGraw-Hill Education, New York, USA.

Reference Books

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2016). Principles of Fermentation Technology (3rd Edition). Butterworth-Heinemann, Elsevier, Oxford, UK.
2. Prescott, L.M., Harley, J.P. and Klein, D.A. (2017). Microbiology (10th Edition). McGraw-Hill Education, New York, USA.

3. Crueger, W. and Crueger, A. (2017). *Biotechnology: A Textbook of Industrial Microbiology*. Panima Publishing Corporation, New Delhi, India.
4. Waite, M.J., Morgan, N.L., Rockey, J.S. and Higon, G. (2013). *Industrial Microbiology: An Introduction* (2nd Edition). Wiley-Blackwell, United Kingdom.
5. Shetty, K., Paliyath, G., Pometto, A. and Levin, R.E. (2006). *Food Biotechnology* (2nd Edition). CRC Press, Boca Raton, Florida, USA.
6. Frazier, W.C. and Westhoff, D.C. (2008). *Food Microbiology* (4th Edition). Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Demonstrate safe laboratory practices and aseptic techniques used in food biotechnology laboratories.	K2
CO2	Isolate, cultivate, and identify food-related microorganisms using standard microbiological methods.	K3
CO3	Perform fermentation and enzyme-based experiments relevant to food biotechnology applications.	K1
CO4	Evaluate the role of microorganisms and enzymes in food processing, preservation, and quality improvement.	K5
CO5	Develop and assess value-added fermented and probiotic food products using biotechnological approaches.	K3 K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	2	1	1	2	1	3
CO2	3	1	3	2	3	2	2	1	2	2	3
CO3	3	1	3	2	3	3	2	1	2	2	3
CO4	3	2	3	3	3	3	2	2	3	2	3
CO5	3	2	3	3	3	3	2	2	3	2	3

Semester IV	Elective Theory - 1. FOOD QUALITY AND CONTROL
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Learning Objectives

- Understand the concepts, principles, and significance of food quality control and quality assurance in food industries.

- Apply analytical, sensory, microbiological, and regulatory approaches for evaluating food quality and safety.
- Develop skills in implementing quality management systems, food standards, and quality control measures throughout food production and processing.

UNIT I

Fundamentals of Food Quality and Quality Control

Definition and the Concept of food quality and quality attributes, Factors affecting food quality, Quality control and quality assurance concepts, Quality costs and quality management principles, Total Quality Management (TQM) in food industries

UNIT II

Food Quality Evaluation Techniques

Physical methods of quality evaluation, Chemical methods of food analysis, Instrumental methods of food quality assessment, Sensory evaluation of foods, Sampling procedures and statistical quality control

UNIT III

Microbiological Quality and Food Safety

Microbiological standards for foods, Food spoilage and foodborne pathogens, Microbiological testing methods, Food hygiene and sanitation, Analysis and Critical Control Point (HACCP)

UNIT IV

Food Standards, Regulations and Quality Management Systems

National and international food standards, Food Safety and Standards Authority of India (FSSAI), Codex Alimentarius standards, ISO 9001, ISO 22000 and Food Safety Management Systems, Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP).

UNIT V

Quality Assurance in Food Processing Industries

Quality assurance programs, Traceability systems in food industries, Documentation and auditing procedures, Quality control in dairy, cereal, fruit, vegetable, meat, and processed food industries, Recent advances in food quality control and future trends.

Text Books

- 1.Kramer, A. and Twigg, B.A. (2012). Quality Control for the Food Industry (4th Edition). Springer Science & Business Media, New York, USA.
- 2.Ranganna, S. (2014). Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edition). Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.
- 3.Nielsen, S.S. (2017). Food Analysis (5th Edition). Springer International Publishing, Switzerland.

Reference Books

- 1.Pomeranz, Y. and Meloan, C.E. (2000). Food Analysis: Theory and Practice (3rd Edition). Springer Science & Business Media, New York, USA.
- 2.Early, R. (2012). Guide to Quality Management Systems for the Food Industry. Springer Publications, USA.
- 3.Hubbard, M.R. (2003). Statistical Quality Control for the Food Industry. Springer

Publications, USA.

4. Mortimore, S. and Wallace, C. (2013). HACCP: A Practical Approach (3rd Edition). Springer Science & Business Media, New York, USA.

5. Fellows, P.J. (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing, Cambridge, UK.

6. Jay, J.M., Loessner, M.J. and Golden, D.A. (2005). Modern Food Microbiology (7th Edition). Springer Science & Business Media, New York, USA.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the principles, concepts, and importance of food quality control and quality assurance systems.	K1
CO2	Apply physical, chemical, sensory, and instrumental methods for food quality evaluation.	K3
CO3	Assess microbiological quality and implement food safety measures in food processing operations.	K5
CO4	Interpret food standards, regulations, and quality management systems applicable to food industries.	K2
CO5	Illustrate the quality assurance programs and auditing procedures for food quality improvement.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	2	2	3	0
CO2	3	1	2	1	2	1	1	2	2	3	1
CO3	3	1	3	2	2	2	2	2	3	3	1
CO4	3	2	3	3	3	2	2	3	3	3	2
CO5	3	2	3	3	3	2	2	3	3	3	2

Semester IV	Elective Theory - 2. FOOD SAFETY AND STANDARDS
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Learning Objectives

- Understand the principles of food safety, food hazards, and national and international food safety standards.

- Apply food safety management systems, regulatory requirements, and quality assurance practices in food processing and distribution.
- Evaluate food safety risks and implement preventive measures to ensure consumer health and compliance with food laws.

UNIT I

Introduction to Food Safety

Concept and importance of food safety, Food safety issues and public health significance, Food hazards: biological, chemical, and physical hazards, Food contamination and foodborne diseases, Food safety challenges in the food supply chain

UNIT II

Food Safety Management Systems

Principles of food safety management, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Sanitation Standard Operating Procedures (SSOP), Hazard Analysis and Critical Control Point (HACCP), Risk assessment and risk management

UNIT III

Food Standards and Regulatory Framework

Food Safety and Standards Act, 2006, Food Safety and Standards Authority of India (FSSAI), Codex Alimentarius Commission, International food standards and guidelines, Food import and export regulations, Role of regulatory agencies in food safety

UNIT IV

Food Inspection, Certification and Auditing

Food inspection procedures, Sampling and food testing protocols, Food certification systems, ISO 22000 Food Safety Management System, Internal and external food safety audits, Documentation and record keeping

UNIT V

Emerging Issues and Advances in Food Safety

Food traceability systems, Food fraud and food defense, Allergen management, Food recall procedures, Emerging pathogens and food safety concerns, Recent trends and technological innovations in food safety.

Text Books

1. Forsythe, S.J. (2020). The Microbiology of Safe Food (3rd Edition). Wiley-Blackwell, Chichester, United Kingdom.
2. Mortimore, S. and Wallace, C. (2013). HACCP: A Practical Approach (3rd Edition). Springer Science & Business Media, New York, USA.
3. Marriott, N.G., Schilling, M.W. and Gravani, R.B. (2018). Principles of Food Sanitation (6th Edition). Springer International Publishing, Switzerland.

Reference Books

1. Adams, M.R. and Moss, M.O. (2015). Food Microbiology (4th Edition). Royal Society of Chemistry, Cambridge, UK.
2. Jay, J.M., Loessner, M.J. and Golden, D.A. (2005). Modern Food Microbiology (7th Edition). Springer Science & Business Media, New York, USA.
3. Sivasankar, B. (2014). Food Processing and Preservation. PHI Learning Private Limited,

New Delhi, India.

4. Early, R. (2012). Guide to Quality Management Systems for the Food Industry. Springer Publications, USA.

5. Lelieveld, H.L.M., Mostert, M.A. and Holah, J. (2005). Handbook of Hygiene Control in the Food Industry. Woodhead Publishing, Cambridge, UK.

6. Motarjemi, Y. and Moy, G. (2014). Encyclopedia of Food Safety. Academic Press, Elsevier, USA.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the concepts, importance, and principles of food safety and food hazard management.	K1
CO2	Identify biological, chemical, and physical hazards associated with foods and food processing operations.	K3
CO3	Apply food safety management systems such as GMP, GHP, SSOP, and HACCP in food industries.	K3
CO4	Interpret food laws, standards, regulations, and certification systems at national and international levels.	K2
CO5	Evaluate food safety risks and implement effective food safety and quality assurance programs.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	2	2	3	0
CO2	3	1	2	1	1	1	1	3	2	3	1
CO3	3	1	3	2	2	1	2	3	3	3	1
CO4	3	2	3	3	2	2	2	3	3	3	2
CO5	3	2	3	3	3	2	2	3	3	3	2

Semester IV	SEC 2 -FOOD PRODUCT DEVELOPMENT
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Learning Objectives

- Understand the principles, stages, and strategies involved in food product development and innovation.

- Apply scientific, technological, nutritional, and consumer-oriented approaches in the design and development of food products.
- Evaluate product quality, market potential, regulatory requirements, and commercialization aspects of newly developed food products.

UNIT I

Introduction to Food Product Development

Concept and importance of food product development, Product development process and lifecycle, Factors influencing food product development, Consumer needs and market research, Product innovation and entrepreneurship in food industries

UNIT II

Product Design and Formulation

Selection of raw materials and ingredients, Product formulation techniques, Functional ingredients and additives, Nutritional considerations in product development, Development of health-oriented and specialty food products

UNIT III

Product Processing and Optimization

Process selection and optimization, Pilot plant studies and scale-up operations, Sensory evaluation in product development, Shelf-life studies and quality assessment, Packaging considerations for new food products

UNIT IV

Quality, Safety and Regulatory Aspects

Food quality assurance in product development, Food safety requirements and HACCP, Food standards and regulations, Labeling requirements for new products, Intellectual property rights and patents in food innovations

UNIT V

Commercialization and Emerging Trends

Product launch strategies, Market testing and consumer acceptance studies, Cost analysis and economic feasibility, Functional foods, nutraceuticals, and sustainable products, Recent trends and future prospects in food product development

Text Books

1. Earle, M., Earle, R. and Anderson, A. (2009). Food Product Development: Maximising Success. Woodhead Publishing Limited, Cambridge, United Kingdom.
2. Fuller, G.W. (2016). New Food Product Development: From Concept to Marketplace (3rd Edition). CRC Press, Boca Raton, Florida, USA.
3. MacFie, H. (2007). Consumer-Led Food Product Development. Woodhead Publishing Limited, Cambridge, United Kingdom.

Reference Books

1. Moskowitz, H.R., Saguy, I.S. and Straus, T. (2009). An Integrated Approach to New Food Product Development. CRC Press, Boca Raton, Florida, USA.
2. Smith, J. and Charter, E. (2010). Functional Food Product Development. Wiley-Blackwell Publishing, Oxford, United Kingdom.
3. Ramaswamy, H.S. and Marcotte, M. (2006). Food Processing: Principles and Applications.

CRC Press, Boca Raton, Florida, USA.

4. Robertson, G.L. (2016). Food Packaging: Principles and Practice (4th Edition). CRC Press, Boca Raton, Florida, USA.

5. Fellows, P.J. (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing, Cambridge, United Kingdom.

6. Manay, N.S. and Shadaksharaswamy, M. (2017). Foods: Facts and Principles (3rd Edition). New Age International Publishers, New Delhi, India.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the concepts, principles, and stages involved in food product development.	K1
CO2	Develop food product formulations considering nutritional, functional, and sensory requirements.	K3
CO3	Apply appropriate processing, packaging, and quality evaluation techniques for food product optimization.	K3
CO4	Interpret food safety regulations, labeling requirements, and quality assurance measures applicable to new food products.	K4
CO5	Evaluate market feasibility, commercialization strategies, and emerging trends in food product innovation.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	1	1	1	1	2	1	3
CO2	3	1	2	2	1	1	2	1	2	2	3
CO3	3	1	3	2	2	2	2	1	3	2	3
CO4	3	2	3	3	2	2	2	1	3	2	3
CO5	3	2	3	3	3	2	2	1	3	2	3

Semester V	Core Theory— PROCESSING TECHNOLOGY OF LEGUMES AND OIL SEEDS
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Learning Objectives

- Understand the composition, processing characteristics, and industrial importance of legumes and oilseeds.

- Apply appropriate processing technologies for the production of pulses, edible oils, protein products, and value-added foods.
- Evaluate quality, safety, storage, and the application of Artificial Intelligence (AI) in modern legumes and oilseed processing industries.

UNIT I

Introduction to Legumes and Oilseeds

Importance and classification of legumes and oilseeds, Production status and economic significance, Structure and composition of pulses and oilseeds, Nutritional value and health benefits, Anti-nutritional factors in legumes and oilseeds, Quality characteristics and grading standards

UNIT II

Processing Technology of Legumes

Cleaning, grading, and storage of legumes, De-husking and splitting of pulses, Soaking, germination, and malting processes, Thermal processing of legumes, Production of pulse flours and protein concentrates, Value-added products from legumes.

UNIT III

Processing Technology of Oilseeds

Pre-processing operations: cleaning, conditioning, and decortication, Mechanical oil extraction methods, Solvent extraction technology, Refining of edible oils, Hydrogenation, interesterification, and winterization, By-products utilization of oilseed processing industries

UNIT IV

Quality Control, Packaging and Storage

Quality evaluation of pulses and edible oils, Physical and chemical quality parameters, Storage behavior of legumes and oilseeds, Packaging requirements and packaging materials, Prevention of rancidity and spoilage, Food safety regulations and standards for edible oils

UNIT V

Artificial Intelligence and Emerging Technologies in Legume and Oilseed Processing

Introduction to Artificial Intelligence (AI) in food processing, AI-based grading and sorting of legumes and oilseeds, Machine vision systems for quality inspection, AI applications in predictive maintenance of processing equipment, AI-assisted quality control and defect detection, Smart sensors and Internet of Things (IoT) in processing plants, Precision processing and automation in oil extraction industries, Future trends in AI-enabled food processing systems

Text Books

1. Lawson, H. (2013). Food Oils and Fats: Technology, Utilization and Nutrition. Springer Science & Business Media, New York, USA.
2. Shahidi, F. (Ed.) (2005). Bailey's Industrial Oil and Fat Products (6th Edition). John Wiley & Sons, Hoboken, New Jersey, USA.
3. Salunkhe, D.K., Kadam, S.S. and Chavan, J.K. (2017). Postharvest Biotechnology of Food Legumes. CRC Press, Boca Raton, Florida, USA.

Reference Books

1. Owens, G. (2001). Cereals Processing Technology. Woodhead Publishing, Cambridge, UK.
2. Sahay, K.M. and Singh, K.K. (2015). Unit Operations of Agricultural Processing (2nd Edition). Vikas Publishing House Pvt. Ltd., New Delhi, India.

- 3.Fellows, P.J. (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing, Cambridge, UK.
- 4.O'Brien, R.D. (2008). Fats and Oils: Formulating and Processing for Applications (3rd Edition). CRC Press, Boca Raton, Florida, USA.
- 5.Ranganna, S. (2014). Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edition). Tata McGraw-Hill Education, New Delhi, India.
- 6.Chavan, J.K., Kadam, S.S. and Salunkhe, D.K. (1989). CRC Handbook of World Food Legumes: Nutritional Chemistry, Processing Technology and Utilization. CRC Press, USA.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the composition, nutritional characteristics, and processing requirements of legumes and oilseeds.	K1
CO2	Demonstrate knowledge of pulse milling, oil extraction, and refining technologies.	K2
CO3	Develop value-added products from legumes and oilseeds using appropriate processing techniques.	K3
CO4	Evaluate quality, packaging, storage, and safety aspects of legumes, edible oils, and their products.	K5
CO5	Analyze the application of Artificial Intelligence, automation, and emerging technologies in modern legume and oilseed processing industries.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	1
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	2
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester V	Core Theory - PROCESSING TECHNOLOGY OF DAIRY
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Learning Objectives

- Understand the composition, properties, processing principles, and technological aspects of milk and dairy products.
- Apply various dairy processing techniques for the manufacture of safe, high-quality, and value-added dairy products.

- Evaluate quality control measures, dairy regulations, and the application of Artificial Intelligence (AI) in modern dairy processing industries.

UNIT I

Introduction to Milk and Dairy Processing

Importance and status of the dairy industry, Composition and physico-chemical properties of milk, Factors affecting milk quality, Collection, transportation, and reception of milk, Platform tests and grading of milk, Dairy plant layout and sanitation

UNIT II

Primary Processing of Milk

Filtration and clarification of milk, Standardization of milk, Homogenization of milk, Pasteurization methods (LTLT, HTST, UHT), Sterilization and aseptic processing, Cream separation and milk storage

UNIT III

Manufacture of Dairy Products

Processing of market milk, Manufacture of butter and ghee, Production of cheese and paneer, Manufacture of fermented dairy products (curd, yogurt, kefir), Ice cream processing technology, Concentrated and dried milk products

UNIT IV

Quality Control, Packaging and Storage of Dairy Products

Quality evaluation of milk and dairy products, Chemical, microbiological, and sensory quality assessment, Packaging materials for dairy products, Shelf-life studies and storage conditions, Dairy regulations and food safety standards, HACCP and quality assurance in dairy industries

UNIT V

Artificial Intelligence and Emerging Technologies in Dairy Processing

Introduction to Artificial Intelligence (AI) in dairy industries, AI-based milk quality monitoring systems, Machine vision for defect detection in dairy products, AI applications in dairy process automation, Predictive maintenance of dairy equipment using AI, Smart sensors and Internet of Things (IoT) in dairy plants, Blockchain and digital traceability in dairy supply chains, Future trends in AI-enabled dairy processing.

Text book

1. De, S. (2018). Outlines of Dairy Technology (24th Edition). Oxford University Press, New Delhi, India.
2. Sukumar De (2017). Indian Dairy Products. Oxford University Press, New Delhi, India.
3. Walstra, P., Wouters, J.T.M. and Geurts, T.J. (2006). Dairy Science and Technology (2nd Edition). CRC Press, Boca Raton, Florida, USA.

Reference Books

1. Tamine, A.Y. and Robinson, R.K. (2007). Yoghurt: Science and Technology (3rd Edition). Woodhead Publishing, Cambridge, UK.
2. Fox, P.F., McSweeney, P.L.H., Cogan, T.M. and Guinee, T.P. (2017). Fundamentals of Cheese Science (2nd Edition). Springer International Publishing, Switzerland.
3. Early, R. (2012). The Technology of Dairy Products (2nd Edition). Springer Science & Business Media, USA.
4. Aneja, R.P., Mathur, B.N., Chandan, R.C. and Banerjee, A.K. (2002). Technology of Indian

Milk Products. Dairy India Yearbook, New Delhi, India.

5.Fellows, P.J. (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing, Cambridge, UK.

6.Bylund, G. (2015). Dairy Processing Handbook. Tetra Pak Processing Systems AB, Lund, Sweden.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the composition, properties, and processing requirements of milk and dairy products.	K1
CO2	Demonstrate knowledge of milk processing operations and dairy product manufacturing technologies.	K2
CO3	Develop and evaluate value-added dairy products using appropriate processing techniques.	K3
CO4	Assess the quality control, packaging, storage, and food safety principles in dairy processing.	K5
CO5	Analyze the application of Artificial Intelligence, automation, and smart technologies in modern dairy industries.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	2	1
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	3	2
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester V	Core Practical – PROCESSING TECHNOLOGY OF LEGUMES AND OIL SEEDS PRACTICALS
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Learning Objectives

- Perform laboratory and pilot-scale operations involved in the processing of legumes and oilseeds, including milling, oil extraction, and value addition.
- Evaluate the physical, chemical, and quality characteristics of legumes, oilseeds, and their processed products.

- Apply quality control, packaging, storage, and modern analytical techniques in legumes and oilseed processing.

Practical Exercises

1. Identification and classification of major legumes and oilseeds, Determination of grain size, shape, and thousand-kernel weight.
2. Measurement of bulk density and true density. Grading of legumes and oilseeds according to quality standards.
3. Cleaning and grading of pulses, Soaking characteristics of legumes, Germination and malting of legumes, De-husking and splitting of pulses.
4. Determination of pulse milling efficiency and recovery percentage.
5. Preparation of pulse flour and evaluation of flour yield.
6. Decortication of oilseeds and Determine the oil content in oilseeds, Mechanical oil extraction using laboratory expeller.
7. Solvent extraction of edible oils. Determination of oil extraction efficiency.
8. Observation of refining steps in edible oil processing.
9. Moisture content determination of legumes and oilseeds.
10. Estimation of protein content in pulse flour.
11. Determination of acid value of edible oils.
12. Determination of peroxide value of oils.
13. Estimation of free fatty acid (FFA) content.
14. Sensory evaluation of pulse-based and oilseed-based products.
15. Preparation of value-added pulse products (snacks, instant mixes, protein-rich products).
16. Preparation of oilseed-based products.
17. Packaging of legumes and edible oils using suitable packaging materials.
18. Storage studies of legumes and oilseeds. Evaluation of shelf-life and quality changes during storage.

Text Books

1. Salunkhe, D.K., Kadam, S.S. and Chavan, J.K. (2017). Postharvest Biotechnology of Food Legumes. CRC Press, Boca Raton, Florida, USA.
2. Shahidi, F. (Ed.) (2005). Bailey's Industrial Oil and Fat Products (6th Edition). John Wiley & Sons, Hoboken, New Jersey, USA.
3. Lawson, H. (2013). Food Oils and Fats: Technology, Utilization and Nutrition. Springer Science & Business Media, New York, USA.

Reference Books

1. Chavan, J.K., Kadam, S.S. and Salunkhe, D.K. (1989). CRC Handbook of World Food Legumes: Nutritional Chemistry, Processing Technology and Utilization. CRC Press, Boca Raton, Florida, USA.
2. O'Brien, R.D. (2008). Fats and Oils: Formulating and Processing for Applications (3rd Edition). CRC Press, Boca Raton, Florida, USA.
3. Sahay, K.M. and Singh, K.K. (2015). Unit Operations of Agricultural Processing (2nd Edition). Vikas Publishing House Pvt. Ltd., New Delhi, India.
4. Fellows, P.J. (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing, Cambridge, UK.
5. Ranganna, S. (2014). Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd Edition). Tata McGraw-Hill Education, New Delhi, India.
6. Nielsen, S.S. (2017). Food Analysis (5th Edition). Springer International Publishing, Switzerland.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Identify and evaluate the physical and quality characteristics of legumes and oilseeds.	K1
CO2	Perform processing operations such as soaking, germination, milling, de-husking, and oil extraction.	K2
CO3	Analyze the chemical and quality attributes of legumes, edible oils, and processed products.	K4
CO4	Develop and evaluate value-added products from legumes and oilseeds.	K3 K5
CO5	Determine the packaging, storage, and quality control techniques to maintain product quality and shelf stability.	K5

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	1	1	1	3	1	1
CO2	3	1	3	2	3	1	2	1	3	2	1
CO3	3	1	3	2	3	2	2	1	3	2	2
CO4	3	2	3	3	3	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester V	INTERNSHIP VIVA-VOCE (Summer vacation at end of IV semester)
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COURSE OBJECTIVES

● **Integrate Knowledge:** Apply theoretical concepts of food processing, food chemistry, food microbiology, food engineering, and food safety in industrial settings. (K3)

- **Professional Competency:** Develop practical skills in food production, quality assurance, quality control, food safety management, and product development. (K3)
- **Industrial Evaluation:** Analyze industrial workflows, quality systems, food safety protocols, and operational practices in food industries. (K4)

INTERNSHIP – FOOD INDUSTRIES / FOOD TESTING LABORATORIES / RESEARCH INSTITUTES

FOOD INDUSTRY INTERNSHIP

Students shall undergo internship training in food processing industries, food manufacturing units, dairy industries, beverage industries, bakery and confectionery units, fruit and vegetable processing industries, seafood processing industries, or allied food sectors.

The internship shall provide hands-on exposure to raw material handling, processing operations, production management, packaging, storage, and distribution practices. Students will observe and participate in quality control and quality assurance activities, including sampling procedures, analytical testing, GMP, GHP, HACCP, and food safety management systems.

Students will gain practical experience in food processing equipment, industrial sanitation, waste management, documentation practices, and regulatory compliance. Exposure to research and development activities, product development, shelf-life studies, and sensory evaluation may also be included wherever applicable.

Students shall maintain a daily training logbook documenting activities carried out during the internship period. At the end of the training, students shall prepare a comprehensive internship report detailing the organization profile, industrial operations, quality systems, observations, learning outcomes, and professional experiences gained during the internship.

The internship concludes with a viva-voce examination based on the training undertaken, internship report, industrial observations, and application of food technology principles in industrial environments.

COURSE OUTCOMES

On successful completion of the course the students will be able to:

CO	Course Outcomes	K level
CO1	Describe the organizational structure and operational activities of food industries.	K2
CO2	Apply food processing, quality assurance, and food safety principles in industrial environments.	K3
CO3	Analyze industrial production processes, quality control measures, and food safety systems	K4
CO4	Evaluate industrial practices related to quality management, sanitation, and regulatory compliance.	K5
CO5	Illustrate and Present a comprehensive internship report demonstrating professional and technical competencies.	K1

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	1	3	2	3	2	1
CO2	3	3	3	2	2	1	3	2	3	3	2
CO3	3	3	3	3	2	2	3	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

Semester V	Elective Theory 2 - 1. CONVENIENCE FOODS
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Learning Objectives

- Understand the principles, classification, processing methods, and nutritional aspects of convenience foods.
- Apply technologies involved in the development, preservation, packaging, and quality evaluation of convenience food products.
- Analyze market trends, consumer preferences, safety regulations, and innovations in the convenience food industry.

UNIT I

Introduction to Convenience Foods

Definition, scope, and significance of convenience foods, History and development of convenience foods, Classification of convenience foods, Consumer demand and market trends, Nutritional aspects of convenience foods.

UNIT II

Processing Technologies for Convenience Foods

Raw material selection and preparation, Dehydration and drying techniques, Freezing and refrigerated convenience foods, Extrusion cooking technology, Retort processing and aseptic packaging.

UNIT III

Types of Convenience Foods

Ready-to-Eat (RTE) foods, Ready-to-Cook (RTC) foods, Ready-to-Serve (RTS) foods, Instant foods and mixes, Traditional and ethnic convenience foods.

UNIT IV

Packaging, Quality and Safety of Convenience Foods

Packaging materials and systems, Modified Atmosphere Packaging (MAP), Shelf-life evaluation, Quality control and quality assurance, Food safety regulations and standards

UNIT V

Product Development and Emerging Trends

Product formulation and development, Functional and fortified convenience foods, Novel preservation technologies, Consumer acceptance and sensory evaluation, Future trends in convenience food industries.

Text Books

1. Manay, N.S. and Shadaksharaswamy, M. (2017). **Foods: Facts and Principles** (3rd Edition). New Age International Publishers, New Delhi, India.
2. Ramaswamy, H.S. and Marcotte, M. (2006). **Food Processing: Principles and Applications**. CRC Press, Boca Raton, Florida, USA.
3. Fellows, P.J. (2017). **Food Processing Technology: Principles and Practice** (4th Edition). Woodhead Publishing, Cambridge, UK.

Reference Books

1. Brennan, J.G. (2006). **Food Processing Handbook**. Wiley-VCH Verlag GmbH & Co. KGaA, Germany.

- 2.Hui, Y.H. (Ed.) (2006). Handbook of Food Products Manufacturing. Wiley-Interscience, New Jersey, USA.
- 3.Potter, N.N. and Hotchkiss, J.H. (2012). Food Science (5th Edition). Springer Science & Business Media, New York, USA.
- 4.Robertson, G.L. (2016). Food Packaging: Principles and Practice (4th Edition). CRC Press, USA.
- 5.Smith, J. and Charter, E. (2010). Functional Food Product Development. Wiley-Blackwell, United Kingdom.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the concepts, classification, nutritional significance, and market importance of convenience foods.	K1
CO2	Demonstrate knowledge of processing technologies used in the manufacture of convenience food products.	K2
CO3	Develop and evaluate various ready-to-eat, ready-to-cook, and instant food products.	K5
CO4	Apply packaging, quality assurance, and food safety measures for convenience food production.	K3
CO5	Analyze innovations, emerging technologies, and future opportunities in the convenience food sector.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	2	1	3
CO2	3	1	2	1	1	1	2	1	2	2	3
CO3	3	1	3	2	2	2	2	1	3	2	3
CO4	3	2	3	3	2	2	2	1	3	2	3
CO5	3	2	3	3	3	2	2	1	3	2	3

Semester V	Elective Theory 2- 2. NOVEL FOOD TECHNOLOGY
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Learning Objectives

- Understand the principles, applications, and advancements in novel food processing and preservation technologies.
- Evaluate the impact of emerging technologies on food quality, safety, nutrition, and shelf life.
- Apply innovative approaches for the development of sustainable, functional, and value-added food products.

UNIT I

Introduction to Novel Food Technology

Concept and scope of novel food technology, Need for innovative food processing methods, Emerging trends in food processing industries, Advantages and limitations of novel technologies, Regulatory aspects and consumer acceptance of novel foods.

UNIT II

Novel Thermal and Non-Thermal Processing Technologies

High Pressure Processing (HPP), Pulsed Electric Field (PEF) Technology, Cold Plasma Technology, Ohmic Heating, Radio Frequency and Microwave Processing

UNIT III

Advanced Food Preservation Technologies

Irradiation technology, Ultraviolet (UV) treatment, Membrane processing technology, Hurdle technology, Active and intelligent preservation systems

UNIT IV

Nanotechnology and Biotechnology in Food Processing

Fundamentals of food nanotechnology, Nanoencapsulation and nano-delivery systems, Applications of biotechnology in food processing, Genetically modified foods and novel ingredients, Biosensors for food quality and safety monitoring

UNIT V

Functional Foods, Sustainable Processing and Future Trends

Functional foods and nutraceutical development, 3D food printing technology, Alternative proteins and plant-based foods, Sustainable and green food processing technologies, Future prospects and innovations in food industries.

Text Books

- 1.Barbosa-Cánovas, G.V., Tapia, M.S. and Cano, M.P. (2005). **Novel Food Processing Technologies**. CRC Press, Boca Raton, Florida, USA.
- 2.Sun, D.W. (2014). **Emerging Technologies for Food Processing** (2nd Edition). Academic Press, Elsevier, London, UK.
- 3.Jha, S.N. (2015). **Nondestructive Evaluation of Food Quality: Theory and Practice**. Springer International Publishing, Switzerland.

Reference Books

- 1.Chemat, F. and Khan, M.K. (2011). **Applications of Ultrasound in Food Technology: Processing, Preservation and Extraction**. Ultrasonics Sonochemistry, Elsevier.
- 2.Da-Wen Sun (Ed.) (2016). **Thermal Food Processing: New Technologies and Quality**

Issues. CRC Press, USA.

3.Ramaswamy, H.S. and Marcotte, M. (2006). Food Processing: Principles and Applications. CRC Press, Boca Raton, Florida, USA.

4.Knorr, D., Zenker, M., Heinz, V. and Lee, D.U. (2004). Applications and Potential of Ultrasonics in Food Processing. Trends in Food Science & Technology.

5.Rastogi, N.K. (2011). Opportunities and Challenges in High Pressure Processing of Foods. Critical Reviews in Food Science and Nutrition.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the principles and applications of emerging food processing and preservation technologies.	K1
CO2	Evaluate the effects of novel processing methods on food quality, safety, nutrition, and shelf life.	K5
CO3	Apply advanced preservation and processing technologies for food product development.	K3
CO4	Analyze the role of nanotechnology, biotechnology, and innovative packaging systems in modern food industries.	K4
CO5	Identify the sustainable food processing approaches and emerging trends in functional and novel food products.	K2

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	1	2	1	3
CO2	3	1	2	1	2	2	1	1	2	2	3
CO3	3	1	3	2	2	2	2	1	3	2	3
CO4	3	2	3	3	3	2	2	1	3	2	3
CO5	3	2	3	3	3	3	2	1	3	2	3

Semester V	SEC 3 - FOOD PACKAGING AND LABELLING
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Learning Objectives

- Understand the principles, functions, materials, and systems used in food packaging and their role in food quality preservation.
- Interpret national and international food labeling regulations, standards, and legal requirements for packaged foods.
- Apply packaging and labeling concepts to ensure food safety, consumer protection, product marketing, and regulatory compliance.

UNIT I

Introduction to Food Packaging

Definition, functions, and importance of food packaging, History and evolution of food packaging, Packaging requirements for different food products, Factors affecting package selection, Packaging systems and package design.

UNIT II

Packaging Materials and Packaging Technologies

Paper and paperboard packaging, Glass packaging, Metal containers and cans, Plastic and polymer-based packaging materials, Flexible packaging systems, Active packaging and intelligent packaging, Modified Atmosphere Packaging (MAP) and Vacuum Packaging

UNIT III

Food Packaging Operations and Quality Evaluation

Filling, sealing, and packaging machinery, Package integrity testing, Migration and compatibility studies, Shelf-life evaluation of packaged foods, Quality control in food packaging industries

UNIT IV

Food Labelling Regulations and Standards

Importance and objectives of food labeling, Components of food labels, Nutritional labeling requirements, Food Safety and Standards Authority of India (FSSAI) labeling regulations, Codex Alimentarius guidelines, International labeling standards

UNIT V

Consumer Information, Marketing and Emerging Trends

Health claims and nutrition claims, Organic food labeling, Eco-labeling and sustainability labels, Barcoding, QR codes, RFID technology, Smart packaging and digital labeling, Current trends and innovations in food packaging and labeling.

Text Books

1. Robertson, G.L. (2016). Food Packaging: Principles and Practice (4th Edition). CRC Press, Boca Raton, Florida, USA.
2. Coles, R., McDowell, D. and Kirwan, M.J. (2003). Food Packaging Technology. Blackwell Publishing Ltd., Oxford, United Kingdom.
3. Ahvenainen, R. (Ed.) (2003). Novel Food Packaging Techniques. Woodhead Publishing Limited, Cambridge, United Kingdom.

Reference Books

1. Paine, F.A. and Paine, H.Y. (2012). A Handbook of Food Packaging (2nd Edition). Springer Science & Business Media, New York, USA.

- 2.Soroka, W. (2008). Fundamentals of Packaging Technology (4th Edition). Institute of Packaging Professionals, Illinois, USA.
- 3.Marsh, K. and Bugusu, B. (2007). Food Packaging—Roles, Materials and Environmental Issues. Journal of Food Science.
- 4.Yam, K.L. (2009). The Wiley Encyclopedia of Packaging Technology (3rd Edition). John Wiley & Sons, New Jersey, USA.
- 5.Man, C.M.D. and Jones, A.A. (2012). Shelf Life Evaluation of Foods (2nd Edition). Springer Publications, USA.

Course Outcomes

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

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the functions, importance, and types of food packaging materials and systems.	K1
CO2	Differentiate various packaging technologies and select suitable packaging methods for food products.	K2
CO3	Evaluate packaging quality, package integrity, and shelf-life of packaged foods.	K5
CO4	Illustrate the food labeling regulations, standards, and legal requirements applicable to food products.	K4
CO5	Apply packaging and labeling principles to ensure food safety, regulatory compliance, and effective consumer communication.	K3

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	2	2	3	1
CO2	3	1	2	1	2	1	1	2	2	3	1
CO3	3	1	3	2	2	1	2	2	3	3	2
CO4	3	2	3	3	3	2	2	2	3	3	2
CO5	3	2	3	3	3	2	2	3	3	3	3

Semester VI	Core Theory- PROCESSING TECHNOLOGY OF SEA FOODS AND FLESHLY FOODS
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Learning Objectives

- Understand the composition, quality characteristics, and post-harvest handling of seafoods and flesh foods.
- Apply appropriate processing, preservation, packaging, and storage techniques for seafood and meat products.
- Evaluate quality, safety, and regulatory aspects associated with seafood and flesh food processing industries.

Unit I

Introduction to Sea Foods and Flesh Foods

Classification and composition of fish, shellfish, meat, poultry, and eggs: Nutritional significance of seafoods and flesh foods: Post-harvest changes in fish and meat: Factors affecting quality deterioration: Handling and transportation of raw materials.

Unit II

Processing of Fish and Seafood Products

Fish processing operations: cleaning, dressing, filleting, and deboning: Chilling, freezing, and cold storage of fish: Canning of fish and shellfish: Drying, smoking, salting, and fermentation of seafoods: Value-added seafood products.

Unit III

Processing of Meat and Poultry Products

Slaughtering and dressing operations: Meat cutting and carcass evaluation: Processing of poultry products: Cured, smoked, and fermented meat products: Ready-to-eat and convenience meat products.

Unit IV

Preservation, Packaging and Storage

Principles of preservation of seafood and meat: Refrigeration and frozen storage: Modified atmosphere packaging (MAP): Vacuum packaging techniques: Shelf-life evaluation and storage studies.

Unit V

Quality Control, Safety and Regulations

Quality assessment of fish and meat products: Microbiological standards and food safety: HACCP and GMP in seafood and meat industries: Food adulteration and detection methods: National and international regulations for seafood and meat exports.

Text Books

1. **Hall, G.M. (2011).***Fish Processing: Sustainability and New Opportunities*. 2nd Edition. Wiley-Blackwell, Oxford, UK. ISBN: 978-1405180706.
2. **Hui, Y.H. (Ed.). (2012).***Handbook of Meat and Meat Processing*. 2nd Edition. CRC Press, Boca Raton, Florida, USA. ISBN: 978-1439849044. SS
3. **Shahidi, F. (Ed.). (2015).***Handbook of Seafood Quality, Safety and Health Applications*. Wiley-Blackwell, Chichester, UK. ISBN: 978-1118313774.
4. **Lawrie, R.A. & Ledward, D.A. (2014).***Lawrie's Meat Science*. 8th Edition. Woodhead Publishing, Cambridge, UK. ISBN: 978-0857090670.
5. **Fellows, P.J. (2017).***Food Processing Technology: Principles and Practice*. 4th Edition. Woodhead Publishing, Cambridge, UK. ISBN: 978-0081019072.

Reference Books

1. **Gopalkumar, K. (2002).***Textbook of Fish Processing Technology*. Indian Council of Agricultural Research (ICAR), New Delhi.
2. **Aberle, E.D., Forrest, J.C., Gerrard, D.E. & Mills, E.W. (2012).***Principles of Meat Science*. 5th Edition. Kendall Hunt Publishing, Iowa, USA.
3. **Toldrá, F. (2010).***Handbook of Meat Processing*. Wiley-Blackwell, Ames, Iowa, USA.
4. **Balachandran, K.K. (2001).***Post-Harvest Technology of Fish and Fish Products*. Daya Publishing House, New Delhi.
5. **FAO. (2018).***Fishery and Aquaculture Statistics*. Food and Agriculture Organization, Rome, Italy.

Course Outcomes

After completing this course, students will be able to:

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the composition, nutritional value, and quality characteristics of seafoods and flesh foods.	K1
CO2	Describe various processing operations involved in fish, meat, and poultry processing.	K2
CO3	Apply suitable preservation and packaging techniques to extend shelf life and maintain product quality.	K3
CO4	Evaluate quality, safety, and microbiological aspects of seafood and flesh food products.	K5
CO5	Analyze regulatory requirements, HACCP principles, and export standards for seafood and meat industries.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	2	1
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	3	2
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester VI	Core Paper - PROCESSING TECHNOLOGY OF FRUITS AND VEGETABLES
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Learning Objectives

- Understand the composition, quality characteristics, maturity indices, and post-harvest physiology of fruits and vegetables.
- Apply appropriate processing, preservation, packaging, and storage techniques for fruits and vegetable products.
- Evaluate quality, safety, and value-addition opportunities in fruit and vegetable processing industries.

Unit I

Introduction to Fruits and Vegetables Processing

Classification and composition of fruits and vegetables, Nutritional importance and health benefits, Maturity indices and harvesting practices, Post-harvest physiology and spoilage, Handling, grading, sorting, and transportation.

Unit II

Processing of Fruit Products

Fruit juice extraction and clarification, Production of squash, syrup, nectar, cordial, and RTS beverages, Processing of jams, jellies, marmalades, preserves, and candies, Fruit concentrates and pulps, Quality control of processed fruit products.

Unit III

Processing of Vegetable Products

Preparation and processing of vegetables, Canning of vegetables, Production of pickles, chutneys, sauces, and ketchup, Fermented vegetable products, Dehydrated and powdered vegetable products.

Unit IV

Preservation, Packaging and Storage, Principles of food preservation, Thermal processing and blanching, Refrigeration, freezing, and cold storage, Drying and dehydration techniques, Packaging materials, modified atmosphere packaging, and shelf-life studies.

Unit V

Quality Assurance and Industrial Application, Quality evaluation of processed products, Food safety standards and regulations, HACCP and GMP in fruit and vegetable processing industries, Waste utilization and by-product development, Emerging technologies in fruit and vegetable processing.

Text Books

1. **Lal, G., Siddappa, G.S., and Tandon, G.L. (2015).***Preservation of Fruits and Vegetables*. ICAR Publications, New Delhi, India.
2. **Verma, L.R. and Joshi, V.K. (2000).***Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management*. Indus Publishing Company, New Delhi, India.
3. **Hui, Y.H., Barta, J., Cano, M.P., Gusek, T.W., Sidhu, J.S., and Sinha, N.K. (2006).***Handbook of Fruits and Fruit Processing*. Blackwell Publishing, Ames, Iowa, USA.
4. **Barrett, D.M., Somogyi, L.P., and Ramaswamy, H.S. (2005).***Processing Fruits: Science and Technology*. 2nd Edition. CRC Press, Boca Raton, Florida, USA.
5. **Fellows, P.J. (2017).***Food Processing Technology: Principles and Practice*. 4th Edition. Woodhead Publishing, Cambridge, UK.

Reference Books

1. **Sinha, N.K., Sidhu, J.S., Barta, J., Wu, J.S.B., and Cano, M.P. (2012).***Handbook of Vegetables and Vegetable Processing*. 2nd Edition. Wiley-Blackwell, Ames, Iowa, USA.
2. **Thakur, N.S., and Singh, R. (2018).***Postharvest Management and Processing of Fruits and Vegetables*. New India Publishing Agency, New Delhi.
3. **Salunkhe, D.K., Kadam, S.S., and Desai, B.B. (1991).***Postharvest Biotechnology of Fruits*. CRC Press, Boca Raton, Florida, USA.
4. **Srivastava, R.P. and Kumar, S. (2017).***Fruit and Vegetable Preservation: Principles and Practices*. International Book Distributing Co., Lucknow, India.
5. **Potter, N.N. and Hotchkiss, J.H. (2012).***Food Science*. 5th Edition. Springer Science & Business Media, New York, USA.

Course Outcomes

On successful completion on this course, students will be able to:

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the composition, nutritional value, post-harvest physiology, and quality characteristics of fruits and vegetables.	K1
CO2	Describe various processing techniques used in the manufacture of fruit and vegetable products.	K2
CO3	Apply suitable preservation, packaging, and storage methods to enhance product quality and shelf life.	K3
CO4	Evaluate quality, safety, and regulatory requirements of processed fruit and vegetable products.	K5
CO5	Analyze industrial processing practices, waste utilization strategies, and emerging technologies in the fruit and vegetable sector.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	1	3	1	1
CO2	3	1	2	1	1	1	1	1	3	2	1
CO3	3	1	3	2	2	2	2	1	3	2	2
CO4	3	2	3	3	2	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester VI	Core Practical – PROCESSING TECHNOLOGY OF FRUITS AND VEGETABLES PRACTICALS
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Learning Objectives

- Develop skills in processing, preservation, packaging, and storage of fruit and vegetable products.

- Perform quality evaluation and analyze physicochemical characteristics of processed products.
- Apply food safety and hygiene practices in the preparation of value-added fruit and vegetable products.

List of Practical Experiments

1. Determination of maturity indices and grading of fruits and vegetables.
2. Preparation and evaluation of fruit juice.
3. Preparation of Ready-to-Serve (RTS) fruit beverage.
4. Preparation of fruit squash and syrup.
5. Preparation and quality evaluation of jam.
6. Preparation and quality evaluation of jelly.
7. Preparation of marmalade from citrus fruits.
8. Preparation of fruit candy and preserves.
9. Preparation of tomato ketchup and sauce.
10. Preparation of vegetable pickles.
11. Preparation of chutney and relish.
12. Dehydration of fruits and vegetables and determination of drying ratio.
13. Preparation of fruit and vegetable powders.
14. Packaging and shelf-life evaluation of processed fruit and vegetable products.
15. Determination of Total Soluble Solids (TSS), acidity, pH, and sensory evaluation of processed products.

Text Books

1. **Lal, G., Siddappa, G.S., and Tandon, G.L. (2015).***Preservation of Fruits and Vegetables*. Indian Council of Agricultural Research (ICAR), New Delhi, India.
2. **Verma, L.R. and Joshi, V.K. (2000).***Postharvest Technology of Fruits and Vegetables: Handling, Processing, Fermentation and Waste Management*. Indus Publishing Company, New Delhi, India.
3. **Barrett, D.M., Somogyi, L.P., and Ramaswamy, H.S. (2005).***Processing Fruits: Science and Technology*. 2nd Edition. CRC Press, Boca Raton, Florida, USA.
4. **Sinha, N.K., Sidhu, J.S., Barta, J., Wu, J.S.B., and Cano, M.P. (2012).***Handbook of Vegetables and Vegetable Processing*. 2nd Edition. Wiley-Blackwell, Ames, Iowa, USA.
5. **Fellows, P.J. (2017).***Food Processing Technology: Principles and Practice*. 4th Edition. Woodhead Publishing, Cambridge, UK.

Reference Books

1. **Srivastava, R.P. and Kumar, S. (2017).***Fruit and Vegetable Preservation: Principles and Practices*. International Book Distributing Co., Lucknow, India.
2. **Ranganna, S. (2014).***Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Edition. Tata McGraw-Hill Publishing Company Ltd., New Delhi, India.
3. **Thakur, N.S. and Singh, R. (2018).***Postharvest Management and Processing of Fruits and Vegetables*. New India Publishing Agency, New Delhi, India.
4. **Potter, N.N. and Hotchkiss, J.H. (2012).***Food Science*. 5th Edition. Springer Science & Business Media, New York, USA.
5. **Desrosier, N.W. and Desrosier, J.N. (2018).***The Technology of Food Preservation*. CBS Publishers & Distributors Pvt. Ltd., New Delhi, India.

Course Outcomes

After completing this course, students will be able to:

CO	COURSE OUTCOME	K LEVEL
CO1	Identify suitable raw materials and assess maturity and quality parameters of fruits and vegetables.	K1
CO2	Prepare various processed fruit products such as juices, beverages, jams, jellies, marmalades, and preserves.	K1
CO3	Develop value-added vegetable products including pickles, sauces, chutneys, and dehydrated products.	K3
CO4	Evaluate physicochemical, sensory, and shelf-life characteristics of processed fruit and vegetable products.	K5
CO5	Apply food safety, hygiene, packaging, and quality control practices during fruit and vegetable processing.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	1	2	1	1	1	3	1	1
CO2	3	1	3	2	3	1	2	1	3	2	1
CO3	3	1	3	2	3	2	2	1	3	2	2
CO4	3	2	3	3	3	2	2	1	3	3	2
CO5	3	2	3	3	3	2	2	1	3	3	3

Semester VI	CORE PROJECT--PROJECT VIVA-VOCE
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COURSE OBJECTIVES

- To provide students with an opportunity to apply food technology knowledge to real-world problems.
- To develop research, analytical, and problem-solving skills in food science and technology.

- To enhance teamwork, technical writing, and presentation skills.
- To promote innovation and product development in food processing and value addition.

Each project may be undertaken by a group of up to four students

Broad Project Areas

1. Food Processing and Preservation
2. Food Product Development and Value Addition
3. Functional Foods and Nutraceuticals
4. Food Quality Assurance and Quality Control
5. Food Safety and HACCP Studies
6. Food Packaging and Shelf-life Evaluation
7. Cereal, Pulse, Fruit and Vegetable Processing
8. Dairy Technology
9. Seafood and Meat Processing
10. Food Waste Utilization and By-product Development
11. Nutritional Assessment and Food Fortification
12. Consumer Acceptance and Sensory Evaluation Studies

Field Visit

Students will select one specialized project area and participate in a strategic field visit to observe the real-world application of nutrition-based business models and industrial safety standards.

Suggested Reference Resources

- J. Fellows (2017). Food Processing Technology: Principles and Practice (4th Edition). Woodhead Publishing.
- S. Suzanne Nielsen (2017). Food Analysis (5th Edition). Springer.
- John M. deMan (2018). Principles of Food Chemistry (4th Edition). Springer.
- Gordon L. Robertson (2016). Food Packaging: Principles and Practice (3rd Edition). CRC Press.
- William C. Frazier and Dennis C. Westhoff (2013). Food Microbiology (5th Edition). McGraw-Hill Education.

COURSEOUTCOMES

On successful completion of the course the students will be able to:

CO	COURSE OUTCOMES	K LEVEL
CO1	Explain research methodology and literature review techniques in food technology.	K1
CO2	Apply scientific principles and laboratory techniques to conduct a research project.	K3
CO3	Analyze experimental data and interpret research findings.	K4
CO4	Evaluate the outcomes of the project and propose suitable recommendations.	K5
CO5	Develop and present a technical project report with professional communication skills.	K6

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	1	1	2	2	3	1
CO2	3	1	2	1	2	1	1	2	2	3	1
CO3	3	1	3	2	2	1	2	2	3	3	2
CO4	3	2	3	3	3	2	2	2	3	3	2
CO5	3	2	3	3	3	2	2	3	3	3	3

Semester VI	Core Theory- FUNCTIONAL FOODS AND NUTRACEUTICALS
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Learning Objectives

- Understand the concepts, classifications, and health benefits of functional foods and nutraceuticals.
- Identify bioactive compounds and their role in disease prevention, health promotion, and wellness.
- Evaluate the development, safety, quality, and regulatory aspects of functional food and nutraceutical products.

Unit I

Introduction to Functional Foods and Nutraceuticals

Definition, concepts, and scope of functional foods and nutraceuticals, Historical development and current trends, Classification of functional foods and nutraceuticals, Relationship between diet, nutrition, and health, Market potential and consumer acceptance.

Unit II

Bioactive Components and Health Benefits

Phytochemicals: polyphenols, flavonoids, carotenoids, and glucosinolates, Dietary fiber and resistant starch, Omega-3 fatty acids and bioactive lipids, Antioxidants and their health implications, Mechanisms of action of bioactive compounds.

Unit III

Functional Ingredients and Nutraceutical Products

Probiotics, prebiotics, and synbiotics, Functional proteins and peptides, Fortified and enriched foods, Nutraceuticals from plant, animal, and marine sources, Development of functional beverages and dietary supplements.

Unit IV

Processing, Quality and Safety Aspects

Processing technologies for functional foods, Stability of bioactive compounds during processing and storage, Encapsulation and delivery systems, Quality assurance and quality control, Safety evaluation and toxicological considerations.

Unit V

Regulatory and Clinical Aspects

National and international regulations for functional foods and nutraceuticals, Health claims and labeling requirements, Clinical evaluation and efficacy studies, Ethical issues and consumer protection, Future trends and innovations in nutraceutical development.

Text Books

1. **Wildman, R.E.C. and Kelley, M. (2018).***Handbook of Nutraceuticals and Functional Foods*. 3rd Edition. CRC Press, Boca Raton, Florida, USA. ISBN: 978-1498758769.
2. **Bagchi, D. (Ed.). (2021).***Nutraceuticals and Functional Foods in Human Health and Disease Prevention*. CRC Press, Boca Raton, Florida, USA. ISBN: 978-0367495163.
3. **Gibson, G.R. and Williams, C.M. (Eds.). (2000).***Functional Foods: Concept to Product*. Woodhead Publishing Limited, Cambridge, UK. ISBN: 978-1855735037.
4. **Shi, J. (Ed.). (2006).***Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press, Boca Raton, Florida, USA. ISBN: 978-0849324097.
5. **Biesalski, H.K., Dragsted, L.O., Elmadfa, I., Grossklaus, R. and Müller, M. (2009).***Bioactive Compounds: Safety and Efficacy*. Springer-Verlag, Berlin, Germany. ISBN: 978-3540693943.

Reference Books

1. **Hasler, C.M. (Ed.). (2005).***Regulation of Functional Foods and Nutraceuticals: A Global Perspective*. Wiley-Blackwell Publishing, Ames, Iowa, USA.
2. **Gupta, R.C., Lall, R. and Srivastava, A. (2019).***Nutraceuticals: Efficacy, Safety and Toxicity*. Academic Press, Elsevier, London, UK.
3. **Fereidoon Shahidi and Naczki, M. (2003).***Phenolics in Food and Nutraceuticals*. CRC Press, Boca Raton, Florida, USA.
4. **Roberfroid, M.B. (2007).***Prebiotics: The Concept Revisited*. CRC Press, Boca Raton, Florida, USA.
5. **Mazza, G. (1998).***Functional Foods: Biochemical and Processing Aspects*. Technomic Publishing Company, Lancaster, Pennsylvania, USA.

Course Outcomes

After completing this course, students will be able to:

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the concepts, classifications, and significance of functional foods and nutraceuticals in health promotion.	K1
CO2	Identify major bioactive compounds and describe their physiological and therapeutic effects.	K2
CO3	Develop knowledge of functional ingredients and their applications in food and nutraceutical products.	K3
CO4	Evaluate processing, quality, safety, and stability aspects of functional foods and nutraceuticals.	K5
CO5	Analyze regulatory requirements, health claims, and emerging trends in the functional food and nutraceutical industry.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	1	2	1	3
CO2	3	1	2	1	1	2	1	1	2	2	3
CO3	3	1	3	2	2	2	2	1	2	2	3
CO4	3	2	3	3	2	3	2	2	3	2	3
CO5	3	2	3	3	3	3	2	2	3	2	3

Semester VI	Elective Theory 3- 1. BASICS IN RESEARCH METHODOLOGY
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Learning Objectives

- Understand the fundamental concepts, principles, and types of research methodologies used in scientific investigations.
- Develop skills in research design, data collection, analysis, interpretation, and report writing.
- Apply ethical principles and statistical tools in conducting and evaluating research studies.

Unit I

Introduction to Research Methodology

Meaning, objectives, and significance of research, Types of research: Basic, Applied, Qualitative, Quantitative, and Experimental, Research process and scientific method, Identification and formulation of research problems, Selection of research topics and hypotheses.

Unit II

Research Design and Data Collection

Research design: Exploratory, Descriptive, Analytical, and Experimental, Sampling techniques and sample size determination, Sources of data: Primary and Secondary data, Methods of data collection: Surveys, questionnaires, interviews, observations, and experiments, Reliability and validity of research instruments.

Unit III

Data Analysis and Interpretation

Classification and tabulation of data, Descriptive statistics: Mean, median, mode, standard deviation, Inferential statistics: Correlation, regression, t-test, chi-square test, ANOVA, Data presentation using tables, charts, and graphs, Interpretation of results and drawing conclusions.

Unit IV

Research Ethics and Scientific Communication

Principles of research ethics, Plagiarism and intellectual property rights, approval and informed consent, Scientific writing and publication ethics, Reference management and citation styles (APA, MLA, Vancouver, Harvard).

Unit V

Research Proposal and Report Writing

Structure of a research proposal, Literature review and bibliography preparation, Writing research reports, dissertations, and theses, Preparation of research papers and presentations, Funding agencies and project proposal development.

Text Books

1. **Kothari, C.R. and Garg, G. (2019).***Research Methodology: Methods and Techniques*. 4th Edition. New Age International Publishers, New Delhi, India. ISBN: 978-9386649229.
2. **Creswell, J.W. and Creswell, J.D. (2018).***Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. 5th Edition. Sage Publications, Thousand Oaks, California, USA. ISBN: 978-1506386706.
3. **Kumar, R. (2019).***Research Methodology: A Step-by-Step Guide for Beginners*. 5th Edition. Sage Publications, New Delhi, India. ISBN: 978-1526449900.
4. **Cooper, D.R. and Schindler, P.S. (2014).***Business Research Methods*. 12th Edition. McGraw-Hill Education, New York, USA. ISBN: 978-0073521507.

5. **Levin, R.I., Rubin, D.S., Rastogi, S. and Siddiqui, M.H. (2017).***Statistics for Management*. 8th Edition. Pearson Education, New Delhi, India. ISBN: 978-9332586585.

Reference Books

1. **Montgomery, D.C. and Runger, G.C. (2018).***Applied Statistics and Probability for Engineers*. 7th Edition. Wiley India Pvt. Ltd., New Delhi, India.
2. **Best, J.W. and Kahn, J.V. (2016).***Research in Education*. 10th Edition. Pearson Education, New Delhi, India.
3. **Kerlinger, F.N. and Lee, H.B. (2008).***Foundations of Behavioral Research*. 4th Edition. Cengage Learning, Boston, USA.
4. **Bhattacharyya, D.K. (2016).***Research Methodology*. 3rd Edition. Excel Books, New Delhi, India.
5. **Sekaran, U. and Bougie, R. (2019).***Research Methods for Business: A Skill Building Approach*. 8th Edition. Wiley India Pvt. Ltd., New Delhi, India.

Course Outcomes

After completing this course, students will be able to:

CO	COURSE OUTCOME	K LEVEL
CO1	Explain the concepts, objectives, types, and processes involved in scientific research.	K1
CO2	Design research studies and select appropriate methods for data collection and sampling.	K2
CO3	Apply statistical tools and techniques for data analysis and interpretation	K3
CO4	Demonstrate ethical practices and scientific communication skills in research activities.	K2
CO5	Analyze proper research proposals, reports, dissertations, and scientific publications following accepted standards.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	3	1	2	1	1	1
CO2	3	1	2	1	1	3	1	2	1	1	1
CO3	3	1	3	2	2	3	2	2	2	1	2
CO4	3	2	3	3	2	3	2	2	2	2	2
CO5	3	2	3	3	3	3	2	2	2	2	3

Semester VI	Elective Theory 3- 2. FOOD TOXICOLOGY
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Learning Objectives

- Understand the principles of toxicology and the occurrence of natural and synthetic toxic substances in foods.
- Identify foodborne toxins, contaminants, and their effects on human health and food safety.
- Evaluate methods for detection, risk assessment, prevention, and regulatory control of food toxicants.

Unit I

Introduction to Food Toxicology

Definition, scope, and importance of food toxicology, Principles of toxicology: dose-response relationship, toxicity, exposure assessment, Absorption, distribution, metabolism, and excretion of toxic substances, Acute and chronic toxicity, Factors influencing toxicity in foods.

Unit II

Natural Toxicants in Foods

Naturally occurring toxic compounds in plants and animal foods, Cyanogenic glycosides, alkaloids, lectins, and goitrogens, Toxic mushrooms and marine toxins, Antinutritional factors and their health effects, Methods for reducing natural toxicants during food processing.

Unit III

Food Contaminants and Environmental Toxicants

Heavy metals: lead, mercury, cadmium, and arsenic, Pesticide residues and veterinary drug residues, Environmental contaminants and industrial pollutants, Radioactive contaminants in food, Health effects and preventive measures.

Unit IV

Microbial and Chemical Food Toxicants

Mycotoxins: aflatoxins, ochratoxins, fumonisins, and patulin, Bacterial toxins and food poisoning, Food additives and safety concerns, Processing-induced toxicants: acrylamide, nitrosamines, heterocyclic amines, and polycyclic aromatic hydrocarbons, Detection and monitoring of food toxicants.

Unit V

Risk Assessment, Regulations and Food Safety

Toxicological risk assessment and hazard analysis, Food safety standards and regulatory frameworks, Maximum residue limits (MRLs) and acceptable daily intake (ADI), National and international food safety regulations, Emerging issues and future trends in food toxicology.

Text Books

1. **Shibamoto, T. and Bjeldanes, L.F. (2009).***Introduction to Food Toxicology*. 2nd Edition. Academic Press, Elsevier, Burlington, Massachusetts, USA. ISBN: 978-0123742869.
2. **Duffus, J.H. and Worth, H.G.J. (2006).***Fundamental Toxicology*. Royal Society of Chemistry, Cambridge, UK. ISBN: 978-0854046144.
3. **Walstra, P., Wouters, J.T.M. and Geurts, T.J. (2005).***Food Toxicology and Safety*. CRC Press, Boca Raton, Florida, USA.
4. **Gupta, R.C. (Ed.). (2018).***Veterinary Toxicology: Basic and Clinical Principles*. 3rd Edition. Academic Press, Elsevier, London, UK.

5. **Klaassen, C.D. (2021).***Casarett and Doull's Toxicology: The Basic Science of Poisons*. 9th Edition. McGraw-Hill Education, New York, USA. ISBN: 978-1260452314.

Reference Books

1. **Watson, D.H. (Ed.). (2001).***Food Chemical Safety: Contaminants*. Woodhead Publishing, Cambridge, UK.
2. **Maga, J.A. and Tu, A.T. (1995).***Food Poisoning*. Marcel Dekker Inc., New York, USA.
3. **DeVries, J.W. (1997).***Food Safety and Toxicity*. CRC Press, Boca Raton, Florida, USA.
4. **Nriagu, J.O. (Ed.). (2011).***Encyclopedia of Environmental Health*. Elsevier Academic Press, Amsterdam, Netherlands.
5. **Hariharan, H. and Nair, P.M. (2015).***Food Safety and Toxicological Evaluation*. New India Publishing Agency, New Delhi, India.

Course Outcomes

After completing this course, students will be able to:

CO	COURSE OUTCOME	K LEVELS
CO1	Explain the basic principles, concepts, and significance of food toxicology in public health and food safety.	K 1
CO2	Identify natural toxicants, contaminants, and toxic substances present in foods and their health implications.	K2
CO3	Evaluate the occurrence and effects of microbial toxins, chemical contaminants, and processing-induced toxicants.	K5
CO4	Apply methods for detection, monitoring, prevention, and control of food toxicants.	K3
CO5	Analyze risk assessment procedures, regulatory standards, and food safety policies related to toxic substances in foods.	K4

MAPPING (CO/PO/PSO):

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3
CO1	3	1	2	0	1	2	1	2	2	3	0
CO2	3	1	2	1	1	2	1	2	2	3	1
CO3	3	1	3	2	2	2	2	2	3	3	1
CO4	3	2	3	3	2	2	2	3	3	3	1
CO5	3	2	3	3	3	2	2	3	3	3	2

B.Sc FOOD TECHNOLOGY
NAAN MUDHALVAN ARREAR PAPERS
(2026 – 2027 Onwards)

SEMESTER-II

NAME OF THE COURSE: **Fundamentals of Food Science**

UNIT I : Introduction to Food Science

Definition, scope of food science and technology. Classification of foods, Functions of foods, Food groups and food pyramid, Food as a source of nutrients, Relationship between food, nutrition, and health, Current trends and future prospects in food science.

UNIT II: Food Constituents

Water: structure, properties, and significance, **Carbohydrates**: classification, properties, and functions, **Proteins**: structure, classification, and functional properties, **Lipids**: classification, composition, and functions, Vitamins and minerals, Dietary fibre and its physiological importance, Pigments and flavor compounds in foods.

UNIT III: Physical and Chemical Properties of Foods

Physical properties of foods, pH and acidity, Water activity and its importance, Colloidal systems in foods, Surface tension and viscosity.

Chemical reactions in foods: Enzymatic browning, Non-enzymatic browning (Maillard reaction), Lipid oxidation and rancidity, Protein denaturation.

UNIT IV: Food Spoilage

Introduction to microorganisms associated with foods, Beneficial and harmful microorganisms, Factors affecting microbial growth, Food spoilage and deterioration, Food-borne diseases and food poisoning, Hygiene and sanitation practices.

UNIT V: Emerging Technologies in Industry

Concepts of food quality and quality attributes, Food adulteration and contamination, Food packaging and storage, Application of biotechnology, nanotechnology, and Artificial Intelligence (AI) in food science, Sustainable food systems and future trends.

Text Books

1. Vaclavik, V.A. and Christian, E.W. (2014). **Essentials of Food Science**, 4th Edition. Springer Science + Business Media, New York, USA. ISBN: 978-1461491378.
2. Potter, N.N. and Hotchkiss, J.H. (1998). **Food Science**, 5th Edition., CBS Publishers and Distributors, New Delhi, India. ISBN: 978-0834212657.
3. Srilakshmi, B. (2022). **Food Science**, 8th Edition. New Age International Publishers, New Delhi, India. ISBN: 978-9395161411.

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SEMESTER-III

NAME OF THE COURSE : **Marketing Skills in Food Technology**

UNIT I: Fundamentals of Marketing in Food Industry

Definition, scope, and importance of marketing, Evolution and functions of

marketing, Marketing environment: micro and macro environment, Marketing concepts and philosophies, Characteristics and structure of food markets, Role of marketing in food processing industries, Challenges and opportunities in food marketing.

UNIT II: Consumer Behavior and Market Segmentation

Consumer buying behavior and decision-making process, Factors influencing consumer behavior, Market segmentation, targeting, and positioning (STP), Market research and demand forecasting, Consumer preferences and food trends, Food labeling and consumer awareness, Customer relationship management (CRM).

UNIT III: Marketing Mix and Product Management

Marketing mix (4Ps and 7Ps), Product life cycle, New product development in the food industry, Branding and packaging strategies, Pricing methods and pricing policies, Distribution channels and supply chain management, Promotion strategies and sales management.

UNIT IV: Food Marketing Communication and Entrepreneurship

Advertising and publicity, Personal selling and sales promotion, Public relations and customer service, Entrepreneurship opportunities in food technology, Start-up ecosystem in food processing sector, Government schemes for food entrepreneurs, Export marketing and international trade of food products.

UNIT V: Digital Marketing and Emerging Technologies

Introduction to digital marketing, Social media marketing and content marketing, E-commerce and online food delivery platforms, Search Engine Optimization (SEO) and email marketing, Applications of Artificial Intelligence (AI) in food marketing, Big data analytics and consumer insights, Sustainable marketing and green marketing practices, Future trends in food marketing.

Text Books

1. Philip Kotler and Gary Armstrong (2021). **Principles of Marketing**, 18th Edition Pearson Education, New Delhi, India. ISBN: 978-1292341132.
2. Kotler, P. and Keller, K.L. (2016). **Marketing Management**, 15th Edition Pearson Education Limited, London, UK. ISBN: 978-9332587403.
3. Saxena, R. (2017). **Marketing Management**, 6th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi. ISBN: 978-9352605224.

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SEMESTER –IV

NAME OF THE COURSE : Intellectual Property Rights

UNIT I: Introduction to Intellectual Property Rights

Concept, meaning, and importance of Intellectual Property Rights, History and

evolution of IPR, Need and significance of IPR in food science and technology, International conventions and agreements, World Intellectual Property Organization (WIPO), Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Role of IPR in innovation and economic development.

UNIT II: Types of Intellectual Property Rights

Patents: concepts, criteria for patentability. Copyrights and related rights. Trademarks and service marks, Industrial designs, Geographical Indications (GI), Trade secrets and confidential information, Plant variety protection and farmers' rights. Examples of IPR in food and agricultural products.

UNIT III: Patent System and Patent Filing Procedures

Patentable and non-patentable inventions, Components of a patent document, Patent search and patent databases, Patent application procedures in India, Indian Patent Office and patent laws, Patent cooperation treaty (PCT), Patent infringement and remedies. Case studies related to food technology innovations.

UNIT IV: IPR Management and Commercialization

Technology transfer and licensing, Assignment and franchising, Valuation of intellectual property, Commercialization of food technologies, Start-ups and entrepreneurship in food industries. Role of incubation centers and technology business incubators. IPR management strategies for food industries. Ethical issues in IPR.

UNIT V: Emerging Trends and Contemporary Issues in IPR

Digital intellectual property rights, Protection of traditional knowledge and biodiversity, Geographical indications in Indian food products, Biotechnology and patent issues, Artificial Intelligence and intellectual property, Cyber laws and data protection. Recent developments in Indian IPR policies. Future challenges and opportunities in IPR.

Text Books

1. Narayanan, P. (2017) Intellectual Property Law, 4th Edition .Eastern Law House, New Delhi, India.ISBN: 978-8171772490.
2. Ganguli, P. (2001).Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Publishing Company Ltd., New Delhi, India ISBN: 978-0074638606.
3. Bouchoux, D.E. (2012).Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, 4th Edition. Cengage Learning, Boston, USA. ISBN: 978-1111831806.
4. Bainbridge, D.I. (2012).Intellectual Property, 9th Edition. pearson Education, Harlow, UK.ISBN: 978-0273760993.
- 5.. Cornish, W.R., Llewelyn, D. and Aplin, T. (2019).Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights, 9th Edition. Sweet & Maxwell, London, UK. ISBN: 978-0414065789.

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SEMESTER-V

NAME OF THE COURSE : ENTREPRENEURSHIP DEVELOPMENT

UNIT-I

Entrepreneur: Definition, qualities and essential skills of an entrepreneur,

communication and presentation skill; innovativeness; idea generation and SWOT analysis. Steps to start a small enterprise, learning journey of a successful entrepreneur.

UNIT-II

Business plan for small enterprises: Importance of business plan, purpose, contents and benefits of business plan; business plan creation process, benefits of business plan, preparation of sample business plan. Business ethics and etiquettes.

UNIT-III

Market survey: Meaning, process of conducting market survey, points to be considered for effective market research; steps to register a company; regulatory requirements.

UNIT-IV

Management process and policies: Importance of policy creation, corporate governance, management process, management functions- production and operation management, marketing management, financial management and human resource management. Pricing policy and methods of pricing.

UNIT-V

Marketing management- Concept of marketing, market assessment, market regulation, market targeting, marketing mix, promotional strategies and tips for successful marketing. Financial needs: Types of financial needs- fixed and working capital; methods of raising capital, working capital management, working capital cycle.

REFERENCES

1. Entrepreneurship development- Your gateway to the journey of entrepreneurship, ICT Academy of Tamil Nadu, Chennai. 2015.
2. S.S. Khanka, Entrepreneurial development, S.Chand Publications, 2007.
3. Vasant Desai, Entrepreneurial development, Vol-1, Himalaya Publishing House, 2009.

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SEMESTER-VI

NAME OF THE COURSE : Food Waste Management and Sustainability

UNIT I: Introduction to Food Waste and Sustainability

Definition and classification of food waste. Sources and generation of food waste in food processing industries. Characteristics of food wastes from fruit and vegetable, dairy, meat, poultry, fish, and beverage industries. Environmental, economic, and social impacts of food waste. Concepts of sustainability and sustainable development. Waste hierarchy: Reduce, Reuse, Recycle, Recover, and Dispose.

UNIT II: Food Waste Management and Treatment Technologies

Collection, segregation, and storage of food wastes. Physical treatment methods. Chemical treatment methods. Biological treatment methods. Solid waste management techniques. Liquid waste treatment methods. Effluent treatment systems in food industries. Composting, vermicomposting, and landfilling.

UNIT III: By-product Utilization and Resource Recovery

Valorization of food processing by-products. Recovery of bioactive compounds, Production of pectin, pigments, dietary fiber, and antioxidants. Conversion of food waste into animal feed. Biogas and biofuel production. Production of organic acids and enzymes. Extraction of functional ingredients from agro-industrial residues. Waste-to-protein and waste-to-energy technologies.

UNIT IV: Environmental Management and Sustainable Food Systems

Environmental Management Systems (EMS). ISO 14000 standards and applications. Green processing technologies. Water and energy conservation in food industries. Carbon footprint and life cycle assessment. Sustainable packaging and eco-friendly materials. Government regulations and environmental legislation. Sustainable food supply chain management.

UNIT V: Emerging Technologies and Future Perspectives

Artificial Intelligence (AI) in food waste management. Internet of Things (IoT) and smart sensors. Block chain for food traceability and waste reduction. Machine learning applications in waste prediction. Computer vision for food waste estimation. Industry 4.0 and smart food factories. Zero-waste processing and circular bio economy. Future trends and innovations in sustainable food systems.

Text Book

1. Arvanitoyannis, I.S. (2008). Waste Management for the Food Industries. Academic Press, Elsevier, London, UK. ISBN: 978-0123736543.
2. Kosseva, M.R. and Webb, C. (2013). Food Industry Wastes: Assessment and Recuperation of Commodities. Academic Press, Elsevier, London, UK. ISBN: 978-0123919212.
3. Joshi, V.K. (Ed.) (2011). Food Processing Waste Management: Treatment and Utilization Technology. Daya Publishing House, New Delhi, India. ISBN: 978-8170357650.

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