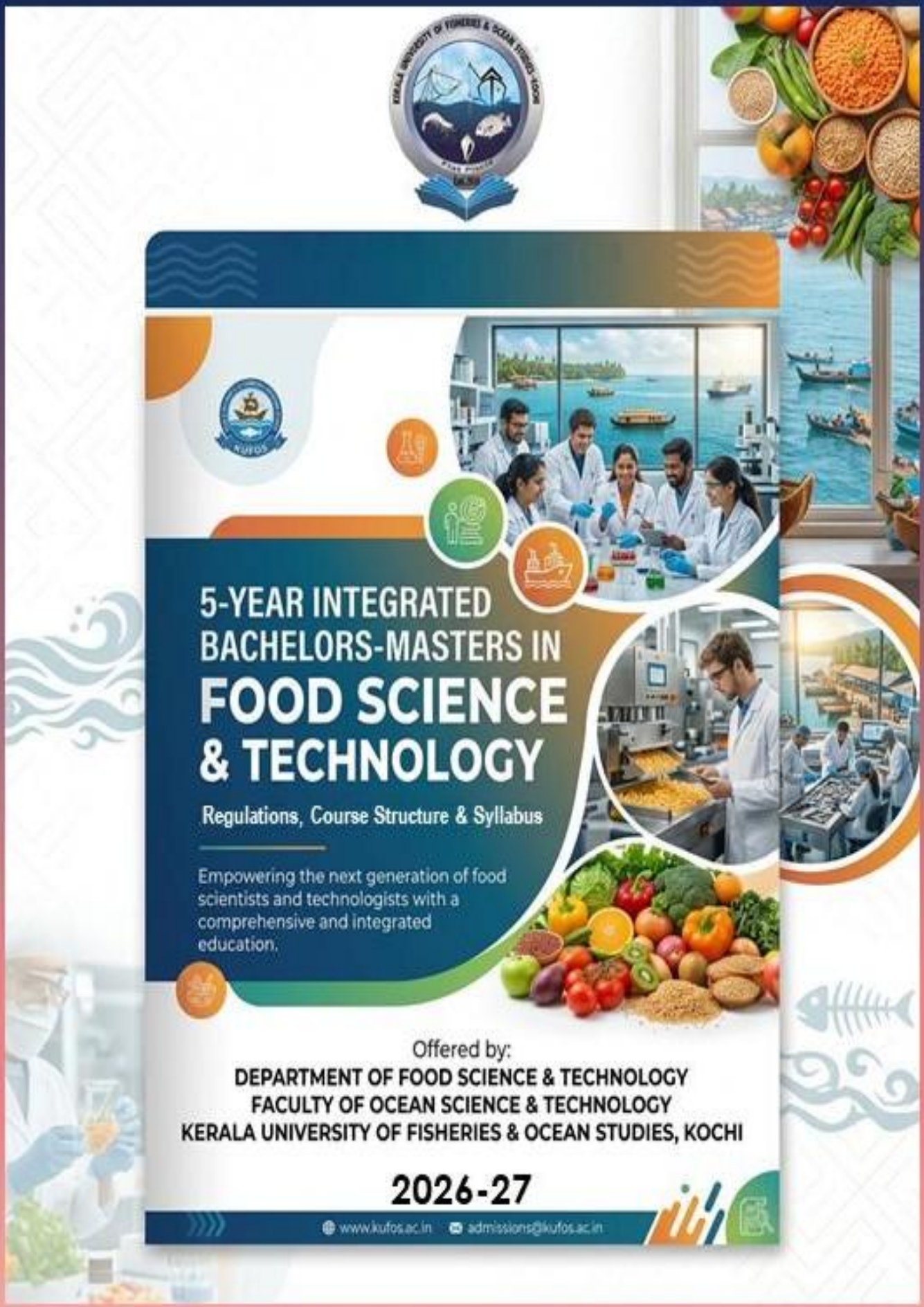
5-YEAR INTEGRATED
BACHELORS-MASTERS IN
FOOD SCIENCE
& TECHNOLOGY
Regulations, Course Structure & Syllabus
Empowering the next generation of food scientists and technologists with a comprehensive and integrated education.
Offered by:
DEPARTMENT OF FOOD SCIENCE & TECHNOLOGY
FACULTY OF OCEAN SCIENCE & TECHNOLOGY
KERALA UNIVERSITY OF FISHERIES & OCEAN STUDIES, KOCHI
2026-27
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Kerala University of Fisheries and Ocean Studies

Panangad, Kochi-682506, Kerala

Regulations, Course Structure & Syllabus

of

Integrated Bachelors-Masters in Food Science and Technology

Department of Food Science and Technology
Faculty of Ocean Science and Technology
Kerala University of Fisheries and Ocean Studies

2026-27

Objectives of the Programme

- To provide comprehensive knowledge of the fundamental and applied aspects of Food Science and Technology.
- To familiarize students with processing, preservation, and value-addition techniques for pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk, and milk products.
- To emphasize the principles and applications of food safety, food quality assurance, food plant sanitation, food laws and regulations, food engineering, and food packaging in the food industry.
- To develop the ability to innovate, design, and evaluate new food products and to encourage entrepreneurial skills for establishing food-based enterprises.
- To impart knowledge and understanding of recent innovations, emerging technologies, and research trends in Food Science and Technology.

Regulation for 5-year Integrated Bachelors-Masters in Food Science and Technology

Eligibility for admission

Sl.No	**Eligibility**	**Entry point**	**Exit point after successful completion**	**Degree offered**
1	A candidate must have passed a 10+2 science examination (Biology mandatory) with or without mathematics as additional subject. Having scored not less than 55% marks (50% for SC & ST candidates) in aggregate. Must clear University CAT	First semester	Second semester/ One year	Certificate (Food Science and Technology)
		-	Fourth semester/ Two years	Diploma (Food Science and Technology)
		-	Sixth semester/ Three years	Bachelors (Food Science and Technology)
		-	Eighth semester/ Four years	Bachelors of Honors (Food Science and Technology) *'With Research'*
		-	Tenth semester/ Five years	5-year Integrated Bachelor-Masters in Food Science and Technology

I. Duration of Programme:

- The Undergraduate programme (Honors) shall extend over a period of 8 consecutive semesters spread over four academic years- two semesters constituting one year with

multiple entry and exit options outlined in S. No. I and five year Integrated Bachelors-Masters in Food Science and Technology Programme shall extend over a period of 10 consecutive semesters spread over five academic years. The duration of each semester shall normally be 15 weeks, excluding examinations.

II. Total number of seats- 25 (University reservation policy will be implemented for admission)

III. Fees:
The fee (per semester) in 5-year Integrated Bachelors-Masters Food Science and Technology programme is as follows:

S. No.	Semester	Amount (Rs.)
1	Semester I	₹ 38160/-
2	Semester II	₹ 29850/-
3	Semester III	₹ 30160/-
4	Semester IV	₹ 29850/-
5	Semester V	₹ 30160/-
6	Semester VI	₹ 29850/-
7	Semester VII	₹ 30160/-
8	Semester VIII	₹ 29850/-
9	Semester IX	₹ 30160/-
10	Semester X	₹ 29850/-
	Total	₹ 308050/-

IV. Examination and Assessment, Scheme of examination, Revision of Regulations and Curriculum will be as per "Kerala University of Fisheries and Ocean Studies Regulations for Choice Based Credit System (CBCS) on the academic programmes in the University.

Types of Courses

Discipline Core Course (DCC)

A Core Course is a compulsory course that forms the foundational component of the programme. These courses provide fundamental knowledge, theoretical concepts, practical exposure, and subject-specific competencies essential for the discipline of study.

Elective/ Minor Course:

A course which may be very specific, specialized or advanced or supportive to the Core Courses.

Discipline Specific Elective (DSE) Course

A Discipline Specific Elective Course is an elective offered within the main discipline of the programme, enabling students to acquire advanced knowledge and specialization in specific areas of the subject. The programme may also include interdisciplinary electives related to the core discipline to broaden academic exposure and application.

Ability Enhancement Course (AEC) / Foundation Course

An Ability Enhancement Course or Foundation Course is designed to develop basic competencies, communication skills, analytical abilities, professional ethics, and overall academic proficiency of the students. These courses enhance the intellectual and personal development necessary for higher learning and professional growth.

Skill Enhancement Course (SEC)

A Skill Enhancement Course is aimed at imparting practical skills, technical expertise, and hands-on training related to the programme of study. These courses focus on employability, entrepreneurship, laboratory competence, industrial applications, and professional skill development in the concerned field.

Multidisciplinary Course (MDC)

A Multidisciplinary Course enables students to gain knowledge beyond their primary discipline by exploring subjects from other academic domains. These courses promote interdisciplinary learning, critical thinking, innovation, and holistic understanding of emerging areas relevant to food science and allied sectors.

Value Added Course (VAC)

A Value Added Course is designed to supplement the curriculum with additional knowledge, professional competencies, life skills, environmental awareness, ethics, and emerging technological advancements. These courses enhance the overall personality, employability, and societal responsibility of the students.

Internships

Internships provide students with experiential learning opportunities in industries, research institutions, laboratories, food processing units, regulatory agencies, or allied sectors. The internship programme aims to bridge the gap between academic learning and professional practice through hands-on exposure and industry interaction.

Industrial Visits

Industrial Visits are organized to provide practical exposure to food industries, processing plants, research organizations, quality control laboratories, and related establishments. These visits help students understand industrial operations, modern technologies, processing systems, quality assurance practices, and professional work environments.

Dissertation/ Thesis/ Project

The Dissertation, Thesis, or Project is an independent research-oriented academic component undertaken by students under the guidance of a faculty member. It is intended to develop research

aptitude, scientific writing, analytical skills, problem-solving ability, and advanced understanding in specialized areas related to the programme.

Programme Outcomes (POs)

PO_1	Demonstrate a strong understanding of core subject knowledge, fundamental concepts, and contemporary issues relevant to the discipline.
PO_2	Design and conduct experiments, and analyze, interpret, and validate experimental data using scientific reasoning.
PO_3	Apply appropriate techniques, skills, and modern tools essential for a successful scientific and professional career.
PO_4	Identify, analyze, and solve complex problems using logical, analytical, and evidence-based approaches.
PO_5	Exhibit adaptive thinking, flexibility, and resilience in response to evolving professional and technological environments.
PO_6	Understand and uphold professional, ethical, and societal responsibilities in scientific practice**.**
PO_7	Demonstrate effective teamwork, leadership qualities, and cross-cultural competence in diverse professional settings.
PO_8	Communicate effectively in English, both orally and in writing, for academic, professional, and technical purposes.
PO_9	Manage cognitive workload efficiently by prioritizing tasks, applying time-management strategies, and maintaining professional effectiveness.
PO_10	Recognize the importance of lifelong learning and engage in continuous professional development.

Programme Specific Outcomes (PSOs)

PSO_1	Formulate innovative solutions to real-time problems in the food sector by applying critical research skills and integrating appropriate scientific and technological principles, while exploring and adopting modern techniques and tools for the advancement of food processing, preservation, and production.
PSO_2	Assess and ensure food quality and safety while upholding ethical standards in food production to promote public health and well-being
PSO_3	Apply knowledge, problem-solving abilities, and research skills to pursue and perform effectively in diverse careers across healthcare, the food industry, agricultural sectors, and government services.

Programme structure

I. Integrated Bachelors (Hons) -Masters in Food Science and Technology – Subject Count

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Sem 9	Sem 10	Total
Core Paper	4	4	4	6	5	5	5	6	5	2	46
AEC	2	2	-	-	-	-	-	-	-	-	4
VAC	-	-	2	1	-	-	-	-	-	-	3
SEC	-	-	-	1	1	1	-	-	-	-	3
MDC	1	1	1	-	-	-	-	-	-	-	3
Internship	-	-	-	-	1	1	-	-	-	-	2
DSE	2	2	2	3	3	2	3	1	3	1	22
Total	9	9	9	11	10	9	8	7	8	3	84

Integrated Bachelors (Hons)-Masters in Food Science and Technology (219 Credits)

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Sem 9	Sem 10	Total
Core Paper	10	8	8	12	11	11	13	16	11	22	122
AEC	6	6	-	-	-	-	-	-	-	-	12
VAC	-	-	6	3	-	-	-	-	-	-	9
SEC	-	-	-	3	3	3	-	-	-	-	9
MDC	3	3	3	-	-	-	-	-	-	-	9
Internship	-	-	-	-	2	2	-	-	-	-	4
DSE	4	4	4	7	6	6	9	3	9	2	54
Total	23	21	21	25	22	22	22	19	20	24	219

II. Bachelor of Science in Food Science and Technology-Honors - Subject count

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Total
Core Paper	4	4	4	6	5	5	5	6	39
AEC	2	2	-	-	-	-	-	-	4
VAC	-	-	2	1	-	-	-	-	3
SEC	-	-	-	1	1	1	-	-	3
MDC	1	1	1	-	-	-	-	-	3
Internship	-	-	-	-	1	1	-	-	2
DSE	2	2	2	3	3	2	3	1	18
Total	9	9	9	11	10	9	8	7	72

Bachelor of Science in Food Science and Technology-Honors (175 Credits)

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Total
Core Paper	10	8	8	12	11	11	13	16	89
AEC	6	6	-	-	-	-	-	-	12
VAC	-	-	6	3	-	-	-	-	9
SEC	-	-	-	3	3	3	-	-	9
MDC	3	3	3	-	-	-	-	-	9
Internship	-	-	-	-	2	2	-	-	4
DSE	4	4	4	7	6	6	9	3	43
Total	23	21	21	25	22	22	22	19	175

III. Bachelor of Science in Food Science and Technology-Honors with research- Subject count

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Total
Core Paper	4	4	4	6	5	5	5	3	36
AEC	2	2	-	-	-	-	-	-	4
VAC	-	-	2	1	-	-	-	-	3
SEC	-	-	-	1	1	1	-	-	3
MDC	1	1	1	-	-	-	-	-	3
Internship	-	-	-	-	1	1	-	-	2
DSE	2	2	2	3	3	2	3	-	17
Total	9	9	9	11	10	9	8	3	68

Bachelor of Science in Food Science and Technology-Honors with research (175 Credits)

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Sem 7	Sem 8	Total
Core Paper	10	8	8	12	11	11	13	19	92
AEC	6	6	-	-	-	-	-	-	12
VAC	-	-	6	3	-	-	-	-	9
SEC	-	-	-	3	3	3	-	-	9
MDC	3	3	3	-	-	-	-	-	9
Internship	-	-	-	-	2	2	-	-	4
DSE	4	4	4	7	6	6	9	-	40
Total	23	21	21	25	22	22	22	19	175

IV. Bachelor of Science in Food Science and Technology-Subject count

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Total
Core Paper	4	4	4	6	5	5	28
AEC	2	2	-	-	-	-	4
VAC	-	-	2	1	-	-	3
SEC	-	-	-	1	1	1	3
MDC	1	1	1	-	-	-	3
Internship	-	-	-	-	1	1	2
DSE	2	2	2	3	3	2	14
Total	9	9	9	11	10	9	55

Bachelor of Science in Food Science and Technology (134 Credits)

Course Category	Sem 1	Sem 2	Sem 3	Sem 4	Sem 5	Sem 6	Total
Core Paper	10	8	8	12	11	11	60
AEC	6	6	-	-	-	-	12
VAC	-	-	6	3	-	-	9
SEC	-	-	-	3	3	3	9
MDC	3	3	3	-	-	-	9
Internship	-	-	-	-	2	2	4
DSE	4	4	4	7	6	6	31
Total	23	21	21	25	22	22	134

COMPLETE SEMESTER-WISE LIST OF COURSES

Semester I (23 Credit)

Code	Course Title	Category	Credit	Hours
IMFT45.1101T	Principles of Food Science	Core	3-0-0-3	45
IMFT45.1102T	Introduction to Food Chemistry	Core	3-0-0-3	45
IMFT45.1102P	Food Chemistry	Core	0-0-1-1	30
IMFT45.1103T	Analytical Methods and Calculations in Food Science	Core	3-0-0-3	45
IMFT45.1104T	Introduction to Food Microbiology	Minor	3-0-0-3	45
IMFT45.1104P	Food Microbiology	Minor	0-0-1-1	30
IMFT45.1105T	Nutrition and Health	MDC	3-0-0-3	45
IMFT45.1106T	English I	AEC	3-0-0-3	45
IMFT45.1107T	Hindi/Malayalam- I	AEC	3-0-0-3	45
	Total		**23**	**375**

Semester II (21 Credits)

Code	Course	Category	Credit	Hours
IMFT45.2107T	Food Preservation Technology	Core	3-0-0-3	45
IMFT45.2107P	Food Preservation Technology	Core	0-0-1-1	30
IMFT45.2108T	Fermentation Technology	Core	3-0-0-3	45
IMFT45.2108P	Fermentation Technology	Core	0-0-1-1	30
IMFT45.2109T	Food Quality and Safety	Minor	3-0-0-3	45
IMFT45.2109P	Food Quality and Safety	Minor	0-0-1-1	30
IMFT45.2110T	Marine Bioprospecting	MDC	3-0-0-3	45
IMFT45.2111T	English II	AEC	3-0-0-3	45
IMFT45.2112T	Hindi/Malayalam-II	AEC	3-0-0-3	45
	Total		**21**	**360**

Semester III (21 credits)

Code	Course	Category	Credit	Hours
IMFT50.3201T	Advanced Food Chemistry	Core	3-0-0-3	45
IMFT50.3201P	Advanced Food Chemistry	Core	0-0-1-1	30
IMFT50.3202T	Fruit and vegetable processing technology	Core	3-0-0-3	45
IMFT50.3202P	Fruit and vegetable processing technology	Core	0-0-1-1	30
IMFT50.3203T	Spice and Plantation Crops Production Technology	Minor	3-0-0-3	45
IMFT50.3203P	Spice and Plantation Crops Production Technology	Minor	0-0-1-1	30
IMFT50.3204T	Intellectual Property Rights	MDC	3-0-0-3	45
IMFT50.3205T	Medicinal Foods	VAC	3-0-0-3	45
IMFT50.3206T	Green Chemistry in Food Sector	VAC	3-0-0-3	45
	Total		**21**	**360**

Semester IV (25 Credit)

Code	Course	Category	Credit	Hours
IMFT50.4207T	Technology of Meat, Dairy, and Poultry Processing	Core	3-0-0-3	45
IMFT50.4207P	Technology of Meat, Dairy, and Poultry Processing	Core	0-0-1-1	30
IMFT50.4208T	Technology of Cereals, Pulses and oilseeds	Core	3-0-0-3	45
IMFT50.4208P	Technology of Cereals, Pulses and oilseeds	Core	0-0-1-1	30
IMFT50.4209T	Food Engineering	Core	3-0-0-3	45
IMFT50.4209P	Food Engineering	Core	0-0-1-1	30
IMFT50.4210T	Instrumentation and analytical techniques	Minor	3-0-0-3	45
IMFT50.4211T	Fish processing technology	Minor	3-0-0-3	45
IMFT50.4211P	Fish processing technology	Minor	0-0-1-1	30
IMFT50.4212T	Ethnic Foods of India and Nutrition	VAC	3-0-0-3	45

IMFT50.4213T	Food By-product Valorization	SEC	3-0-0-3	45
	Total		**25**	**435**

Semester V (22 Credits)

Code	Course	Category	Credit	Hours
IMFT55.5301T	Food Biotechnology	Core	3-0-0-3	45
IMFT55.5301P	Food Biotechnology	Core	0-0-1-1	30
IMFT55.5302T	Food laws and regulation	Core	3-0-0-3	45
IMFT55.5303T	Food Additives & Flavor Technology	Core	3-0-0-3	45
IMFT55.5303P	Food Additives & Flavor Technology	Core	0-0-1-1	30
IMFT55.5304T	Food Adulteration	Minor	3-0-0-3	45
IMFT55.5304P	Food Adulteration	Minor	0-0-1-1	30
IMFT55.5305T	Fundamentals of Management and Consumer Behavior in Food Industry	Minor	2-0-0-2	30
IMFT55.5306T	Basic Techniques in Microbiology and Immunology	SEC	3-0-0-3	45
IMFT55.5307P	Internship	Internship	0-0-2-2	2
	Total		**22**	**347**

Semester VI (22 Credits)

Code	Course	Category	Credit	Hours
IMFT55.6308T	Food Packaging Technology	Core	3-0-0-3	45
IMFT55.6308P	Food Packaging Technology	Core	0-0-1-1	30
IMFT55.6309T	Nutraceuticals and Functional Foods	Core	3-0-0-3	45
IMFT55.6310T	Biostatistics in Food Industry	Core	3-0-0-3	45
IMFT55.6310P	Biostatistics in Food Industry	Core	0-0-1-1	15
IMFT55.6311T	Digital Technologies in Food Sector	Minor	3-0-0-3	45
IMFT55.6312T	Supply Chain management in food sector	Minor	3-0-0-3	45

IMFT55.6313T	Food Data Analytics and Descriptive Statistics	SEC	3-0-0-3	45
IMFT55.6314P	Internship	Internship	0-0-2-2	30
	Total		**22**	**315**

Semester VII (22 Credits)

Code	Course	Category	Credit	Hours
IMFT60.7401T	Research methodology and scientific writing	Core	3-0-0-3	45
IMFT60.7402T	Food Toxicology	Core	3-0-0-3	45
IMFT60.7402P	Food Toxicology	Core	0-0-1-1	30
IMFT60.7403T	Food quality evaluation : sensory and rheological approaches	Core	3-0-0-3	45
IMFT60.7404T	Biochemistry and Human Nutrition	Core	3-0-0-3	45
IMFT60.7405T	Baking and confectionary technology	Minor	3-0-0-3	45
IMFT60.7405P	Baking and confectionary technology	Minor	0-0-1-1	30
IMFT60.7406T	Bioethics and Biosafety	Minor	3-0-0-3	45
IMFT60.7407T	MOOC	Minor	2-0-0-2	30
	Total		**22**	**360**

Semester VIII (Honors with Research- 19 Credits)

Code	Course	Category	Credit	Hours
IMFT60.8407P	Thesis	Core	0-0-12-12	225
IMFT60.8408T	MOOC (two)	Core	2-0-0-2 2-0-0-2	60
IMFT60.8409T	Seminar	Core	3-0-0-3	45
	Total		**19**	**330**

Semester VIII (Honors – 19 Credits)

Code	Course Title	Category	Credit	Hours
IMFT60.8409P	Mini Project	Core	0-0-4-4	60
IMFT60.8410T	Technology of fats and oils	Core	3-0-0-3	45
IMFT60.8410P	Technology of fats and oils	Core	0-0-1-1	30
IMFT60.8411T	Industrial enzymology	Core	3-0-0-3	45
IMFT60.8412T	Total Quality Management	Core	3-0-0-3	45

IMFT60.8413T	Finance Management in Food Industry	Minor	3-0-0-3	45
IMFT60.8414T	MOOC	Core	2-0-0-2	30
	Total		**19**	**330**

Semester IX (20 Credits)

Code	**Course**	**Category**	**Credit**	**Hours**
IMFT65.9501T	Advanced materials and Nanotechnology in food	Core	3-0-0-3	45
IMFT65.9501P	Advanced materials and Nanotechnology in food	Core	0-0-1-1	30
IMFT65.9502T	Process Modelling & Simulations	Core	3-0-0-3	45
IMFT65.9502P	Process Modelling & Simulations	Core	0-0-1-1	30
IMFT65.9503T	Entrepreneurship in Food Sector	Core	3-0-0-3	45
IMFT65.9504T	Waste management practices	Minor	3-0-0-3	45
IMFT65.9505P	Case study project relevant to Food Industry	Minor	0-0-3-3	30
IMFT65.9506P	Laboratory project	Minor	0-0-3-3	30
	Total		**20**	**300**

Semester X (24 Credit)

Code	**Course**	**Category**	**Credit**	**Hours**
IMFT65.10507P	Thesis	Core	0-0-20-20	300
IMFT65.10508T	Seminar	Core	2-0-0-2	30
IMFT65.10509T	MOOC	Core	2-0-0-2	30
	Total		**24**	**360**

Total Credit Distribution

Programme	
Bachelors in Food Science and Technology	134
Bachelors in Food Science and Technology (Honours)	178
Bachelors in Food Science and Technology (Honours with Research)	178
Integrated Bachelors-Masters in Food Science and Technology (with Bachelors Honors)	219
Integrated Bachelors-Masters in Food Science and Technology (with Bachelors Honors with Research)	219

DCC: Discipline Core Course, DSE: Discipline Specific Elective, Elective/ Minor courses, AEC: Ability enhancement Course/ Foundation course, SEC: Skill Enhancement Course, VAC: Value added Course

Additional Non-Credit Programmes

The programme also proposes a range of value-added, non-credit activities aimed at enhancing students' professional competency, industry readiness, entrepreneurship skills, and practical exposure.

Semester I, II, III

- Industry Interaction Programmes
- Industrial Visits
- Institutional Interaction Programmes

Semester IV, IX

- Expert Lectures by Industry Professionals and Scientists
- Entrepreneurship Development and Start-up Orientation

Semester V, VIII

- HACCP Training and Certification Programmes
- Food Safety Training
- Experiential Learning (Earn While You Learn)
- Skill Development Workshops in Food Processing and Packaging
- Hands-on Training in Advanced Analytical Instruments
- Training on Quality Assurance and Food Regulatory Systems
- Participation in National and International Webinars/Seminars

Semester VI, VII, IX

- Competitive examination training
- Soft Skill, Communication and Personality Development Programmes
- Research Aptitude and Scientific Writing Workshops
- Career Guidance and Competitive Examination Coaching
- Exposure to Emerging Technologies in Food Processing
- Innovation, Incubation and Product Development Activities
- Community Outreach and Extension Activities
- Placement Assistance and Industry Networking Support
- Training in Sustainable Food Systems and Blue Economy Concepts

SEMESTER I

IMFT45.1101T – Principles of Food Science

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Level**: Undergraduate
- **Course Type**: Discipline Core Course (DCC)

Course Objectives

1. To introduce the fundamental concepts and scope of Food Science and Technology.
2. To familiarize students with the composition and properties of foods.
3. To explain the basic principles of food processing and preservation.
4. To develop understanding of food quality, safety, and regulatory aspects.
5. To provide an overview of the food industry, emerging trends, and sustainability.

Course Outcome-Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the scope, importance, and interdisciplinary nature of food science	Module I
CO2	Describe the composition and functional properties of major food components	Module II
CO3	Discuss principles of food processing and preservation techniques	Module III
CO4	Interpret concepts of food quality, safety, and spoilage mechanisms	Module IV
CO5	Evaluate food industry structure, regulations, and emerging trends	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	1	1	1	1	1	2
CO3	3	2	3	2	2	2	1	1	1	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	1	2	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the scope, importance, and interdisciplinary nature of food science	Understand (K2)
CO2	Describe the composition and functional properties of major food components	Understand (K2)
CO3	Discuss principles of food processing and preservation techniques	Apply (K3)
CO4	Interpret concepts of food quality, safety, and spoilage mechanisms	Analyze (K4)
CO5	Evaluate food industry structure, regulations, and emerging trends	Evaluate (K5)

Module I: Introduction to Food Science (8 Hours)

- Definition, scope, and importance of food science and technology
- Evolution and history of food processing
- Interdisciplinary nature of food science
- Classification of foods (plant, animal, processed foods)
- Functions of food: physiological, psychological, social
- Food as a system: physical, chemical, and biological aspects
- Overview of food supply chain (farm to fork concept)
- Role of food science in nutrition, health, and economy

Module II: Composition and Properties of Foods (10 Hours)

- Major food components:
  - Water: structure, properties, water activity
  - Carbohydrates: classification, functions
  - Proteins: structure, functional properties
  - Lipids: types, properties, rancidity
- Minor components:
  - Vitamins and minerals
  - Pigments (chlorophyll, carotenoids, anthocyanins)
  - Flavor compounds
- Functional properties of foods:
  - Emulsification, gelation, foaming
- Physical properties of foods:

- Texture, color, rheology (introductory)

Module III: Principles of Food Processing and Preservation (10 Hours)

- Objectives of food processing
- Unit operations in food processing (cleaning, grading, size reduction, mixing)
- Principles of food preservation:
  - Heat processing (pasteurization, sterilization)
  - Low temperature preservation (refrigeration, freezing)
  - Drying and dehydration
  - Fermentation (basic concept)
  - Chemical preservation
- Packaging basics and its role in preservation
- Concept of shelf life

Module IV: Food Spoilage, Quality and Safety (9 Hours)

- Food spoilage:
  - Microbial spoilage
  - Enzymatic spoilage
  - Chemical spoilage
- Factors affecting spoilage:
  - Intrinsic and extrinsic factors
- Food quality:
  - Definition and attributes (sensory, nutritional, microbiological)
- Food safety:
  - Hazards (biological, chemical, physical)
  - Food contamination and adulteration
- Basic concept of HACCP
- Introduction to food standards and regulations (FSSAI overview)

Module V: Food Industry, Regulations and Emerging Trends (8 Hours)

- Structure of food industry:
  - Primary, secondary, tertiary processing sectors
- Food product development: basic concepts
- Entrepreneurship in food sector (introductory)
- Food laws and regulations:
  - FSSAI, Codex Alimentarius (overview)
- Labelling and consumer awareness
- Emerging trends:
  - Functional foods and nutraceuticals

    - Organic foods
    - Convenience foods
    - Sustainable food processing
- Food waste management and sustainability

Recommended References

1. Fellows, P. J. (2022). Food Processing Technology: Principles and Practice. Elsevier.
2. Potter, N. N., & Hotchkiss, J. H. (2012). Food Science. Springer.
3. Vaclavik, V. A., & Christian, E. W. (2014). Essentials of Food Science. Springer.
4. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). Fennema's Food Chemistry. CRC Press.
5. Rao, D. G. (2010). Fundamentals of Food Engineering. PHI Learning.

IMFT45.1102T – Introduction to Food Chemistry

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Level**: Undergraduate
- **Course Type**: Discipline Core Course (DCC)

Course Objectives

1. To introduce the chemical composition and structure of food components.
2. To understand physicochemical properties and reactions in food systems.
3. To explain the role of water in food stability and preservation.
4. To develop knowledge on food deterioration and chemical changes.
5. To provide insight into food additives and their functions.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the composition and structure of major food constituents	Module I
CO2	Describe physicochemical properties of water and its role in foods	Module II
CO3	Discuss chemical properties and reactions of carbohydrates, proteins, and lipids	Module III
CO4	Interpret chemical changes leading to food deterioration and quality loss	Module IV
CO5	Evaluate the role of food additives and chemical aspects of food quality	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	1	1	1	1	1	2
CO3	3	3	2	2	2	2	1	1	1	2
CO4	3	3	2	3	2	2	2	2	1	2
CO5	2	2	2	2	3	3	2	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	2	2
CO3	3	2	3
CO4	2	3	2
CO5	3	3	3

Bloom's Taxonomy Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain composition and structure of food constituents	Understand (K2)
CO2	Describe water properties and its role in foods	Understand (K2)
CO3	Discuss chemical reactions of food components	Apply (K3)
CO4	Interpret chemical changes in food deterioration	Analyze (K4)
CO5	Evaluate role of additives and food quality	Evaluate (K5)

Module I: Composition of Foods (8 Hours)

- Definition and scope of food chemistry
- Composition of foods: moisture, carbohydrates, proteins, lipids
- Minor constituents: vitamins, minerals, enzymes
- Structure of food components (overview)
- Chemical bonds and interactions in food systems
- Colloidal systems in foods

Module II: Water in Foods (9 Hours)

- Structure and properties of water
- Types of water in foods (free, bound, immobilized)
- Water activity (aw): concept and significance
- Moisture sorption isotherms
- Role of water in food stability and spoilage
- Glass transition (introductory concept)

Module III: Chemistry of Major Food Components (12 Hours)

Carbohydrates

- Classification and structure
- Functional properties (gelation, viscosity)
- Reactions: caramelization, Maillard reaction

Proteins

- Structure (primary to quaternary)
- Functional properties (solubility, emulsification, foaming)
- Denaturation and coagulation

Lipids

- Classification and structure
- Physical and chemical properties

- Lipid oxidation and rancidity

Module IV: Chemical Changes in Foods (8 Hours)

- Enzymatic browning
- Non-enzymatic browning
- Lipid oxidation mechanisms
- Protein degradation
- Vitamin losses during processing
- Factors affecting chemical reactions in foods

Module V: Food Additives and Quality (8 Hours)

- Definition and classification of food additives
- Functions:
    - Preservatives
    - Antioxidants
    - Colors and flavors
    - Emulsifiers and stabilizers
- Chemical basis of food quality attributes
- Introduction to food standards (FSSAI overview)
- Safety aspects of additives

Recommended References

1. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). Fennema's Food Chemistry. CRC Press.
2. Belitz, H. D., Grosch, W., &Schieberle, P. (2009). Food Chemistry. Springer.
3. Vaclavik, V. A., & Christian, E. W. (2014). Essentials of Food Science. Springer.
4. DeMan, J. M. (2018). Principles of Food Chemistry. Springer.
5. Coultate, T. P. (2016). Food: The Chemistry of Its Components. Royal Society of Chemistry.

IMFT45.1102P – Food Chemistry Practical

- **Credits**: 2 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: ~30 Hours
- **Course type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To familiarize students with basic laboratory techniques in food chemistry.
2. To develop skills in qualitative and quantitative analysis of food components.
3. To understand physicochemical properties of foods through experiments.
4. To train students in safe handling of chemicals and laboratory equipment.
5. To interpret experimental results related to food composition and quality.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate basic laboratory skills and safety practices
PCO2	Perform qualitative analysis of major food components
PCO3	Conduct quantitative estimation of food constituents
PCO4	Analyze physicochemical properties of food samples
PCO5	Detect adulterants and interpret food quality parameters

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and Good Laboratory Practices (GLP)	PCO1
2	Calibration and use of basic laboratory instruments (balance, pH meter)	PCO1
3	Determination of moisture content by oven drying method	PCO3
4	Determination of water activity (demonstration/interpretation)	PCO4
5	Qualitative tests for carbohydrates (Molisch's, Benedict's, Iodine test)	PCO2
6	Estimation of reducing sugars (DNS / Lane-Eynon method)	PCO3
7	Qualitative tests for proteins (Biuret, Ninhydrin, Xanthoproteic)	PCO2
8	Estimation of protein (Lowry / Kjeldahl method – demonstration)	PCO3
9	Determination of fat content (Soxhlet extraction – demonstration)	PCO3
10	Determination of peroxide value of fats and oils	PCO4
11	Determination of acid value of fats and oils	PCO4
12	Determination of pH and titratable acidity	PCO4
13	Determination of total soluble solids (TSS) using refractometer	PCO4
14	Detection of common food adulterants (milk, spices, oils)	PCO5
15	Detection of synthetic colors in food samples	PCO5

16	Record preparation and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	1	1	1	1	1	2
PCO3	3	3	3	2	2	2	1	1	1	2
PCO4	3	3	2	3	2	2	2	1	1	2
PCO5	2	2	2	3	2	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	2	3
PCO4	2	3	2
PCO5	3	3	3

List of Experiments

1. Laboratory safety rules and good laboratory practices (GLP)
2. Calibration and use of basic instruments (balance, pH meter, glassware)
3. Determination of moisture content in food samples (oven drying method)
4. Determination of water activity (demonstration/interpretation-based)
5. Qualitative tests for carbohydrates (Molisch's, Benedict's, Iodine test)
6. Estimation of reducing sugars (DNS method / Lane-Eynon method – demo)
7. Qualitative tests for proteins (Biuret, Ninhydrin, Xanthoproteic test)
8. Estimation of protein (Lowry method / Kjeldahl method – demonstration)
9. Determination of fat content (Soxhlet extraction – demonstration)
10. Determination of peroxide value of fats/oils
11. Determination of acid value of fats/oils
12. Determination of pH and titratable acidity of food samples
13. Determination of total soluble solids (TSS) using refractometer
14. Detection of common food adulterants (milk, spices, oils)
15. Detection of synthetic colors in food samples
16. Preparation of laboratory record with interpretation of results

IMFT45.1103T – Introduction to Food Microbiology

- **Credits**: 2 **L–T–P Structure**: 2–0–0 **Total Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To introduce the basic concepts of microbiology relevant to food systems.
2. To understand different groups of microorganisms associated with foods.
3. To explain microbial growth and factors affecting it in foods.
4. To study food spoilage and foodborne diseases.
5. To provide knowledge on food preservation and basic safety measures.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain basic concepts and classification of food microorganisms	Module I
CO2	Describe morphology and characteristics of bacteria, yeasts, and molds	Module II
CO3	Discuss microbial growth and factors influencing growth in foods	Module III
CO4	Interpret mechanisms of food spoilage and foodborne diseases	Module IV
CO5	Evaluate methods of food preservation and control of microorganisms	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	1	1	1	1	1	2
CO3	3	2	2	2	2	2	1	1	1	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	2	2	3	3	2	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	2	3
CO4	2	3	2
CO5	3	3	3

Bloom's Taxonomy Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain basic microbiological concepts	Understand (K2)
CO2	Describe morphology of microorganisms	Understand (K2)
CO3	Discuss microbial growth in foods	Apply (K3)
CO4	Interpret spoilage and foodborne diseases	Analyze (K4)
CO5	Evaluate preservation methods and control measures	Evaluate (K5)

Module I: Introduction to Food Microbiology (6 Hours)

- Definition, scope, and importance of food microbiology
- Historical developments (Pasteur, Koch – brief overview)
- Microorganisms in foods: beneficial vs harmful
- Sources of microorganisms in foods:
  - Soil, water, air, equipment, handlers
- Classification of microorganisms:
  - Bacteria, yeasts, molds, viruses (introductory)
- Role of microorganisms in food industry and environment

Module II: Morphology and Characteristics of Microorganisms (6 Hours)
Bacteria

- Structure of bacterial cell
- Shapes and arrangements
- Gram-positive and Gram-negative bacteria
- Spore-forming vs non-spore-forming bacteria

Yeasts

- Structure and reproduction
- Role in fermentation

Molds

- Structure (hyphae, mycelium)
- Reproduction (spores)

General Characteristics

- Nutritional requirements
- Aerobic vs anaerobic microorganisms

Module III: Microbial Growth in Foods (6 Hours)

- Growth curve of microorganisms (lag, log, stationary, death phase)
- Factors affecting microbial growth:

Intrinsic Factors

- pH
- Water activity (aw)

- Nutrient content
- Natural antimicrobial substances

Extrinsic Factors

- Temperature
- Relative humidity
- Oxygen availability

Other Factors

- Microbial interactions (competition, synergy)

Module IV: Food Spoilage and Foodborne Diseases (6 Hours)

Food Spoilage

- Definition and types
- Spoilage of:
  - Cereals and bakery products
  - Fruits and vegetables
  - Milk and dairy products
  - Meat, fish, and poultry
- Indicators of spoilage

Foodborne Diseases

- Infection vs intoxication
- Common foodborne pathogens:
  - *Salmonella*, *E. coli*, *Staphylococcus aureus*
- Symptoms and transmission
- Basic control measures

Module V: Food Preservation and Microbial Control (6 Hours)

- Principles of food preservation
- Methods of microbial control:
  - Heat (pasteurization, sterilization)
  - Low temperature (refrigeration, freezing)
  - Drying
  - Chemical preservatives
- Introduction to fermentation
- Concept of asepsis and hygiene
- Basic concept of food safety systems (HACCP – introductory)

Recommended References

1. Frazier, W. C., & Westhoff, D. C. (2008). *Food Microbiology*. McGraw-Hill.
2. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). *Modern Food Microbiology*. Springer.
3. Ray, B., & Bhunia, A. (2013). *Fundamental Food Microbiology*. CRC Press.
4. Adams, M. R., & Moss, M. O. (2008). *Food Microbiology*. Royal Society of Chemistry.
5. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2005). *Microbiology*. McGraw-Hill.

IMFT45.1103P – Food Microbiology Practical

- **Credits**: 2 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: ~30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To introduce students to basic microbiological laboratory techniques.
2. To develop skills in handling microorganisms safely.
3. To demonstrate methods of isolation, cultivation, and enumeration of microbes.
4. To study microorganisms associated with food.
5. To interpret microbiological results in relation to food quality and safety.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate aseptic techniques and laboratory safety
PCO2	Perform staining and microscopic identification of microorganisms
PCO3	Apply microbial culturing and enumeration techniques
PCO4	Analyze microbial load in food and water samples
PCO5	Evaluate factors affecting microbial growth and food safety

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Microbiology laboratory safety and aseptic techniques	PCO1
2	Cleaning and sterilization of glassware	PCO1
3	Preparation and sterilization of culture media	PCO1
4	Handling and use of microscope	PCO2
5	Simple staining of bacteria	PCO2
6	Gram staining of bacteria	PCO2
7	Streak plate technique	PCO3
8	Spread and pour plate techniques	PCO3
9	Total Plate Count (TPC)	PCO3
10	Isolation of microorganisms from food samples	PCO4
11	Yeast and mold count in food	PCO4
12	Microbiological analysis of water (MPN)	PCO4
13	Detection of coliforms	PCO4
14	Effect of temperature on microbial growth	PCO5
15	Effect of pH on microbial growth	PCO5
16	Record preparation and interpretation	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	1	1	1	1	1	2
PCO3	3	3	3	3	2	2	1	1	1	2
PCO4	3	3	2	3	2	3	2	2	1	2
PCO5	2	2	2	3	3	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Microbiology laboratory safety and aseptic techniques
2. Cleaning, sterilization, and preparation of glassware
3. Preparation and sterilization of culture media (Nutrient agar/broth)
4. Handling and use of microscope
5. Simple staining of bacteria
6. Gram staining of bacteria
7. Inoculation techniques: streak plate method
8. Spread plate and pour plate techniques
9. Enumeration of microorganisms (Total Plate Count)
10. Isolation of microorganisms from food samples (milk/curd/fruits)
11. Yeast and mold count in food samples
12. Microbiological analysis of water (MPN method – demonstration)
13. Detection of coliforms (qualitative test)
14. Effect of temperature on microbial growth
15. Effect of pH on microbial growth
16. Laboratory record submission and interpretation of results

IMFT45.1103T – Analytical Methods and Calculations in Food Science

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To introduce fundamental analytical methods used in food science laboratories.
2. To understand principles of qualitative and quantitative food analysis.
3. To develop knowledge of laboratory calculations and solution preparation.
4. To familiarize students with analytical instruments and data interpretation.
5. To build competency in food quality evaluation and analytical problem-solving.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain principles of analytical methods used in food science laboratories	Module I
CO2	Describe laboratory calculations, solution preparation, and analytical procedures	Module II
CO3	Understand qualitative and quantitative analysis techniques for food components	Module III
CO4	Analyze food quality parameters using analytical instruments and calculations	Module IV
CO5	Apply analytical methods and data interpretation skills in food science applications	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	1	2	2
CO2	3	3	2	2	3	1	1	1	2	2
CO3	3	3	3	2	3	2	1	1	2	2
CO4	3	3	3	3	3	2	2	1	2	2
CO5	3	3	3	3	3	2	2	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	1
CO3	3	3	2
CO4	3	3	2

CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain principles of analytical methods used in food science laboratories	Understand (K2)
CO2	Describe laboratory calculations and analytical procedures	Understand (K2)
CO3	Understand qualitative and quantitative analysis techniques	Apply (K3)
CO4	Analyze food quality parameters using analytical methods	Analyze (K4)
CO5	Apply analytical methods and data interpretation skills in food science	Apply (K3)

Module 1: Introduction to Food Analysis and Laboratory Safety (9 Hours)

- Importance of analytical methods in food science
- Types of food analysis: qualitative and quantitative
- Accuracy, precision, sensitivity, and specificity
- Errors in analytical measurements
- Laboratory safety rules and Good Laboratory Practices (GLP)
- Cleaning and maintenance of laboratory glassware
- Introduction to laboratory instruments and equipment

Module 2: Units, Concentrations and Laboratory Calculations (9 Hours)

- Units and measurements in food analysis
- SI units and conversions
- Molarity, molality, normality, and percentage solutions
- Preparation and standardization of solutions
- Dilution calculations
- pH calculations and buffer solutions
- Numerical problems related to analytical chemistry

Module 3: Proximate Analysis and Food Composition (9 Hours)

- Principles of proximate analysis
- Determination of moisture content
- Ash analysis and mineral estimation
- Crude protein determination

- Lipid extraction and fat analysis
- Crude fibre estimation
- Carbohydrate estimation and energy calculations

Module 4: Instrumental Methods of Food Analysis (9 Hours)

- Principles and applications of spectroscopy
- Colorimetry and spectrophotometry
- Chromatographic techniques: paper, TLC, HPLC, GC
- pH meter and conductivity meter
- Centrifugation and refractometry
- Introduction to thermal analysis techniques
- Applications in food quality assessment

Module 5: Data Interpretation and Quality Assurance (9 Hours)

- Recording and presentation of analytical data
- Statistical treatment of analytical results
- Calibration curves and standard graphs
- Quality control and quality assurance in laboratories
- Validation of analytical methods
- Interpretation of food analysis reports
- Applications in food quality and safety evaluation

Recommended References

1. Nielsen, S. S. (2017). *Food Analysis*. Springer.
2. Ranganna, S. (2014). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw Hill.
3. Pomeranz, Y., & Meloan, C. E. (2013). *Food Analysis: Theory and Practice*. Springer.
4. AOAC International. (2019). *Official Methods of Analysis*. AOAC International.
5. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). *Principles of Instrumental Analysis*. Cengage Learning.

SEMESTER II

IMFT45.2107T – Food Preservation Technology

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To understand principles and importance of food preservation.
2. To study various methods of food preservation and their scientific basis.
3. To analyze factors affecting shelf-life and food stability.
4. To learn preservation techniques for different food commodities.
5. To develop knowledge on modern preservation technologies and safety.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain principles and importance of food preservation	Module I
CO2	Describe methods of preservation using temperature and dehydration	Module II
CO3	Apply preservation techniques using chemical and biological methods	Module III
CO4	Analyze preservation methods for different food commodities	Module IV
CO5	Evaluate modern preservation technologies and shelf-life	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	2	1	1	1	1	2
CO3	3	3	3	2	2	2	1	1	1	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	3	3	3	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3

CO5	3	3	3

Bloom's Taxonomy Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain preservation principles	Understand (K2)
CO2	Describe temperature and drying methods	Understand (K2)
CO3	Apply preservation techniques	Apply (K3)
CO4	Analyze preservation of food commodities	Analyze (K4)
CO5	Evaluate modern preservation methods	Evaluate (K5)

Module I: Principles of Food Preservation (9 Hours)

- Definition, scope, and importance of food preservation
- Causes of food spoilage:
  - Microbial, enzymatic, chemical
- Principles of preservation:
  - Asepsis, removal of microorganisms
  - Inhibition of microbial growth
  - Killing of microorganisms
- Factors affecting shelf-life:
  - Intrinsic and extrinsic factors
- Hurdle technology (basic concept)

Module II: Preservation by Temperature and Drying (9 Hours)
High Temperature Preservation

- Pasteurization (methods and applications)
- Sterilization and commercial sterility
- Canning (principles and process overview)

Low Temperature Preservation

- Refrigeration and freezing
- Changes during freezing and frozen storage

Drying and Dehydration

- Principles of drying
- Methods: sun drying, mechanical drying, spray drying (intro)
- Effects of drying on food quality

Module III: Chemical and Biological Methods of Preservation (9 Hours)

Chemical Preservation

- Use of preservatives:

    - Benzoates, sulfites, nitrates
- Mechanism of action and permissible limits

Biological Methods

- Fermentation:
    - Types (lactic, alcoholic)
    - Applications in foods
- Use of natural antimicrobials

Other Methods

- Osmotic preservation (sugar and salt)
- Use of acids and pH control

Module IV: Preservation of Food Commodities (9 Hours)

Fruits and Vegetables

- Processing and preservation methods:
    - Canning, pickling, dehydration

Milk and Dairy Products

- Pasteurization, sterilization, fermented products

Meat, Fish, and Poultry

- Chilling, freezing, curing, smoking

Cereals and Pulses

- Storage and pest control methods

Module V: Modern Preservation Techniques and Shelf-life (9 Hours)

- Introduction to modern techniques:
    - Irradiation
    - High-pressure processing (HPP)
    - Modified atmosphere packaging (MAP)
- Packaging and preservation
- Shelf-life evaluation methods
- Food safety and quality assurance (HACCP – overview)
- Emerging trends in food preservation

Recommended References

1. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.
2. Rahman, M. S. (2007). *Handbook of Food Preservation*. CRC Press.
3. Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer.
4. Ranganna, S. (2010). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.
5. Jay, J. M. (2005). *Modern Food Microbiology*. Springer.

IMFT45.2107P – Food Preservation Technology Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To provide hands-on training in basic food preservation techniques.
2. To understand practical applications of preservation methods.
3. To develop skills in preparation and storage of preserved foods.
4. To evaluate quality and shelf-life of preserved products.
5. To relate theory of preservation with practical applications.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate basic food preservation techniques
PCO2	Apply different preservation methods to food products
PCO3	Analyze quality parameters of preserved foods
PCO4	Evaluate packaging and shelf-life of food products
PCO5	Interpret results and relate theory with practice

Practical–PCO Mapping (with Practical No. & Title)

Practical No.	Practical Title	Mapped PCO
1	Blanching of vegetables	PCO1
2	Pasteurization of milk	PCO1
3	Canning of fruits/vegetables	PCO2
4	Refrigeration storage study	PCO2
5	Freezing and quality assessment	PCO2
6	Sun drying of products	PCO2
7	Tray drying and moisture analysis	PCO2
8	Preparation of squash/RTS beverage	PCO2
9	Preparation of jam/jelly	PCO2
10	Preparation of pickles	PCO2
11	Preparation of fermented product	PCO2
12	Determination of TSS and acidity	PCO3
13	Sensory evaluation of products	PCO3
14	Packaging of preserved foods	PCO4
15	Shelf-life study	PCO4
16	Record preparation and interpretation	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	2	2	2	1	2	2
PCO2	3	3	3	2	2	2	2	1	2	2
PCO3	2	3	2	3	2	2	2	2	2	2
PCO4	2	2	2	3	3	3	2	2	2	2
PCO5	2	2	2	3	2	2	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	2	3	2
PCO4	2	3	3
PCO5	2	2	3

List of Practical Exercises (Experiments)

1. Blanching of vegetables and study of enzyme inactivation
2. Pasteurization of milk (demonstration)
3. Canning of fruits/vegetables
4. Refrigeration storage study (short-term observation)
5. Freezing of fruits/vegetables and quality assessment
6. Sun drying of fruits/vegetables
7. Tray drying/dehydration and moisture loss calculation
8. Preparation of fruit squash/RTS beverage using preservatives
9. Preparation of jam/jelly with preservation principles
10. Preparation of pickles using salt/oil preservation
11. Preparation of fermented product (curd/pickled vegetables)
12. Determination of TSS and acidity in preserved products
13. Sensory evaluation of preserved foods
14. Packaging of preserved products (basic methods)
15. Shelf-life study of preserved foods (short-term observation)
16. Record preparation and interpretation of results

IMFT45.2108T – Fermentation Technology

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core (Major)
- **Level**: Undergraduate

Course Objectives

1. To understand the fundamentals of fermentation and microbial growth.
2. To study industrially important microorganisms and fermentation processes.
3. To learn different types of fermentation systems and bioreactors.
4. To understand downstream processing and product recovery.
5. To develop knowledge of applications of fermentation in food industries.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the principles and types of fermentation processes	Module I
CO2	Describe microbial growth kinetics and fermentation media	Module II
CO3	Apply knowledge of fermentation systems and bioreactors	Module III
CO4	Analyze downstream processing and product recovery techniques	Module IV
CO5	Evaluate industrial applications of fermentation technology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	2	3	2	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	2	2	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the principles and types of fermentation processes	Understand (K2)
CO2	Describe microbial growth kinetics and fermentation media	Understand (K2)
CO3	Apply knowledge of fermentation systems and bioreactors	Apply (K3)
CO4	Analyze downstream processing and product recovery techniques	Analyze (K4)
CO5	Evaluate industrial applications of fermentation technology	Evaluate (K5)

Module 1: Fundamentals of Fermentation (9 Hours)

- Definition and history of fermentation
- Types of fermentation:
  - Alcoholic fermentation
  - Lactic acid fermentation
  - Acetic acid fermentation
- Role of microorganisms in fermentation
- Classification of fermentation processes:
  - Batch, fed-batch, continuous fermentation
- Aerobic vs anaerobic fermentation
- Factors affecting fermentation: temperature, pH, oxygen, substrate

Module 2: Microbial Growth and Fermentation Media (9 Hours)

- Growth kinetics of microorganisms
- Growth curve and phases
- Measurement of microbial growth
- Nutritional requirements of microorganisms
- Types of fermentation media:
  - Synthetic and complex media
- Sterilization of media and equipment
- Inoculum preparation and maintenance of cultures

Module 3: Fermentation Systems and Bioreactors (9 Hours)

- Types of fermenters/bioreactors:
  - Stirred tank reactor
  - Airlift fermenter
  - Packed bed reactor
- Design and components of fermenters
- Agitation and aeration systems
- Scale-up of fermentation processes
- Monitoring and control of fermentation parameters

Module 4: Downstream Processing (9 Hours)

- Introduction to downstream processing
- Separation techniques:
  - Filtration
  - Centrifugation
- Cell disruption methods
- Product recovery and purification:
  - Extraction, precipitation, chromatography
- Drying and formulation of products
- Waste management in fermentation industries

Module 5: Applications of Fermentation in Food Industry (9 Hours)

- Fermented food products:
  - Dairy (curd, cheese, yogurt)
  - Bakery (bread fermentation)
  - Beverages (beer, wine)
  - Traditional fermented foods
- Production of organic acids, enzymes, vitamins
- Probiotics and functional foods
- Industrial case studies
- Emerging trends in fermentation technology

Recommended References

1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). *Principles of Fermentation Technology*. Elsevier.
2. Waites, M. J., Morgan, N. L., Rockey, J. S., & Higton, G. (2013). *Industrial Microbiology*. Wiley-Blackwell.
3. Crueger, W., &Crueger, A. (2017). *Biotechnology: A Textbook of Industrial Microbiology*. Sinauer Associates.
4. Adams, M. R., & Moss, M. O. (2015). *Food Microbiology*. RSC Publishing.
5. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). *Microbiology*. McGraw-Hill.

IMFT45.2108P – Fermentation Technology Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Hours**: ~30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester II

Course Objectives

1. To provide hands-on experience in basic fermentation techniques.
2. To understand microbial growth and fermentation processes practically.
3. To develop skills in preparation of fermented food products.
4. To study fermentation parameters and product evaluation.
5. To relate theoretical fermentation concepts with practical applications.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate aseptic and fermentation laboratory techniques
PCO2	Apply fermentation processes for food product preparation
PCO3	Analyze microbial growth and fermentation parameters
PCO4	Evaluate fermented products and process conditions
PCO5	Interpret experimental results and prepare reports

Practical–PCO Mapping (with Practical No. & Title)

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and aseptic techniques	PCO1
2	Preparation and sterilization of media	PCO1
3	Isolation of microorganisms from fermented foods	PCO1
4	Preparation of inoculum and culture maintenance	PCO2
5	Study of microbial growth curve	PCO3
6	Alcoholic fermentation using yeast	PCO2
7	Lactic acid fermentation (curd/yogurt)	PCO2
8	Acetic acid fermentation (vinegar)	PCO2
9	Bread making using yeast	PCO2
10	Preparation of idli/dosa batter	PCO2
11	Effect of temperature and pH on fermentation	PCO3
12	Estimation of alcohol content	PCO3
13	Determination of acidity in fermented products	PCO3
14	Biomass separation techniques	PCO4
15	Sensory evaluation of fermented foods	PCO4
16	Record preparation and interpretation	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	2	2	2	1	2	2
PCO2	3	3	3	2	2	2	2	2	2	2
PCO3	2	3	2	3	2	2	2	2	2	2
PCO4	2	2	2	3	3	3	2	2	2	2
PCO5	2	2	2	3	2	2	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	2	3	2
PCO4	2	3	3
PCO5	2	2	3

List of Experiments

1. Laboratory safety and aseptic techniques in fermentation lab
2. Preparation and sterilization of culture media
3. Isolation of microorganisms from fermented foods
4. Preparation of inoculum and maintenance of pure cultures
5. Study of microbial growth curve (turbidity method)
6. Alcoholic fermentation using yeast (CO_2 evolution study)
7. Lactic acid fermentation (curd/yogurt preparation)
8. Acetic acid fermentation (vinegar production – demonstration)
9. Bread making (baker's yeast fermentation)
10. Preparation of traditional fermented food (idli/dosa batter)
11. Effect of temperature and pH on fermentation
12. Estimation of alcohol content (basic method/demonstration)
13. Determination of acidity in fermented products
14. Separation of biomass (centrifugation/filtration – demonstration)
15. Sensory evaluation of fermented products
16. Record preparation and interpretation of results

IMFT45.2109T – Food Quality and Safety

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To understand the concepts of food quality and quality attributes.
2. To study food safety hazards and their control measures.
3. To introduce quality control and assurance systems.
4. To familiarize with national and international food safety regulations.
5. To develop analytical and evaluation skills related to food quality and safety.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain concepts of food quality and quality attributes	Module I
CO2	Describe food safety hazards and their sources	Module II
CO3	Apply principles of food quality control and assurance	Module III
CO4	Analyze food safety management systems and standards	Module IV
CO5	Evaluate regulatory frameworks and food safety practices	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	2	3	2	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	2	2	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts of food quality and quality attributes	Understand (K2)

CO2	Describe food safety hazards and their sources	Understand (K2)
CO3	Apply principles of food quality control and assurance	Apply (K3)
CO4	Analyze food safety management systems and standards	Analyze (K4)
CO5	Evaluate regulatory frameworks and food safety practices	Evaluate (K5)

Module 1: Food Quality – Concepts and Attributes (9 Hours)

- Definition and dimensions of food quality
- Objective vs subjective quality
- Quality attributes:
  - **Physical**: color, size, shape, texture, appearance
  - **Chemical**: composition, pH, acidity, nutrient profile
  - **Sensory**: taste, aroma, mouthfeel, acceptability
  - **Nutritional quality**
- Factors affecting food quality:
  - Raw materials, processing, packaging, storage
- Quality deterioration:
  - Physical, chemical, enzymatic, and microbiological changes
- Shelf-life: concept, factors influencing shelf-life
- Introduction to quality evaluation techniques

Module 2: Food Safety Hazards and Risk Analysis (9 Hours)

- Concept and importance of food safety
- Types of food hazards:
  - **Biological**: bacteria, viruses, parasites, fungi
  - **Chemical**: pesticides, heavy metals, additives, toxins
  - **Physical**: foreign objects (glass, metal, plastic)
- Foodborne diseases: causes, symptoms, and prevention
- Sources of contamination:
  - Farm, processing, transportation, storage
- Risk analysis framework:
  - Hazard identification
  - Risk assessment
  - Risk management
  - Risk communication
- Case studies of food safety outbreaks

Module 3: Quality Control and Quality Assurance (9 Hours)

- Concept of quality control (QC) and quality assurance (QA)

- Differences between QC and QA
- Sampling techniques in food analysis
- Statistical quality control tools:
    - Control charts
    - Acceptance sampling
- Good practices in food industry:
    - GMP (Good Manufacturing Practices)
    - GHP (Good Hygiene Practices)
    - SSOP (Sanitation Standard Operating Procedures)
- Documentation and standard operating procedures (SOPs)
- Role of quality assurance in food industry

Module 4: Food Safety Management Systems (9 Hours)

- HACCP (Hazard Analysis and Critical Control Point):
    - Principles (7 principles)
    - Steps in implementation
    - Identification of CCPs
- ISO standards:
    - ISO 22000 (Food Safety Management System)
    - Overview of ISO 9001
- Total Quality Management (TQM)
- Food safety auditing and certification
- Traceability and recall systems
- Role of food safety culture

Module 5: Food Laws, Standards and Regulations (9 Hours)

- Food Safety and Standards Act (FSSAI):
    - Structure and functions
    - Licensing and registration
- Codex Alimentarius Commission:
    - Objectives and importance
- International food safety systems:
    - WHO, FAO guidelines
- Food labeling:
    - Mandatory and voluntary labeling requirements
    - Nutritional labeling
- Food standards and specifications
- Emerging issues in food safety:
    - Food fraud and adulteration
    - Novel foods and GM foods

- Sustainability and food safety

Recommended References

1. Potter, N. N., & Hotchkiss, J. H. (2012). *Food Science*. Springer.
2. Fellows, P. J. (2017). *Food Processing Technology*. Woodhead Publishing.
3. Lawley, R., Curtis, L., & Davis, J. (2012). *The Food Safety Hazard Guidebook*. RSC Publishing.
4. Motarjemi, Y., &Lelieveld, H. (2014). *Food Safety Management*. Academic Press.
5. FSSAI (Latest Edition). *Food Safety and Standards Regulations Manual*.

IMFT45.2109P – Food Quality and Safety Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Undergraduate

Course Objectives

1. To develop practical skills in food quality evaluation.
2. To understand analytical methods used in food safety assessment.
3. To apply quality control techniques in food analysis.
4. To detect adulterants and contaminants in food.
5. To interpret analytical results related to food quality and safety.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate basic food quality evaluation techniques
PCO2	Apply analytical methods for food quality and safety
PCO3	Analyze physicochemical and microbiological parameters
PCO4	Evaluate food safety aspects including adulteration and labelling
PCO5	Interpret results and prepare technical reports

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Calibration and use of pH meter	PCO1
2	Determination of moisture content	PCO2
3	Determination of TSS	PCO2
4	Determination of titratable acidity	PCO2
5	Determination of ash content	PCO2
6	Determination of fat content (Soxhlet)	PCO2
7	Detection of adulterants in milk	PCO4
8	Detection of adulterants in spices and oils	PCO4
9	Detection of synthetic food colors	PCO4
10	Total plate count	PCO3
11	Study of microbial spoilage	PCO3
12	Sensory evaluation (hedonic scale)	PCO3
13	Sampling techniques in food analysis	PCO1
14	Food labeling study (FSSAI compliance)	PCO4
15	Evaluation of packaging materials	PCO4
16	Record preparation and interpretation	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	2	2	2	1	2	2
PCO2	3	3	3	2	2	2	2	2	2	2
PCO3	2	3	2	3	2	2	2	2	2	2
PCO4	2	2	2	3	3	3	2	2	2	2
PCO5	2	2	2	3	2	2	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	2	3	2
PCO4	2	3	3
PCO5	2	2	3

List of Experiments

1. Calibration and use of pH meter
2. Determination of moisture content in food samples
3. Determination of total soluble solids (TSS) using refractometer
4. Determination of titratable acidity
5. Determination of ash content
6. Determination of fat content (Soxhlet method – demonstration)
7. Detection of common food adulterants in milk
8. Detection of adulterants in spices and oils
9. Detection of synthetic food colors
10. Total plate count (demonstration/basic enumeration)
11. Study of microbial spoilage in food samples
12. Sensory evaluation of food products (hedonic scale)
13. Sampling techniques in food quality analysis
14. Study of food labeling and label compliance (FSSAI)
15. Evaluation of packaging materials and quality
16. Record preparation and interpretation of results

SEMESTER III

IMFT50.3201T – Advanced Food Chemistry

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To understand the advanced chemistry of food components.
2. To study chemical reactions affecting food quality and stability.
3. To analyze interactions between food constituents.
4. To explore functional properties of macromolecules in foods.
5. To relate chemical principles to food processing and preservation.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the structure and properties of major food components	Module I
CO2	Describe chemical reactions occurring in foods during processing	Module II
CO3	Analyze interactions between food constituents and their effects	Module III
CO4	Evaluate factors influencing food stability and quality	Module IV
CO5	Apply food chemistry principles in processing and product development	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3

CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain structure and properties of food components	Understand (K2)
CO2	Describe chemical reactions in foods	Understand (K2)
CO3	Analyze interactions between food constituents	Analyze (K4)
CO4	Evaluate factors affecting food stability and quality	Evaluate (K5)
CO5	Apply food chemistry principles in processing	Apply (K3)

Module 1: Water and Food Macromolecules (9 Hours)

- Structure and properties of water
- Water activity (aw) and its significance
- Sorption isotherms and moisture migration
- Structure and functional properties of carbohydrates
- Polysaccharides: starch, cellulose, pectin – structure and functionality
- Protein structure (primary to quaternary) and functionality
- Lipid chemistry: classification, structure, and properties

Module 2: Chemistry of Carbohydrates and Proteins (9 Hours)

- Caramelization and Maillard reaction: mechanism and factors affecting
- Enzymatic and non-enzymatic browning
- Gelatinization and retrogradation of starch
- Protein denaturation and coagulation
- Functional properties of proteins: solubility, emulsification, foaming
- Enzyme kinetics in food systems

Module 3: Lipid Chemistry and Deterioration (9 Hours)

- Lipid oxidation: mechanisms (autooxidation, photooxidation)
- Hydrolytic rancidity
- Factors affecting lipid oxidation
- Antioxidants: natural and synthetic
- Flavor deterioration due to lipid oxidation
- Control of oxidative reactions

Module 4: Food Additives and Minor Components (9 Hours)

- Role of additives in modifying food chemistry
- Chemistry of vitamins and minerals
- Pigments: chlorophyll, carotenoids, anthocyanins
- Flavor compounds: formation and degradation
- Interaction of additives with food components
- Bioactive compounds and nutraceuticals

Module 5: Chemical Changes During Processing and Storage (9 Hours)

- Effects of heat processing on food components
- Changes during freezing and drying
- Chemical changes during storage
- Shelf-life and quality deterioration
- Packaging interactions with food
- Emerging trends: clean label chemistry, functional foods

Recommended References

1. Belitz, H. D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry*. Springer.
2. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). *Fennema's Food Chemistry*. CRC Press.
3. Coultate, T. P. (2009). *Food: The Chemistry of Its Components*. RSC Publishing.
4. DeMan, J. M. (2018). *Principles of Food Chemistry*. Springer.
5. Nielsen, S. S. (2017). *Food Analysis*. Springer.

IMFT50.3201P – Advanced Food Chemistry Practical

Course Details

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To develop laboratory skills in advanced food chemical analysis.
2. To understand physicochemical properties of food components.
3. To perform analytical techniques related to proteins, lipids, carbohydrates, and pigments.
4. To evaluate food quality through chemical methods.
5. To interpret analytical data and laboratory observations.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform proximate analysis of food components
PCO2	Apply analytical techniques for evaluation of food quality
PCO3	Analyze physicochemical properties of food constituents
PCO4	Interpret laboratory results and analytical data
PCO5	Demonstrate laboratory safety and scientific reporting skills

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Determination of moisture content	PCO1
2	Determination of ash content	PCO1
3	Estimation of crude protein	PCO1
4	Determination of crude fat	PCO1
5	Estimation of sugars	PCO2
6	Determination of pH and acidity	PCO2
7	Determination of peroxide value	PCO3
8	Determination of saponification value	PCO3
9	Estimation of ascorbic acid	PCO2
10	Determination of enzymatic browning	PCO3
11	Separation of food pigments	PCO3
12	Determination of water activity	PCO4
13	Determination of emulsifying properties	PCO3
14	Study of starch gelatinization	PCO3
15	Practical record submission	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	2	2	2	2	1	1	2	2
PCO2	3	3	2	2	2	2	1	1	2	2
PCO3	3	3	3	3	3	2	1	1	2	2
PCO4	3	3	2	3	3	2	1	1	2	2
PCO5	2	2	2	2	2	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	2	2	3

List of Experiments

1. Determination of moisture content in food samples
2. Determination of ash content by muffle furnace method
3. Estimation of crude protein by Kjeldahl method
4. Determination of crude fat using Soxhlet extraction
5. Estimation of reducing and non-reducing sugars
6. Determination of pH and titratable acidity of foods
7. Determination of peroxide value of edible oils
8. Determination of saponification value of fats and oils
9. Estimation of ascorbic acid by dye titration method
10. Determination of enzymatic browning in fruits
11. Separation of food pigments using paper/TLC chromatography
12. Determination of water activity and its effect on food stability
13. Determination of emulsifying properties of proteins
14. Study of gel formation and gelatinization in starch
15. Preparation and submission of practical record

IMFT50.3202T – Fruit and Vegetable Processing Technology

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To understand the composition and post-harvest physiology of fruits and vegetables.
2. To study processing techniques and preservation methods.
3. To learn value-added product development from fruits and vegetables.
4. To understand quality evaluation and storage methods.
5. To apply processing technologies in industrial contexts.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain composition and post-harvest behavior of fruits and vegetables	Module I
CO2	Describe processing and preservation techniques	Module II
CO3	Apply methods for preparation of value-added products	Module III
CO4	Analyze quality parameters and storage conditions	Module IV
CO5	Evaluate processing technologies for industrial applications	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain composition and post-harvest behavior	Understand (K2)
CO2	Describe processing and preservation methods	Understand (K2)
CO3	Apply methods for product preparation	Apply (K3)
CO4	Analyze quality parameters and storage	Analyze (K4)
CO5	Evaluate industrial processing technologies	Evaluate (K5)

Module 1: Composition and Post-Harvest Physiology (9 Hours)

- Classification of fruits and vegetables
- Composition: water, carbohydrates, organic acids, pigments, vitamins, minerals
- Post-harvest physiology: respiration, transpiration, ethylene production
- Ripening and senescence
- Maturity indices and harvesting methods
- Post-harvest losses and their control

Module 2: Principles of Processing and Preservation (9 Hours)

- Objectives of processing
- Principles of food preservation
- Methods of preservation:
    - Thermal processing
    - Refrigeration and freezing
    - Drying and dehydration
    - Chemical preservation
- Pre-processing operations: washing, peeling, cutting, blanching
- Enzymatic browning and its control

Module 3: Processing of Fruit Products (9 Hours)

- Fruit beverages: juices, nectars, RTS drinks, squashes
- Jam, jelly, marmalade: principles and preparation
- Canned fruits and fruit pulp processing
- Fruit concentrates and powders
- Role of pectin, sugar, acid in gel formation
- Standards and quality parameters

Module 4: Processing of Vegetable Products (9 Hours)

- Canning of vegetables
- Dehydrated vegetable products
- Pickles and chutneys
- Fermented vegetable products
- Frozen vegetables
- Quality changes during processing

Module 5: Quality Control, Packaging and Industrial Applications (9 Hours)

- Quality evaluation: physical, chemical, sensory parameters
- Food safety and standards (FSSAI)
- Packaging materials and methods for fruits and vegetables
- Storage and shelf-life studies
- Waste utilization (peels, pomace)
- Industrial processing units and recent advancements

Recommended References

1. Srivastava, R. P., & Kumar, S. (2012). *Fruit and Vegetable Preservation*. International Book Distributing Co.
2. Lal, G., Siddappa, G. S., & Tandon, G. L. (2015). *Preservation of Fruits and Vegetables*. ICAR.
3. Desrosier, N. W., & Desrosier, J. N. (2018). *The Technology of Food Preservation*. CBS Publishers.
4. Ranganna, S. (2010). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. Tata McGraw-Hill.
5. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.

IMFT50.3202P – Fruit and Vegetable Processing Technology Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To impart practical knowledge of fruit and vegetable processing techniques.
2. To develop skills in preparation and preservation of processed products.
3. To understand quality evaluation of processed foods.
4. To apply preservation principles in fruit and vegetable products.
5. To familiarize students with industrial processing operations and hygiene practices.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform processing and preservation of fruit and vegetable products
PCO2	Apply quality evaluation techniques for processed foods
PCO3	Analyze processing parameters affecting product quality
PCO4	Demonstrate hygienic and safe food processing practices
PCO5	Interpret sensory and analytical results of processed products

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Preparation of fruit juice and squash	PCO1
2	Preparation of RTS beverage	PCO1
3	Preparation of jam	PCO1
4	Preparation of jelly	PCO1
5	Preparation of marmalade	PCO1
6	Preparation of tomato ketchup and sauce	PCO1
7	Preparation of pickle	PCO1
8	Preparation of chutney	PCO1
9	Osmotic dehydration of fruits	PCO3
10	Drying and dehydration of vegetables	PCO3
11	Canning of fruits and vegetables	PCO3
12	Preparation of fruit candy	PCO1
13	Determination of TSS, acidity, and pH	PCO2
14	Sensory evaluation of products	PCO5
15	Practical record submission	PCO4

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	3	2	2	2	2	1	2	2
PCO2	3	3	2	3	3	2	1	1	2	2
PCO3	3	3	3	3	3	2	2	1	2	2
PCO4	2	2	2	2	2	3	3	2	3	3
PCO5	2	3	2	3	2	2	1	2	3	2

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	2	2	3
PCO5	2	3	3

List of Experiments

1. Preparation of fruit juice and squash
2. Preparation of RTS (Ready-to-Serve) beverage
3. Preparation of jam from seasonal fruits
4. Preparation of jelly and determination of end point
5. Preparation of marmalade
6. Preparation of tomato ketchup and sauce
7. Preparation of pickle from fruits/vegetables
8. Preparation of chutney
9. Osmotic dehydration of fruits
10. Drying and dehydration of vegetables
11. Canning of fruits and vegetables
12. Preparation of fruit candy
13. Determination of TSS, acidity, and pH of processed products
14. Sensory evaluation of processed products
15. Preparation and submission of practical record

IMFT50.3205T – Spices and Plantation Crops

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 30 Hours
- **Course Type**: Discipline Specific Elective
- **Level**: Semester III)

Course Objectives

1. To understand the classification and importance of spices and plantation crops.
2. To study production, processing, and value addition of major spices.
3. To learn processing technologies of plantation crops like tea, coffee, and cocoa.
4. To analyze quality characteristics and standards.
5. To understand trade, export, and industrial applications.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain classification, composition, and importance of spices and plantation crops	Module I
CO2	Describe processing techniques of major spices	Module II
CO3	Apply processing methods for tea, coffee, and cocoa	Module III
CO4	Analyze quality parameters and standards	Module IV
CO5	Evaluate industrial applications and trade aspects	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	3	2	2
CO3	3	3	2
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain classification and composition	Understand (K2)
CO2	Describe processing techniques	Understand (K2)
CO3	Apply processing methods	Apply (K3)
CO4	Analyze quality and standards	Analyze (K4)
CO5	Evaluate trade and applications	Evaluate (K5)

Module 1: Introduction to Spices and Plantation Crops (6 Hours)

- Definition and classification of spices and plantation crops
- Importance in food industry and economy
- Major spice-producing regions (India and world)
- Composition of spices: essential oils, oleoresins, pigments
- Overview of plantation crops: tea, coffee, cocoa, coconut

Module 2: Processing of Major Spices (6 Hours)

- Post-harvest handling of spices
- Processing of major spices:
  - Black pepper, cardamom, clove
  - Turmeric, ginger, chilli
- Drying, curing, grading, and storage
- Extraction of essential oils and oleoresins
- Value-added spice products

Module 3: Processing of Tea, Coffee, and Cocoa (6 Hours)

- Tea processing: withering, rolling, fermentation, drying
- Types of tea: black, green, oolong
- Coffee processing: wet and dry methods
- Roasting and grinding of coffee
- Cocoa processing: fermentation, drying, roasting
- Chocolate manufacturing basics

Module 4: Quality Evaluation and Standards (6 Hours)

- Quality characteristics of spices and plantation products
- Physical and chemical quality parameters
- Detection of adulteration in spices
- Food safety standards (FSSAI, AGMARK, ISO)

- Packaging and storage

Module 5: Trade, Export, and Industrial Applications (6 Hours)

- Domestic and international trade of spices
- Role of Spices Board of India
- Export quality requirements
- Industrial applications: food, pharmaceuticals, cosmetics
- Emerging trends: organic spices, nutraceuticals
- Case studies on spice industry

Recommended References

1. Peter, K. V. (2012). *Handbook of Herbs and Spices*. Woodhead Publishing.
2. Pruthi, J. S. (2013). *Spices and Condiments: Chemistry, Microbiology and Technology*. Academic Press.
3. Ramaswamy, H., & Marcotte, M. (2006). *Food Processing: Principles and Applications*. CRC Press.
4. Clarke, R. J., & Macrae, R. (2012). *Coffee: Chemistry*. Springer.
5. Beckett, S. T. (2017). *Industrial Chocolate Manufacture and Use*. Wiley-Blackwell.

IMFT50.3205P – Spices and Plantation Crops Production Technology Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Specific Elective
- **Level**: Semester III

Course Objectives

1. To impart practical knowledge on production and processing of spices and plantation crops.
2. To familiarize students with identification and quality evaluation of spices.
3. To understand post-harvest handling and processing technologies.
4. To develop skills in value addition and product preparation.
5. To apply quality and safety practices in spice and plantation crop processing.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform processing and value addition of spices and plantation crops
PCO2	Apply analytical methods for quality evaluation of spices
PCO3	Analyze processing parameters affecting quality and shelf life
PCO4	Demonstrate product development and sensory evaluation skills
PCO5	Practice scientific documentation and industrial exposure reporting

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Identification and classification of spices	PCO1
2	Study of morphological characteristics	PCO1
3	Determination of moisture content	PCO2
4	Determination of volatile oil content	PCO2
5	Preparation of spice powders and blends	PCO1
6	Processing of black pepper and cardamom	PCO1
7	Processing and grading of tea leaves	PCO1
8	Processing and roasting of coffee beans	PCO1
9	Processing of cocoa beans	PCO1
10	Determination of curcumin content	PCO2
11	Extraction of essential oils	PCO3
12	Packaging and storage studies	PCO3
13	Sensory evaluation of products	PCO4
14	Visit report preparation	PCO5
15	Practical record submission	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	3	2	2	2	2	1	2	2
PCO2	3	3	2	3	3	2	1	1	2	2
PCO3	3	3	3	3	3	2	2	1	2	2
PCO4	3	3	2	2	2	2	1	2	3	3
PCO5	2	2	2	2	2	3	3	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	2	2	3

List of Experiments

1. Identification and classification of major spices and plantation crops
2. Study of morphological characteristics of spices
3. Determination of moisture content in spices
4. Determination of volatile oil content in spices
5. Preparation of spice powders and blends
6. Processing of black pepper and cardamom
7. Processing and grading of tea leaves
8. Processing and roasting of coffee beans
9. Processing of cocoa beans and cocoa powder preparation
10. Determination of curcumin content in turmeric
11. Extraction of essential oils from spices
12. Packaging and storage studies of spice products
13. Sensory evaluation of spice blends and beverages
14. Visit report preparation on spice/plantation crop processing unit
15. Preparation and submission of practical record

SEMESTER IV

IMFT50.4208T – Technology of Meat, Dairy, Fish and Poultry Processing

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester IV

Course Objectives

1. To understand composition and structure of animal-based foods.
2. To study processing technologies of meat, poultry, fish, and dairy products.
3. To learn preservation and storage techniques.
4. To analyze quality and safety aspects of animal products.
5. To evaluate industrial processing and value-added products.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain composition and structure of meat, milk, fish, and poultry	Module I
CO2	Describe processing techniques of animal-based foods	Module II
CO3	Apply preservation and product development methods	Module III
CO4	Analyze quality, safety, and storage conditions	Module IV
CO5	Evaluate industrial processing and value-added products	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain composition and structure	Understand (K2)
CO2	Describe processing techniques	Understand (K2)
CO3	Apply preservation and product development	Apply (K3)
CO4	Analyze quality and safety aspects	Analyze (K4)
CO5	Evaluate industrial processing technologies	Evaluate (K5)

Module 1: Composition and Structure of Animal Foods (9 Hours)

- Structure and composition of meat (muscle proteins, lipids, pigments)
- Structure and composition of milk (proteins, fats, lactose, minerals)
- Composition of fish and seafood
- Structure and composition of poultry meat and eggs
- Post-mortem changes in meat (rigor mortis)
- Nutritional significance of animal-based foods

Module 2: Meat and Poultry Processing (9 Hours)

- Slaughtering and dressing of animals
- Meat processing: curing, smoking, cooking
- Comminuted meat products: sausages, patties
- Poultry processing: slaughtering, evisceration, chilling
- Egg processing and preservation
- Meat and poultry product development

Module 3: Fish and Seafood Processing (9 Hours)

- Handling and processing of fish
- Preservation methods: icing, freezing, drying, canning
- Fish products: fish fillets, surimi, fish meal
- Spoilage of fish and its control
- Packaging and storage of fish products
- Value-added seafood products

Module 4: Dairy Processing Technology (9 Hours)

- Milk processing: pasteurization, homogenization
- Cream, butter, and ghee production

- Fermented dairy products: yogurt, cheese
- Ice cream and frozen dairy products
- Milk powder and condensed milk
- Quality control and standards in dairy industry

Module 5: Quality, Safety and Industrial Applications (9 Hours)

- Quality evaluation of meat, dairy, fish, and poultry products
- Microbial safety and food-borne diseases
- HACCP and food safety regulations (FSSAI)
- Packaging and cold chain management
- Waste utilization (bones, blood, whey, fish waste)
- Emerging technologies and industrial applications

Recommended References

1. Lawrie, R. A., & Ledward, D. (2014). *Lawrie's Meat Science*. Woodhead Publishing.
2. Jay, J. M. (2012). *Modern Food Microbiology*. Springer.
3. Robinson, R. K. (2015). *Dairy Microbiology Handbook*. Wiley.
4. Huss, H. H. (2013). *Quality and Quality Changes in Fresh Fish*. FAO.
5. Toldrá, F. (2010). *Handbook of Meat Processing*. Wiley-Blackwell.

IMFT50.4208P – Technology of Meat, Dairy and Poultry Processing Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester IV

Course Objectives

1. To provide practical knowledge on processing of meat, dairy, and poultry products.
2. To develop skills in preparation and preservation of animal-based foods.
3. To understand quality analysis and safety evaluation techniques.
4. To familiarize students with hygienic handling and processing operations.
5. To impart skills in value-added product development and sensory evaluation.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform processing and preservation of meat, dairy, and poultry products
PCO2	Apply analytical methods for quality evaluation of animal-based foods
PCO3	Analyze processing parameters affecting quality and shelf life
PCO4	Demonstrate hygienic handling, packaging, and storage practices
PCO5	Interpret sensory and microbiological evaluation results

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Identification and quality evaluation of meat	PCO2
2	Determination of pH and WHC of meat	PCO2
3	Preparation of meat pickle	PCO1
4	Preparation of sausages and patties	PCO1
5	Processing and preservation of poultry meat	PCO1
6	Egg quality evaluation	PCO2
7	Microbial quality analysis of meat products	PCO5
8	Platform tests for milk quality	PCO2
9	Determination of fat and SNF in milk	PCO2
10	Preparation of paneer	PCO1
11	Preparation of yogurt/curd	PCO1
12	Preparation of butter and ghee	PCO1
13	Sensory evaluation of products	PCO5
14	Packaging and storage studies	PCO4
15	Practical record submission	PCO4

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	3	2	2	2	2	1	2	2
PCO2	3	3	2	3	3	2	1	1	2	2
PCO3	3	3	3	3	3	2	2	1	2	2
PCO4	2	2	2	2	3	3	3	2	3	3
PCO5	2	3	2	3	2	2	1	2	3	2

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	2	2	3
PCO5	2	3	3

List of Experiments

1. Identification and quality evaluation of meat samples
2. Determination of pH and water holding capacity of meat
3. Preparation of meat pickle
4. Preparation of sausages and meat patties
5. Processing and preservation of poultry meat
6. Egg quality evaluation (albumen index, yolk index, Haugh unit)
7. Determination of microbial quality of meat products
8. Platform tests for milk quality
9. Determination of fat and SNF content in milk
10. Preparation of paneer
11. Preparation of yogurt/curd
12. Preparation of butter and ghee
13. Sensory evaluation of dairy and meat products
14. Packaging and storage studies of processed products
15. Preparation and submission of practical record

IMFT50.3208T – Technology of Cereals, Pulses and Oilseeds

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To understand the composition and structure of cereals, pulses, and oilseeds.
2. To study processing technologies and unit operations involved.
3. To analyze quality characteristics and nutritional aspects.
4. To learn value addition and product development.
5. To understand storage, preservation, and industrial applications.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain structure and composition of cereals, pulses, and oilseeds	Module I
CO2	Describe processing techniques and milling operations	Module II
CO3	Apply methods for product development and value addition	Module III
CO4	Analyze quality parameters and storage conditions	Module IV
CO5	Evaluate industrial processing technologies and applications	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain structure and composition	Understand (K2)
CO2	Describe processing techniques	Understand (K2)
CO3	Apply methods for product development	Apply (K3)
CO4	Analyze quality and storage conditions	Analyze (K4)
CO5	Evaluate industrial applications	Evaluate (K5)

Module 1: Structure and Composition (9 Hours)

- Classification of cereals, pulses, and oilseeds
- Structure of cereal grain (wheat, rice, maize)
- Composition: carbohydrates, proteins, lipids, fiber, vitamins, minerals
- Structure and composition of pulses
- Structure and composition of oilseeds
- Anti-nutritional factors in pulses and oilseeds

Module 2: Milling and Primary Processing (9 Hours)

- Cleaning, grading, and conditioning of grains
- Wheat milling: roller milling process
- Rice milling: parboiling and milling operations
- Maize processing: dry and wet milling
- Pulse milling: dehusking and splitting
- Oilseed preparation: decortication, flaking, conditioning

Module 3: Processing and Product Development (9 Hours)

- Bakery products: bread, biscuits, cakes
- Extruded products: breakfast cereals, snacks
- Traditional cereal and pulse products
- Protein-rich products from pulses
- Edible oil extraction: mechanical and solvent extraction
- Refining of edible oils

Module 4: Quality Evaluation and Storage (9 Hours)

- Quality characteristics of cereals, pulses, and oilseeds
- Physical, chemical, and functional properties
- Storage conditions and grain deterioration
- Insect infestation and control

- Packaging and shelf-life
- Quality standards (FSSAI, BIS)

Module 5: Advanced Processing and Industrial Applications (9 Hours)

- Modified starches and their applications
- Pulse protein isolates and concentrates
- Functional foods from cereals and pulses
- By-product utilization: bran, husk, oilseed cake
- Emerging technologies in grain processing
- Industrial processing units and innovations

Recommended References

1. Kent, N. L., & Evers, A. D. (2018). *Kent's Technology of Cereals*. Woodhead Publishing.
2. Chakraverty, A. (2013). *Postharvest Technology of Cereals, Pulses and Oilseeds*. Oxford & IBH.
3. Sahay, K. M., & Singh, K. K. (2012). *Unit Operations of Agricultural Processing*. Vikas Publishing.
4. Gunstone, F. D. (2011). *Vegetable Oils in Food Technology*. Wiley-Blackwell.
5. Manay, N. S., & Shadaksharaswamy, M. (2010). *Foods: Facts and Principles*. New Age International.

IMFT50.4208P – Technology of Cereals, Pulses and Oilseeds Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester III

Course Objectives

1. To provide practical knowledge on processing of cereals, pulses, and oilseeds.
2. To understand milling, extraction, and value-addition techniques.
3. To develop skills in quality analysis of cereal, pulse, and oilseed products.
4. To study functional and physicochemical properties of grains and oils.
5. To familiarize students with industrial processing operations and product development.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform processing operations for cereals, pulses, and oilseeds
PCO2	Apply analytical techniques for quality evaluation
PCO3	Analyze functional and physicochemical properties of grains and oils
PCO4	Demonstrate product development and sensory evaluation skills
PCO5	Practice laboratory safety and scientific documentation

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Determination of physical properties	PCO2
2	Milling characteristics of rice and wheat	PCO1
3	Preparation and analysis of wheat flour	PCO1
4	Determination of gluten content	PCO2
5	Preparation of bakery products	PCO4
6	Germination and malting of cereals	PCO1
7	Dehulling and cooking quality of pulses	PCO1
8	Hydration and swelling capacity of pulses	PCO3
9	Extraction of oil from oilseeds	PCO1
10	Determination of peroxide value	PCO2
11	Determination of iodine value	PCO2
12	Preparation of roasted and extruded products	PCO4
13	Functional property analysis	PCO3
14	Sensory evaluation of products	PCO4
15	Practical record submission	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	3	2	2	2	2	1	2	2
PCO2	3	3	2	3	3	2	1	1	2	2
PCO3	3	3	3	3	3	2	1	1	2	2
PCO4	3	3	3	2	2	2	2	2	3	3
PCO5	2	2	2	2	2	3	3	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	2	3

List of Experiments

1. Determination of physical properties of cereals and pulses
2. Milling characteristics of rice and wheat
3. Preparation of wheat flour and analysis of flour quality
4. Determination of gluten content in wheat flour
5. Preparation of bakery products from cereal flour
6. Germination and malting of cereals
7. Dehulling and cooking quality evaluation of pulses
8. Determination of hydration and swelling capacity of pulses
9. Extraction of oil from oilseeds
10. Determination of peroxide value of edible oils
11. Determination of iodine value of oils
12. Preparation of roasted and extruded cereal products
13. Functional property analysis of cereal and pulse flours
14. Sensory evaluation of developed products
15. Preparation and submission of practical record

IMFT50.4210T – Food Engineering

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Discipline Core Course
- **Level**: Semester IV

Course Objectives

1. To introduce engineering principles applied in food processing operations.
2. To understand heat transfer, mass transfer, fluid flow, and mechanical operations in food industries.
3. To familiarize students with food processing equipment and unit operations.
4. To study engineering concepts related to food preservation and processing systems.
5. To develop analytical and problem-solving skills relevant to food engineering applications.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain basic engineering principles and unit operations used in food processing	Module I
CO2	Describe heat transfer, fluid flow, and mass transfer processes in food industries	Module II
CO3	Understand working principles of food processing equipment and machinery	Module III
CO4	Analyze engineering parameters involved in food processing and preservation operations	Module IV
CO5	Apply food engineering concepts in design, operation, and optimization of food processing systems	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	1	2	2
CO2	3	3	2	2	3	2	1	1	2	2
CO3	3	3	3	2	3	2	1	1	2	2
CO4	3	3	3	3	3	2	2	1	2	2
CO5	3	3	3	3	3	3	2	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1

CO2	3	2	1
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain engineering principles and unit operations used in food processing	K2 – Understand
CO2	Describe heat transfer, fluid flow, and mass transfer processes	K2 – Understand
CO3	Understand working principles of food processing equipment	K3 – Apply
CO4	Analyze engineering parameters involved in food processing operations	K4 – Analyze
CO5	Apply food engineering concepts in food processing systems	K3 – Apply

Module 1: Introduction to Food Engineering and Physical Properties of Foods (9 Hours)

- Scope and importance of food engineering
- Unit operations and unit processes in food industries
- Physical properties of foods: density, viscosity, specific gravity, surface tension, rheological properties
- Thermal properties of foods
- Engineering measurements and units
- Dimensions and unit conversions
- Basic concepts of process calculations and material balance

Module 2: Fluid Flow and Mechanical Operations (9 Hours)

- Properties of fluids and fluid statics
- Laminar and turbulent flow
- Flow measurement devices
- Pumps and pumping systems
- Size reduction and size separation
- Mixing and agitation operations
- Filtration and centrifugation in food industries

Module 3: Heat Transfer and Thermal Processing (9 Hours)

- Modes of heat transfer: conduction, convection, and radiation
- Heat exchangers and their applications
- Thermal processing of foods
- Pasteurization and sterilization
- Evaporation and concentration
- Refrigeration and freezing principles
- Drying and dehydration technologies

Module 4: Mass Transfer Operations in Food Processing (9 Hours)

- Principles of mass transfer
- Diffusion and osmosis
- Moisture migration in foods
- Distillation and extraction
- Membrane separation processes
- Absorption and adsorption
- Applications of mass transfer in food industries

Module 5: Food Processing Equipment and Emerging Technologies (9 Hours)

- Design and operation of food processing equipment
- Conveying systems and material handling
- Packaging machinery and automation
- Clean-in-place (CIP) systems
- Emerging food processing technologies
- Energy conservation in food industries
- Safety measures and maintenance of food engineering equipment

Recommended References

1. Singh, R. P., & Heldman, D. R. (2017). *Introduction to Food Engineering*. Academic Press.
2. Toledo, R. T. (2018). *Fundamentals of Food Process Engineering*. Springer.
3. Brennan, J. G. (2012). *Food Processing Handbook*. Wiley-VCH.
4. Geankoplis, C. J. (2018). *Transport Processes and Separation Process Principles*. Pearson Education.
5. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.

IMFT50.4210P – Food Engineering Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–2 **Total Practical Hours**: 30 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester IV

Course Objectives

1. To provide practical understanding of engineering principles applied in food processing.
2. To familiarize students with unit operations and food engineering equipment.
3. To develop skills in measurement and analysis of engineering parameters.
4. To understand heat transfer, fluid flow, and size reduction operations.
5. To impart operational and safety practices in food engineering laboratories.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Perform engineering operations related to food processing
PCO2	Apply analytical and measurement techniques in food engineering
PCO3	Analyze heat transfer, drying, and flow properties of food materials
PCO4	Demonstrate operational efficiency and equipment handling skills
PCO5	Practice scientific documentation and industrial exposure reporting

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Study of engineering properties of foods	PCO1
2	Determination of bulk and true density	PCO2
3	Measurement of viscosity	PCO2
4	Determination of thermal conductivity	PCO2
5	Study of heat transfer	PCO3
6	Determination of overall heat transfer coefficient	PCO3
7	Study of drying characteristics	PCO3
8	Determination of drying rate and moisture ratio	PCO3
9	Size reduction and particle size analysis	PCO1
10	Study of filtration process	PCO1
11	Determination of flow properties of powders	PCO2
12	Study of mixing efficiency	PCO4
13	Determination of refrigeration efficiency/COP	PCO4
14	Visit report on processing plant/equipment	PCO5
15	Practical record submission	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	3	2	2	2	2	1	2	2
PCO2	3	3	2	3	3	2	1	1	2	2
PCO3	3	3	3	3	3	2	2	1	2	2
PCO4	2	2	2	3	3	3	2	2	3	3
PCO5	2	2	2	2	2	3	3	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	3	2	2
PCO2	3	3	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	2	2	3

List of Experiments

1. Study of engineering properties of food materials
2. Determination of bulk density and true density of food grains
3. Measurement of viscosity of liquid foods
4. Determination of thermal conductivity of food materials
5. Study of heat transfer using heat exchanger models
6. Determination of overall heat transfer coefficient
7. Study of drying characteristics of food materials
8. Determination of drying rate and moisture ratio
9. Size reduction using grinder/mill and particle size analysis
10. Study of filtration process in food systems
11. Determination of flow properties of food powders
12. Study of mixing efficiency in food mixers
13. Determination of refrigeration efficiency/COP
14. Visit report on food engineering equipment or processing plant
15. Preparation and submission of practical record

IMFT50.4210T – Instrumentation and Analytical Techniques

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Type**: Discipline Core Course
- **Level**: Semester IV

Course Objectives

1. To introduce basic principles of analytical techniques used in food science.
2. To understand instrumentation and working principles of analytical equipment.
3. To study chemical, physical, and microbiological analysis methods.
4. To develop skills in interpretation of analytical data.
5. To understand quality control and food safety analysis.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain principles of analytical techniques used in food analysis	Module I
CO2	Describe working principles of analytical instruments	Module II
CO3	Apply analytical methods for food quality evaluation	Module III
CO4	Analyze data obtained from analytical techniques	Module IV
CO5	Evaluate the role of instrumentation in food safety and quality control	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain analytical principles	Understand (K2)
CO2	Describe instrumentation	Understand (K2)
CO3	Apply analytical methods	Apply (K3)
CO4	Analyze analytical data	Analyze (K4)
CO5	Evaluate role in quality and safety	Evaluate (K5)

Module 1: Introduction to Food Analysis and Instrumentation (9Hours)

- Importance of food analysis in quality control
- Types of analytical methods: physical, chemical, microbiological
- Basic principles of instrumentation
- Calibration and standardization
- Sampling techniques and sample preparation
- Errors in analysis and accuracy/precision

Module 2: Spectroscopic Techniques (9 Hours)

- Principles of spectroscopy
- UV–Visible spectrophotometry
- Infrared (IR) spectroscopy
- Atomic absorption spectroscopy (AAS)
- Applications in food analysis
- Instrumentation components and working

Module 3: Chromatographic Techniques (9 Hours)

- Principles of chromatography
- Types: paper, TLC, column chromatography
- Gas chromatography (GC)
- High Performance Liquid Chromatography (HPLC)
- Applications in food quality and safety
- Detection systems

Module 4: Physical and Chemical Analytical Techniques (9 Hours)

- Proximate analysis of food (moisture, ash, protein, fat)
- pH and acidity measurement
- Rheological measurements
- Texture analysis

- Color measurement techniques
- Thermal analysis (DSC basics)

Module 5: Microbiological and Advanced Analytical Techniques (9 Hours)

- Microbiological analysis: total plate count, coliform detection
- Rapid detection techniques
- Immunological methods (ELISA)
- Biosensors in food analysis
- Food safety testing and standards
- Data interpretation and reporting

Recommended References

1. Nielsen, S. S. (2017). *Food Analysis*. Springer.
2. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). *Principles of Instrumental Analysis*. Cengage Learning.
3. Pomeranz, Y., & Meloan, C. E. (2000). *Food Analysis: Theory and Practice*. Springer.
4. Harris, D. C. (2016). *Quantitative Chemical Analysis*. W.H. Freeman.
5. Wilson, K., & Walker, J. (2010). *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University Press.

IMFT50.4212T – Fish Processing Technology

- **Credits**: 3 **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Discipline Specific Course
- **Level**: Semester IV

Course Objectives

1. To introduce the principles and importance of fish processing technology.
2. To understand post-harvest handling, preservation, and processing methods of fish and fishery products.
3. To study quality evaluation and safety aspects of fish products.
4. To familiarize students with value-added fish products and packaging technologies.
5. To develop technical knowledge regarding fish processing industries and emerging technologies.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the principles and importance of fish processing technology	Module I
CO2	Describe methods of fish preservation and processing	Module II
CO3	Understand quality control and safety measures in fish processing industries	Module III
CO4	Analyze processing parameters and storage conditions affecting fish quality	Module IV
CO5	Apply fish processing technologies for development of value-added fish products	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	2	1	2	2
CO2	3	3	2	2	3	2	2	1	2	2
CO3	3	3	3	2	3	2	3	1	2	2
CO4	3	3	3	3	3	2	3	1	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	1

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain principles and importance of fish processing technology	Understand (K2)
CO2	Describe methods of fish preservation and processing	Understand (K2)
CO3	Understand quality control and safety measures in fish processing	Apply (K3)
CO4	Analyze processing parameters affecting fish quality	Analyze (K4)
CO5	Apply fish processing technologies for value-added products	Apply (K3)

Module 1: Introduction to Fish Processing Technology (9 Hours)

- Scope and importance of fish processing technology
- Classification and composition of fish and shellfish
- Nutritional significance of fish products
- Post-harvest changes in fish
- Spoilage mechanisms in fish and seafood
- Fish handling onboard and landing center operations
- Hygiene and sanitation in fish processing plants

Module 2: Fish Preservation Methods (9 Hours)

- Principles of fish preservation
- Chilling and refrigeration of fish
- Freezing and frozen storage
- Drying and dehydration techniques
- Salting, curing, and smoking methods
- Canning of fish products
- Irradiation and modern preservation techniques

Module 3: Fish Processing Operations and Equipment (9 Hours)

- Fish cleaning, grading, and dressing
- Filleting and deboning operations

- Minced fish and surimi production
- Fish meal and fish oil production
- Processing equipment and machinery
- Waste management in fish processing industries
- Sanitation and maintenance of processing equipment

Module 4: Quality Control and Safety in Fish Processing (9 Hours)

- Quality assessment of fresh and processed fish
- Physical, chemical, and microbiological quality parameters
- HACCP and GMP in fish industries
- Seafood-borne pathogens and toxins
- Packaging methods for fish products
- Storage stability and shelf-life evaluation
- National and international standards for fish products

Module 5: Value Addition and Emerging Technologies (9 Hours)

- Value-added fish products
- Fish pickles, cutlets, sausages, and ready-to-eat products
- Functional and nutraceutical fish products
- By-product utilization in fish industries
- Novel processing technologies in seafood industries
- Export potential and marketing of fish products
- Future trends in fish processing technology

Recommended References

1. Govindan, T. K. (2012). *Fish Processing Technology*. Oxford & IBH Publishing.
2. Hall, G. M. (2011). *Fish Processing: Sustainability and New Opportunities*. Wiley-Blackwell.
3. Huss, H. H. (2010). *Quality and Quality Changes in Fresh Fish*. FAO Fisheries Technical Paper.
4. Gopakumar, K. (2015). *Fish Processing and Preservation*. ICAR Publications.
5. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.

IMFT50.4213P – Fish Processing Technology Practical

- **Credits**: 1 **L–T–P Structure**: 0–0–1 **Total Practical Hours**: 30 Hours
- **Course Category**: Discipline Specific Course
- **Level**: Semester IV

Course Objectives

1. To provide practical exposure to fish handling and processing operations.
2. To develop skills in preservation and value addition of fish products.
3. To familiarize students with quality evaluation and safety assessment of fish products.
4. To understand processing equipment and packaging methods used in fish industries.
5. To enhance technical competency in fish processing laboratory practices.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate safe handling and hygienic processing of fish and seafood products
PCO2	Perform basic preservation techniques for fish and fishery products
PCO3	Evaluate physical and chemical quality characteristics of fish products
PCO4	Prepare value-added fish products using standard processing techniques
PCO5	Apply packaging and storage methods for processed fish products

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Study of morphology and identification of commercially important fishes	PCO1
2	Dressing, cleaning, and filleting of fish	PCO1
3	Determination of freshness and sensory quality of fish	PCO3
4	Estimation of moisture content in fish samples	PCO3
5	Preparation of dried fish products	PCO2
6	Preparation of salted and cured fish	PCO2
7	Preparation of smoked fish products	PCO2
8	Preparation of fish pickle	PCO4
9	Preparation of fish cutlet/fish fingers	PCO4
10	Extraction of fish oil from fish waste	PCO4
11	Preparation of surimi/minced fish products	PCO4
12	Packaging and storage studies of processed fish products	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	3	2	2	1	2	2	3	1	2	2

PCO2	3	3	2	2	3	2	3	1	2	2
PCO3	3	3	3	2	3	2	3	1	2	2
PCO4	3	3	3	3	3	2	3	2	2	2
PCO5	3	3	3	3	3	3	3	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	1	1
PCO2	3	2	1
PCO3	3	3	2
PCO4	3	3	2
PCO5	3	3	3

List of Experiments

1. Study of morphology and identification of commercially important fishes
2. Dressing, cleaning, and filleting of fish
3. Determination of freshness and sensory quality of fish
4. Estimation of moisture content in fish samples
5. Preparation of dried fish products
6. Preparation of salted and cured fish
7. Preparation of smoked fish products
8. Preparation of fish pickle
9. Preparation of fish cutlet/fish fingers
10. Extraction of fish oil from fish waste
11. Preparation of surimi/minced fish products
12. Packaging and storage studies of processed fish products

SEMESTER V

IMFT55.5301T – Food Biotechnology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester V

Course Objectives

1. To introduce the fundamental concepts and scope of food biotechnology.
2. To familiarize students with microbial, enzymatic, and molecular approaches used in food biotechnology.
3. To explain the principles of fermentation, genetic engineering, and biotechnology-based food production.
4. To develop understanding of biotechnology applications in food quality, nutrition, safety, and functional foods.
5. To provide awareness on biosafety, ethical, regulatory, and consumer aspects related to food biotechnology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and importance of food biotechnology	Module I
CO2	Describe microbial and fermentation processes used in food biotechnology	Module II
CO3	Discuss molecular and genetic approaches used in food improvement and food biotechnology	Module III
CO4	Interpret applications of biotechnology in food processing, quality enhancement, nutrition, and safety	Module IV
CO5	Evaluate biosafety, ethical, regulatory, and consumer aspects associated with food biotechnology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	3	3	2	2	2	1	1	1	2
CO4	3	3	3	3	2	3	2	1	2	2
CO5	2	2	3	2	1	3	2	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and importance of food biotechnology	Understand (K2)
CO2	Describe microbial and fermentation processes used in food biotechnology	Understand (K2)
CO3	Discuss molecular and genetic approaches used in food improvement and food biotechnology	Apply (K3)
CO4	Interpret applications of biotechnology in food processing, quality enhancement, nutrition, and safety	Analyze (K4)
CO5	Evaluate biosafety, ethical, regulatory, and consumer aspects associated with food biotechnology	Evaluate (K5)

Module I: Fundamentals of Food Biotechnology (10 Hours)

• Definition, concept, and scope of biotechnology
• Historical development of food biotechnology
• Branches of biotechnology relevant to food science
• Principles and applications of food biotechnology
• Biotechnology and sustainable food systems
• Role of biotechnology in:
  - Food production
  - Food processing
  - Food preservation
  - Nutritional improvement
• Overview of microbial, enzymatic, and molecular biotechnology
• Introduction to bioprocess technology

Module II: Microbial and Fermentation Biotechnology (12 Hours)

• Role of microorganisms in food biotechnology
• Important microorganisms used in foods:
  - Bacteria
  - Yeasts
  - Moulds

• Fermented foods and beverages
• Principles of fermentation technology
• Types of fermentation:

  - Batch fermentation
  - Continuous fermentation

• Starter cultures and their applications
• Probiotics and prebiotics
• Production and applications of microbial enzymes in foods
• Single cell protein and microbial biomass production
• Biotechnological production of food ingredients and additives

Module III: Molecular Biotechnology and Genetic Engineering (11 Hours)

• Introduction to molecular biotechnology
• Structure and functions of DNA and genes
• Recombinant DNA technology
• Principles of genetic engineering
• Gene transfer methods (introductory concept)
• Genetically modified organisms (GMOs) and foods
• PCR and molecular detection techniques (introductory overview)
• Molecular markers and diagnostic tools
• Applications of genetic engineering in food crops and microorganisms
• Biofortification and nutritional enhancement of foods
• Introduction to genome editing technologies

Module IV: Applications of Biotechnology in Food Systems (11 Hours)

• Biotechnology in food processing and preservation
• Enzyme technology in food industry
• Applications in:

  - Dairy industry
  - Bakery industry
  - Beverage industry
  - Meat and fish processing

• Functional foods and nutraceuticals
• Production of bioactive compounds
• Biotechnology for food quality improvement
• Biotechnology in food safety and pathogen detection
• Waste utilization and by-product valorization
• Emerging applications and industrial prospects of food biotechnology

Module V: Biosafety, Ethics and Regulatory Aspects (10 Hours)

• Biosafety concepts in food biotechnology
• Risk assessment and safety evaluation of biotech foods
• Ethical and social issues related to food biotechnology
• Consumer perception and acceptance of biotech foods
• Labeling and traceability of genetically modified foods
• Regulatory aspects of biotechnology and GM foods
• Intellectual property rights in biotechnology
• Environmental concerns related to biotechnology
• National and international guidelines related to biotechnology and food safety

Recommended References

1. Joshi, V. K., & Pandey, A. (Eds.). *Biotechnology: Food Fermentation*. Educational Publishers & Distributors.
2. Frazier, W. C., & Westhoff, D. C. *Food Microbiology*. McGraw-Hill Education.
3. Waites, M. J., Morgan, N. L., Rockey, J. S., & Higton, G. *Industrial Microbiology: An Introduction*. Wiley-Blackwell.
4. Rastall, R. A., & Gibson, G. R. *Advances in Food Biotechnology*. Wiley-Blackwell.
5. Bielecki, S., Tramper, J., & Polak, J. *Food Biotechnology*. Elsevier.

IMFT55.5301P – Food Biotechnology Practical

• **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
• **Course Type:** Discipline Core Course
• **Level:** Semester V

Course Objectives

1. To familiarize students with basic laboratory techniques used in food biotechnology.
2. To develop practical skills in microbial culture handling, fermentation, and biotechnology-related experiments.
3. To understand the applications of microorganisms and enzymes in food systems.
4. To train students in aseptic techniques, laboratory safety, and handling of biotechnological tools.
5. To interpret experimental observations related to food biotechnology applications and processes.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate laboratory safety practices and aseptic handling techniques
PCO2	Perform basic microbiological and fermentation-related experiments
PCO3	Analyze the role of microorganisms and enzymes in food biotechnology
PCO4	Conduct biotechnology-based experiments related to food quality and processing
PCO5	Interpret experimental data and prepare laboratory reports related to food biotechnology

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and aseptic techniques	PCO1
2	Preparation and sterilization of culture media	PCO1
3	Isolation of microorganisms from fermented foods	PCO2
4	Staining techniques for microorganisms (simple staining / Gram staining)	PCO2
5	Enumeration of microorganisms by serial dilution and plate count method	PCO2
6	Preparation of curd/yogurt using starter culture	PCO3
7	Preparation of fermented beverage/food product	PCO3
8	Study of yeast fermentation activity	PCO3
9	Estimation of enzyme activity (amylase/protease demonstration)	PCO3

10	Production of microbial biomass / single cell protein (demonstration)	PCO4
11	Detection of probiotics in fermented foods (demonstration)	PCO4
12	Determination of alcohol production during fermentation (demonstration)	PCO4
13	Observation of biotechnological processes in food industry (video/demo based)	PCO4
14	Mini experiment on fermentation parameters	PCO4
15	Preparation of laboratory record and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	2	2	1	1	1	2
PCO3	3	3	3	2	2	2	1	1	1	2
PCO4	3	3	2	3	2	3	2	1	1	2
PCO5	2	2	2	3	2	2	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Laboratory safety practices and aseptic techniques in biotechnology laboratory
2. Preparation and sterilization of culture media and laboratory glassware
3. Isolation of microorganisms from fermented food samples
4. Simple staining and Gram staining of microorganisms
5. Enumeration of microorganisms by serial dilution and plate count method
6. Observation of yeast cells and bacterial cultures under microscope
7. Preparation of curd/ yogurt using starter culture
8. Study of yeast fermentation activity and carbon dioxide production
9. Preparation of fermented food product (pickle/fermented beverage/bread dough)
10. Estimation of enzyme activity (amylase/protease/lipase – demonstration)
11. Study of probiotics in fermented foods
12. Determination of alcohol production during fermentation (demonstration)
13. Demonstration of immobilized enzyme or immobilized yeast system
14. Extraction of DNA from plant material (demonstration)
15. Demonstration of PCR and molecular biotechnology techniques (demo based)

IMFT55.5302T – Food Laws and Regulations

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester V

Course Objectives

1. To introduce the basic concepts and importance of food laws and regulations.
2. To familiarize students with national and international food regulatory systems.
3. To explain standards, labeling requirements, and food safety regulations.
4. To develop understanding of food quality control, inspection, and certification systems.
5. To create awareness on consumer protection, legal compliance, and ethical practices in food sector.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and significance of food laws and regulations	Module I
CO2	Describe national and international food regulatory systems and standards	Module II
CO3	Discuss food labeling, packaging, and legal requirements related to food products	Module III
CO4	Interpret food quality assurance, inspection, and certification procedures	Module IV
CO5	Evaluate consumer protection measures, food safety compliance, and ethical issues in food regulation	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	1	1	2	2
CO2	3	2	2	2	1	3	1	1	1	2
CO3	3	2	2	2	2	3	1	1	2	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	3	2	2	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and significance of food laws and regulations	Understand (K2)
CO2	Describe national and international food regulatory systems and standards	Understand (K2)
CO3	Discuss food labeling, packaging, and legal requirements related to food products	Apply (K3)
CO4	Interpret food quality assurance, inspection, and certification procedures	Analyze (K4)
CO5	Evaluate consumer protection measures, food safety compliance, and ethical issues in food regulation	Evaluate (K5)

Module I: Introduction to Food Laws and Regulatory Framework (8 Hours)

• Concept, scope, and importance of food laws
• Need for food legislation and regulatory systems
• Objectives of food laws and regulations
• Relationship between food quality, safety, and regulation
• Overview of food control systems
• Food regulatory authorities and their functions
• Introduction to food safety management systems
• Basic legal terminology related to food regulation

Module II: National and International Food Standards (10 Hours)

• Food Safety and Standards Act (FSSA) – overview
• Structure and functions of FSSAI
• Food standards and specifications
• Food additives and permissible limits
• Standards related to contaminants and residues
• AGMARK and BIS standards
• Codex Alimentarius Commission – objectives and functions
• International food regulatory agencies:
  - WHO
  - FAO
  - ISO
• WTO and SPS/TBT agreements (introductory concept)

Module III: Food Labeling, Packaging and Legal Requirements (9 Hours)

• Importance of food labeling
• Mandatory and voluntary labeling requirements
• Nutritional labeling and health claims
• Labeling regulations under FSSAI
• Packaging regulations and legal requirements
• Claims related to organic foods and functional foods
• Misbranding and misleading advertisements
• Shelf life, expiry date, and best-before labeling
• Introduction to traceability and recall systems

Module IV: Food Quality Assurance and Certification Systems (9 Hours)

• Food quality assurance concepts
• Food inspection and sampling procedures
• Quality control and quality assurance systems
• Good Manufacturing Practices (GMP)
• Good Hygienic Practices (GHP)
• HACCP – principles and importance
• ISO standards in food industry
• Food certification systems:
    - ISO 22000
    - FSSC
    - Organic certification
• Role of laboratories in food quality assurance

Module V: Consumer Protection, Ethics and Emerging Regulatory Issues (9 Hours)

• Consumer protection laws related to food
• Food adulteration and legal consequences
• Food fraud and food authenticity
• Ethical issues in food industry
• Consumer rights and awareness
• Legal responsibilities of food business operators
• E-commerce and online food regulations
• Emerging issues in food regulations:
    - Novel foods
    - GM foods
    - Nutraceuticals and functional foods
• Sustainable food regulations and future trends

Recommended References

1. S. R. Ahuja. *Food Safety and Standards Act, Rules and Regulations*. Universal Law Publishing.
2. Mahindru, S. N. *Food Safety: Concepts and Reality*. APH Publishing Corporation.
3. Marriott, N. G., Schilling, M. W., & Gravani, R. B. *Principles of Food Sanitation*. Springer.
4. Early, R. *Guide to Food Regulations and Quality Assurance*. Springer.
5. The Food Safety and Standards Authority of India (FSSAI). *Manuals and Guidelines on Food Safety and Standards*.

IMFT55.5203T – Food Additives and Flavour Technology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester V

Course Objectives

1. To introduce the concepts, classification, and functions of food additives and flavouring agents.
2. To familiarize students with various additives used in food processing and preservation.
3. To explain the chemistry, production, and applications of flavours in foods.
4. To develop understanding of regulations, safety, and quality aspects related to food additives and flavours.
5. To provide knowledge on recent trends and innovations in additive and flavour technology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, classification, and functions of food additives and flavouring agents	Module I
CO2	Describe different food additives and their technological applications in food systems	Module II
CO3	Discuss flavour compounds, flavour generation, and flavour technology in foods	Module III
CO4	Interpret safety, quality, and regulatory aspects related to additives and flavours	Module IV
CO5	Evaluate recent developments and consumer trends in food additives and flavour technology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	2	3	2	2	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	3	2	2	3	3	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, classification, and functions of food additives and flavouring agents	Understand (K2)
CO2	Describe different food additives and their technological applications in food systems	Understand / Apply (K2/K3)
CO3	Discuss flavour compounds, flavour generation, and flavour technology in foods	Apply (K3)
CO4	Interpret safety, quality, and regulatory aspects related to additives and flavours	Analyze (K4)
CO5	Evaluate recent developments and consumer trends in food additives and flavour technology	Evaluate (K5)

Module I: Introduction to Food Additives and Flavour Technology (8 Hours)

• Definition, scope, and importance of food additives
• Historical development of food additive usage
• Classification of food additives:
- Natural additives
- Synthetic additives
- Direct and indirect additives
  • Functions of food additives in food processing
  • Introduction to flavour science and flavour technology
  • Types of flavouring agents:
- Natural flavours
- Nature-identical flavours
- Artificial flavours

• Role of additives and flavours in food quality and acceptability

Module II: Food Additives and Their Applications (10 Hours)

- Preservatives
- Sequestrants
- Colourants
- Sweeteners
- Emulsifiers, stabilizers, thickeners, and gelling agents

- Acidulants and buffering agents
- Anti-caking agents and humectants
- Leavening agents and flour improvers
- Miscellaneous
- Applications of additives in processed foods and beverages

Module III: Flavour Chemistry and Flavour Technology (10 Hours)

• Concept and importance of flavour in foods
• Taste and aroma perception
• Chemistry of flavour compounds:
  - Aldehydes
  - Ketones
  - Esters
  - Alcohols
  - Terpenes
- Natural flavour sources:
  - Spices
  - Herbs
  - Essential oils
- Flavour generation during food processing:
  - Maillard reaction
  - Caramelization
  - Lipid oxidation
- Extraction and isolation of flavours
- Encapsulation of flavours
- Flavour deterioration and flavour stability
- Applications of flavours in food products

Module IV: Safety, Quality and Regulatory Aspects (8 Hours)

• Safety evaluation of food additives and flavours
• Acceptable Daily Intake (ADI) concept
• Toxicological aspects of additives
• Food additive regulations and standards
• FSSAI regulations related to food additives and flavours
• Codex standards for additives
• Labeling requirements related to additives and flavours
• Consumer concerns regarding synthetic additives
• Quality assurance in flavour industry

Module V: Recent Trends and Emerging Technologies (9 Hours)

- Clean label foods and natural additives
- Functional additives and nutraceutical ingredients
- Biotechnology in flavour production
- Novel sweeteners and fat replacers
- Nanoencapsulation of flavours and additives
- Flavour enhancers and taste modifiers
- Sustainable and eco-friendly additives
- Consumer trends in flavour and additive usage
- Future prospects in food additive and flavour technology

Recommended References

1. Branen, A. L., Davidson, P. M., Salminen, S., & Thorngate, J. *Food Additives*. CRC Press.
2. Reineccius, G. *Flavor Chemistry and Technology*. CRC Press.
3. Belitz, H. D., Grosch, W., & Schieberle, P. *Food Chemistry*. Springer.
4. Morton, I. D., & Macleod, A. J. *Food Flavours*. Elsevier.
5. Fennema, O. R. *Fennema's Food Chemistry*. CRC Press.

IMFT55.5303P – Food Additives and Flavor Technology Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester V

Course Objectives

1. To familiarize students with laboratory techniques related to food additives and flavour analysis.
2. To develop practical skills in identification and analysis of food additives.
3. To understand the role of additives and flavours in food quality and stability.
4. To train students in preparation and evaluation of flavoured food products.
5. To interpret experimental observations related to food additives, flavour compounds, and food quality.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate laboratory safety and handling of food additive chemicals
PCO2	Identify and analyze common food additives used in food products
PCO3	Perform experiments related to flavour compounds and flavour evaluation
PCO4	Evaluate the role of additives and flavours in food quality and stability
PCO5	Interpret experimental results and prepare laboratory records related to additives and flavour technology

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and handling of food additives	PCO1
2	Identification of permitted food colours in food samples	PCO2
3	Detection of synthetic colours in beverages and confectionery	PCO2
4	Identification of preservatives in food samples	PCO2
5	Estimation of acidity regulators and acidulants	PCO2
6	Preparation of flavoured beverage using permitted additives	PCO3
7	Sensory evaluation of flavoured food products	PCO3
8	Extraction of flavour compounds from spices/herbs	PCO3
9	Determination of flavour stability during storage (demonstration)	PCO4
10	Study of emulsifiers and stabilizers in food systems	PCO4
11	Preparation of food product using natural and synthetic flavours	PCO4

12	Comparative evaluation of natural and artificial flavouring agents	PCO4
13	Label analysis of food additives in packaged foods	PCO5
14	Case study on food additive regulations and labeling	PCO5
15	Preparation of laboratory record and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	1	2	1	1	1	2
PCO3	3	3	3	2	2	2	1	1	2	2
PCO4	3	3	2	3	2	2	2	1	1	2
PCO5	2	2	2	3	2	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	3	3	3

List of Experiments

1. Laboratory safety and handling of food additives and flavour chemicals
2. Determination of peroxide value
3. Determination of BHT/ BHA/ propyl gallate antioxidant activity
4. Determination of preservatives (benzoate, sulphite, metabisulphite, sorbaste, propionate) in processed foods
5. Estimation of acidity regulators and acidulants
6. Sensory evaluation of flavoured food products
7. Extraction of flavour compounds from spices and herbs and preparation of flavoured beverage using permitted additives
8. Detection of intentional/ unintentional food additives
9. Determination of taste threshold value
10. Study of emulsifiers and stabilizers in food systems
11. Preparation of food product using natural and synthetic flavours
12. Comparative evaluation of natural and artificial flavouring agents
13. Estimation of Vitamin C
14. Determination of minerals (demonstration)
15. Determination of sodium chloride

IMFT55.5504T – Food Adulteration

• **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
• **Course Type:** Discipline Core Course
• **Level:** Semester V

Course Objectives

1. To introduce the concepts, causes, and significance of food adulteration.
2. To familiarize students with different types of adulterants and methods of adulteration in foods.
3. To explain analytical and detection techniques used for identifying food adulterants.
4. To develop understanding of food safety regulations and legal aspects related to adulteration.
5. To create awareness regarding consumer protection, food authenticity, and preventive measures against adulteration.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, causes, and public health significance of food adulteration	Module I
CO2	Describe different adulterants and adulteration practices in various food commodities	Module II
CO3	Discuss analytical methods and detection techniques used for identifying adulterants	Module III
CO4	Interpret food safety regulations, standards, and legal provisions related to adulteration	Module IV
CO5	Evaluate preventive strategies, food authenticity measures, and consumer awareness programs	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	1	1	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	3	3	3	2	2	1	1	1	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	3	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3

CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, causes, and public health significance of food adulteration	Understand (K2)
CO2	Describe different adulterants and adulteration practices in various food commodities	Understand (K2)
CO3	Discuss analytical methods and detection techniques used for identifying adulterants	Apply (K3)
CO4	Interpret food safety regulations, standards, and legal provisions related to adulteration	Analyze (K4)
CO5	Evaluate preventive strategies, food authenticity measures, and consumer awareness programs	Evaluate (K5)

Module I: Fundamentals of Food Adulteration (10 Hours)

• Definition and concept of food adulteration
• Historical perspectives and significance
• Types of adulteration:
- Intentional adulteration
- Incidental adulteration
- Metallic contamination
- Microbial contamination

• Causes and factors responsible for adulteration
• Public health significance of adulterated foods
• Economic impact of food adulteration
• Food contamination versus food adulteration
• Food authenticity and traceability concepts
• Consumer awareness and food safety concerns

Module II: Adulteration in Food Commodities (12 Hours)

• Adulteration in cereals, pulses, and flour products
• Adulteration in milk and milk products
• Adulteration in fats and edible oils
• Adulteration in spices and condiments
• Adulteration in tea, coffee, and beverages
• Adulteration in fruits and vegetables
• Adulteration in meat, fish, and poultry products
• Adulteration in honey and sweeteners
• Artificial ripening agents and chemical contaminants
• Common adulterants and their health hazards

Module III: Detection and Analytical Techniques (11 Hours)

• Principles of food adulterant detection
• Physical methods of detection
• Chemical methods of detection
• Microscopic examination techniques
• Rapid test kits and field detection methods
• Instrumental analytical techniques:
    - Chromatography
    - Spectroscopy
    - PCR-based methods
• Detection of synthetic colours and preservatives
• Detection of contaminants and toxic substances
• Sampling procedures and interpretation of results

Module IV: Food Laws, Standards and Regulatory Aspects (10 Hours)

• Food Safety and Standards Act (FSSA)
• Role and functions of FSSAI
• Standards related to food adulteration
• Prevention of Food Adulteration (PFA) Act – overview
• Food inspection and enforcement procedures
• Labeling regulations and legal compliance
• Food safety standards and certification systems
• Role of Codex Alimentarius in food regulation
• Legal actions and penalties related to adulteration
• Ethical issues in food quality and safety

Module V: Food Authenticity, Consumer Protection and Emerging Issues (11 Hours)

• Food authenticity and traceability systems
• Food fraud and economically motivated adulteration
• Consumer protection and awareness programs
• Quality assurance and surveillance systems
• Role of laboratories in food authenticity testing
• Emerging technologies in adulterant detection
• Blockchain and digital traceability in food supply chain
• Sustainable food quality management
• Case studies on food adulteration incidents
• Future trends in food safety and authenticity assessment

Recommended References

1. Lakshmanan, R. *Food Adulteration and Food Safety*. New India Publishing Agency.
2. Manay, N. S., & Shadaksharaswamy, M. *Foods: Facts and Principles*. New Age International.

3. Khopkar, S. M. *Basic Concepts of Analytical Chemistry*. New Age International.
4. FSSAI Manuals and Guidelines on Food Safety and Adulteration.
5. Nielsen, S. S. *Food Analysis*. Springer.

IMFT55.5504P – Food Adulteration Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester V

Course Objectives

1. To familiarize students with practical techniques for detection of food adulterants.
2. To develop skills in qualitative analysis of adulterants in different food commodities.
3. To understand laboratory methods used in food quality and authenticity assessment.
4. To train students in safe laboratory practices and interpretation of analytical observations.
5. To create awareness regarding food safety, consumer protection, and regulatory compliance.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate laboratory safety practices and handling of food samples
PCO2	Perform qualitative detection of common adulterants in foods
PCO3	Analyze food samples using standard adulteration detection methods
PCO4	Interpret analytical results related to food quality and authenticity
PCO5	Prepare laboratory reports and evaluate food safety issues associated with adulteration

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and sampling procedures for food analysis	PCO1
2	Detection of starch adulteration in milk	PCO2
3	Detection of detergent and urea in milk	PCO2
4	Detection of vanaspati in ghee/butter	PCO2
5	Detection of argemone oil in edible oils	PCO2
6	Detection of artificial colours in spices and sweets	PCO2
7	Detection of adulterants in turmeric powder	PCO3
8	Detection of adulterants in chilli powder	PCO3
9	Detection of adulterants in black pepper and coriander powder	PCO3
10	Detection of chicory in coffee powder	PCO3
11	Detection of exhausted tea leaves in tea powder	PCO3
12	Detection of artificial sweeteners in beverages (demonstration)	PCO4
13	Detection of ripening agents in fruits (demonstration)	PCO4
14	Label examination and interpretation of packaged food products	PCO5
15	Preparation of laboratory record and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	2	2	1	1	1	2
PCO3	3	3	3	3	2	2	1	1	1	2
PCO4	3	3	2	3	2	3	2	1	1	2
PCO5	2	2	2	3	2	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	3	3	3

List of Experiments

1. Detection of starch in milk
2. Detection of detergent and urea in milk
3. Detection of vanaspati in ghee/butter
4. Sensory evaluation-score cards
5. Detection of argemone oil in edible oils
6. Detection of artificial colours in spices and sweets
7. Detection of adulterants in turmeric powder
8. Detection of adulterants in chilli powder
9. Detection of adulterants in black pepper and coriander powder
10. Detection of chicory in coffee powder
11. Detection of exhausted tea leaves in tea powder
12. Detection of artificial sweeteners in beverages
13. Detection of artificial ripening agents in fruits
14. Detection of toxins
15. Detection of pesticides

IMFT55.5305T – Fundamentals of Management and Consumer Behaviour

• **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
• **Course Type:** Discipline Specific Elective
• **Level:** Semester V

Course Objectives

1. To introduce the basic principles and functions of management.
2. To familiarize students with organizational structure, leadership, and managerial practices.
3. To explain the concepts and determinants of consumer behaviour.
4. To develop understanding of consumer decision-making and market behaviour.
5. To provide knowledge on consumer satisfaction, ethics, and emerging trends in consumer studies.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, principles, and functions of management	Module I
CO2	Describe organizational structure, leadership, motivation, and communication processes	Module II
CO3	Discuss concepts and determinants influencing consumer behaviour	Module III
CO4	Interpret consumer decision-making processes and buying behaviour	Module IV
CO5	Evaluate consumer satisfaction, ethical issues, and emerging consumer trends	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	1	2	1	1	2	2
CO2	3	2	3	2	2	3	2	1	2	2
CO3	3	3	2	2	2	2	1	1	2	2
CO4	3	3	3	3	2	2	2	1	2	2
CO5	2	2	3	2	2	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	3
CO3	3	2	2
CO4	3	3	3

CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, principles, and functions of management	Understand (K2)
CO2	Describe organizational structure, leadership, motivation, and communication processes	Understand (K2)
CO3	Discuss concepts and determinants influencing consumer behaviour	Apply (K3)
CO4	Interpret consumer decision-making processes and buying behaviour	Analyze (K4)
CO5	Evaluate consumer satisfaction, ethical issues, and emerging consumer trends	Evaluate (K5)

Module I: Principles and Functions of Management (9 Hours)

• Definition, scope, and importance of management
• Evolution of management thought
• Functions of management:
  - Planning
  - Organizing
  - Staffing
  - Directing
  - Controlling
• Principles of management
• Levels of management
• Managerial roles and skills
• Decision-making process in management
• Introduction to business environment

Module II: Organizational Behaviour and Leadership (9 Hours)

• Organizational structure and types of organizations
• Formal and informal organizations
• Leadership concepts and leadership styles
• Motivation theories:
  - Maslow's hierarchy
  - Herzberg's theory
• Communication process and barriers
• Teamwork and group dynamics
• Conflict management
• Organizational culture and ethics
• Time and stress management

Module III: Fundamentals of Consumer Behaviour (9 Hours)

• Definition and importance of consumer behaviour
• Nature and scope of consumer studies
• Factors influencing consumer behaviour:
  - Psychological factors
  - Social factors
  - Cultural factors
  - Economic factors
• Consumer needs and motivation
• Personality and perception
• Learning and attitude formation
• Consumer awareness and education

Module IV: Consumer Decision-Making and Buying Behaviour (9 Hours)

• Consumer decision-making process
• Types of buying behaviour
• Consumer purchase patterns
• Brand perception and brand loyalty
• Market segmentation and targeting
• Consumer behaviour in food purchasing
• Online consumer behaviour and digital marketing influence
• Consumer satisfaction and feedback systems
• Case studies related to consumer buying behaviour

Module V: Consumer Satisfaction, Ethics and Emerging Trends (9 Hours)

• Consumer rights and responsibilities
• Consumer Protection Act – overview
• Ethical issues in marketing and consumer management
• Sustainable consumption behaviour
• Green consumerism and eco-labeling
• Role of advertisements and media influence
• Emerging trends in consumer behaviour:
  - E-commerce
  - Health-conscious consumers
  - Smart consumers
• Future prospects in consumer research and management

Recommended References

1. Koontz, H., & Weihrich, H. *Essentials of Management*. McGraw-Hill.
2. Robbins, S. P., & Coulter, M. *Management*. Pearson Education.

3. Schiffman, L. G., & Kanuk, L. L. *Consumer Behaviour*. Pearson.
4. Kotler, P., & Keller, K. L. *Marketing Management*. Pearson Education.
5. Gupta, C. B., & Rajan Nair, N. *Marketing Management*. Sultan Chand & Sons.

SEMESTER VI

IMFT55.6308T – Food Packaging Technology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester VI

Course Objectives

1. To introduce the principles and importance of food packaging in food preservation and marketing.
2. To familiarize students with packaging materials, packaging systems, and packaging equipment used in food industry.
3. To explain the relationship between packaging, food quality, safety, and shelf life.
4. To develop understanding of modern packaging technologies and labeling regulations.
5. To provide awareness on sustainable packaging and emerging trends in food packaging technology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, functions, and importance of food packaging	Module I
CO2	Describe packaging materials, properties, and packaging systems used for foods	Module II
CO3	Discuss packaging operations, machinery, and packaging methods in food industry	Module III
CO4	Interpret the role of packaging in food quality, safety, shelf life, and regulations	Module IV
CO5	Evaluate sustainable packaging systems and emerging technologies in food packaging	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	2	3	2	2	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	3	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, functions, and importance of food packaging	Understand (K2)
CO2	Describe packaging materials, properties, and packaging systems used for foods	Understand (K2)
CO3	Discuss packaging operations, machinery, and packaging methods in food industry	Apply (K3)
CO4	Interpret the role of packaging in food quality, safety, shelf life, and regulations	Analyze (K4)
CO5	Evaluate sustainable packaging systems and emerging technologies in food packaging	Evaluate (K5)

Module I: Fundamentals of Food Packaging (10 Hours)

• Definition, scope, and importance of food packaging
• Functions of packaging:
  - Protection
  - Preservation
  - Containment
  - Communication
  - Convenience
• History and development of food packaging
• Packaging requirements for different foods
• Factors affecting package selection
• Packaging and shelf life of foods
• Packaging terminology and concepts
• Packaging design and aesthetics
• Role of packaging in food marketing

Module II: Packaging Materials and Packaging Systems (12 Hours)

• Classification of packaging materials
• Properties and applications of:
  - Paper and paperboard

- Glass containers
- Metal containers
- Plastics and polymeric materials
- Laminates and composite materials

• Flexible and rigid packaging systems
• Aseptic packaging systems
• Retort packaging
• Vacuum and modified atmosphere packaging (MAP)
• Edible films and coatings
• Barrier properties of packaging materials
• Selection criteria for packaging materials

Module III: Packaging Operations and Packaging Machinery (11 Hours)

• Packaging operations:
- Filling
- Sealing
- Labeling
- Coding

• Packaging machinery and equipment
• Form-fill-seal systems
• Bottling and canning operations
• Packaging of:
- Dairy products
- Bakery products
- Meat and fish products
- Fruits and vegetables
- Beverages

• Package testing methods
• Packaging defects and quality evaluation

Module IV: Packaging, Food Quality and Regulations (10 Hours)

• Interaction between food and packaging materials
• Packaging and food safety
• Migration of packaging components
• Packaging and storage stability
• Shelf-life studies and quality evaluation
• Labeling requirements and standards
• FSSAI regulations related to packaging and labeling
• Codex guidelines for food packaging

• Packaging waste management
• Quality assurance in packaging industry

Module V: Sustainable and Emerging Packaging Technologies (11 Hours)

• Sustainable packaging concepts
• Biodegradable and eco-friendly packaging materials
• Active packaging systems
• Intelligent and smart packaging
• Nanotechnology in food packaging
• RFID and digital traceability systems
• Innovations in food packaging technology
• Recycling and environmental concerns
• Consumer trends in packaging
• Future prospects in food packaging industry

Recommended References

1. Robertson, G. L. *Food Packaging: Principles and Practice*. CRC Press.
2. Coles, R., McDowell, D., & Kirwan, M. J. *Food Packaging Technology*. Wiley-Blackwell.
3. Ahvenainen, R. *Novel Food Packaging Techniques*. Woodhead Publishing.
4. Han, J. H. *Innovations in Food Packaging*. Elsevier.
5. Sacharow, S., & Griffin, R. C. *Food Packaging*. AVI Publishing.

IMFT55.6308P – Food Packaging Technology Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VI

Course Objectives

1. To familiarize students with different food packaging materials and packaging systems.
2. To develop practical skills in package testing, evaluation, and labeling analysis.
3. To understand the role of packaging in food preservation and shelf-life enhancement.
4. To train students in handling packaging equipment and quality assessment techniques.
5. To interpret packaging performance and regulatory aspects related to food packaging.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate safe handling and identification of food packaging materials
PCO2	Analyze physical and functional properties of packaging materials
PCO3	Perform packaging operations and package evaluation techniques
PCO4	Assess packaging quality, labeling standards, and shelf-life related parameters
PCO5	Interpret experimental observations and prepare laboratory reports related to food packaging

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Identification of different food packaging materials	PCO1
2	Study of properties of paper and paperboard packaging	PCO2
3	Study of plastic packaging materials and symbols	PCO2
4	Measurement of thickness of packaging materials	PCO2
5	Determination of GSM (gram per square meter) of paper packaging	PCO2
6	Determination of water absorption capacity of paper packaging	PCO2
7	Evaluation of sealing efficiency of packages	PCO3
8	Vacuum packaging demonstration	PCO3
9	Modified atmosphere packaging (MAP) demonstration	PCO3
10	Packaging of food products using suitable packaging materials	PCO3
11	Leakage test for food packages	PCO4
12	Drop test/compression test of packages (demonstration)	PCO4
13	Label examination and interpretation of packaged foods	PCO4
14	Shelf-life observation study of packaged food products	PCO4

15	Preparation of laboratory record and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	2	3	2	2	2	1	1	1	2
PCO3	3	3	3	2	2	2	1	1	2	2
PCO4	3	3	2	3	2	3	2	1	1	2
PCO5	2	2	2	3	2	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	2	3	3
PCO5	3	3	3

List of Experiments

1. Identification of different food packaging materials
2. Determination of global migration
3. Determination of tensile strength, elongation at break and Young's modulus
4. Measurement of thickness of packaging materials and GSM (gram per square meter) of paper packaging
5. Determination of water absorption capacity and oxygen transmission rate of paper packaging
6. Determination of Cobb's value, bursting strength, and puncture resistance of CFB
7. Evaluation of sealing efficiency of food packages
8. Demonstration of vacuum packaging
9. Packaging of selected food products using suitable packaging materials
10. Determination of transport worthiness and grease resistance
11. Leakage test for packaged food products
12. Drop test/compression test of packages (demonstration)
13. Visit to packaging industry
14. Shelf-life observation study of packaged food products

IMFT55.6309T – Nutraceuticals and Functional Foods

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VI

Course Objectives

1. To introduce the concepts, scope, and significance of nutraceuticals and functional foods.
2. To familiarize students with bioactive compounds and their health benefits.
3. To explain the development, processing, and applications of functional foods and nutraceutical products.
4. To develop understanding of health claims, safety, quality evaluation, and regulatory aspects.
5. To provide awareness on emerging trends and industrial applications of nutraceuticals and functional foods.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, classification, and importance of nutraceuticals and functional foods	Module I
CO2	Describe major bioactive compounds and their physiological functions	Module II
CO3	Discuss processing, formulation, and applications of nutraceuticals and functional foods	Module III
CO4	Interpret quality, safety, health claims, and regulatory aspects of nutraceutical products	Module IV
CO5	Evaluate emerging trends, industrial applications, and future prospects of nutraceuticals and functional foods	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	3	3	2	2	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	1	2
CO5	2	2	3	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3

CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, classification, and importance of nutraceuticals and functional foods	Understand (K2)
CO2	Describe major bioactive compounds and their physiological functions	Understand (K2)
CO3	Discuss processing, formulation, and applications of nutraceuticals and functional foods	Apply (K3)
CO4	Interpret quality, safety, health claims, and regulatory aspects of nutraceutical products	Analyze (K4)
CO5	Evaluate emerging trends, industrial applications, and future prospects of nutraceuticals and functional foods	Evaluate (K5)

Module I: Fundamentals of Nutraceuticals and Functional Foods (10 Hours)

• Definition and concepts of nutraceuticals and functional foods
• Historical development and significance
• Classification of nutraceuticals:

- Traditional nutraceuticals
- Non-traditional nutraceuticals
- Dietary supplements
- Functional foods

Concept of designer foods
• Difference between nutraceuticals, functional foods, and pharmaceuticals
• Scope and importance in human health
• Role in disease prevention and health promotion
• Global and Indian nutraceutical market overview
• Consumer awareness and trends

Module II: Bioactive Components and Health Benefits (12 Hours)

• Bioactive compounds and their functions
• Phytochemicals:

- Polyphenols
- Flavonoids
- Carotenoids
- Glucosinolates
- Dietary fibre and prebiotics
- Probiotics and synbiotics

- Omega-3 fatty acids and bioactive lipids
- Bioactive peptides and proteins
- Antioxidants and their health significance

• Functional roles in:
- Cardiovascular health
- Diabetes management
- Gut health
- Immune modulation
- Cancer prevention

• Sources of nutraceutical ingredients

Module III: Processing and Product Development (11 Hours)

• Extraction and isolation of bioactive compounds
• Processing techniques for nutraceuticals
• Stability of bioactive compounds during processing and storage
• Encapsulation and delivery systems
• Fermentation and biotechnology applications
• Development of functional foods:
- Functional beverages
- Dairy products
- Bakery products
- Fortified foods

• Nutraceutical formulation and dosage forms
• Packaging and storage considerations
• Quality evaluation of nutraceutical products

Module IV: Safety, Quality and Regulatory Aspects (10 Hours)

• Safety evaluation of nutraceuticals and functional foods
• Toxicological considerations and adverse effects
• Quality standards and standardization
• Nutritional labeling and health claims
• FSSAI regulations related to nutraceuticals
• Codex Alimentarius guidelines
• Good Manufacturing Practices (GMP)
• Ethical and legal aspects
• Consumer protection and awareness
• Challenges in regulation and commercialization

Module V: Emerging Trends and Industrial Applications (11 Hours)

• GM Foods

• Personalized nutrition and precision health
• Functional foods for lifestyle disorders
• Nutrigenomics and nutrigenetics
• Nanotechnology applications in nutraceuticals
• Marine nutraceuticals and plant-based bioactives
• Sustainable nutraceutical production
• Waste utilization and value addition
• Industrial applications and commercialization
• Market trends and entrepreneurship opportunities
• Future prospects in nutraceutical and functional food sector

Recommended References

1. Wildman, R. E. C. *Handbook of Nutraceuticals and Functional Foods*. CRC Press.
2. Gibson, G. R., & Williams, C. M. *Functional Foods: Concept to Product*. Woodhead Publishing.
3. Shi, J. *Functional Food Ingredients and Nutraceuticals*. CRC Press.
4. Gupta, R. C. *Nutraceuticals: Efficacy, Safety and Toxicity*. Elsevier.
5. Bagchi, D. *Nutraceutical and Functional Food Regulations in the United States and Around the World*. Academic Press.

IMFT55.1802T – Digital Technologies in Food Sector

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VI

Course Objectives

1. To introduce the role and significance of digital technologies in the food sector.
2. To familiarize students with digital tools used in food production, processing, quality control, and supply chain management.
3. To explain applications of artificial intelligence, IoT, automation, and data analytics in food systems.
4. To develop understanding of digital traceability, smart manufacturing, and e-commerce in food industries.
5. To provide awareness on emerging trends, cybersecurity, and future prospects of digital transformation in the food sector.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and importance of digital technologies in the food sector	Module I
CO2	Describe digital tools and automation technologies used in food production and processing	Module II
CO3	Discuss applications of AI, IoT, robotics, and data analytics in food industries	Module III
CO4	Interpret digital systems used for quality assurance, traceability, and food supply chain management	Module IV
CO5	Evaluate emerging digital innovations, cybersecurity, and future trends in food technology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	2	1	1	1	2	2
CO2	3	2	3	2	3	2	1	1	2	2
CO3	3	3	3	3	3	2	2	1	2	2
CO4	3	3	2	3	3	3	2	2	1	2
CO5	2	2	3	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and importance of digital technologies in the food sector	Understand (K2)
CO2	Describe digital tools and automation technologies used in food production and processing	Understand (K2)
CO3	Discuss applications of AI, IoT, robotics, and data analytics in food industries	Apply (K3)
CO4	Interpret digital systems used for quality assurance, traceability, and food supply chain management	Analyze (K4)
CO5	Evaluate emerging digital innovations, cybersecurity, and future trends in food technology	Evaluate (K5)

Module I: Introduction to Digital Technologies in Food Sector (10 Hours)

• Digital transformation in food industries
• Scope and significance of digital technologies
• Industry 4.0 concepts in food sector
• Components of smart food systems
• Digitalization in:
  - Agriculture
  - Food processing
  - Packaging
  - Distribution
• Information and communication technologies (ICT) in food sector
• Advantages and challenges of digital transformation
• Role of digital technologies in sustainability and food security
• Overview of smart manufacturing systems

Module II: Automation and Smart Food Processing Systems (11 Hours)

• Principles of automation in food industries
• Sensors and control systems in food processing
• Programmable logic controllers (PLC) – introductory concept
• Robotics in food manufacturing and packaging
• Automated sorting and grading systems
• Smart processing and monitoring systems
• Computer vision systems in food quality evaluation

• Digital process control and optimization
• Applications in:
  - Dairy processing
  - Bakery industries
  - Beverage industries
  - Meat and fish processing
• Benefits and limitations of automation

Module III: Artificial Intelligence, IoT and Data Analytics (12 Hours)

• Introduction to Artificial Intelligence (AI) in food sector
• Machine learning concepts and applications
• Internet of Things (IoT) in food industries
• Smart sensors and real-time monitoring systems
• Big data analytics in food production and marketing
• Predictive analytics for food quality and shelf life
• AI applications in:
  - Food safety
  - Product development
  - Consumer analysis
  - Precision agriculture
• Cloud computing and digital platforms
• Blockchain technology in food systems
• Case studies on AI-driven food technologies

Module IV: Digital Quality Management and Supply Chain Systems (10 Hours)

• Digital quality assurance systems
• Traceability and tracking technologies
• RFID and barcode systems
• Digital documentation and record management
• Supply chain management software
• E-commerce and online food retail systems
• Cold chain monitoring technologies
• Food safety monitoring systems
• Cybersecurity and data protection in food industries
• Regulatory compliance and digital standards

Module V: Emerging Technologies and Future Trends (11 Hours)

• Smart packaging technologies
• Digital twins and simulation in food industries
• 3D food printing and personalized nutrition
• Augmented reality (AR) and virtual reality (VR) applications

• Mobile applications in food services and nutrition
• Sustainable digital technologies in food sector
• Digital entrepreneurship and innovation
• Challenges in digital adoption
• Ethical and social issues related to digital technologies
• Future prospects of digital food systems

Recommended References

1. Sun, D.-W. *Computer Vision Technology for Food Quality Evaluation*. Academic Press.
2. Erdogdu, F. *Digitalization in the Food Industry*. CRC Press.
3. Zhang, Q., & Pierce, F. J. *Agricultural Automation: Fundamentals and Practices*. CRC Press.
4. Mahalik, N. P. *Food Safety and Preservation: Modern Biological Approaches to Improving Consumer Health*. Springer.
5. Mariani, C., & Ferrigno, G. *Artificial Intelligence and Digital Transformation in Food Industries*. Elsevier.

IMFT55.6310T – Biostatistics in Food Industry

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VI

Course Objectives

1. To introduce the basic concepts and applications of biostatistics in food science and food industry.
2. To familiarize students with methods of data collection, classification, and statistical analysis.
3. To explain statistical tools used in quality control, food analysis, and research interpretation.
4. To develop understanding of hypothesis testing, correlation, regression, and experimental design.
5. To provide practical knowledge of statistical interpretation and decision-making in food-related studies.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and importance of biostatistics in food industry	Module I
CO2	Describe methods of data collection, organization, and presentation	Module II
CO3	Apply statistical measures and probability concepts in food-related data analysis	Module III
CO4	Interpret hypothesis testing, correlation, regression, and experimental designs	Module IV
CO5	Evaluate applications of biostatistics in quality control, food research, and industrial decision-making	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	2	2	1	1	1	2	2
CO2	3	2	2	3	2	2	1	1	1	2
CO3	3	3	3	3	3	2	1	1	2	2
CO4	3	3	3	3	2	3	2	1	2	2
CO5	2	2	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and importance of biostatistics in food industry	Understand (K2)
CO2	Describe methods of data collection, organization, and presentation	Understand (K2)
CO3	Apply statistical measures and probability concepts in food-related data analysis	Apply (K3)
CO4	Interpret hypothesis testing, correlation, regression, and experimental designs	Analyze (K4)
CO5	Evaluate applications of biostatistics in quality control, food research, and industrial decision-making	Evaluate (K5)

Module I: Fundamentals of Biostatistics (10 Hours)

• Definition, scope, and importance of biostatistics
• Applications in food science and food industry
• Types of data:
  - Qualitative and quantitative
  - Primary and secondary data
• Population and sample
• Variables and scales of measurement
• Sampling methods:
  - Random sampling
  - Stratified sampling
  - Systematic sampling
• Statistical errors and bias
• Role of statistics in food quality and research

Module II: Data Collection and Descriptive Statistics (11 Hours)

• Methods of data collection and classification
• Tabulation and graphical representation:
  - Bar diagrams
  - Histograms
  - Pie charts
  - Frequency curves
• Measures of central tendency:

- Mean
- Median
- Mode

• Measures of dispersion:

- Range
- Variance
- Standard deviation
- Coefficient of variation

• Skewness and kurtosis
• Data interpretation and reporting
• Problems

Module III: Probability and Statistical Distributions (11 Hours)

• Basic concepts of probability
• Laws of probability
• Conditional probability
• Probability distributions:

- Binomial distribution
- Poisson distribution
- Normal distribution

• Standard normal distribution and Z-test
• Introduction to statistical software applications
• Sampling distribution and standard error
• Applications in food quality analysis and food safety studies
• Problems

Module IV: Hypothesis Testing and Experimental Design (11 Hours)

• Concepts of hypothesis testing
• Null and alternative hypothesis
• Level of significance and p-value
• Tests of significance:

- t-test
- Chi-square test
- F-test

• Correlation and regression analysis
• Analysis of variance (ANOVA) – introductory concept
• Experimental designs:

- Completely randomized design (CRD)
- Randomized block design (RBD)
  • Interpretation of statistical results

• Problems

Module V: Applications of Biostatistics in Food Industry (11 Hours)

• Statistical quality control in food industry
• Control charts and process monitoring
• Sampling inspection methods
• Shelf-life and sensory data analysis
• Statistical applications in food microbiology and toxicology
• Consumer preference and market survey analysis
• Data interpretation in research and product development
• Applications in nutrition and public health studies
• Use of spreadsheets and statistical software in food data analysis
• Case studies related to food industry data interpretation

Recommended References

1. Gupta, S. C., & Kapoor, V. K. *Fundamentals of Applied Statistics*. Sultan Chand & Sons.
2. Daniel, W. W. *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley.
3. Montgomery, D. C. *Introduction to Statistical Quality Control*. Wiley.
4. Sundararaj, N., Nagaraju, S., Venkataramu, M. N., & Jagannath, M. K. *Design and Analysis of Field Experiments*. University of Agricultural Sciences.
5. Mahajan, B. K. *Methods in Biostatistics*. Jaypee Brothers Medical Publishers.

IMFT55.6310P – Biostatistics in Food Industry Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VI

Course Objectives

1. To familiarize students with statistical tools and techniques used in food industry data analysis.
2. To develop practical skills in data collection, organization, tabulation, and graphical presentation.
3. To train students in statistical analysis and interpretation of food-related experimental data.
4. To provide hands-on experience in using spreadsheet/statistical software for data analysis.
5. To develop analytical and decision-making skills for food quality control and research applications.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate basic statistical data handling and tabulation techniques
PCO2	Perform graphical representation and descriptive statistical analysis of food-related data
PCO3	Apply probability and hypothesis testing methods to food industry datasets
PCO4	Analyze correlation, regression, and quality control data using statistical tools
PCO5	Interpret statistical results and prepare analytical reports using spreadsheet/statistical software

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Introduction to statistical software/spreadsheet applications	PCO1
2	Collection, classification, and tabulation of food industry data	PCO1
3	Graphical representation of data (bar chart, histogram, pie chart)	PCO2
4	Calculation of mean, median, and mode	PCO2
5	Calculation of variance and standard deviation	PCO2
6	Calculation of coefficient of variation and standard error	PCO2
7	Probability exercises related to food quality data	PCO3
8	Application of normal distribution in food analysis	PCO3

9	t-test for comparison of food sample data	PCO3
10	Chi-square test using food-related datasets	PCO3
11	Correlation analysis of food quality parameters	PCO4
12	Regression analysis using food industry data	PCO4
13	Preparation and interpretation of control charts	PCO4
14	Statistical interpretation of sensory evaluation data	PCO5
15	Preparation of statistical report and interpretation of results	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	2	2	1	1	1	2	2
PCO2	3	3	3	3	2	2	1	1	1	2
PCO3	3	3	3	3	3	2	1	1	2	2
PCO4	3	3	3	3	2	3	2	1	2	2
PCO5	2	2	3	3	2	3	2	2	2	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	3	3	3

List of Experiments

1. Introduction to spreadsheet/statistical software applications
2. Collection, classification, and tabulation of food industry data
3. Graphical representation of food-related data using charts and graphs
4. Calculation of mean, median, and mode
5. Calculation of variance and standard deviation
6. Calculation of coefficient of variation and standard error
7. Probability exercises related to food quality parameters
8. Application of normal distribution in food analysis
9. t-test for comparison of food sample data
10. Chi-square test using food-related datasets
11. Correlation analysis of food quality parameters
12. Regression analysis using food industry data
13. Preparation and interpretation of statistical quality control charts
14. Statistical interpretation of sensory evaluation data

IMFT55.6312T – Supply Chain Management in Food Sector

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester VI

Course Objectives

1. To introduce the concepts and importance of supply chain management in the food sector.
2. To familiarize students with procurement, storage, transportation, and distribution systems in food industries.
3. To explain logistics, inventory management, cold chain systems, and digital traceability in food supply chains.
4. To develop understanding of quality assurance, risk management, and sustainability in food supply systems.
5. To provide awareness on emerging technologies and future trends in food supply chain management.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and importance of supply chain management in food sector	Module I
CO2	Describe procurement, storage, transportation, and logistics systems in food industries	Module II
CO3	Discuss inventory management, cold chain systems, and digital traceability technologies	Module III
CO4	Interpret quality assurance, food safety, and risk management practices in food supply chains	Module IV
CO5	Evaluate sustainability, emerging technologies, and future prospects in food supply chain management	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	2	1	1	1	2	2
CO2	3	2	3	2	3	2	1	1	2	2
CO3	3	3	3	3	3	2	2	1	2	2
CO4	3	3	2	3	3	3	2	2	1	2
CO5	2	2	3	2	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3

CO1	2	1	2
CO2	3	2	3
CO3	3	3	3
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and importance of supply chain management in food sector	Understand (K2)
CO2	Describe procurement, storage, transportation, and logistics systems in food industries	Understand (K2)
CO3	Discuss inventory management, cold chain systems, and digital traceability technologies	Apply (K3)
CO4	Interpret quality assurance, food safety, and risk management practices in food supply chains	Analyze (K4)
CO5	Evaluate sustainability, emerging technologies, and future prospects in food supply chain management	Evaluate (K5)

Module I: Fundamentals of Food Supply Chain Management (10 Hours)

• Definition, scope, and importance of supply chain management
• Components of food supply chain
• Farm-to-fork concept
• Characteristics of food supply chains
• Supply chain integration and coordination
• Supply chain functions:
  - Procurement
  - Production
  - Storage
  - Transportation
  - Distribution
• Role of supply chain management in food quality and food security
• Challenges in food supply chains
• Overview of global and Indian food supply systems

Module II: Procurement, Logistics and Distribution Systems (11 Hours)

• Procurement and sourcing strategies
• Supplier relationship management
• Logistics management in food industries
• Transportation systems for perishable and non-perishable foods
• Warehousing and storage management

• Distribution channels in food sector
• Retail and wholesale food distribution
• Packaging and handling during transportation
• Third-party logistics (3PL) services
• E-commerce and online food delivery systems

Module III: Inventory Management and Cold Chain Systems (11 Hours)

• Principles of inventory management
• Inventory control techniques:
  - FIFO
  - LIFO
  - EOQ
• Demand forecasting in food industries
• Cold chain management concepts
• Refrigerated storage and transportation
• Temperature monitoring systems
• Post-harvest handling of foods
• Traceability systems and digital tracking
• RFID and barcode technologies
• Role of IoT and automation in cold chain management

Module IV: Food Safety, Quality Assurance and Risk Management (11 Hours)

• Food safety in supply chains
• Quality assurance systems
• HACCP and GMP in supply chain management
• Risk assessment and risk management
• Traceability and recall systems
• Food fraud and adulteration risks
• Regulatory standards and compliance
• Documentation and auditing systems
• Supply chain resilience and crisis management
• Case studies related to food supply chain failures and recalls

Module V: Sustainability and Emerging Technologies in Food Supply Chains (11 Hours)

• Sustainable supply chain management
• Green logistics and eco-friendly transportation
• Food waste management and loss reduction
• Blockchain technology in food traceability
• Artificial intelligence and data analytics in supply chains
• Smart warehousing and automation
• Digital supply chain systems
• Circular economy concepts in food sector

• Entrepreneurship opportunities in food logistics
• Future prospects and innovations in food supply chain management

Recommended References

1. Chopra, S., & Meindl, P. *Supply Chain Management: Strategy, Planning, and Operation*. Pearson.
2. Christopher, M. *Logistics and Supply Chain Management*. Pearson Education.
3. Bourlakis, M., & Weightman, P. *Food Supply Chain Management*. Wiley-Blackwell.
4. Handfield, R. B., & Nichols, E. L. *Introduction to Supply Chain Management*. Pearson.
5. Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. *Designing and Managing the Supply Chain*. McGraw-Hill.

SEMESTER VII

IMFT60.7401T– Research Methodology and Scientific Writing

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester VII

Course Objectives

1. To introduce the principles and significance of research methodology in food science and allied disciplines.
2. To familiarize students with research design, data collection, sampling, and analytical techniques.
3. To develop skills in scientific writing, referencing, and preparation of research reports and publications.
4. To explain ethical practices, plagiarism, and intellectual integrity in scientific research.
5. To provide practical understanding of research communication, presentation, and publication processes.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, types, and significance of research methodology	Module I
CO2	Describe research design, sampling methods, and data collection techniques	Module II
CO3	Apply statistical and analytical approaches for interpretation of research data	Module III
CO4	Interpret principles of scientific writing, referencing, and publication ethics	Module IV
CO5	Evaluate research reports, scientific presentations, and publication procedures	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	2	1	1	2	2	2
CO2	3	3	2	3	2	2	1	1	2	2
CO3	3	3	3	3	3	2	1	1	2	2
CO4	3	2	3	3	2	3	2	3	2	3
CO5	2	2	3	3	3	3	2	3	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	2	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, types, and significance of research methodology	Understand (K2)
CO2	Describe research design, sampling methods, and data collection techniques	Understand (K2)
CO3	Apply statistical and analytical approaches for interpretation of research data	Apply (K3)
CO4	Interpret principles of scientific writing, referencing, and publication ethics	Analyze (K4)
CO5	Evaluate research reports, scientific presentations, and publication procedures	Evaluate (K5)

Module I: Fundamentals of Research Methodology (10 Hours)

• Definition, objectives, and significance of research
• Types of research:
  - Basic research
  - Applied research
  - Experimental research
  - Survey research
• Research process and steps in scientific investigation
• Identification and selection of research problems
• Review of literature and literature survey methods
• Formulation of hypothesis and research objectives
• Variables in research
• Scope of interdisciplinary research in food science
• Research ethics and integrity

Module II: Research Design and Data Collection (11 Hours)

• Research design and its importance
• Types of research design:
  - Exploratory

- Descriptive
- Experimental

• Sampling methods:
- Probability sampling
- Non-probability sampling

• Sample size determination
• Methods of data collection:
- Observation
- Questionnaire
- Interview
- Experimental methods

• Preparation of research plan and protocol
• Reliability and validity of data
• Documentation and maintenance of research records

Module III: Data Analysis and Interpretation (11 Hours)

• Classification and tabulation of data
• Graphical presentation of data
• Descriptive statistics:
- Mean
- Median
- Standard deviation

• Statistical tests:
- t-test
- Chi-square test
- ANOVA

• Correlation and regression analysis
• Interpretation of experimental data
• Introduction to statistical software and spreadsheet applications
• Presentation of research findings and discussion

Module IV: Scientific Writing and Publication Ethics (11 Hours)

• Principles of scientific writing
• Structure of scientific documents:
- Abstract
- Introduction
- Materials and methods
- Results and discussion
- Conclusion

• Thesis and dissertation writing
• Preparation of research articles and review papers
• Referencing styles:
  - APA
  - Vancouver
  - Harvard
• Citation management tools
• Plagiarism and plagiarism detection tools
• Publication ethics and intellectual honesty
• Copyright and intellectual property basics

Module V: Research Communication and Publication (11 Hours)

• Preparation of seminar and conference presentations
• Poster and oral presentation techniques
• Preparation of project proposals and reports
• Scientific communication skills
• Journal selection and manuscript submission process
• Peer review process
• Open access publishing and predatory journals
• Research funding agencies and grant writing basics
• Patents and commercialization of research
• Emerging trends in scientific publishing and digital research communication

Recommended References

1. Kothari, C. R. *Research Methodology: Methods and Techniques*. New Age International.
2. Montgomery, D. C. *Design and Analysis of Experiments*. Wiley.
3. Day, R. A., & Gastel, B. *How to Write and Publish a Scientific Paper*. Cambridge University Press.
4. Kumar, R. *Research Methodology: A Step-by-Step Guide for Beginners*. Sage Publications.
5. Gurumani, N. *Research Methodology for Biological Sciences*. MJP Publishers.

IMFT60.7402T – Food Toxicology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VII

Course Objectives

1. To introduce the concepts and principles of food toxicology.
2. To familiarize students with natural and synthetic toxicants present in foods.
3. To explain toxicological effects, metabolism, and risk assessment of food contaminants.
4. To develop understanding of food safety evaluation, regulatory standards, and toxicological testing methods.
5. To provide awareness on prevention and control of food toxicants for consumer safety and public health.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, scope, and significance of food toxicology	Module I
CO2	Describe natural toxicants, food contaminants, and adulterants present in foods	Module II
CO3	Discuss toxicokinetics, toxicological mechanisms, and health effects of food toxicants	Module III
CO4	Interpret toxicological evaluation, risk assessment, and analytical approaches related to food safety	Module IV
CO5	Evaluate food safety regulations, preventive measures, and emerging issues in food toxicology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	2	1	1	1	2	2	2
CO2	3	2	2	3	2	2	1	1	2	2
CO3	3	3	3	3	2	2	1	1	2	2
CO4	3	3	3	3	3	3	2	2	1	2
CO5	2	2	3	3	3	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3

CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, scope, and significance of food toxicology	Understand (K2)
CO2	Describe natural toxicants, food contaminants, and adulterants present in foods	Understand (K2)
CO3	Discuss toxicokinetics, toxicological mechanisms, and health effects of food toxicants	Apply (K3)
CO4	Interpret toxicological evaluation, risk assessment, and analytical approaches related to food safety	Analyze (K4)
CO5	Evaluate food safety regulations, preventive measures, and emerging issues in food toxicology	Evaluate (K5)

Module I: Fundamentals of Food Toxicology (10 Hours)

• Definition, scope, and importance of food toxicology
• History and development of toxicology
• Basic principles of toxicology
• Classification of toxic substances
• Dose-response relationship
• Toxicity parameters:
  - LD50
  - NOAEL
  - ADI
• Exposure routes of food toxicants
• Factors influencing toxicity
• Toxicology and public health significance
• Introduction to food safety and toxicological concerns

Module II: Food Toxicants and Contaminants (12 Hours)

• Natural toxicants in foods:
  - Plant toxins
  - Marine toxins
  - Mushroom toxins
• Mycotoxins:
  - Aflatoxins
  - Ochratoxins
  - Patulin
• Food additives and safety concerns
• Pesticide residues in foods

• Veterinary drug residues
• Heavy metals:
    - Lead
    - Mercury
    - Cadmium
    - Arsenic
• Environmental contaminants:
    - Dioxins
    - PCBs
• Food adulterants and intentional contaminants
• Packaging migrants and chemical contaminants
• Marine toxicants

Module III: Toxicokinetics and Toxicological Effects (11 Hours)

• Toxicokinetics:
    - Absorption
    - Distribution
    - Metabolism
    - Excretion
• Biotransformation of toxicants
• Mechanisms of toxicity
• Acute, subacute, and chronic toxicity
• Carcinogenicity, mutagenicity, and teratogenicity
• Neurotoxicity and immunotoxicity
• Allergens and food intolerance
• Oxidative stress and cellular damage
• Toxic effects of food processing contaminants:
    - Acrylamide
    - PAHs
    - Nitrosamines

Module IV: Toxicological Evaluation and Risk Assessment (10 Hours)

• Principles of toxicological testing
• In vivo and in vitro toxicity studies
• Risk analysis:
    - Risk assessment
    - Risk management
    - Risk communication
• Hazard identification and exposure assessment
• Biomarkers in toxicology

• Analytical methods for detection of toxicants
• Food surveillance and monitoring programs
• Safety evaluation of food additives and contaminants
• Interpretation of toxicological data

Module V: Food Safety Regulations and Emerging Issues (11 Hours)

• Food safety standards and regulations
• Role of:
  - FSSAI
  - WHO
  - FAO
  - Codex Alimentarius
• Maximum residue limits (MRLs)
• HACCP and food safety management systems
• Prevention and control of food toxicants
• Consumer awareness and food labeling
• Emerging contaminants in foods
• Nanotoxicology and novel food safety concerns
• Climate change and food toxicology
• Future trends in food toxicology and risk management

Recommended References

1. Shibamoto, T., & Bjeldanes, L. F. *Introduction to Food Toxicology*. Academic Press.
2. DeVries, J. W. *Food Safety and Toxicity*. CRC Press.
3. Hayes, A. W. *Principles and Methods of Toxicology*. CRC Press.
4. Duffus, J. H., & Worth, H. G. J. *Fundamental Toxicology*. Royal Society of Chemistry.
5. Reilly, C. *Metal Contamination of Food*. Wiley-Blackwell.

IMFT60.7402P – Food Toxicology Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VII

Course Objectives

1. To familiarize students with laboratory techniques used in food toxicology analysis.
2. To develop skills in detection and estimation of toxicants, contaminants, and adulterants in foods.
3. To train students in safe laboratory handling and toxicological evaluation procedures.
4. To provide practical understanding of food safety monitoring and quality assessment.
5. To develop analytical and interpretative skills related to food toxicology and public health safety.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate laboratory safety practices and handling of toxicological samples
PCO2	Perform detection and analysis of food adulterants and contaminants
PCO3	Analyze toxicological parameters and interpret food safety data
PCO4	Apply analytical methods for detection of chemical and biological toxicants
PCO5	Prepare toxicological reports and evaluate food safety and regulatory compliance

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety practices and handling of toxic samples	PCO1
2	Sampling and preparation of food samples for toxicological analysis	PCO1
3	Detection of common food adulterants in milk	PCO2
4	Detection of adulterants in spices and edible oils	PCO2
5	Detection of artificial/synthetic food colors	PCO2
6	Determination of pesticide residues (demonstration/interpretation based)	PCO3
7	Detection of heavy metals in food samples (lead/arsenic – demonstration)	PCO3
8	Determination of peroxide value in fats and oils	PCO3
9	Determination of acid value in edible oils	PCO3
10	Microbial toxin awareness and interpretation of mycotoxin contamination data	PCO4
11	Detection of formaldehyde/boric acid in food samples	PCO4

12	Detection of rancidity and oxidative spoilage in foods	PCO4
13	Interpretation of toxicological standards and permissible limits	PCO5
14	Preparation of toxicological analysis report	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	2	1	2	1	2	2	2
PCO2	3	3	3	3	2	2	1	1	2	2
PCO3	3	3	3	3	3	2	1	1	2	2
PCO4	3	3	2	3	2	3	2	1	2	2
PCO5	2	2	3	3	2	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Laboratory safety practices and handling of toxicological samples
2. Sampling and preparation of food samples for toxicological analysis
3. Detection of adulterants in milk
4. Detection of adulterants in spices and edible oils
5. Detection of synthetic/artificial food colors
6. Determination of pesticide residues (demonstration based)
7. Detection of heavy metals in food samples (demonstration based)
8. Determination of peroxide value in fats and oils
9. Determination of acid value in edible oils
10. Interpretation of mycotoxin contamination data
11. Detection of formaldehyde and boric acid in foods
12. Detection of rancidity and oxidative spoilage in food samples
13. Interpretation of food toxicological standards and permissible limits

IMFT60.7403T – Food Quality Evaluation: Sensory and Rheological Approaches

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VII

Course Objectives

1. To introduce the principles and importance of food quality evaluation.
2. To familiarize students with sensory evaluation methods and sensory attributes of foods.
3. To explain rheological properties and texture analysis of food systems.
4. To develop understanding of instrumental and subjective methods used in food quality assessment.
5. To provide practical knowledge on interpretation of sensory and rheological data for quality control and product development.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts, importance, and principles of food quality evaluation	Module I
CO2	Describe sensory attributes and sensory evaluation methods used in foods	Module II
CO3	Discuss rheological and textural properties of food systems	Module III
CO4	Interpret instrumental techniques and analytical methods for food quality assessment	Module IV
CO5	Evaluate sensory and rheological data for food quality control and product development	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	2	2	2
CO2	3	2	2	3	2	2	1	1	2	2
CO3	3	3	3	3	2	2	1	1	1	2
CO4	3	3	3	3	3	3	2	1	2	2
CO5	2	2	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3

CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts, importance, and principles of food quality evaluation	Understand (K2)
CO2	Describe sensory attributes and sensory evaluation methods used in foods	Understand (K2)
CO3	Discuss rheological and textural properties of food systems	Apply (K3)
CO4	Interpret instrumental techniques and analytical methods for food quality assessment	Analyze (K4)
CO5	Evaluate sensory and rheological data for food quality control and product development	Evaluate (K5)

Module I: Fundamentals of Food Quality Evaluation (10 Hours)

• Definition and concept of food quality
• Quality attributes of foods:
  - Appearance
  - Color
  - Flavor
  - Texture
  - Nutritional quality
• Importance of food quality evaluation
• Subjective and objective methods of quality assessment
• Factors affecting food quality
• Consumer perception and acceptability
• Quality standards and specifications
• Introduction to sensory and rheological evaluation
• Role of quality evaluation in food industry and product development

Module II: Sensory Evaluation of Foods (12 Hours)

• Principles of sensory evaluation
• Physiology of sensory perception:
  - Taste
  - Smell
  - Vision
  - Touch
• Sensory attributes of foods
• Sensory laboratory design and panel selection
• Types of sensory tests:

- Difference tests
- Descriptive tests
- Hedonic tests

• Threshold tests and flavor profile analysis
• Sensory score cards and evaluation scales
• Factors influencing sensory evaluation
• Statistical interpretation of sensory data
• Applications of sensory evaluation in food industry

Module III: Rheology and Texture of Foods (11 Hours)

• Definition and importance of rheology
• Rheological properties of foods:
- Viscosity
- Elasticity
- Plasticity

• Newtonian and non-Newtonian fluids
• Viscoelastic behavior of foods
• Texture profile analysis
• Factors affecting texture and rheological properties
• Gelation, emulsification, and foaming properties
• Rheology of liquid, semi-solid, and solid foods
• Texture modification and food processing effects
• Applications of rheology in food product development

Module IV: Instrumental Quality Evaluation Techniques (10 Hours)

• Instrumental methods in food quality analysis
• Color measurement techniques
• Texture analyzers and viscometers
• Use of pH meter and refractometer
• Moisture analysis and water activity measurement
• Basic spectroscopic techniques in quality evaluation
• Instrumental flavor analysis (introductory concepts)
• Correlation between sensory and instrumental methods

Module V: Applications in Quality Control and Product Development (11 Hours)

• Sensory quality control in food industry
• Shelf-life evaluation and stability studies
• Consumer acceptance studies
• Product optimization and reformulation
• Quality evaluation of:
- Dairy products

- Bakery products
- Beverages
- Meat and fish products

• Packaging influence on sensory quality
• Emerging trends in sensory science and rheology
• Digital technologies and AI in sensory evaluation

Recommended References

1. Lawless, H. T., & Heymann, H. *Sensory Evaluation of Food: Principles and Practices*. Springer.
2. Meilgaard, M., Civille, G. V., & Carr, B. T. *Sensory Evaluation Techniques*. CRC Press.
3. Rao, M. A. *Rheology of Fluid and Semisolid Foods: Principles and Applications*. Springer.
4. Kilcast, D. *Instrumental Assessment of Food Sensory Quality*. Woodhead Publishing.
5. Szczesniak, A. S. *Texture Measurement of Foods*. Springer.

IMFT60.7404T – Biochemistry and Human Nutrition

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester VII

Course Objectives

1. To introduce the fundamental concepts of biochemistry related to food and human nutrition.
2. To familiarize students with the structure, functions, and metabolism of biomolecules.
3. To explain the nutritional significance of macro and micronutrients in human health.
4. To develop understanding of digestion, absorption, metabolism, and energy balance.
5. To provide awareness on nutritional disorders, balanced diet, and current nutritional concerns.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts and significance of biochemistry and human nutrition	Module I
CO2	Describe the structure, functions, and metabolism of major biomolecules	Module II
CO3	Discuss digestion, absorption, and metabolic pathways related to nutrients	Module III
CO4	Interpret nutritional requirements, dietary balance, and nutritional disorders	Module IV
CO5	Evaluate current nutritional issues and the role of nutrition in health promotion	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	2	2	2
CO2	3	2	2	2	2	1	1	1	1	2
CO3	3	3	2	3	2	2	1	1	1	2
CO4	3	3	3	3	2	3	2	2	1	2
CO5	2	2	3	3	3	3	3	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	2

CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts and significance of biochemistry and human nutrition	Understand (K2)
CO2	Describe the structure, functions, and metabolism of major biomolecules	Understand (K2)
CO3	Discuss digestion, absorption, and metabolic pathways related to nutrients	Apply (K3)
CO4	Interpret nutritional requirements, dietary balance, and nutritional disorders	Analyze (K4)
CO5	Evaluate current nutritional issues and the role of nutrition in health promotion	Evaluate (K5)

Module I: Fundamentals of Biochemistry and Nutrition (7 Hours)

• Definition, scope, and importance of biochemistry
• Relationship between biochemistry and nutrition
• Structure and functions of cells
• Introduction to biomolecules
• Water and electrolyte balance
• Enzymes:
  - Classification
  - Properties
  - Factors affecting enzyme activity
• Introduction to human nutrition
• Concepts of balanced diet and nutritional status

Module II: Biomolecules and Metabolism (8 Hours)

• Carbohydrates:
  - Classification
  - Functions
  - Metabolism
• Proteins:
  - Amino acids
  - Structure and functions
  - Metabolism
• Lipids:

- Classification
- Essential fatty acids
- Metabolism

• Nucleic acids and their significance
• Vitamins and coenzymes
• Minerals and trace elements
• Metabolic pathways and bioenergetics

Module III: Digestion, Absorption and Energy Metabolism (7 Hours)

• Digestion and absorption of carbohydrates, proteins, and lipids
• Gastrointestinal physiology (introductory concepts)
• Energy metabolism and ATP production
• Basal metabolic rate (BMR) and factors affecting BMR
• Energy requirements and energy balance
• Hormonal regulation of metabolism
• Nutrient interactions and bioavailability
• Nutritional significance of dietary fibre and water

Module IV: Human Nutrition and Nutritional Disorders (7 Hours)

• Recommended dietary allowances (RDA)
• Nutritional requirements at different life stages
• Macronutrient and micronutrient deficiencies
• Protein-energy malnutrition
• Vitamin deficiency disorders
• Mineral deficiency disorders
• Over-nutrition and obesity
• Lifestyle disorders related to nutrition:
  - Diabetes
  - Cardiovascular diseases
• Assessment of nutritional status

Module V: Functional Nutrition and Current Nutritional Concerns (7 Hours)

• Functional foods and nutraceuticals
• Antioxidants and bioactive compounds
• Immunonutrition and gut health
• Probiotics and prebiotics
• Food allergies and intolerances
• Nutritional labeling and consumer awareness
• Public health nutrition and food security
• Emerging trends in personalized nutrition and sustainable diets
• Role of nutrition in health promotion and disease prevention

Recommended References

1. Nelson, D. L., & Cox, M. M. *Lehninger Principles of Biochemistry*. W.H. Freeman.
2. Devlin, T. M. *Textbook of Biochemistry with Clinical Correlations*. Wiley.
3. Srilakshmi, B. *Nutrition Science*. New Age International.
4. Gropper, S. S., & Smith, J. L. *Advanced Nutrition and Human Metabolism*. Cengage Learning.
5. Satyanarayana, U., & Chakrapani, U. *Biochemistry*. Elsevier.

IMFT60.7405T – Baking and Confectionery Technology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To introduce the principles and importance of baking and confectionery technology.
2. To familiarize students with raw materials, processing methods, and equipment used in bakery and confectionery industries.
3. To explain formulation, production, and quality evaluation of bakery and confectionery products.
4. To develop understanding of packaging, storage, and shelf-life aspects of baked and confectionery products.
5. To provide awareness on industrial trends, food safety, and innovations in bakery and confectionery technology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the principles, scope, and raw materials used in baking and confectionery technology	Module I
CO2	Describe processing methods and equipment used in bakery and confectionery industries	Module II
CO3	Discuss production and quality evaluation of bakery products	Module III
CO4	Interpret confectionery processing techniques and quality characteristics of confectionery products	Module IV
CO5	Evaluate packaging, storage, safety, and emerging trends in baking and confectionery technology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	3	2	2	1	1	1	2
CO3	3	3	3	3	2	2	1	1	1	2
CO4	3	3	2	3	3	3	2	1	2	2
CO5	2	2	3	3	3	3	3	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the principles, scope, and raw materials used in baking and confectionery technology	Understand (K2)
CO2	Describe processing methods and equipment used in bakery and confectionery industries	Understand (K2)
CO3	Discuss production and quality evaluation of bakery products	Apply (K3)
CO4	Interpret confectionery processing techniques and quality characteristics of confectionery products	Analyze (K4)
CO5	Evaluate packaging, storage, safety, and emerging trends in baking and confectionery technology	Evaluate (K5)

Module I: Fundamentals and Raw Materials (10 Hours)

• Introduction to baking and confectionery technology
• History and scope of bakery and confectionery industries
• Raw materials used in baking:
  - Wheat flour
  - Sugar
  - Fats and oils
  - Eggs
  - Milk and dairy ingredients
  - Yeast and leavening agents
• Functional role of ingredients in bakery products
• Raw materials used in confectionery products
• Food additives and improvers in bakery and confectionery
• Quality requirements of bakery ingredients
• Nutritional aspects of bakery and confectionery products

Module II: Bakery Processing and Equipment (11 Hours)

• Dough preparation and mixing methods
• Fermentation and proofing processes
• Baking principles and heat transfer
• Cooling and storage of bakery products
• Bakery equipment:
  - Mixers
  - Ovens

- Dough sheeters
- Fermentation chambers

• Automation in bakery industry
• Hygiene and sanitation in bakery processing
• Packaging requirements for bakery products
• Process flow diagrams for bakery operations

Module III: Bakery Products and Quality Evaluation (11 Hours)

• Bread making technology
• Cakes and pastries
• Biscuits and cookies
• Crackers and specialty bakery products
• Quality characteristics of bakery products:
  - Texture
  - Volume
  - Crumb structure
  - Color and flavor
• Common defects in bakery products and corrective measures
• Shelf-life evaluation of bakery products
• Functional and fortified bakery products
• Gluten-free and health-oriented bakery products

Module IV: Confectionery Technology (12 Hours)

• Introduction to confectionery processing
• Sugar chemistry and crystallization
• Manufacture of:
  - Hard candies
  - Soft candies
  - Toffees
  - Caramels
  - Chocolates
  - Chewing gums
• Cocoa processing and chocolate technology
• Tempering and molding techniques
• Confectionery additives and flavoring agents
• Quality evaluation of confectionery products
• Defects in confectionery products and prevention
• Novel and functional confectionery products

Module V: Packaging, Safety, and Emerging Trends (10 Hours)

• Packaging materials for bakery and confectionery products
• Storage stability and shelf-life
• Food safety and quality standards:
  - GMP
  - HACCP
  - FSSAI regulations
• Contamination and spoilage in bakery and confectionery products
• Consumer preferences and sensory evaluation
• Sustainable and eco-friendly packaging
• Emerging trends:
  - Low-sugar products
  - Functional confectionery
  - Clean-label bakery products
  - Digital technologies in bakery industry

Recommended References

1. Manley, D. *Technology of Biscuits, Crackers and Cookies*. Woodhead Publishing.
2. Pyler, E. J., & Gorton, L. A. *Baking Science and Technology*. Sosland Publishing.
3. Beckett, S. T. *Industrial Chocolate Manufacture and Use*. Wiley-Blackwell.
4. Potter, N. N., & Hotchkiss, J. H. *Food Science*. Springer.
5. Cauvain, S. P., & Young, L. S. *Technology of Breadmaking*. Springer.

IMFT60.7405P – Baking and Confectionery Technology Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To develop practical skills in bakery and confectionery product preparation.
2. To familiarize students with raw materials, formulations, and processing techniques.
3. To train students in quality evaluation of bakery and confectionery products.
4. To understand defects, shelf-life, and improvement techniques in bakery systems.
5. To gain hands-on experience in equipment handling, hygiene, and safety practices.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate safe handling of bakery and confectionery ingredients and equipment
PCO2	Prepare basic bakery products using standard formulations
PCO3	Produce confectionery products using appropriate techniques
PCO4	Evaluate quality attributes and identify defects in bakery and confectionery products
PCO5	Interpret results and prepare product quality reports

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety, hygiene, and bakery sanitation practices	PCO1
2	Identification and function of bakery ingredients	PCO1
3	Preparation of white bread using yeast fermentation	PCO2
4	Preparation of whole wheat bread	PCO2
5	Preparation of sponge cake	PCO2
6	Preparation of butter cake	PCO2
7	Preparation of biscuits (short dough method)	PCO2
8	Preparation of cookies (drop/rolled type)	PCO2
9	Preparation of pastry cream and fillings	PCO3
10	Preparation of hard candy (sugar boiling stages)	PCO3
11	Preparation of toffee or caramel	PCO3
12	Chocolate tempering and moulding techniques	PCO3
13	Evaluation of bread quality (volume, texture, crumb structure)	PCO4
14	Sensory evaluation of bakery and confectionery products	PCO4
15	Detection of defects in bakery products and corrective measures	PCO4
16	Preparation of practical record and product report	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	3	3	2	2	2	1	1	1	2
PCO3	3	3	3	3	2	2	1	1	2	2
PCO4	3	3	2	3	3	3	2	2	2	3
PCO5	2	2	3	3	2	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	1	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Laboratory safety, hygiene, and sanitation practices in bakery unit
2. Identification and functional role of bakery ingredients
3. Preparation of white bread (yeast fermentation method)
4. Preparation of whole wheat bread
5. Preparation of sponge cake
6. Preparation of butter cake
7. Preparation of biscuits (short dough method)
8. Preparation of cookies (drop/rolled type)
9. Preparation of pastry cream and fillings
10. Preparation of hard candy (sugar boiling stages)
11. Preparation of toffee or caramel
12. Chocolate tempering and moulding techniques
13. Evaluation of bread quality (volume, crumb structure, texture)
14. Sensory evaluation of bakery and confectionery products
15. Detection of defects in bakery products and corrective measures

IMFT60.7405T – Bioethics and Biosafety

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester VII

Course Objectives

1. To introduce the concepts and significance of bioethics and biosafety in biological and food sciences.
2. To familiarize students with ethical principles related to biotechnology, food research, and public health.
3. To explain biosafety practices, laboratory safety measures, and risk assessment procedures.
4. To develop understanding of national and international biosafety regulations and ethical guidelines.
5. To provide awareness on environmental, societal, and legal aspects related to biosafety and bioethics.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, principles, and importance of bioethics and biosafety	Module I
CO2	Describe ethical issues related to biotechnology, food science, and research practices	Module II
CO3	Discuss biosafety principles, laboratory practices, and risk assessment methods	Module III
CO4	Interpret biosafety regulations, guidelines, and legal frameworks	Module IV
CO5	Evaluate environmental, societal, and emerging issues associated with bioethics and biosafety	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	2	3	2	2
CO2	3	2	2	2	1	2	2	3	2	3
CO3	3	3	3	3	2	3	2	2	1	2
CO4	3	2	2	3	2	3	3	3	1	2
CO5	2	2	3	3	2	3	3	3	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	2	3

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, principles, and importance of bioethics and biosafety	Understand (K2)
CO2	Describe ethical issues related to biotechnology, food science, and research practices	Understand (K2)
CO3	Discuss biosafety principles, laboratory practices, and risk assessment methods	Apply (K3)
CO4	Interpret biosafety regulations, guidelines, and legal frameworks	Analyze (K4)
CO5	Evaluate environmental, societal, and emerging issues associated with bioethics and biosafety	Evaluate (K5)

Module I: Fundamentals of Bioethics and Biosafety (7 Hours)

• Definition, scope, and significance of bioethics
• Principles of bioethics:
- Autonomy
- Beneficence
- Non-maleficence
- Justice
  • Introduction to biosafety
  • Historical development of bioethics and biosafety
  • Relationship between biotechnology, ethics, and society
  • Biosafety levels and containment concepts
  • Importance of ethics and safety in biological sciences

Module II: Ethical Issues in Biotechnology and Food Science (7 Hours)

• Ethics in scientific research and experimentation
• Ethical issues related to genetically modified organisms (GMOs)
• Ethical concerns in food biotechnology and nanotechnology
• Human and animal ethics in research
• Ethical issues in clinical and nutritional studies
• Intellectual property rights and patent ethics
• Scientific misconduct:
- Fabrication
- Falsification
- Plagiarism

• Social and cultural dimensions of biotechnology

Module III: Biosafety Practices and Risk Assessment (8 Hours)

• Biosafety principles and laboratory safety
• Good Laboratory Practices (GLP)
• Handling and disposal of biological materials
• Chemical and microbial hazards
• Personal protective equipment (PPE)
• Sterilization and disinfection methods
• Biological risk assessment and management
• Occupational health and laboratory accidents
• Emergency response and safety documentation

Module IV: Biosafety Regulations and Legal Framework (7 Hours)

• National biosafety guidelines and policies
• International biosafety agreements and conventions
• Cartagena Protocol on Biosafety
• Food safety and biosafety regulations
• Role of:
  - FSSAI
  - WHO
  - FAO
  - DBT
• Institutional biosafety committees
• Ethical review committees and informed consent
• Regulatory framework for biotechnology products

Module V: Environmental and Emerging Issues (7 Hours)

• Environmental impact of biotechnology
• Biosafety concerns in waste disposal and environmental release
• Biosecurity and dual-use research concerns
• Public perception and communication of biotechnology risks
• Ethical and biosafety issues in synthetic biology
• Artificial intelligence and ethics in biological sciences
• Sustainable biotechnology and responsible innovation
• Emerging trends and future perspectives in bioethics and biosafety

Recommended References

1. Sateesh, M. K. *Bioethics and Biosafety*. I.K. International Publishing House.
2. Rathore, H. S., & Mathur, A. *Biosafety and Bioethics*. Macmillan Publishers.
3. Fleming, D. A., & Hunt, D. L. *Biological Safety: Principles and Practices*. ASM Press.

4. UNESCO. *Universal Declaration on Bioethics and Human Rights*. UNESCO Publications.
5. Singh, B. D. *Biotechnology: Expanding Horizons*. Kalyani Publishers.

SEMESTER VIII

IMFT60.8410T – Technology of Fats and Oils

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To introduce the chemistry, composition, and properties of fats and oils.
2. To familiarize students with processing, refining, and modification technologies of edible oils and fats.
3. To explain quality evaluation, spoilage mechanisms, and stability of fats and oils.
4. To develop understanding of functional applications of fats and oils in food systems.
5. To provide awareness on nutritional, industrial, and regulatory aspects related to fats and oils technology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the chemistry, composition, and properties of fats and oils	Module I
CO2	Describe extraction, refining, and processing technologies of fats and oils	Module II
CO3	Discuss modification techniques and functional applications of fats and oils in foods	Module III
CO4	Interpret quality evaluation, spoilage, and stability of fats and oils	Module IV
CO5	Evaluate nutritional, industrial, and regulatory aspects of fats and oils technology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	3	2	2	1	1	1	2
CO3	3	3	3	3	2	2	1	1	1	2
CO4	3	3	2	3	3	3	2	2	1	2
CO5	2	2	3	3	3	3	3	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the chemistry, composition, and properties of fats and oils	Understand (K2)
CO2	Describe extraction, refining, and processing technologies of fats and oils	Understand (K2)
CO3	Discuss modification techniques and functional applications of fats and oils in foods	Apply (K3)
CO4	Interpret quality evaluation, spoilage, and stability of fats and oils	Analyze (K4)
CO5	Evaluate nutritional, industrial, and regulatory aspects of fats and oils technology	Evaluate (K5)

Module I: Chemistry and Properties of Fats and Oils (10 Hours)

• Definition and classification of fats and oils
• Sources of edible fats and oils:
- Plant sources
- Animal sources
- Marine oils

• Chemical composition of fats and oils
• Fatty acids:
- Saturated
- Unsaturated
- Essential fatty acids

• Physical properties:
- Melting point
- Smoke point
- Plasticity

• Chemical properties:
- Hydrolysis
- Hydrogenation
- Oxidation

• Structure and functions of triglycerides and phospholipids
• Role of fats and oils in food systems

Module II: Extraction and Processing Technology (12 Hours)

• Oilseed structure and composition
• Preparation of oilseeds for extraction
• Methods of oil extraction:
    - Mechanical pressing
    - Solvent extraction
• Refining of edible oils:
    - Degumming
    - Neutralization
    - Bleaching
    - Deodorization
    - Winterization
• fractionation
• Processing of specialty fats and oils
• By-products utilization in oil industry
• Packaging and storage of edible oils
• Quality standards for edible oils

Module III: Modification and Functional Applications (11 Hours)

• Hydrogenation of oils and fats
• Interesterification and emulsification
• Production of margarine and shortening
• Fat replacers and low-fat products
• Functional properties of fats in foods:
    - Texture
    - Flavor
    - Mouthfeel
• Applications in:
    - Bakery products
    - Dairy products
    - Confectionery
    - Fried foods
• Specialty fats and structured lipids
• Emerging technologies in fats and oils processing

Module IV: Quality Evaluation and Stability (10 Hours)

• Deterioration and spoilage of fats and oils
• Oxidative rancidity and hydrolytic rancidity
• Factors affecting stability of fats and oils
• Antioxidants:

- Natural antioxidants
- Synthetic antioxidants

• Quality evaluation parameters:
- Acid value
- Peroxide value
- Iodine value
- Saponification value

• Shelf-life studies of fats and oils
• Packaging influence on oil stability
• Food safety issues related to fats and oils

Module V: Nutritional and Industrial Aspects (11 Hours)

• Nutritional significance of dietary fats
• Trans fatty acids and health concerns
• Omega-3 and omega-6 fatty acids
• Lipid metabolism and health
• Functional lipids and nutraceutical applications
• Industrial uses of fats and oils
• Regulatory standards:
- FSSAI
- Codex standards

• Sustainability issues in oil processing industry
• Emerging trends in edible oil technology
• Consumer awareness and labeling of fat-rich foods

Recommended References

1. Gunstone, F. D. *Vegetable Oils in Food Technology: Composition, Properties and Uses*. Wiley-Blackwell.
2. Shahidi, F. *Bailey's Industrial Oil and Fat Products*. Wiley-Interscience.
3. Lawson, H. *Food Oils and Fats: Technology, Utilization and Nutrition*. Springer.
4. O'Brien, R. D. *Fats and Oils: Formulating and Processing for Applications*. CRC Press.
5. Hui, Y. H. *Bailey's Industrial Oil and Fat Products*. Wiley.

IMFT60.8410P – Technology of Fats and Oils Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To familiarize students with laboratory techniques used in fats and oils analysis.
2. To develop skills in physicochemical evaluation of edible fats and oils.
3. To train students in quality assessment and detection of rancidity and adulteration in oils.
4. To provide practical understanding of processing characteristics and functional properties of fats and oils.
5. To enhance analytical and interpretative skills related to fats and oils technology.

Practical Course Outcomes (PCOs)

At the end of the practical course, the student will be able to:

PCO No.	Practical Course Outcome
PCO1	Demonstrate laboratory safety and handling practices for fats and oils analysis
PCO2	Perform physicochemical analysis of edible fats and oils
PCO3	Analyze quality parameters and stability characteristics of oils
PCO4	Detect rancidity, adulteration, and functional properties of fats and oils
PCO5	Interpret analytical results and prepare quality evaluation reports

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and handling of fats and oils samples	PCO1
2	Sampling and preparation of edible oil samples	PCO1
3	Determination of moisture and volatile matter in oils	PCO2
4	Determination of specific gravity of oils	PCO2
5	Determination of refractive index of edible oils	PCO2
6	Determination of acid value of fats and oils	PCO3
7	Determination of peroxide value of fats and oils	PCO3
8	Determination of saponification value	PCO3
9	Determination of iodine value	PCO3
10	Detection of rancidity in oils	PCO4
11	Detection of adulteration in edible oils	PCO4
12	Determination of smoke point of oils	PCO4
13	Preparation and stability evaluation of emulsions	PCO4

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2

PCO2	3	3	3	2	2	2	1	1	1	2
PCO3	3	3	3	3	2	2	1	1	2	2
PCO4	3	3	2	3	3	3	2	1	2	2
PCO5	2	2	3	3	2	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	2	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Laboratory safety practices and handling of fats and oils samples
2. Sampling and preparation of edible oil samples
3. Determination of moisture and volatile matter in oils
4. Determination of specific gravity of edible oils
5. Determination of refractive index of oils
6. Determination of acid value
7. Determination of peroxide value
8. Determination of saponification value
9. Determination of iodine value
10. Detection of rancidity in oils
11. Detection of adulteration in edible oils
12. Determination of smoke point of oils
13. Preparation and stability evaluation of emulsions

IMFT60.8411T – Industrial Enzymology

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VII

Course Objectives

1. To introduce the fundamentals and significance of enzymes in industrial applications.
2. To familiarize students with enzyme production, extraction, purification, and immobilization techniques.
3. To explain kinetics, mechanisms, and factors influencing enzyme activity and stability.
4. To develop understanding of industrial applications of enzymes in food and allied industries.
5. To provide awareness on emerging trends and biotechnological advances in industrial enzymology.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain the concepts, classification, and characteristics of industrial enzymes	Module I
CO2	Describe enzyme production, extraction, purification, and immobilization methods	Module II
CO3	Discuss enzyme kinetics, mechanisms, and factors affecting enzyme activity	Module III
CO4	Interpret applications of enzymes in food processing and industrial biotechnology	Module IV
CO5	Evaluate recent advances, regulatory aspects, and future prospects of industrial enzymology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	3	2	2	1	1	1	2
CO3	3	3	3	3	2	2	1	1	1	2
CO4	3	3	3	3	3	3	2	2	2	2
CO5	2	2	3	3	3	3	3	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain the concepts, classification, and characteristics of industrial enzymes	Understand (K2)
CO2	Describe enzyme production, extraction, purification, and immobilization methods	Understand (K2)
CO3	Discuss enzyme kinetics, mechanisms, and factors affecting enzyme activity	Apply (K3)
CO4	Interpret applications of enzymes in food processing and industrial biotechnology	Analyze (K4)
CO5	Evaluate recent advances, regulatory aspects, and future prospects of industrial enzymology	Evaluate (K5)

Module I: Fundamentals of Enzymology (10 Hours)

• Definition and classification of enzymes
• Nomenclature and enzyme specificity
• Structure and functions of enzymes
• Cofactors, coenzymes, and prosthetic groups
• Mechanism of enzyme action
• Factors affecting enzyme activity:
  - Temperature
  - pH
  - Substrate concentration
• Sources of industrial enzymes:
  - Plants
  - Animals
  - Microorganisms
• Industrial importance of enzymes
• Introduction to industrial biocatalysis

Module II: Enzyme Production and Immobilization (12 Hours)

• Microbial production of enzymes
• Fermentation methods for enzyme production:
  - Submerged fermentation
  - Solid-state fermentation

• Screening and selection of enzyme-producing microorganisms
• Extraction and recovery of enzymes
• Purification techniques:
    - Precipitation
    - Dialysis
    - Chromatography
• Enzyme immobilization:
    - Adsorption
    - Entrapment
    - Covalent binding
• Advantages and applications of immobilized enzymes
• Enzyme stabilization and storage

Module III: Enzyme Kinetics and Mechanisms (10 Hours)

• Enzyme kinetics and rate equations
• Michaelis–Menten kinetics
• Lineweaver–Burk plot
• Enzyme inhibition:
    - Competitive
    - Non-competitive
    - Uncompetitive
• Allosteric enzymes and regulation
• Factors influencing enzyme stability
• Thermodynamics of enzyme reactions
• Enzyme engineering and protein modification
• Introduction to biosensors and enzyme assays

Module IV: Industrial Applications of Enzymes (12 Hours)

• Enzymes in food processing:
    - Dairy industry
    - Baking industry
    - Brewing and beverage industry
    - Meat and fish processing
• Enzymes in starch and sugar industries
• Enzymes in fruit juice clarification
• Lipases and proteases in food applications
• Enzymes in waste management and environmental applications
• Enzymes in detergent, textile, leather, and pharmaceutical industries
• Enzyme applications in nutraceuticals and functional foods
• Industrial enzyme formulations and commercialization

Module V: Advances and Regulatory Aspects (10 Hours)

- Recombinant enzymes and genetic engineering
- Enzyme biotechnology and synthetic biology
- Nanotechnology in enzymology
- Biosafety and regulatory aspects of industrial enzymes
- Quality control and standardization of enzyme preparations
- Intellectual property rights in enzyme technology
- Environmental sustainability and green processing
- Emerging trends in industrial enzymology
- Future prospects and innovations in enzyme technology

Recommended References

1. Wiseman, A. *Handbook of Enzyme Biotechnology*. Ellis Horwood.
2. Rao, M. B., Deshpande, V. V., & Srinivasan, M. C. *Industrial Enzymes*. Springer.
3. Trevan, M. D. *Immobilized Enzymes: An Introduction and Applications in Biotechnology*. Wiley.
4. Whitaker, J. R. *Principles of Enzymology for the Food Sciences*. CRC Press.
5. Palmer, T. *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry*. Horwood Publishing.

IMFT60.8412T – Total Quality Management

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To introduce the principles, concepts, and philosophy of Total Quality Management (TQM).
2. To familiarize students with quality planning, quality control, and continuous improvement techniques.
3. To explain statistical tools and quality management systems used in food and allied industries.
4. To develop understanding of quality assurance, auditing, and customer satisfaction approaches.
5. To provide awareness on global quality standards, certifications, and emerging trends in quality management.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts, principles, and importance of Total Quality Management	Module I
CO2	Describe quality planning, quality control, and continuous improvement tools	Module II
CO3	Discuss statistical quality control techniques and process management systems	Module III
CO4	Interpret quality assurance systems, audits, and food industry certifications	Module IV
CO5	Evaluate customer-oriented quality approaches and emerging trends in quality management	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	1	2	2	2
CO2	3	2	3	2	2	2	1	1	1	2
CO3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	2	3	3	3	2	2	2	3
CO5	2	2	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3

CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts, principles, and importance of Total Quality Management	Understand (K2)
CO2	Describe quality planning, quality control, and continuous improvement tools	Understand (K2)
CO3	Discuss statistical quality control techniques and process management systems	Apply (K3)
CO4	Interpret quality assurance systems, audits, and food industry certifications	Analyze (K4)
CO5	Evaluate customer-oriented quality approaches and emerging trends in quality management	Evaluate (K5)

Module I: Fundamentals of Total Quality Management (10 Hours)

• Definition, concepts, and evolution of quality
• Principles and philosophy of TQM
• Importance of quality in food and allied industries
• Dimensions of quality
• Quality costs and economics of quality
• Contributions of quality gurus:
  - Deming
  - Juran
  - Crosby
  - Ishikawa
• Leadership and employee involvement in TQM
• Organizational culture and teamwork
• Continuous improvement concepts
• Quality management in food industries

Module II: Quality Planning and Improvement Tools (11 Hours)

• Quality planning and policy development
• Quality function deployment (QFD)
• Benchmarking and best practices
• PDCA cycle and Kaizen
• Seven basic quality control tools:

- Cause-and-effect diagram
- Check sheet
- Histogram
- Pareto chart
- Scatter diagram
- Control chart
- Flow chart

• Failure mode and effect analysis (FMEA)
• Root cause analysis
• Problem-solving techniques in quality management

Module III: Statistical Quality Control and Process Management (11 Hours)

• Statistical concepts in quality management
• Sampling methods and acceptance sampling
• Statistical process control (SPC)
• Control charts for variables and attributes
• Process capability analysis
• Process variability and quality improvement
• Six Sigma concepts and DMAIC approach
• Reliability and process performance
• Introduction to quality data analysis software
• Applications of statistical quality control in food industry

Module IV: Quality Assurance Systems and Auditing (12 Hours)

• Quality assurance and quality control concepts
• Good Manufacturing Practices (GMP)
• Good Hygienic Practices (GHP)
• Hazard Analysis and Critical Control Point (HACCP)
• ISO standards:
  - ISO 9001
  - ISO 22000
• Food safety management systems
• Documentation and record keeping
• Internal and external quality audits
• Accreditation and certification systems
• Regulatory standards related to food quality and safety

Module V: Customer Satisfaction and Emerging Trends (10 Hours)

• Customer satisfaction and consumer perception
• Customer complaints and feedback systems
• Service quality management

• Supplier quality management
• Sustainability and quality management
• Digital technologies in quality assurance
• Artificial intelligence and automation in quality systems
• Emerging trends in TQM and food safety management
• Ethics and social responsibility in quality management
• Future prospects of TQM in food industries

Recommended References

1. Dale, B. G. *Total Quality Management*. Wiley-Blackwell.
2. Oakland, J. S. *Total Quality Management and Operational Excellence*. Routledge.
3. Goetsch, D. L., & Davis, S. B. *Quality Management for Organizational Excellence*. Pearson.
4. Besterfield, D. H. *Total Quality Management*. Pearson Education.
5. Hoyle, D. *ISO 9000 Quality Systems Handbook*. Routledge.

IMFT60.8413T – Financial Management in Food Industry

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester VIII

Course Objectives

1. To introduce the principles and concepts of financial management in the food industry.
2. To familiarize students with cost analysis, budgeting, and financial planning in food enterprises.
3. To explain investment decisions, working capital management, and financial risk in food businesses.
4. To develop understanding of pricing strategies, profitability, and financial performance evaluation.
5. To provide awareness on funding sources, entrepreneurship finance, and financial regulations in the food sector.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts and principles of financial management in food industry	Module I
CO2	Describe cost accounting, budgeting, and financial planning techniques	Module II
CO3	Discuss investment decisions, working capital management, and financial risk analysis	Module III
CO4	Interpret pricing strategies and financial performance indicators	Module IV
CO5	Evaluate funding sources, entrepreneurship finance, and regulatory aspects in food sector	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	1	2	2	2
CO2	3	2	3	2	2	2	1	1	1	2
CO3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	2	3	3	3	2	2	2	3
CO5	2	2	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts and principles of financial management in food industry	Understand (K2)
CO2	Describe cost accounting, budgeting, and financial planning techniques	Understand (K2)
CO3	Discuss investment decisions, working capital management, and financial risk analysis	Apply (K3)
CO4	Interpret pricing strategies and financial performance indicators	Analyze (K4)
CO5	Evaluate funding sources, entrepreneurship finance, and regulatory aspects in food sector	Evaluate (K5)

Module I: Fundamentals of Financial Management (10 Hours)

• Meaning, scope, and objectives of financial management
• Role of finance in food industry enterprises
• Types of business organizations in food sector
• Financial statements overview:
  - Balance sheet
  - Profit and loss statement
• Time value of money (basic concepts)
• Financial decision-making in food businesses
• Overview of financial markets and institutions
• Ethics in financial management

Module II: Costing, Budgeting and Financial Planning (12 Hours)

• Cost concepts and classification of costs
• Cost behavior in food processing industries
• Cost sheet preparation
• Break-even analysis
• Budgeting:
  - Production budget
  - Cash budget
  - Sales budget
• Standard costing and variance analysis
• Financial planning in food enterprises
• Cost control techniques
• Capital budgeting basics

Module III: Investment and Working Capital Management (11 Hours)

• Capital investment decisions
• Methods of investment appraisal:
  - Payback period
  - Net present value
  - Internal rate of return
• Working capital management:
  - Cash management
  - Inventory management
  - Receivables management
• Financing of working capital
• Risk and uncertainty in investment decisions
• Financial leverage and operating leverage
• Risk-return relationship

Module IV: Pricing Strategies and Financial Performance Analysis (11 Hours)

• Pricing objectives in food industry
• Pricing strategies:
  - Cost-based pricing
  - Value-based pricing
  - Competitive pricing
• Pricing of processed food products
• Profit planning and margin analysis
• Financial ratios:
  - Liquidity ratios
  - Profitability ratios
  - Efficiency ratios
• Trend analysis and comparative statements
• Break-even analysis in pricing decisions
• Performance evaluation of food businesses

Module V: Entrepreneurship Finance and Regulatory Framework (10 Hours)

• Sources of finance:
  - Equity
  - Debt
  - Venture capital
  - Government funding schemes
• MSME financing in food sector
• Startup financing and incubators

• Financial support institutions (SIDBI, NABARD – overview)
• Foreign investment in food industry
• Taxation and GST basics for food businesses
• Financial compliance and reporting
• Sustainability and green financing
• Emerging trends in fintech for food industry

Recommended References

1. Pandey, I. M. *Financial Management*. Vikas Publishing House.
2. Khan, M. Y., & Jain, P. K. *Financial Management: Text, Problems and Cases*. McGraw Hill.
3. Brigham, E. F., & Ehrhardt, M. C. *Financial Management: Theory and Practice*. Cengage Learning.
4. Drury, C. *Management and Cost Accounting*. Cengage Learning.
5. Gitman, L. J. *Principles of Managerial Finance*. Pearson Education.

SEMESTER IX

IMFT65.9501T – Advanced Materials and Nanotechnology in Food

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester IX

Course Objectives

1. To introduce the fundamental concepts of advanced materials and nanotechnology in food systems.
2. To familiarize students with types, synthesis, and characterization of nanomaterials relevant to food applications.
3. To explain nano-encapsulation, nano-delivery systems, and functional food design.
4. To develop understanding of applications of nanotechnology in food processing, packaging, and safety.
5. To provide awareness on toxicological, regulatory, and ethical aspects of nanotechnology in food.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts and scope of advanced materials and nanotechnology in food systems	Module I
CO2	Describe types, synthesis, and characterization of food-grade nanomaterials	Module II
CO3	Discuss nano-encapsulation and nano-delivery systems in food applications	Module III
CO4	Interpret applications of nanotechnology in food processing, packaging, and safety	Module IV
CO5	Evaluate toxicological, ethical, and regulatory aspects of food nanotechnology	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	2	2	3	2	2	1	1	1	2
CO3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	3	3	3	3	2	2	2	3
CO5	2	2	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts and scope of nanotechnology in food systems	Understand (K2)
CO2	Describe synthesis and characterization of food nanomaterials	Understand (K2)
CO3	Discuss nano-encapsulation and delivery systems	Apply (K3)
CO4	Interpret applications of nanotechnology in food processing and packaging	Analyze (K4)
CO5	Evaluate safety, ethical, and regulatory issues in food nanotechnology	Evaluate (K5)

Module I: Introduction to Advanced Materials and Nanoscience (10 Hours)

• Concept of advanced materials in food science
• Introduction to nanoscience and nanotechnology
• Nano-scale properties and surface phenomena
• Classification of nanomaterials
• Top-down and bottom-up approaches
• Importance of nanotechnology in food systems
• Smart and functional materials in food applications
• Overview of interdisciplinary nature of food nanotechnology

Module II: Food Nanomaterials – Types, Synthesis and Characterization (11 Hours)

• Types of nanomaterials:
  - Nanoparticles
  - Nanofibers
  - Nanotubes
  - Nanoemulsions
• Food-grade nanomaterials and biopolymers
• Synthesis methods:
  - Physical methods
  - Chemical methods
  - Biological (green synthesis)

• Characterization techniques:
  - Electron microscopy (SEM, TEM)
  - XRD
  - DLS
  - Zeta potential
• Stability and behavior of nanomaterials in food systems
• Functional properties of nanomaterials

Module III: Nano-Encapsulation and Delivery Systems (11 Hours)

• Concept of nano-encapsulation
• Types of encapsulation systems:
  - Liposomes
  - Nanoemulsions
  - Polymeric nanoparticles
• Controlled and targeted delivery in foods
• Encapsulation of bioactive compounds
• Release mechanisms and kinetics
• Improvement of bioavailability
• Applications in nutraceutical delivery
• Stability enhancement of sensitive food ingredients

Module IV: Applications in Food Processing, Packaging and Safety (12 Hours)

• Nanotechnology in food processing
• Nano-based food additives and ingredients
• Smart and active food packaging:
  - Antimicrobial packaging
  - Oxygen scavengers
  - Freshness indicators
• Nanosensors for food safety and quality monitoring
• Detection of pathogens and contaminants
• Improvement of shelf-life using nanomaterials
• Nano-fortification of foods
• Industrial applications and case studies

Module V: Toxicology, Ethics and Regulatory Aspects (10 Hours)

• Nanotoxicology in food systems
• Health risks and safety assessment
• Bioaccumulation and environmental impact
• Ethical concerns in nanotechnology
• Consumer perception and acceptance
• Regulatory frameworks:

- FSSAI guidelines
- Codex considerations
- International regulations

• Risk assessment methods
• Future perspectives

Recommended References

1. Cushen, M., et al. *Nanotechnology in the Food Industry*. Woodhead Publishing.
2. Weiss, J., Takhistov, P., & McClements, D. J. *Functional Materials in Food Nanotechnology*. Springer.
3. Rao, P. S., & Das, S. *Food Nanotechnology*. CRC Press.
4. McClements, D. J. *Nanoparticle and Nanoemulsion-Based Delivery Systems*. Elsevier.
5. Chaudhry, Q., & Castle, L. *Food Nanotechnology: Applications and Impacts*. Royal Society of Chemistry.

IMFT65.9501P – Advanced Materials and Nanotechnology in Food Practical

• **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
• **Course Type:** Discipline Core Course
• **Level:** Semester IX

Course Objectives

1. To provide hands-on exposure to advanced materials used in food systems.
2. To train students in basic preparation and characterization of nano-based food systems.
3. To demonstrate encapsulation, emulsification, and delivery systems in food applications.
4. To familiarize students with nano-enabled food packaging and quality testing methods.
5. To develop skills in observation, interpretation, and reporting of nanotechnology-based experiments.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate safe laboratory handling and preparation of nano/advanced material systems
PCO2	Prepare nanoemulsions and basic encapsulation systems
PCO3	Perform characterization tests for nano/advanced food materials (basic level)
PCO4	Evaluate functional properties and stability of nano-based food systems
PCO5	Analyze and report experimental results in structured scientific format

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Laboratory safety and handling of nanomaterials	PCO1
2	Preparation of food-grade nanoemulsion (oil-in-water system)	PCO2
3	Preparation of simple polymer-based micro/nano encapsulation (alginate beads)	PCO2
4	Preparation of biopolymer films for food packaging	PCO2
5	Preparation of liposome model system (demonstration)	PCO2
6	Particle size estimation using dynamic light scattering (demo/virtual data)	PCO3
7	Zeta potential analysis (interpretation-based practical)	PCO3
8	Stability analysis of nanoemulsions (creaming, separation index)	PCO4
9	Effect of pH and ionic strength on nanoemulsion stability	PCO4
10	Preparation of active packaging film with antimicrobial extract	PCO2
11	Moisture barrier property testing of biopolymer films	PCO4
12	Optical clarity and transparency measurement of packaging films	PCO4
13	Encapsulation efficiency determination (basic calculation-based exercise)	PCO4

14	Release study of encapsulated bioactive compound (simulated data/experiment)	PCO4
15	Detection of nano-enabled food quality indicators (color change/indicator films)	PCO4

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	1	1	2	1	2	2	2
PCO2	3	3	3	2	2	2	1	1	1	2
PCO3	3	3	3	3	3	2	1	1	1	2
PCO4	3	3	2	3	3	3	2	2	2	3
PCO5	2	2	3	3	2	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	1	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Laboratory safety and handling of nanomaterials
2. Preparation of food-grade nanoemulsion (oil-in-water system)
3. Preparation of alginate bead-based encapsulation system
4. Preparation of biopolymer-based edible films
5. Preparation of liposome model system (demonstration)
6. Preparation of active antimicrobial packaging film
7. Particle size and distribution analysis (demo)
8. Zeta potential interpretation for stability prediction (demo)
9. Stability analysis of nanoemulsions (creaming index)
10. Effect of pH and ionic strength on stability
11. Moisture barrier property of edible films
12. Transparency and optical property measurement of films
13. Encapsulation efficiency calculation (bioactive compounds)
14. Controlled release study (simulation/experimental data)
15. Performance of indicator-based smart packaging systems

IMFT65.9502T – Process Modelling and Simulation in Food Engineering

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course (DCC) – Major
- **Level:** Semester IX

Course Objectives

1. To introduce the fundamental concepts of process modelling and simulation in food engineering systems.
2. To familiarize students with mathematical formulation of food processing operations.
3. To explain numerical methods and computational approaches used in process simulation.
4. To develop understanding of transport phenomena-based modelling in food systems.
5. To provide exposure to software tools and applications for process optimization and design.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts, scope, and importance of process modelling and simulation	Module I
CO2	Formulate mathematical models for food processing operations	Module II
CO3	Apply numerical methods for solving process models	Module III
CO4	Analyze transport phenomena-based models in food systems	Module IV
CO5	Evaluate simulation tools and optimization approaches in food engineering	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	1	1	1	2	2
CO2	3	3	2	2	2	1	1	1	1	2
CO3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	3	3	3	2	1	1	2	2
CO5	2	3	3	3	3	3	2	2	2	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level

CO1	Explain concepts of process modelling and simulation	Understand (K2)
CO2	Formulate mathematical models for food processing systems	Apply (K3)
CO3	Apply numerical methods for solving models	Apply (K3)
CO4	Analyze transport phenomena-based models	Analyze (K4)
CO5	Evaluate simulation tools and optimization techniques	Evaluate (K5)

Module I: Fundamentals of Process Modelling (8 Hours)

• Introduction to process modelling and simulation
• Role of modelling in food engineering and industry
• Types of models:
  - Empirical models
  - Mechanistic models
  - Hybrid models
• Model building methodology
• Dimensional analysis and scaling concepts
• Assumptions and simplifications in modelling
• Overview of process systems engineering
• Applications in food processing operations

Module II: Mathematical Modelling of Food Processes (8 Hours)

• Development of mass and energy balance equations
• Modelling of batch, continuous, and semi-batch systems
• Reaction kinetics in food processing
• Empirical regression models
• Parameter estimation techniques
• Model validation and verification
• Case studies in food processes (drying, heating, fermentation)
• Introduction to differential equation-based modelling

Module III: Numerical Methods and Computational Techniques (12 Hours)

• Solution of linear and nonlinear equations
• Numerical integration and differentiation methods
• Euler and Runge-Kutta methods
• Finite difference method (introductory level)
• Iterative techniques for model solving
• Error analysis and stability
• Introduction to MATLAB
• Introduction to Python-based modeling
  - Variables and data types
  - Operators and expressions
  - Input/output functions
  - Conditional statements and loops
  - Arrays and lists

- Strings in C and Functions
- Algorithms

• Simulation of simple food process systems

Module IV: Transport Phenomena in Food Systems (9 Hours)

• Fundamentals of heat transfer in food processing
• Mass transfer in food systems
• Momentum transfer and rheological behavior
• Unsteady-state transport processes
• Diffusion and Fick's law applications
• Drying and freezing models
• Heat exchanger and reactor modeling in food systems
• Coupled transport phenomena models

Module V: Simulation Tools and Process Optimization (10 Hours)

• Introduction to process simulation software
• Role of simulation in food industry design and optimization
• Optimization techniques:
  - Linear programming
  - Nonlinear optimization
• Sensitivity analysis
• Process design and improvement strategies
• Digital twin concepts in food engineering (introductory)
• Case studies in food process simulation
• Emerging trends in AI-based process modelling

Recommended References

1. Fogler, H. S. *Elements of Chemical Reaction Engineering*. Pearson.
2. Banga, J. R., & Balsa-Canto, E. *Process Modelling and Optimization in Food Engineering*. CRC Press.
3. Singhania, R. R. *Food Process Modelling and Simulation*. Springer.
4. Welty, J. R., et al. *Fundamentals of Momentum, Heat, and Mass Transfer*. Wiley.
5. Rao, D. G. *Process Engineering in Food Industry*. PHI Learning.

IMFT65.9502P– Process Modelling and Simulation in Food Engineering Practical

- **Credits:** 1 **L–T–P Structure:** 0–0–2 **Total Practical Hours:** 30 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester IX

Course Objectives

1. To provide hands-on experience in developing mathematical models for food processes.
2. To train students in numerical methods for solving engineering problems.
3. To introduce simulation tools for food process analysis and optimization.
4. To develop skills in interpreting model outputs and validating results.
5. To enable students to apply computational approaches in food engineering systems.

Practical Course Outcomes (PCOs)

PCO No.	Practical Course Outcome
PCO1	Demonstrate basic computational tools for process modelling (Excel/Python/MATLAB basics)
PCO2	Develop mathematical models for simple food process operations
PCO3	Apply numerical methods to solve engineering problems
PCO4	Simulate food process systems and interpret results
PCO5	Analyze and report simulation outcomes in structured format

Practical–PCO Mapping

Practical No.	Practical Title	Mapped PCO
1	Introduction to simulation tools (Excel / MATLAB / Python basics), algorithms and study	PCO1
2	Solution of linear equations using computational tools	PCO3
3	Solution of nonlinear equations (Newton-Raphson method)	PCO3
4	Numerical integration of process data	PCO3
5	Euler method for first-order system simulation	PCO3
6	Runge-Kutta method for dynamic food process modelling	PCO3
7	Mass balance modelling of a simple food process	PCO2
8	Energy balance modelling of heating/cooling process	PCO2
9	Drying kinetics modelling of food products	PCO2
10	Simulation of fermentation growth kinetics	PCO4
11	Heat transfer simulation in food systems	PCO4
12	Mass transfer simulation (diffusion-based system)	PCO4
13	Parameter estimation from experimental data	PCO4
14	Model validation and error analysis	PCO4
15	Optimization of simple food process parameters	PCO4

16	Preparation of simulation report and interpretation	PCO5

PCO–PO Mapping

PCOs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PCO1	2	2	3	2	3	1	1	1	2	2
PCO2	3	3	3	2	3	2	1	1	1	2
PCO3	3	3	3	3	3	2	1	1	1	2
PCO4	3	3	3	3	3	3	2	2	2	3
PCO5	2	2	3	3	3	3	2	2	3	3

PCO–PSO Mapping

PCOs / PSOs	PSO1	PSO2	PSO3
PCO1	2	1	2
PCO2	3	2	2
PCO3	3	3	3
PCO4	3	3	3
PCO5	2	3	3

List of Experiments

1. Introduction to Excel/ MATLAB/ Python basics, algorithms in python and study
2. Solution of linear equations using computational tools
3. Solution of nonlinear equations (Newton-Raphson method)
4. Numerical integration of experimental/process data
5. Euler method for first-order dynamic systems
6. Runge-Kutta method for process simulation
7. Mass balance modelling of food processing unit
8. Energy balance modelling in heating/cooling systems
9. Drying kinetics modelling of food products
10. Fermentation growth kinetics simulation
11. Heat transfer simulation in food systems
12. Mass transfer (diffusion-based) modelling
13. Parameter estimation from experimental data
14. Model validation and error analysis
15. Optimization of process parameters

IMFT65.9503T – Entrepreneurship in Food Sector

- **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
- **Course Type:** Discipline Core Course
- **Level:** Semester IX

Course Objectives

1. To introduce the fundamentals of entrepreneurship with special focus on the food sector.
2. To develop skills in identifying, evaluating, and launching food-based business ideas.
3. To familiarize students with business planning, financing, and startup management in food industry.
4. To explain regulatory, legal, and quality requirements for food enterprises.
5. To encourage innovation, sustainability, and value addition in food entrepreneurship.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts, types, and importance of entrepreneurship in food sector	Module I
CO2	Identify and evaluate food-based business opportunities	Module II
CO3	Develop business plans and financial strategies for food startups	Module III
CO4	Interpret regulatory, quality, and operational requirements of food enterprises	Module IV
CO5	Evaluate innovation, sustainability, and scaling strategies in food entrepreneurship	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	1	2	2	2
CO2	3	2	2	2	2	2	1	1	1	2
CO3	3	3	3	3	3	2	1	1	1	2
CO4	3	3	2	3	3	3	2	2	2	3
CO5	2	2	3	3	3	3	3	3	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts and importance of entrepreneurship in food sector	Understand (K2)
CO2	Identify and evaluate food business opportunities	Apply (K3)
CO3	Develop business plans and financial strategies	Apply (K3)
CO4	Interpret regulatory and operational requirements	Analyze (K4)
CO5	Evaluate innovation and scaling strategies in food startups	Evaluate (K5)

Module I: Fundamentals of Entrepreneurship (10 Hours)

• Meaning, scope, and importance of entrepreneurship
• Types of entrepreneurs in food sector
• Entrepreneurial mindset and skills
• Role of entrepreneurship in economic development
• Characteristics of successful entrepreneurs
• Startups vs traditional businesses
• Overview of food industry ecosystem
• Government support for entrepreneurship

Module II: Food Business Opportunities and Market Analysis (11 Hours)

• Identification of food business opportunities
• Market research and demand analysis
• Consumer trends in food sector
• Value-added food products
• Small-scale food processing units
• Rural and urban food entrepreneurship opportunities
• Competitor analysis
• Feasibility study and project identification

Module III: Business Planning and Financial Management (11 Hours)

• Business plan development
• Project report preparation
• Cost estimation and budgeting
• Pricing strategies for food products
• Funding sources:
  - Banks
  - Venture capital
  - Government schemes
• Cash flow management
• Break-even analysis
• Risk management in startups

Module IV: Regulatory Framework and Operations Management (12 Hours)

• Legal structure of food enterprises
• Registration and licensing (FSSAI, MSME)
• Food safety regulations and compliance
• Good Manufacturing Practices (GMP)

• Quality assurance systems
• Packaging and labeling regulations
• Supply chain and logistics management
• Taxation (GST basics)
• Intellectual Property Rights (overview)

Module V: Innovation, Sustainability and Startup Scaling (10 Hours)

• Innovation in food product development
• Sustainable food entrepreneurship
• Clean label and health-focused products
• Digital marketing and e-commerce in food business
• Branding and consumer engagement
• Scaling up food startups
• Incubation centers and accelerators
• Case studies of successful food startups
• Future trends in food entrepreneurship

Recommended References

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. *Entrepreneurship*. McGraw Hill.
2. Barringer, B. R., & Ireland, R. D. *Entrepreneurship: Successfully Launching New Ventures*. Pearson.
3. Desai, V. *Dynamics of Entrepreneurial Development*. Himalaya Publishing.
4. FSSAI Guidelines and Food Safety Standards – Government of India.
5. Sahay, B. S. *Supply Chain Management for Food Industry*. Springer.

IMFT65.9504T – Waste Management Practices in Food Sector

• **Credits:** 3 **L–T–P Structure:** 3–0–0 **Total Hours:** 45 Hours
• **Course Type:** Discipline Core Course
• **Level:** Semester IX

Course Objectives

1. To introduce the concepts and significance of waste management in the food sector.
2. To familiarize students with types and sources of food and agro-industrial wastes.
3. To explain principles and technologies used in waste reduction, treatment, and valorization.
4. To develop understanding of environmental impacts and regulatory frameworks.
5. To promote sustainable and circular economy approaches in food waste management.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module
CO1	Explain concepts and importance of waste management in food sector	Module I
CO2	Describe sources, types, and characteristics of food wastes	Module II
CO3	Discuss treatment and disposal technologies for food and agro-waste	Module III
CO4	Interpret environmental impacts and regulatory frameworks	Module IV
CO5	Evaluate sustainable waste valorization and circular economy approaches	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	1	2	2	2	2	2
CO2	3	2	2	2	2	2	2	1	1	2
CO3	3	3	3	3	2	3	2	2	2	2
CO4	3	3	2	3	3	3	3	2	2	3
CO5	2	3	3	3	3	3	3	3	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	2	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain concepts and importance of waste management in food sector	Understand (K2)
CO2	Describe sources and types of food and agro-industrial waste	Understand (K2)
CO3	Discuss treatment and disposal technologies	Apply (K3)
CO4	Interpret environmental impacts and regulations	Analyze (K4)
CO5	Evaluate sustainable and circular economy approaches	Evaluate (K5)

Module I: Fundamentals of Waste Management (10 Hours)

• Definition and scope of waste management
• Importance of waste management in food industry
• Types of waste: solid, liquid, gaseous
• Food loss vs food waste
• Hierarchy of waste management (reduce, reuse, recycle)
• Sustainable development goals (SDGs)
• Principles of circular economy
• Overview of environmental sustainability

Module II: Sources and Characteristics of Food Waste (11 Hours)

• Sources of food waste:
- Household
- Retail
- Food processing industries
- Agricultural sector

• Composition of food waste
• Physicochemical characteristics
• Microbial load and spoilage patterns
• Seasonal and supply chain-related losses
• Post-harvest losses in food sector
• Waste quantification and assessment methods

Module III: Waste Treatment and Processing Technologies (11 Hours)

• Physical treatment methods
• Chemical treatment methods
• Biological treatment methods:
- Composting
- Anaerobic digestion
- Biogas production

• Wastewater treatment in food industry
• Solid waste management techniques
• Incineration and landfill management

• Bioconversion technologies
• Emerging waste treatment technologies

Module IV: Environmental Impact and Regulatory Framework (11 Hours)

• Environmental pollution due to food waste
• Greenhouse gas emissions and climate impact
• Soil and water contamination
• Public health implications
• National environmental policies (overview)
• Food waste regulations (FSSAI guidelines overview)
• Environmental Protection Act (basic concepts)
• Waste management standards and compliance
• Role of regulatory agencies

Module V: Waste Valorization and Circular Economy (11 Hours)

• Concept of waste valorization
• Conversion of waste into value-added products
• Animal feed production from food waste
• Biofertilizers and compost production
• Extraction of bioactive compounds from waste
• Bioplastics from food waste
• Circular economy models in food industry
• Zero-waste food processing systems
• Case studies of sustainable waste management

Recommended References

1. Bhatia, S. *Food Waste Management and Valorization*. Springer.
2. Lin, C. S. K. *Biotechnology for Agro-Industrial Residues Utilization*. Elsevier.
3. FAO. *Global Food Losses and Food Waste Reports*. Food and Agriculture Organization.
4. Arvanitoyannis, I. S. *Waste Management for the Food Industries*. Academic Press.
5. Shah, M. P. *Biological Waste Management*. CRC Press.

MULTIDISCIPLINARY COURSES

(*Offered by the Department*)

IMFT45.1104T – Nutrition and Health

- **Credits- 3 L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours per Semester
- **Course Category**: Multidisciplinary course
- **Level**: Undergraduate

Course Objectives

1. To introduce the principles of human nutrition and health.
2. To understand the functions and metabolism of nutrients.
3. To study nutritional requirements during different life stages.
4. To understand nutritional deficiencies and lifestyle disorders.
5. To create awareness regarding balanced diet, food safety, and healthy living.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the principles of nutrition and functions of nutrients	Module I
CO2	Describe digestion, absorption, and metabolism of nutrients	Module II
CO3	Understand nutritional requirements and balanced diet planning	Module III
CO4	Analyze nutritional deficiency disorders and lifestyle diseases	Module IV
CO5	Apply principles of nutrition for health promotion and disease prevention	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	1	1	2	2
CO2	3	3	2	2	2	2	1	1	2	2
CO3	3	2	3	2	2	2	2	1	2	2
CO4	3	3	3	3	3	2	2	1	2	2
CO5	3	3	3	2	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	1

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the principles of nutrition and functions of nutrients	K2 – Understand
CO2	Describe digestion, absorption, and metabolism of nutrients	K2 – Understand
CO3	Understand nutritional requirements and balanced diet planning	K3 – Apply
CO4	Analyze nutritional deficiency disorders and lifestyle diseases	K4 – Analyze
CO5	Apply principles of nutrition for health promotion and disease prevention	K3 – Apply

Module 1: Fundamentals of Nutrition (9 Hours)

- Definition, scope, and importance of nutrition
- Food groups and functions of food
- Classification of nutrients
- Macronutrients: carbohydrates, proteins, fats – sources and functions
- Micronutrients: vitamins and minerals
- Water and dietary fibre in nutrition
- Energy value of foods and calorific requirements

Module 2: Digestion, Absorption and Metabolism (9 Hours)

- Structure and functions of digestive system
- Digestion and absorption of carbohydrates
- Digestion and absorption of proteins
- Digestion and absorption of lipids
- Metabolism of nutrients
- Basal metabolic rate (BMR)
- Factors affecting energy requirements and metabolism

Module 3: Balanced Diet and Nutrition Through Life Cycle (9 Hours)

- Balanced diet and dietary guidelines
- Recommended Dietary Allowances (RDA)
- Meal planning principles

- Nutrition during pregnancy and lactation
- Infant and child nutrition
- Nutrition during adolescence and adulthood
- Nutrition in elderly population

Module 4: Nutritional Deficiencies and Lifestyle Disorders (9 Hours)

- Protein-energy malnutrition
- Vitamin deficiency diseases
- Mineral deficiency disorders
- Obesity and overweight
- Diabetes mellitus
- Cardiovascular diseases and hypertension
- Role of diet in prevention and management of lifestyle disorders

Module 5: Food Safety, Functional Foods and Public Health Nutrition (9 Hours)

- Food safety and hygiene
- Food adulteration and contamination
- Functional foods and nutraceuticals
- Probiotics and prebiotics
- Public health nutrition programs in India
- Nutrition education and health awareness
- Healthy eating habits and lifestyle modification

Recommended References

1. Srilakshmi, B. (2018). *Nutrition Science*. New Age International Publishers.
2. Swaminathan, M. (2015). *Handbook of Food and Nutrition*. BAPPCO.
3. Gibney, M. J., Lanham-New, S. A., Cassidy, A., & Vorster, H. H. (2019). *Introduction to Human Nutrition*. Wiley-Blackwell.
4. Wardlaw, G. M., & Smith, A. M. (2017). *Contemporary Nutrition*. McGraw-Hill Education.
5. Bamji, M. S., Krishnaswamy, K., & Brahmam, G. N. V. (2017). *Textbook of Human Nutrition*. Oxford & IBH Publishing.

IMFT45.2110T – Marine Bioprospecting

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours per Semester
- **Course Category**: Multidisciplinary course
- **Level**: Undergraduate

Course Objectives

1. To introduce the concept and scope of marine bioprospecting.
2. To understand marine biodiversity and marine bioresources of economic importance.
3. To study bioactive compounds derived from marine organisms and their applications.
4. To familiarize students with marine biotechnology and sustainable utilization of marine resources.
5. To create awareness regarding marine conservation, ethics, and industrial applications of marine biomolecules.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the concepts and significance of marine bioprospecting	Module I
CO2	Describe marine biodiversity and commercially important marine organisms	Module II
CO3	Understand extraction and applications of marine bioactive compounds	Module III
CO4	Analyze the role of marine resources in food, pharmaceutical, and biotechnology industries	Module IV
CO5	Apply principles of sustainable marine resource utilization and conservation	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	3	1	2	2
CO2	3	3	2	2	2	2	3	1	2	2
CO3	3	3	3	2	3	2	3	1	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the concepts and significance of marine bioprospecting	K2 – Understand
CO2	Describe marine biodiversity and important marine organisms	K2 – Understand
CO3	Understand extraction and applications of marine bioactive compounds	K3 – Apply
CO4	Analyze the industrial applications of marine resources	K4 – Analyze
CO5	Apply principles of sustainable marine resource utilization	K3 – Apply

Module 1: Introduction to Marine Bioprospecting (9 Hours)

- Definition and scope of marine bioprospecting
- Marine ecosystems and biodiversity
- Ocean resources and their importance
- Marine microorganisms, algae, invertebrates, and fishes
- Concepts of marine biotechnology
- Economic importance of marine bioresources
- Ethical and legal issues in marine bioprospecting

Module 2: Marine Bioactive Compounds (9 Hours)

- Primary and secondary metabolites from marine organisms
- Marine polysaccharides: agar, alginate, carrageenan, chitosan
- Marine pigments and antioxidants
- Bioactive peptides and proteins
- Omega-3 fatty acids and nutraceutical compounds
- Antimicrobial, antiviral, and anticancer compounds
- Functional properties of marine biomolecules

Module 3: Marine Food Resources and Nutraceuticals (9 Hours)

- Marine foods and nutritional significance
- Fish, shellfish, seaweeds, and microalgae as food resources

- Functional foods and nutraceuticals from marine sources
- Marine probiotics and fermented marine foods
- Health benefits of marine-derived compounds
- Marine bioactive ingredients in food industry
- Value addition of marine products

Module 4: Marine Biotechnology and Industrial Applications (9 Hours)

- Marine biotechnology tools and techniques
- Cultivation of marine algae and microorganisms
- Bioprocessing of marine resources
- Marine enzymes and industrial applications
- Pharmaceutical and cosmetic applications
- Marine biomaterials and biodegradable products
- Industrial case studies in marine bioprospecting

Module 5: Sustainability, Conservation and Future Prospects (9 Hours)

- Sustainable utilization of marine resources
- Marine pollution and environmental concerns
- Biodiversity conservation strategies
- Blue economy and marine resource management
- Policies and regulations related to marine resources
- Emerging trends in marine bioprospecting
- Future prospects in marine food biotechnology

Recommended References

1. Kim, S. K. (2015). *Handbook of Marine Biotechnology*. Springer.
2. Shahidi, F., & Ambigaipalan, P. (2018). *Novel Functional Foods from Marine Sources*. CRC Press.
3. Barrow, C., & Shahidi, F. (2007). *Marine Nutraceuticals and Functional Foods*. CRC Press.
4. Tringali, C. (2012). *Bioactive Compounds from Natural Sources*. CRC Press.
5. Kim, S. K. (2014). *Marine Cosmeceuticals: Trends and Prospects*. CRC Press.

IMFT50.3204T – Intellectual Property Rights

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours per Semester
- **Course Category**: Multidisciplinary Course
- **Level**: Semester III

Course Objectives

1. To introduce the concepts and importance of Intellectual Property Rights (IPR).
2. To understand various forms of intellectual property and their protection mechanisms.
3. To familiarize students with patent filing, copyright, trademarks, and GI registration procedures.
4. To create awareness regarding IPR issues in food science, biotechnology, and industry.
5. To develop understanding of legal and ethical aspects related to innovation and technology transfer.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the concepts, scope, and importance of Intellectual Property Rights	Module I
CO2	Describe different forms of IPR and their legal protection systems	Module II
CO3	Understand procedures involved in patents, copyrights, trademarks, and GI registration	Module III
CO4	Analyze IPR-related issues in food industry, biotechnology, and research	Module IV
CO5	Apply knowledge of IPR in innovation, entrepreneurship, and technology management	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	1	2	2	2	2	2
CO2	3	3	2	2	2	2	2	2	2	2
CO3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	3	3	3	3	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1

CO2	2	2	1
CO3	3	2	2
CO4	3	3	2
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the concepts, scope, and importance of IPR	Understand (K2)
CO2	Describe different forms of IPR and protection systems	Understand (K2)
CO3	Understand procedures involved in patents and trademarks	Apply (K3)
CO4	Analyze IPR-related issues in food industry and biotechnology	Analyze (K4)
CO5	Apply IPR knowledge in innovation and entrepreneurship	Apply (K3)

Module 1: Introduction to Intellectual Property Rights (9 Hours)

- Definition and concept of Intellectual Property
- Need and importance of IPR in modern society
- Historical development of IPR
- Types of Intellectual Property Rights
- National and international IPR systems
- World Intellectual Property Organization (WIPO)
- Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement

Module 2: Patents and Patent Filing Procedures (9 Hours)

- Definition and characteristics of patents
- Patentable and non-patentable inventions
- Patent specification and documentation
- Patent search and patent databases
- Patent filing procedures in India
- Rights and obligations of patent holders
- Patent infringement and remedies

Module 3: Copyrights, Trademarks and Geographical Indications (9 Hours)

- Copyright: meaning, scope, and protection
- Copyright laws in India

- Trademarks: concept, registration, and protection
- Industrial designs and trade secrets
- Geographical Indications (GI): concept and significance
- GI products of India related to food and agriculture
- Infringement and legal remedies

Module 4: IPR in Food Industry and Biotechnology (9 Hours)

- IPR issues in food processing and biotechnology
- Protection of traditional knowledge and biodiversity
- Patenting of food products and processes
- Plant variety protection and farmers' rights
- Biosafety and bioethics
- Technology transfer and commercialization
- Case studies related to food and biotechnology patents

Module 5: Entrepreneurship, Innovation and IPR Management (9 Hours)

- Innovation and intellectual property management
- Role of IPR in entrepreneurship and startups
- Licensing and technology transfer agreements
- Role of incubation centers and innovation hubs
- Cyber laws and digital intellectual property
- Ethical issues in IPR
- Current trends and challenges in IPR management

Recommended References

1. Ganguli, P. (2012). *Intellectual Property Rights: Unleashing the Knowledge Economy*. Tata McGraw Hill.
2. Cornish, W. R., Llewelyn, D., & Aplin, T. (2019). *Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights*. Sweet & Maxwell.
3. Narayanan, P. (2017). *Intellectual Property Law*. Eastern Law House.
4. Bouchoux, D. E. (2020). *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets*. Cengage Learning.
5. Wadehra, B. L. (2016). *Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications*. Universal Law Publishing.

ABILITY ENHANCEMENT COURSE

(*Offered by the Department*)

IMFT45.1105T – Effective English Communication: Conversation and Documentation Skills

- **Credits**: 2 **L–T–P Structure**: 2–0–0 **Total Hours**: 30 Hours
- **Course Type**: Ability Enhancement Course (AEC)
- **Level**: Undergraduate

Course Objectives

1. To develop basic proficiency in spoken English for academic and social contexts.
2. To improve listening, speaking, reading, and writing skills.
3. To enhance confidence in conversation and public speaking.
4. To develop formal and professional writing skills.
5. To prepare students for academic documentation and workplace communication.

Course Outcome–Module Mapping

CO No.	Course Outcome	Mapped Module(s)
CO1	Understand fundamentals of English communication and grammar	Module I
CO2	Demonstrate effective listening and speaking skills in conversations	Module II
CO3	Apply reading and comprehension skills for academic texts	Module III
CO4	Develop formal writing skills for documentation	Module IV
CO5	Create professional communication materials for academic and workplace use	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	1	1	1	2	1	2	2	2
CO2	1	2	2	1	1	2	1	2	3	3
CO3	1	2	2	2	1	2	1	2	2	2
CO4	1	2	3	2	1	2	1	3	2	3
CO5	1	2	3	2	1	3	2	3	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3

CO1	1	1	2
CO2	1	2	2
CO3	1	2	2
CO4	1	2	3
CO5	1	2	3

Bloom's Taxonomy Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Understand grammar and communication basics	Understand (K2)
CO2	Demonstrate speaking and listening skills	Apply (K3)
CO3	Apply reading and comprehension techniques	Apply (K3)
CO4	Develop structured written communication	Create (K6)
CO5	Create professional communication outputs	Create (K6)

Module I: Fundamentals of English Communication (6 Hours)

- Importance of English communication in academic and professional contexts
- Basics of grammar:
  - Parts of speech
  - Tenses and sentence structure
- Common errors and correction
- Vocabulary development and word usage
- Basics of pronunciation and phonetics

Module II: Listening and Speaking Skills (6 Hours)

- Listening skills: active listening, note-taking
- Barriers to effective listening
- Speaking skills:
  - Everyday conversations
  - Situational dialogues (formal/informal)
- Pronunciation, stress, and intonation
- Public speaking basics and confidence building

Module III: Reading Skills (6 Hours)

- Types of reading: skimming, scanning, intensive reading
- Reading comprehension techniques
- Understanding academic texts
- Vocabulary building through reading

- Interpretation and summarization

Module IV: Writing Skills and Documentation (6 Hours)

- Principles of effective writing
- Paragraph writing and essay writing
- Formal and informal letters
- Email writing and etiquette
- Report writing basics

Module V: Professional Communication (6 Hours)

- Resume/CV writing
- Cover letter preparation
- Presentation skills (structure and delivery)
- Group discussion techniques
- Interview skills and workplace communication

Recommended References

1. Wren, P. C., & Martin, H. (2016). *High School English Grammar and Composition*. S. Chand.
2. Murphy, R. (2019). *English Grammar in Use*. Cambridge University Press.
3. Swan, M. (2016). *Practical English Usage*. Oxford University Press.
4. Raman, M., & Sharma, S. (2018). *Technical Communication*. Oxford University Press.
5. Bansal, R. K., & Harrison, J. B. (2013). *Spoken English*. Orient BlackSwan.

IMFT45.2111T – Technical English Communication and Report writing

- **Credits**: 3 **L–T–P Structure**: 2–0–0 **Total Hours**: 45 Hours
- **Course Type**: Ability Enhancement Course (AEC)
- **Level**: Undergraduate

Course Objectives

1. To develop technical writing skills for academic and professional purposes.
2. To improve formal written communication in scientific and technical contexts.
3. To enhance oral communication and presentation skills.
4. To train students in documentation, report writing, and correspondence.
5. To build confidence in professional communication environments.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain principles of technical communication and writing	Module I
CO2	Demonstrate effective written communication in technical formats	Module II
CO3	Apply skills in drafting reports, letters, and scientific documents	Module III
CO4	Analyze and edit technical documents for clarity and accuracy	Module IV
CO5	Evaluate and deliver professional oral presentations	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	1	2	2	2	1	2	3
CO2	2	2	3	2	2	2	2	2	3	3
CO3	2	2	3	2	2	2	2	2	3	3
CO4	2	3	2	3	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	2	3
CO3	2	2	3
CO4	2	2	3
CO5	2	2	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain principles of technical communication and writing	Understand (K2)
CO2	Demonstrate effective written communication in technical formats	Apply (K3)
CO3	Apply skills in drafting reports and documents	Apply (K3)
CO4	Analyze and edit technical documents	Analyse (K4)
CO5	Evaluate and deliver professional presentations	Evaluate (K5)

Module 1: Fundamentals of Technical Communication (9 Hours)

- Nature and scope of technical communication
- Characteristics of effective technical writing
- Differences between general and technical writing
- Principles: clarity, conciseness, coherence, correctness
- Barriers to communication and overcoming them
- Communication process and models

Module 2: Technical Writing Skills (9 Hours)

- Structure of technical documents
- Writing style and tone
- Grammar and vocabulary in technical writing
- Sentence construction and paragraph development
- Use of visuals: tables, charts, graphs
- Avoiding plagiarism and basics of referencing

Module 3: Scientific and Professional Writing (9 Hours)

- Writing laboratory reports and project reports
- Abstract, introduction, methodology, results, discussion
- Writing research summaries and reviews
- Preparation of SOPs and manuals
- Resume/CV writing
- Cover letters and job applications

Module 4: Business and Professional Communication (9 Hours)

- Formal and informal communication
- Business correspondence:
    - Emails, memos, notices
    - Official letters

- Meeting skills: agenda, minutes of meeting
- Workplace communication etiquette
- Interpersonal communication skills

Module 5: Oral Communication and Presentation Skills (9 Hours)

- Verbal and non-verbal communication
- Public speaking techniques
- Presentation skills:
    - Structure and delivery
    - Use of audiovisual aids (PPT)
- Group discussion and interview skills
- Confidence building and personality development

Recommended References

1. Raman, M., & Sharma, S. (2015). *Technical Communication: Principles and Practice*. Oxford University Press.
2. Oshima, A., & Hogue, A. (2006). *Writing Academic English*. Pearson.
3. Rizvi, M. A. (2017). *Effective Technical Communication*. McGraw-Hill.
4. Anderson, P. V. (2018). *Technical Communication: A Reader-Centered Approach*. Cengage Learning.
5. Strunk, W., & White, E. B. (2000). *The Elements of Style*. Pearson.

VALUE ADDED COURSE

(*Offered by the Department*)

IMFT50.3205T – Medicinal Foods

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Value Added Course
- **Level**: Semester III

Course Objectives

1. To introduce the concept and importance of medicinal foods in human health.
2. To understand bioactive compounds and therapeutic properties of foods.
3. To study medicinal plants, herbs, spices, and functional foods used in disease prevention.
4. To familiarize students with nutraceuticals, probiotics, and therapeutic diets.
5. To create awareness regarding traditional and modern approaches in medicinal food applications.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the concepts and significance of medicinal foods and bioactive compounds	Module I
CO2	Describe medicinal properties of herbs, spices, and plant-based foods	Module II
CO3	Understand the role of functional foods, probiotics, and nutraceuticals in health promotion	Module III
CO4	Analyze therapeutic applications of medicinal foods in disease prevention and management	Module IV
CO5	Apply principles of medicinal foods for development of healthy dietary practices	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	2	2	2	2	2	1	2	2
CO3	3	3	3	2	3	2	2	1	2	2
CO4	3	3	3	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the concepts and significance of medicinal foods and bioactive compounds	Understand (K2)
CO2	Describe medicinal properties of herbs, spices, and plant-based foods	Understand (K2)
CO3	Understand the role of functional foods and nutraceuticals in health promotion	Apply (K3)
CO4	Analyze therapeutic applications of medicinal foods in disease prevention	Analyze (K3)
CO5	Apply principles of medicinal foods for healthy dietary practices	Apply (K3)

Module 1: Introduction to Medicinal Foods (9 Hours)

- Definition and scope of medicinal foods
- Historical perspectives and traditional food systems
- Functional foods and therapeutic foods
- Bioactive compounds in foods
- Antioxidants, phytochemicals, flavonoids, and polyphenols
- Relationship between food and health
- Current trends in medicinal food research

Module 2: Medicinal Plants, Herbs and Spices (9 Hours)

- Medicinal importance of herbs and spices
- Therapeutic properties of turmeric, ginger, garlic, cinnamon, clove, pepper, and cardamom
- Aloe vera and medicinal plant products
- Tulsi, neem, moringa, and curry leaves

- Herbal teas and beverages
- Active principles and health benefits
- Safety and standardization of herbal foods

Module 3: Functional Foods and Nutraceuticals (9 Hours)

- Functional foods: concept and classification
- Nutraceuticals and dietary supplements
- Probiotics, prebiotics, and synbiotics
- Fermented medicinal foods
- Omega-3 fatty acids and plant sterols
- Dietary fibre and resistant starch
- Role of medicinal foods in immunity enhancement

Module 4: Medicinal Foods in Disease Prevention and Management (9 Hours)

- Role of medicinal foods in diabetes management
- Cardioprotective foods and cholesterol-lowering foods
- Medicinal foods for obesity management
- Foods for gastrointestinal health
- Anti-inflammatory and anticancer foods
- Immune-boosting foods and beverages
- Therapeutic diets and lifestyle modifications

Module 5: Traditional Knowledge, Regulations and Product Development (9 Hours)

- Ayurvedic and traditional medicinal foods
- Indigenous food systems and nutraceutical applications
- Regulations related to medicinal foods and nutraceuticals
- FSSAI guidelines for functional foods
- Quality control and safety evaluation
- Development of medicinal food products
- Future prospects and innovations in medicinal foods

Recommended References

1. Wildman, R. E. C. (2016). *Handbook of Nutraceuticals and Functional Foods*. CRC Press.
2. Goldberg, I. (2012). *Functional Foods: Designer Foods, Pharmafoods, Nutraceuticals*. Springer.

3. Charalampopoulos, D., & Rastall, R. A. (2012). *Prebiotics and Probiotics Science and Technology*. Springer.
4. Shahidi, F. (2018). *Nutraceutical and Specialty Lipids and their Co-Products*. CRC Press.
5. Srilakshmi, B. (2018). *Nutrition Science*. New Age International Publishers.

IMFT50.3206T – Green Chemistry in Food Sector

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Value Added Course
- **Level**: Semester III

Course Objectives

1. To introduce the principles and concepts of green chemistry in food systems.
2. To understand sustainable approaches in food processing and packaging.
3. To study eco-friendly technologies and waste minimization methods in food industries.
4. To familiarize students with green solvents, renewable resources, and cleaner production methods.
5. To develop awareness regarding environmental sustainability and circular economy in the food sector.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the principles and importance of green chemistry in the food sector	Module I
CO2	Describe sustainable and eco-friendly food processing technologies	Module II
CO3	Understand waste management and resource recovery approaches in food industries	Module III
CO4	Analyze the role of green chemistry in environmental protection and food sustainability	Module IV
CO5	Apply green chemistry principles in food production, packaging, and industrial practices	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	3	3	1	2	2
CO2	3	3	2	2	3	3	3	1	2	2
CO3	3	3	3	2	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the principles and importance of green chemistry in food sector	K2 – Understand
CO2	Describe sustainable and eco-friendly food processing technologies	K2 – Understand
CO3	Understand waste management and resource recovery approaches	K3 – Apply
CO4	Analyze the role of green chemistry in environmental protection	K4 – Analyze
CO5	Apply green chemistry principles in food industries	K3 – Apply

Module 1: Fundamentals of Green Chemistry (9 Hours)

- Definition and scope of green chemistry
- Principles of green chemistry
- Importance of sustainability in food industries
- Environmental issues associated with food processing
- Green chemistry versus conventional chemistry
- Renewable and non-renewable resources
- Concept of circular economy in food sector

Module 2: Green Technologies in Food Processing (9 Hours)

- Sustainable food processing technologies
- Minimal processing techniques
- Non-thermal processing methods
- Microwave processing and ohmic heating
- High-pressure processing and pulsed electric field technology
- Green extraction techniques for bioactive compounds
- Energy-efficient food processing operations

Module 3: Green Solvents, Packaging and Additives (9 Hours)

- Green solvents and solvent-free extraction methods
- Supercritical fluid extraction
- Use of natural preservatives and additives
- Biodegradable and edible packaging materials
- Bioplastics in food packaging
- Nanotechnology and sustainable packaging
- Eco-labeling and environmental certification

Module 4: Waste Management and Resource Recovery (9 Hours)

- Food industry waste and environmental pollution
- Waste minimization strategies
- By-product utilization in food industries
- Composting and biofertilizer production
- Bioenergy generation from food waste
- Wastewater treatment in food processing industries
- Zero waste concept and cleaner production

Module 5: Green Chemistry Applications and Future Trends (9 Hours)

- Green chemistry in dairy, meat, fruit, and vegetable industries
- Sustainable agriculture and organic food systems
- Carbon footprint reduction in food sector
- Life cycle assessment (LCA) of food products
- Green analytical techniques in food quality assessment
- Regulatory aspects and environmental policies
- Future trends and innovations in sustainable food industries

Recommended References

1. Anastas, P. T., & Warner, J. C. (2015). *Green Chemistry: Theory and Practice*. Oxford University Press.
2. Clark, J. H., & Macquarrie, D. J. (2012). *Handbook of Green Chemistry and Technology*. Wiley-Blackwell.
3. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.
4. Waldron, K. (2014). *Handbook of Waste Management and Co-Product Recovery in Food Processing*. Woodhead Publishing.
5. Galanakis, C. M. (2021). *Sustainable Food Systems from Agriculture to Industry*. Academic Press.

IMFT50.4214T – Ethnic Foods of India and Nutrition

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Value Added Course
- **Level**: Semester IV

Course Objectives

1. To introduce the diversity and significance of ethnic foods of India.
2. To understand traditional food systems and regional dietary patterns.
3. To study nutritional and therapeutic importance of indigenous foods.
4. To familiarize students with traditional processing and preservation techniques.
5. To create awareness regarding sustainable diets, cultural heritage, and nutritional security.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the diversity and cultural importance of ethnic foods of India	Module I
CO2	Describe traditional food ingredients, preparation methods, and preservation practices	Module II
CO3	Understand the nutritional significance of regional and indigenous foods	Module III
CO4	Analyze the role of ethnic foods in health promotion and sustainable nutrition	Module IV
CO5	Apply knowledge of ethnic foods in dietary planning, food innovation, and entrepreneurship	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	3	2	2	2
CO2	3	3	2	2	2	2	3	1	2	2
CO3	3	3	3	2	3	2	3	1	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	2

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

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the diversity and cultural importance of ethnic foods of India	Understand (K2)
CO2	Describe traditional food ingredients and processing methods	Understand (K2)
CO3	Understand the nutritional significance of indigenous foods	Apply (K3)
CO4	Analyze the role of ethnic foods in health promotion and sustainability	Analyze (K4)
CO5	Apply knowledge of ethnic foods in innovation and entrepreneurship	Apply (K3)

Module 1: Introduction to Ethnic Foods of India (9 Hours)

- Definition and concept of ethnic foods
- Historical evolution of Indian food culture
- Diversity of Indian cuisines and food habits
- Factors influencing regional food patterns
- Traditional food systems and indigenous knowledge
- Role of ethnic foods in nutrition and cultural identity
- Ethnic foods and sustainable dietary practices

Module 2: Regional Ethnic Foods of India (9 Hours)

- North Indian ethnic foods and dietary patterns
- South Indian traditional foods and fermented products
- East Indian and North-Eastern ethnic foods
- Western Indian traditional foods
- Tribal and indigenous food systems
- Traditional beverages and snacks
- Seasonal and festival foods of India

Module 3: Nutritional and Functional Significance of Ethnic Foods (9 Hours)

- Nutritional composition of ethnic foods
- Millets, pulses, and traditional cereals in Indian diets

- Functional foods and nutraceutical value of ethnic preparations
- Fermented foods and probiotic benefits
- Traditional herbs, spices, and medicinal ingredients
- Dietary fibre and bioactive compounds in indigenous foods
- Ethnic foods for immunity and wellness

Module 4: Traditional Food Processing and Preservation Techniques (9 Hours)

- Traditional methods of food processing
- Fermentation, drying, pickling, and smoking
- Indigenous grain processing techniques
- Household preservation methods
- Traditional dairy and meat products
- Hygiene and safety aspects of ethnic foods
- Value addition and commercialization of ethnic foods

Module 5: Ethnic Foods, Nutrition Security and Entrepreneurship (9 Hours)

- Ethnic foods and public health nutrition
- Nutritional security through indigenous foods
- GI-tagged foods and regional specialties
- Consumer acceptance and market trends
- Entrepreneurship opportunities in ethnic foods sector
- Standardization and packaging of traditional foods
- Future prospects and innovations in ethnic food industry

Recommended References

1. Achaya, K. T. (2017). *Indian Food: A Historical Companion*. Oxford University Press.
2. Srilakshmi, B. (2018). *Nutrition Science*. New Age International Publishers.
3. Raghunathan, M. (2015). *Handbook of Spices, Seasonings and Flavorings*. CRC Press.
4. Nene, Y. L. (2012). *Glorious Traditional Foods of India*. Asian Agri-History Foundation.
5. Krishnankutty, B. (2019). *Traditional Foods and Indigenous Knowledge Systems of India*. Scientific Publishers.

SKILL ENHANCEMENT COURSE

(*Offered by the Department*)

IMFT50.4215T – Food By-product Valorization

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Skill Enhancement Course
- **Level**: Semester IV

Course Objectives

1. To introduce concepts of food waste management and by-product utilization.
2. To understand the composition and potential applications of food processing by-products.
3. To study technologies for extraction and recovery of value-added compounds.
4. To familiarize students with sustainable approaches and circular economy concepts in food industries.
5. To develop entrepreneurial and industrial skills related to by-product valorization.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain the concept and importance of food by-product valorization	Module I
CO2	Describe sources, composition, and characteristics of food processing by-products	Module II
CO3	Understand technologies used for recovery of value-added products from food waste	Module III
CO4	Analyze environmental and economic benefits of food waste utilization	Module IV
CO5	Apply by-product valorization strategies for sustainable food processing and entrepreneurship	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	3	3	1	2	2
CO2	3	3	2	2	3	3	3	1	2	2
CO3	3	3	3	2	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the concept and importance of food by-product valorization	Understand (K2)
CO2	Describe sources and characteristics of food processing by-products	Understand (K2)
CO3	Understand technologies used for recovery of value-added products	Apply (K3)
CO4	Analyze environmental and economic benefits of waste utilization	Analyze (K4)
CO5	Apply by-product valorization strategies for sustainable food processing	Apply (K3)

Module 1: Introduction to Food By-products and Waste Management (9 Hours)

- Definition and classification of food by-products
- Food waste generation in processing industries
- Environmental impact of food waste
- Concepts of waste minimization and circular economy
- Sustainable food processing systems
- Scope and importance of by-product valorization
- Economic significance of waste utilization

Module 2: By-products from Plant-based Food Industries (9 Hours)

- Fruit and vegetable processing wastes
- Utilization of peels, pomace, seeds, and pulp residues
- By-products from cereal and pulse processing
- Oilseed cakes and bran utilization
- Recovery of dietary fibre, pectin, starch, and pigments

- Extraction of bioactive compounds from plant wastes
- Applications in functional foods and nutraceuticals

Module 3: By-products from Animal-based Food Industries (9 Hours)

- Dairy industry by-products: whey and skim milk utilization
- Meat and poultry processing wastes
- Fish processing by-products and marine waste utilization
- Collagen, gelatin, and protein hydrolysates
- Utilization of eggshells and animal fats
- Production of feed and biofertilizers from animal wastes
- Safety and regulatory considerations

Module 4: Technologies for By-product Valorization (9 Hours)

- Physical, chemical, and biological treatment methods
- Fermentation technologies for waste utilization
- Enzyme-assisted extraction techniques
- Membrane technology and solvent extraction
- Bioenergy production from food waste
- Composting and anaerobic digestion
- Packaging and commercialization of value-added products

Module 5: Applications, Entrepreneurship and Future Trends (9 Hours)

- Development of functional ingredients from food by-products
- By-products in bakery, beverage, and dairy products
- Nutraceutical and pharmaceutical applications
- Industrial case studies on food waste valorization
- Start-up opportunities and entrepreneurship
- Regulatory aspects and sustainability policies
- Future innovations in food by-product utilization

Recommended References

1. Galanakis, C. M. (2015). *Food Waste Recovery: Processing Technologies and Industrial Techniques*. Academic Press.
2. Waldron, K. (2014). *Handbook of Waste Management and Co-Product Recovery in Food Processing*. Woodhead Publishing.

3. Schieber, A. (2017). *By-Products from Agriculture and Fisheries: Adding Value for Food, Feed, Pharma and Fuels*. Wiley-Blackwell.
4. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice*. Woodhead Publishing.
5. Lal, R. (2020). *Food Waste Recovery and Utilization*. Springer Nature.

IMFT55.5306T – Basic Techniques in Microbiology and Immunology

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Skill Enhancement Course
- **Level**: Semester V

Course Objectives

1. To introduce fundamental microbiological and immunological techniques used in food and biotechnology laboratories.
2. To understand principles of sterilization, aseptic handling, microbial cultivation, and identification.
3. To study basic immunological concepts and antigen–antibody reactions.
4. To familiarize students with laboratory instruments and safety procedures.
5. To develop practical and analytical skills relevant to food microbiology, biotechnology, and health sciences.

Course Outcomes (COs)

CO No.	Course Outcome	Mapped Module(s)
CO1	Explain basic microbiological and immunological concepts and laboratory practices	Module I
CO2	Describe sterilization, cultivation, staining, and microbial identification techniques	Module II
CO3	Understand principles of antigen–antibody reactions and immunological assays	Module III
CO4	Analyze microbiological and immunological data for food and health applications	Module IV
CO5	Apply microbiological and immunological techniques in laboratory and industrial settings	Module V

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	2	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2
CO3	3	3	3	2	3	2	2	1	2	2
CO4	3	3	3	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	3	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	1
CO2	3	2	2
CO3	3	3	2
CO4	3	3	3
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Level
CO1	Explain microbiological and immunological concepts and laboratory practices	Understand (K2)
CO2	Describe microbial cultivation and identification techniques	Understand (K2)
CO3	Understand antigen–antibody reactions and immunological assays	Apply (K3)
CO4	Analyze microbiological and immunological data	Analyze (K4)
CO5	Apply microbiological and immunological techniques in laboratories	Apply (K3)

Module 1: Laboratory Safety and Basic Microbiological Techniques (9 Hours)

- Introduction to microbiology and immunology laboratories
- Laboratory safety rules and biosafety levels
- Good Laboratory Practices (GLP)
- Sterilization and disinfection methods
- Aseptic techniques and contamination control
- Preparation of culture media and reagents
- Handling and maintenance of microbiological equipment

Module 2: Microbial Cultivation and Identification Techniques (9 Hours)

- Isolation and cultivation of microorganisms
- Pure culture techniques
- Enumeration of microorganisms
- Staining techniques: simple, differential, Gram staining
- Morphological and biochemical characterization of microbes
- Use of selective and differential media
- Preservation and maintenance of microbial cultures

Module 3: Microscopy and Instrumentation (9 Hours)

- Principles and applications of microscopy
- Bright field, dark field, fluorescence, and electron microscopy

- Operation and care of microscopes
- Laminar airflow cabinet and autoclave
- Spectrophotometry and centrifugation
- Colony counters and incubators
- Introduction to molecular techniques in microbiology

Module 4: Fundamentals of Immunology and Immunological Techniques (9 Hours)

- Introduction to immune system
- Innate and acquired immunity
- Antigens and antibodies
- Antigen–antibody interactions
- Agglutination and precipitation reactions
- ELISA and immunodiffusion techniques
- Vaccines and immunization principles

Module 5: Applications in Food, Health and Biotechnology (9 Hours)

- Role of microbiology in food safety and quality
- Detection of foodborne pathogens
- Probiotics and beneficial microorganisms
- Immunological techniques in disease diagnosis
- Applications in biotechnology and pharmaceuticals
- Quality assurance and microbial standards
- Emerging trends in microbiology and immunology

Recommended References

1. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2014). *Microbiology*. McGraw Hill Education.
2. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). *Microbiology*. McGraw Hill.
3. Willey, J. M., Sherwood, L., & Woolverton, C. J. (2019). *Prescott's Microbiology*. McGraw Hill Education.
4. Kuby, J. (2018). *Immunology*. W.H. Freeman and Company.
5. Goldsby, R. A., Kindt, T. J., & Osborne, B. A. (2017). *Kuby Immunology*. Freeman Publishers.

IMFT55.6312T – Food Data Analysis and Descriptive Statistics

- **Credit: 3** **L–T–P Structure**: 3–0–0 **Total Hours**: 45 Hours
- **Course Category**: Skill Enhancement Course
- **Level**: Semester VI

Course Objectives

1. To introduce fundamental concepts and applications of descriptive statistics.
2. To understand methods of data collection, classification, tabulation, and presentation.
3. To study measures of central tendency, dispersion, and correlation.
4. To familiarize students with graphical representation and interpretation of statistical data.
5. To develop analytical and problem-solving skills relevant to food science and research.

Course Outcomes (COs)

CO No.	Course Outcome
CO1	Explain fundamental concepts and applications of descriptive statistics
CO2	Describe methods of data collection, classification, and presentation
CO3	Calculate and interpret measures of central tendency and dispersion
CO4	Analyze relationships between variables using correlation and regression techniques
CO5	Apply statistical tools for interpretation of food science and research data

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	1	2	2
CO2	3	3	2	2	3	1	1	1	2	2
CO3	3	3	3	2	3	2	1	1	2	2
CO4	3	3	3	3	3	2	1	1	2	2
CO5	3	3	3	3	3	2	2	2	3	3

CO–PSO Mapping

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	1
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

Bloom's Taxonomy Level Mapping

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain fundamental concepts and applications of descriptive statistics	Understand (K2)
CO2	Describe methods of data collection and presentation	Understand (K2)
CO3	Calculate and interpret measures of central tendency and dispersion	Apply (K3)
CO4	Analyze relationships between variables using correlation and regression	Analyze (K4)
CO5	Apply statistical tools for interpretation of food science data	Apply (K3)

Module 1: Introduction to Statistics and Data Collection (9 Hours)

- Definition, scope, and importance of statistics
- Applications of statistics in food science and technology
- Types of data: qualitative and quantitative
- Primary and secondary data
- Methods of data collection
- Sampling techniques and sampling errors
- Classification and tabulation of data

Module 2: Data Presentation and Graphical Representation (9 Hours)

- Frequency distribution tables
- Diagrammatic representation of data
- Bar diagrams, pie charts, histograms, frequency polygons, and ogives
- Stem-and-leaf plots and box plots
- Measures of skewness and kurtosis
- Interpretation of statistical graphs
- Use of spreadsheet software for graphical analysis

Module 3: Measures of Central Tendency and Dispersion (9 Hours)

- Mean, median, and mode
- Weighted mean and geometric mean
- Partition values: quartiles, deciles, and percentiles
- Range, quartile deviation, mean deviation
- Variance and standard deviation
- Coefficient of variation
- Applications in food quality analysis and research

Module 4: Correlation and Regression Analysis (9 Hours)

- Concept and significance of correlation
- Types of correlation
- Karl Pearson's coefficient of correlation
- Spearman's rank correlation
- Simple linear regression
- Regression equations and interpretation
- Applications in food processing and nutritional studies

Module 5: Statistical Applications in Food Science and Research (9 Hours)

- Statistical quality control concepts
- Data analysis in food experiments
- Interpretation of laboratory and sensory data
- Introduction to statistical software tools
- Report preparation and data interpretation
- Case studies in food industry and research
- Ethical handling and presentation of statistical data

Recommended References

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of Applied Statistics*. Sultan Chand & Sons.
2. Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers*. Wiley.
3. Daniel, W. W. (2017). *Biostatistics: A Foundation for Analysis in the Health Sciences*. Wiley.
4. Gomez, K. A., & Gomez, A. A. (2010). *Statistical Procedures for Agricultural Research*. Wiley India.
5. Snedecor, G. W., & Cochran, W. G. (2014). *Statistical Methods*. Oxford and IBH Publishing.

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DEPARTMENT OF FOOD SCIENCE & TECHNOLOGY

Faculty of Ocean Science & Technology

5-YEAR INTEGRATED BACHELORS–MASTERS PROGRAMME

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