PAAVAI ENGINEERING COLLEGE (AUTONOMOUS)

B.TECH. FOOD TECHNOLOGY

REGULATIONS – 2023 CHOICE BASED CREDIT SYSTEM

CURRICULUM

SEMESTER I

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	GE23101	தமிழர் மரபு /Heritage of Tamils	1	0	0	1
2	BS	MA23101	Matrices and Calculus	3	1	0	4
3	BS	CH23103	Chemistry for Technologists	3	0	0	3
4	ES	EE23101	Basic Electrical and Electronic Engineering	3	0	0	3
5	ES	ME23101	Engineering Graphics	2	0	2	3
Theory with Practical							
6	HS	EN23101	Communication Skills for Engineers I	2	0	2	3
Practical							
7	ES	GE23108	Electrical and Electronics Engineering Practices Laboratory	0	0	2	1
8	BS	CH23104	Chemistry Laboratory	0	0	2	1
			TOTAL	**14**	**1**	**8**	**19**

SEMESTER II

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	HS	GE23201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1
2	BS	MA23201	Complex Variables and Differential Equations	3	1	0	4
3	BS	PH23202	Physics of Materials	3	0	0	3
4	ES	CS23201	Problem Solving and Phyton Programming	3	0	0	3
5	PC	FT23201	Food Chemistry	3	0	0	3
Theory with Practical							
6	HS	EN23201	Communication Skills for Engineers II	2	0	2	3
Practical							
7	BS	PH23205	Physics of Materials Laboratory	0	0	2	1
8	ES	CS23202	Problem Solving and Python Programming Laboratory	0	0	4	2
9	ES	GE23203	Civil and Mechanical Engineering Practices Laboratory	0	0	2	1
10	PC	FT23202	Food Chemistry Laboratory	0	0	4	2
			TOTAL	**15**	**1**	**14**	**23**

SEMESTER III							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	BS	MA23301	Transform Techniques and Partial Differential Equations	3	1	0	4
2	PC	FT23301	Food Process Calculations	3	0	0	3
3	PC	FT23302	Food Microbiology	3	0	0	3
4	PC	FT23303	Fundamentals of Food Technology	3	0	0	3
5	MC	MC23301	Environmental Science and Engineering	2	0	0	0
Theory with Practical							
6	ES	FT23305	Process Fluid Mechanics	3	0	2	4
Practical							
7	PC	FT23306	Fundamentals of Food Technology Laboratory	0	0	2	1
8	PC	FT23307	Food Microbiology Laboratory	0	0	4	2
9	EE	EE23301	Professional Development I	0	0	0	1
			TOTAL	**17**	**1**	**8**	**21**

SEMESTER IV							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	BS	MA23401	Probability and Statistics	3	1	0	4
2	PC	FT23401	Heat and Mass Transfer Operation	3	0	0	3
3	PC	FT23402	Engineering Properties of Food	3	0	0	3
4	PC	FT23403	Food Additives	3	0	0	3
5.	MC	MC23401	Human Value and Gender Equality	2	0	0	0
Theory with Practical							
6	PC	FT23404	Food Analysis	3	0	2	4
Practical							
7	PC	FT23405	Heat and Mass Transfer Laboratory	0	0	4	2
8	PC	FT23406	New Product Development Laboratory	0	0	2	1
9	EE	EE23302	Professional Development II	0	0	2	1
			TOTAL	**17**	**1**	**10**	**21**

SEMESTER V							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	HS	BA23151	Entrepreneurship Development	3	0	0	3
2	PC	FT23501	Dairy Technology	3	0	0	3
3	PC	FT23502	Food Process Engineering	3	0	0	3
4	PC	FT23503	Thermodynamics for Food Technologist	3	0	0	3
5	PC	FT23504	Food Safety Regulations	3	0	0	3
6	PE	FT2315*	Professional Elective – I	3	0	0	3
Practical							
7	PC	FT23505	Dairy Technology Laboratory	0	0	4	2
8	PC	FT23506	Food Process Engineering Laboratory	0	0	4	2
9	EE	FT23507	Industrial Training	0	0	2	1
10	EE	GE23501	Professional Development III	0	0	2	1
			TOTAL	**18**	**0**	**12**	**24**
SEMESTER VI							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	PC	FT23601	Fruits, Vegetables Processing Technology	3	0	0	3
2	PC	FT23602	Baking and Confectionery Technology	3	0	0	3
3	PC	FT23603	Packaging Technology	3	0	0	3
4	PC	FT23604	Evaluation of Sensory Attributes in Food	3	0	0	3
5	PE	FT2325*	Professional Elective – II	3	0	0	3
6	OE	FT2390*	Open Elective – I	3	0	0	3
Practical							
7	PC	FT23605	Fruits, Vegetables Processing and Packaging Laboratory	0	0	4	2
8	PC	FT23606	Baking and Confectionery Laboratory	0	0	4	2
9	EE	FT23607	Design Thinking I	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Food Technology
20/6/25
AUTONOMOUS

PROFESSIONAL ELECTIVE COURSES – VERTICALS							
VERTICAL I – FOOD PROCESSING TECHNOLOGY							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	PE	FT23151	Meat Fish Poultry Processing Technology	3	0	0	3
2	PE	FT23152	Cold Chain Techniques	3	0	0	3
3	PE	FT23153	Technology of Cereals, Pulses and Oilseeds	3	0	0	3
4	PE	FT23154	Fat and Oil Processing Technology	3	0	0	3
5	PE	FT23155	Plantation and Spice Product Technology	3	0	0	3
6	PE	FT23156	Food Flavor Processing Technology	3	0	0	3
7	PE	FT23157	Food Plant and Process Equipment Design	3	0	0	3
VERTICAL II – FOOD BIOTECHNOLOGY							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	PE	FT23251	Cell and Molecular Biology for Food Engineers	3	0	0	3
2	PE	FT23252	Food Phytochemicals	3	0	0	3
3	PE	FT23253	Food Fermentation Technology	3	0	0	3
4	PE	FT23254	Genetically Modified Foods	3	0	0	3
5	PE	FT23255	Food Allergens and Toxicology	3	0	0	3
6	PE	FT23256	Enzymes in Food Processing	3	0	0	3
7	PE	FT23257	Functional Food and Nutraceuticals	3	0	0	3
VERTICAL III – MEAT, FISH, POULTRY PROCESSING							
S. No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
Theory							
1	PE	FT23351	Meat Processing Technology	3	0	0	3
2	PE	FT23352	Management of Halal Foods	3	0	0	3
3	PE	FT23353	Poultry Production I	3	0	0	3
4	PE	FT23354	Poultry Production II	3	0	0	3
5	PE	FT23355	Marine Food Processing Technology I	3	0	0	3
6	PE	FT23356	Marine Food Processing Technology II	3	0	0	3
7	PE	FT23357	HACCP in Meat, Poultry and Fish Processing	3	0	0	3

VERTICAL IV – APPLIED NUTRITION AND DIETETICS							
S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	FT23451	Principle of Nutrition	3	0	0	3
2	PE	FT23452	Nutrition Life Cycle	3	0	0	3
3	PE	FT23453	Dietetics I	3	0	0	3
4	PE	FT23454	Dietetics II	3	0	0	3
5	PE	FT23455	Public Health Nutrition	3	0	0	3
6	PE	FT23456	Sports Nutrition	3	0	0	3
7	PE	FT23457	Traditional and Organic Foods	3	0	0	3
VERTICAL V – FOOD PRODUCT DEVELOPMENT							
S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	FT23551	Flavor Chemistry	3	0	0	3
2	PE	FT23552	Beverage Technology	3	0	0	3
3	PE	FT23553	Emerging Food Processing Techniques	3	0	0	3
4	PE	FT23554	Technology of Snacks and Extruded Foods	3	0	0	3
5	PE	FT23555	Food Plant Sanitation and Layout	3	0	0	3
6	PE	FT23556	Food Waste Management	3	0	0	3
7	PE	FT23557	AI for Food Technologist	3	0	0	3
VERTICAL VI – FOOD SAFETY AND QUALITY							
S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PE	FT23651	Introduction to Food Safety Analysis and Quality Risk Management	3	0	0	3
2	PE	FT23652	Food Laws – Indian and International	3	0	0	3
3	PE	FT23653	Food Safety in Hospitality Industry and GLP in Food Industries	3	0	0	3
4	PE	FT23654	Food Analysis, Testing and Microbial Safety Analysis	3	0	0	3
5	PE	FT23655	Food Quality Assurance and Quality Control	3	0	0	3
6	PE	FT23656	Modeling and Simulation of Food Processes	3	0	0	3
7	PE	BA23152	Total Quality Management	3	0	0	3

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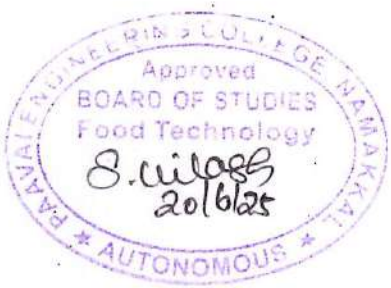
OPEN ELECTIVE							
S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	OE	FT23901	Fundamentals of Food Science	3	0	0	3
2	OE	FT23902	Chemistry of Nutrients	3	0	0	3
3	OE	FT23903	Nutrition and Dietetics	3	0	0	3
4	OE	FT23904	Introduction to Food Preservation	3	0	0	3
5	OE	FT23905	Production of Food Products	3	0	0	3
6	OE	FT23906	Food as Medicine	3	0	0	3
7	OE	FT23907	Traditional and Organic Food	3	0	0	3
8	OE	FT23908	Food Allergens	3	0	0	3
MINORS (FOOD SCIENCE AND ENGINEERING)							
S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	MDC	FT23851	Post Harvesting and Food Spoilage	3	0	0	3
2	MDC	FT23852	Application of Renewable Energy in Food Processing	3	0	0	3
3	MDC	FT23853	Environmental Issues in Food Industries	3	0	0	3
4	MDC	FT23854	Basics of Food Science	3	0	0	3
5	MDC	FT23855	Fundamentals of Food Preservation	3	0	0	3
6	MDC	FT23856	Food Product Technology	3	0	0	3

Vertices I	Vertices II	Vertices III	Vertices IV	Vertices V	Vertices VI
FOOD PROCESSING TECHNOLOGY	**FOOD BIOTECHNOLOGY**	**MEAT FISH POULTRY PROCESSING**	**APPLIED NUTRITION AND DIETETICS**	**FOOD PRODUCT DEVELOPMENT**	**FOOD SAFETY AND QUALITY**
Meat Fish Poultry Processing Technology	Cell and Molecular Biology for Food Engineers	Meat Processing Technology	Principle of Nutrition	Flavor Chemistry	Introduction to Food Safety Analysis and Quality Risk Management
Cold Chain Techniques	Food Phytochemicals	Management of Halal Foods	Nutrition Life Cycle	Beverage Technology	Food Laws – Indian and International
Technology of Cereals, Pulses and Oilseeds	Food Fermentation Technology	Poultry Production I	Dietetics I	Emerging Food Processing Techniques	Food Safety in Hospitality Industry and GLP in Food Industries
Fat and Oil Processing Technology	Genetically Modified Foods	Poultry Production II	Dietetics II	Technology of Snacks and Extruded Food	Food Analysis, Testing and Microbial Safety Analysis
Plantation and Spice Product Technology	Food Allergens and Toxicology	Marine Food Processing Technology I	Public Health Nutrition	Food Plant Sanitation and Layout	Food Quality Assurance and Quality Control
Food Flavor Processing Technology	Enzymes in Food Processing	Marine Food Processing Technology II	Sports Nutrition	Food Waste Management	Modeling and Simulation of Food Processes
Food Plant and Process Equipment Design	Functional Food and Nutraceuticals	HACCP in meat, poultry and fish processing	Traditional and Organic Foods	AI for Food Technologist	Total Quality Management



BA23151	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1	empower to adopt the management principles
2	build entrepreneurial competencies and analyze support from government and agencies in entrepreneurship development.
3	appraise factors for launching a small business
4	adopt business opportunities and prepare feasibility reports.
5	develop entrepreneurial mindset, creativity, and understand startup ecosystems

UNIT I	BASICS OF MANAGEMENT AND ENTREPRENEURSHIP	9

Management: Meaning, Definition, Nature and Importance, Roles - Levels of Management - Functional areas of Management: Marketing, Finance, Production, HRM, IT, Research and Development. Introduction to Entrepreneurship and Intrapreneurship – similarities, differences, types of entrepreneurs - Functions of an entrepreneur

UNIT II	ENTREPRENEURIAL COMPETENCE AND ENVIRONMENT	9

Entrepreneurial Competence: Definitions, Roles, Styles, Characteristics, Competencies

Entrepreneurial Environment: Socio-cultural, Economic, Political factors; Institutional Support for small entrepreneurs. Central and State Government Industrial Policies and Regulations - Entrepreneurial Skillset: motivation, stress, ethical challenges

UNIT III	ENTREPRENEURIAL DEVELOPMENT AND STRUCTURES	9

Ownership Structures: Proprietorship, Partnership, Company, Cooperative, Franchise. Business Opportunity Identification, Feasibility Report, Financial & Technical Evaluation. Entrepreneurial Development Programs, Role of SSI, Failure Causes and Turnaround Strategies. Creativity techniques: Six Thinking Hats, Idea validation, Lean Canvas model.

UNIT IV	BUSINESS PLAN AND FUNDING STRATEGIES	9

Business Plan: Business opportunities-SWOT, Business plan process, Feasibility Study - AI in business plan preparation.

Financing ventures: sources of raising capital, seed funding, venture capital funding, funding opportunities for start-ups in India, - AI driven startup evaluation and scoring - Pitching, funding mix (debt vs equity), incubators, accelerators, crowd funding, angel investors.

UNIT V	WOMEN ENTREPRENEURSHIP AND SECTORAL OPPORTUNITIES	9

Women Entrepreneurship: Growth, Challenges, development. Strategic planning and growth for startups – Women Entrepreneurship Platform in India – Entrepreneurial schemes for women – SSI and MSME.

Entrepreneurship in Formal Sector: AI in Rural, Agriculture, Tourism, Manufacturing, Healthcare, Transport and allied services. Digital economy tools: social media marketing, affiliated marketing,

influential marketing, mobile marketing.		
	TOTAL PERIODS	**45**

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	implement the necessary managerial skills to become an entrepreneur	Applying (K3)
CO2	develop self-employment having been exposed to entrepreneurial environment.	Synthesis (K5)
CO3	select a best business idea by using appropriate methods to assess its viability	Knowledge(K1)
CO4	formulate a business plan and deploy the resources for sustainable growth	Synthesis (K5)
CO5	analyse government support systems and startup ecosystem resources like incubators and funding options.	Analyzing (K4)

TEXT BOOKS

1. Entrepreneurship: Theory, Process, and Practice By Donald F. Kuratko 11th Edition, 2021, Cengage Learning.
2. Entrepreneurship Development: New Venture Creation by S.S. Khanka 6th Edition, 2021, S. Chand Publishing.

REFERENCE BOOKS

1. Entrepreneurship Development, by Sharma Sangeeta – Second Edition, 2020, PHI Learning
2. Entrepreneurship by Rajeev Roy – Second Edition, 2011, Oxford University Press
3. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, By Steve Blank and Bob Dorf, 2020 Edition
4. Entrepreneurship: Starting and Operating a Small Business, By Steve Mariotti and Caroline Glackin, 7th Edition, 2021, Pearson

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes(PO's)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	1	-	1	-	-
CO2	-	-	-	-	1	2
CO3	-	-	-	1	-	1
CO4	-	-	2	-	2	-
CO5	1	-	1	-	2	-
AVG.	1	1	1.5	1	1.6	1.5

FT23501	DAIRY TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	learn about the introduction of dairy industries.
2.	understand the importance of processing and its quality testing.
3.	know about the different types of sanitization methods in milk processing.
4.	learn about different types of milk products.
5.	learn about different types of frozen, fermented, by products and dehydrated dairy products.

UNIT I	INTRODUCTION TO MILK AND MLK INDUSTRIES	9

Introduction - System of pricing of milk, Indian Dairy industry; Basic dairy terminology - milk as raw material ; Composition- Factors affecting composition of milk ;Nutritive value of milk; Physio-chemical properties of milk- Colour, Flavour, Specific Gravity, Boiling point, Freezing point, Refractive Index, Acidity, pH, Viscosity and Surface Tension; Contaminants - microbiology of milk; Milk collection, cooling and milk transport - milk reception - Quality control tests; Applications of enzymes in dairy industry, types of market milk.

UNIT II	DAIRY PROCESSING METHODS AND ITS QUALITY TESTING	9

Milk processing equipment – filtration/clarification of raw milk ; Pasteurization – HTST – LTLT - UHT methods - storage tanks ; Homogenization – theory - working principle of homogenizers – homogenization efficiency; cream separation – principles – gravity and centrifugal separation – separation efficiency; Platform tests of milk: Smell, Appearance, Temperature, Sediment, Acidity, Lactometer Reading, Fat, Solids-Not-Fat; Dye Reduction Test: MBRT test, Resazurin tests, Mastitis test; Bactofugation of milk,– carbon dioxide impregnation.

UNIT III	CLEANING AND SANITIZATION OF DAIRY EQUIPMENTS	9

Plant piping – Pumps - Bottle washers- and cappers-care and maintenance factors affecting washing operation; Fillers - types of fillers-pouch filling form fill seal machines; Aseptic filling; cleaning and sanitization - CIP cleaning- types of CIP systems; Energy use in Dairy plant - sources of energy – cost of energy - Control of energy losses and Energy conservation.

UNIT IV	MILK PRODUCT PROCESSING	9

Butter – method of manufacture – theory of churning - operation of butter churn – over run—batch and continuous methods of butter making; Ghee – methods of manufacture; Cheese – classification – cheddar and cottage cheese - equipment – cheese vats and press- construction details.

UNIT V	FROZEN MILK, FERMENTED, DEHYDRATED AND DAIRY BY PRODUCTS	9

Ice cream - ingredients – preparation of ice cream mix; Special milks - Quality aspects of dairy products; Fermented products – Processing methods of Yoghurt, Curd – cultured butter milk Bulgarian

butter milk Kefir, paneer - acidophilus milk; Concept of Probiotics and Prebiotic; By Products- Definition- Classification- Composition- Principle and Methods of Utilizations.		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	identify to understand the basic introduction and terminologies of dairy industries	Understand (K2)
CO2	apply the acquired knowledge on processing and its quality testing	Apply (K3)
CO3	infer the technical aspects of different types of sanitization methods in milk processing	Apply (K3)
CO4	understand the different types of milk products	Apply (K3)
CO5	infer the process of different types of frozen, fermented, by products and dehydrated dairy products	Analyse (K4)

TEXT BOOKS

1. Sukumar De, —Outlines of Dairy Technologyl, Royal Oxford University Press, Delhi, 2010.
2. Tufail Ahmed, —Dairy Plant Engineering and Managementl, Kitab Mahal, New Delhi, 2012.

REFERENCES

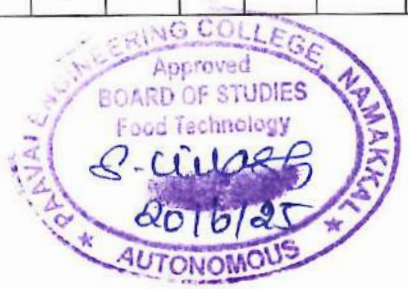
1. Jane Selia dos Reis Coimbra, Jose A. Teixeira, Engineering Aspects of Milk and Dairy Products, CRC Press, New York, 2010.
2. Robinson R.K., Modern Dairy Technology: Advances in Milk Products, Volume 2, Springer London Ltd 2012.
3. Hui, Y.H, —Dairy Science and Technology Handbook: Applications Science, Technology and Engineeringl, Volume 3, Wiley, New Delhi, 2014.
4. Sukumar D E, Outlines of Dairy Technology, Oxford University Press, Oxford.2007.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2
CO1	3	2	-	3	1	1	-	3	-	1	-	1	3	2
CO2	3	2	-	2	1	1	3	3	-	1	2	2	2	3
CO3	2	2	-	1	-	2	-	2	-	1	2	2	2	3
CO4	2	-	-	-	1	2	3	2	-	2	2	2	3	2
CO5	1	2	-	3	1	2	-	3	-	2	2	2	3	2



FT23502	FOOD PROCESS ENGINEERING	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	learn about Basic Units and conversion of engineering.
2.	acquire knowledge on the importance of dehydration and its processes.
3.	understand the importance of Supplemental, extrusion and its processes.
4.	know different thermal preservation technique of food
5.	study preservation by cooling and importance of crystallization.

UNIT I	PROCESSING OPERATIONS	9

Post - harvest losses in field crops; Cleaning Wet and Dry cleaning, Screen Cleaners, Air Screen Cleaners; Peeling - Flash steam, Knife, Abrasion, Caustic and Flame peeling; Grading and Sorting Principles, types and equipment; Moisture content free moisture, bound and unbound moisture; Equilibrium moisture content determination methods; Raoult's Law; Water activity and its importance; Water sorption Isotherms - Hysteresis.

UNIT II	DRYING	9

Drying - Theory and mechanism of drying; Drying characteristics of materials; Psychrometric chart applications; Thin layer and deep bed drying, Batch and continuous drying, Types of Dryers - Tunnel Dryer, Belt Dryer, Drum Dryer, Spray Dryer, Fluidized Bed Dryer, Rotary Dryer, Vacuum Drying and Microwave drying.

UNIT III	MECHANICAL SEPARATION	9

Sedimentation in liquids; Stoke's law; Gravitational sedimentation; Floatation; Centrifugal separation; Filtration Constant rate and Constant pressure filtration and Equipment; Sieving effectiveness and Applications.

UNIT IV	PRESERVATION BY HEATING	9

Preservation by Heating; Methods of applying heat to food Blanching, Pasteurization, Sterilization; Thermal death time relationships (D, Z and F values); Process calculations General method, Ball's formula method; Sterilization-methods and equipment; UHT sterilization; Retort properties of canned foods.

UNIT V	FREEZING AND CRYSTALLIZATION	9

Freezing - Phase transition, freezing point, Freezing Kinetics, freezing time, Effect of freezing and frozen storage on product quality; Freezing equipment's; Crystallization kinetics - Nucleation, Meta stable region, Seed Crystals; Heat of Crystallization; Rate of crystal growth. Crystallization in the food industry - Equipment, Processes.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	adapt specific unit operations and estimate the conversion and energy of food materials.	Understanding (K2)
CO2	infer the concepts of food dehydration.	Analyzing (K4)
CO3	appraise the supplemental and extrusion process in food processing.	Analyzing (K4)
CO4	elaborate the techniques of preservation by heating.	Applying (K3)
CO5	appraise the techniques of preservation by cooling and demonstrate the crystallization process.	Applying (K3)

TEXT BOOKS

1. Rao DG. Fundamentals of food engineering. PHI learning Private Ltd. 2010.
2. Sahay K.M. and Singh K. K., -Unit Operations of Agricultural Processing, 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.

REFERENCES

1. Earle R.L., -Unit Operations in Food Processing, Web Edition, Pergamon Press, U.K., 2004.
2. Paul Singh R. and Dennis R. Heldman, -Introduction to Food Process Engineering, 5th Edition, Academic Press, USA, 2014.
3. James G Brennan, Food Processing Handbook, 2nd Edition, Wiley VCH, Weinheim, 2011.
4. Fellows P.J., Food processing Technology: Principles and Practice, 3rd Edition, Wood Head Publishing Limited, New Delhi, 2009.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	1	1	-	3	-	1	-	1	3	2
CO2	3	2	-	2	1	1	3	3	-	1	2	2	2	3
CO3	2	2	-	1	-	2	-	2	-	1	2	2	2	3
CO4	2	-	-	-	1	2	3	2	-	2	2	2	3	2
CO5	1	2	-	3	1	2	-	3	-	2	2	2	3	2

FT23503	THERMODYNAMICS FOR FOOD TECHNOLOGIST	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	study the fundamentals of thermodynamics and First law.
2.	provide knowledge on application of first law of thermodynamics.
3.	impart knowledge on second law of thermodynamics and entropy.
4.	study the thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
5.	study the working principle of Carnot, Vapor compression, vapor absorption and air refrigeration systems to introduce fundamental thermodynamic principles and their application.

UNIT I	BASIC CONCEPTS	9

Thermodynamics, Terminologies, Systems - Classification - Properties and State of a System. Thermodynamic Process, Cycle and Equilibrium. Zeroth Law of Thermodynamics. Law of Conservation of Energy. Heat - Specific Heat- Thermal Capacity and Water Equivalent. Mechanical Equivalent of Heat, Work - Power - Universal Gas Constant. Internal Energy, Enthalpy and Molar Specific Heat of a Gas.

UNIT II	FIRST LAW OF THERMODYNAMICS	9

First Law of Thermodynamics - Limitations of First Law of Thermodynamics-Application: Work Done During a Non-Flow Process - Work Done for Constant Volume, Constant Pressure, Constant Temperature, Adiabatic and Polytropic Process. Application Of First Law of Thermodynamics to a Steady Flow System -Boiler, Condenser, Evaporator, Nozzle, Turbine, Rotary and Reciprocating Compressor.

UNIT III	SECOND LAW OF THERMODYNAMICS	9

Kelvin plank and Clausius statements. Heat engine, heat pump and refrigeration. Relation between heat and entropy - Importance and units of entropy - Clausius inequality - available and unavailable heat energy.

UNIT IV	STEAM PROPERTIES AND BOILERS	9

Formation of steam at a constant pressure - Temperature vs total heat during steam formation. Wet, dry saturated and super-heated steam - Dryness fraction of wet steam - Enthalpy and specific volume of steam - uses of steam tables. Boilers: Classification of steam boilers, Vertical and Cross tube Cradley boiler, Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories. Introduction to Indian Boiler Regulation Act.

UNIT V	REFRIGERATION SYSTEMS AND COMPONENTS	9

Principles of Refrigeration, Choice of Refrigerants, Components of refrigeration cycle. Types of refrigeration: Carnot Refrigeration, Vapour Compression cycle, Air Refrigeration cycle, Absorption Refrigeration cycle.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	outline the basic concepts and apply the first law of thermodynamics in selected processes.	Understanding (K2)
CO2	understand the principle of second law of thermodynamics and concepts of Carnot cycle.	Analyzing (K4)
CO3	interpret the second law of thermodynamics and relate the properties of pure substance.	Analyzing (K4)
CO4	estimate the properties of steam and measurement of quality of steam using calorimeters.	Applying (K3)
CO5	integrate the use of simple calculation in gaining the working knowledge of different boilers.	Applying (K3)

TEXT BOOKS

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
2. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi,2011.

REFERENCES

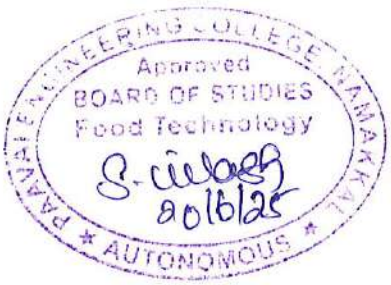
1. V. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2003.
2. Ballaney P.L., "Thermal Engineering", 23'd Edition, Khanna Publishers, New Delhi, 2005.
3. J.P. Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2002.
4. Rao Y.V.C., "An Introduction to Thermodynamics", Universities Press, 2004.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	3	1	1	-	-	-	1	-	1	3	2
CO2	3	2	-	2	1	1	3	3	-	1	1	2	2	3
CO3	2	2	-	1	-	2	-	-	-	2	2	2	2	3
CO4	2	-	-	-	1	2	3	2	-	2	2	1	3	2
CO5	1	2	-	3	1	2	-	3	-	2	2	2	3	2



FT23504	FOOD SAFETY REGULATIONS	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1. study the food safety concept and its classification.
2. define and study the complete food safety system.
3. prepare HACCP standards for food industries.
4. understand the regulations followed in various food industries.
5. study the safety aspects and regulations in water.

UNIT I	FOOD SAFETY CONCEPT	9

Food safety concept - Importance of food safety in the food processing industry, Risk classification, National and international food regulatory agencies, General food laws and food safety regulations, Nutritional labeling regulation (mandatory and optional nutrients, nutritional descriptors and approved health claims); Microbial contamination (including cross-contamination/indirect contamination) Chemical contamination, Physical contamination, Allergen contamination.

UNIT II	FOOD AUTHORITY IN INDIA	9

Food safety and Standards Act – organizational chart – role of individual authority –principles to be followed – Provisions as to articles of food –imported items – Responsibilities of the food business operator – Liability of manufacturers, packers, wholesalers, distributors and sellers –Enforcement of the act – Licensing and registration of food business – Food safety officer and their powers – Analysis of food – regulations regarding labs involved in food analysis – Offences and penalties – Adjudication and food safety appellate tribunal – Laws relating to Food Processing Industries in India - FPO, MMPO, PFA, AGMARK, Essential Commodities Act, BIS.

UNIT III	MICROBIOLOGICAL FOOD SAFETY	9

Concept of HACCP – Assembling the team – Product description – Describing the product's intended use – Establishing a process flow diagram – on site confirmation - Listing potential hazards and control measures - Determination of critical points – decision tree for CCPs- Establishing monitoring procedures- establishing corrective actions – establishing verification Procedures.

UNIT IV	FOOD REGULATIONS	9

World Trade order -Functioning and responsibilities of the WTO-Codex Alimentarius -History, operations of Codex alimentarius, Responsibilities Codex standards and Maximum residue limits Current Issues under consideration SPS (Sanitary and phytosanitwy measures) agreement. World Health Organisation History and mandate Operations and responsibilities- FCGFI-Functions and responsibilities. Concept of Six Sigma.

UNIT V	SAFETY ASPECTS OF WATER	9

Safety aspects of drinking water (microbiological and chemical) - the epidemiological triangle diseases caused by drinking of contaminated water, bottled water – setting of guideline values (microbiological and chemical) – risks and advantages of chlorination of water-Bottled water – origin of water-nutritional

and physiological aspect – safety aspects – microbiological and chemical quality – Regulations for bottled water-EU, US and India.

p

TOTAL PERIODS:	**45**

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand about the food safety concept and its classification	Understand (K2)
CO2	understand about food safety system	Apply (K3)
CO3	understand about the complete concept of HACCP in food safety.	Apply (K3)
CO4	understand international food laws and standards	Apply (K3)
CO5	understand food safety regulations for water.	Analyze (K4)

TEXT BOOKS

1. Kees A. van der Heijden and Sanford Miller, "International Food Safety Handbook: Science, International Regulation, and Control", Published by CRC Press, ISBN 0824793544, 9780824793548, 1999.
2. Food Safety and standards Act 2006, Rules 2011, Regulations, 2011, 10th Edition, ILBCO India, Indian Law Book Company, 2013.

REFERENCES

1. FSSAI, FSIS, EU and FAO website for updates.
2. FSSAI, FSIS, EU and FAO website for updates.
3. Bryan, F.L. (1992): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
4. Guide of Food Safety and Standards Act, Tax-mann Allied Services Pvt. Ltd., ISBN 10-8174968288, 2006.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	2	-	3	2	-	2	2	-	-	-	-	2	3	2
CO3	2	2	-	-	2	2	2	-	-	-	-	2	2	3
CO4	3	1	2	2	1	2	-	1	2	2	2	2	2	3
CO5	2	3	1	-	-	2	2	1	-	2	2	2	2	3

FT23505	DAIRY TECHNOLOGY LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to,

1.	identify the quality of milk.
2.	know the constituents of milk and its nature.
3.	practice the quality procedures in milk processing industry.
4.	gain knowledge about the physical and chemical properties of milk.

LIST OF EXPERIMENTS

1. Studies on milk sampling, judging and grading of milk.
2. Determination of acidity, specific gravity and clot-on-boil test of milk.
3. Determination of fat, SNF and total solids content in milk.
4. Determination of MBRT and alcohol index test of milk.
5. Detection of adulterants in milk.
6. Estimation of surface tension of milk.
7. Determination of total milk protein content in milk.
8. Preparation and analysis of Paneer
9. Preparation and analysis of Ice-cream/ Cream
10. Preparation and analysis of Butter/Ghee

TOTAL PERIODS:	**60**

COURSE OUTCOMES

At the end of this course, the students will be able to,		**BT MAPPED (Highest Level)**
CO1	analyse the physio-chemical properties of milk	Understand (K2)
CO2	apply platform tests for assessing milk quality	Apply (K3)
CO3	estimate the efficiency of dairy processing equipment's	Apply (K3)
CO4	analyse the quality of milk products	Apply (K3)

TEXT BOOKS

1. Sukumar De, -Outlines of Dairy Technology, Royal Oxford University Press, New Delhi, 2010.

2. Ahmed, -Dairy Plant Engineering and Management, Kitab Mahal, New Delhi, 2012.

REFERENCES

1. Manual of Methods of Analysis of Foods (Milk and Milk Products), Directorate General of Health Services, Ministry of Health and Family Welfare, 2005

2. Ramesh C. Chandan: Dairy-based Ingredients, Eagan Press, 1997

3. Aneja, Mathur, Chandan & A.K. Bannerji: Technology of Indian Milk Products: Dairy India Publication.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	-	-	3	-	3	-	-	2	3	3	2
CO2	2	1	3	1	-	2	1	3	-	-	-	-	3	3
CO3	1	-	2	-	-	2	-	2	1	-	-	-	2	2
CO4	3	1	2	1	-	-	-	3	-	2	-	1	3	2

FT23506	FOOD PROCESS ENGINEERING LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable students to

1. understand the properties of grains.
2. know about the performance of agriculture processing equipment.
3. acquire knowledge about size drying properties of foods.
4. gain knowledge in drying characteristics of food materials.

LIST OF EXPERIMENTS

1. Determination of size, roundness, sphericity and 1000 grain weight of food grains
2. Determination of bulk density, true density and porosity
3. Determination of angle of repose for grain sample
4. Osmotic drying of foods with salt and sugar
5. Experiment on drying characteristics of food material using tray dryer
6. Determination of fineness modulus for ground material using ball mill
7. Experiment of centrifugal separation of food samples
8. Drying of vegetables and fruits
9. Filtration and Concentration of Fruit Juices
10. Experiment on paddy dehusker to determine the shelling efficiency
11. Pasteurization of Milk
12. Experiment on studying the freezing characteristics of food material using Deep Freezer

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to,		BT MAPPED (Highest Level)
CO1	estimate engineering properties of grains.	Understanding (K2)
CO2	assess the drying properties of food.	Applying (K3)
CO3	analyze the thermal characterization of foods.	Analyzing (K4)
CO4	know the drying characteristics of food materials.	Applying (K3)

TEXT BOOKS

1. Sarma Shri K., Mulvaney Steven J. and Rizvi Syed S. H., -Food Process Engineering: Theory and Laboratory Experiments, 1st Edition, Wiley Inter-science, New Jersey, 1999.
2. Rao M, Syed. S.H. Rizvi and Ashim K. Datta, -Engineering Properties of Foods, 4th Edition, CRC Prass, Florida, 2005.

REFERENCES

1. Earle R.L., —Unit Operations in Food Processing, Web Edition, Pergamon Press, U.K., 2004
2. Rao DG. Fundamentals of food engineering. PHI learning Private Ltd. 2010

3. Sahay K.M. and Singh K. K., -Unit Operations of Agricultural Processing, 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012

4. Paul Singh R. and Dennis R. Heldman, —Introduction to Food Process Engineering‖, 5th Edition, Academic Press, USA, 2014

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	2	-	-	-	-	-	2	3	2
CO2	-	2	-	-	-	2	-	-	-	-	-	1	2	3
CO3	3	1	2	1	1	-	-	-	-	-	-	-	3	2
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-

FT23507	INDUSTRIAL TRAINING	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1	expose students to real-world industrial and research environments in food technology.
2	provide hands-on experience in standard industrial practices, operations, instrumentation, and regulatory compliance.
3	develop skills in technical problem-solving, troubleshooting, and process optimization.
4	enhance understanding of industrial safety protocols, GMP GEP standards, bioethics, and sustainability practices.

DESCRIPTION

Industrial Training provides work experience relevant to their field of specialization, before graduation, and it is an essential component for the development of practical and professional skills required for an engineering graduate and supports for prospective employment.

At the end of the industrial training, students should be able to improve their knowledge and skills relevant to their areas of specialization where they have been trained. The students should also be able to relate, apply, and adapt the relevant knowledge, concepts, and theories within an industrial organization, and also to practice the general workplace behavior and interpersonal skills.

The student (either in group or single) should undergo industrial training for a minimum period of two weeks during the summer vacation after the completion of fourth semester as specified in the curriculum in any research organization/university/industry of State/National and International level industry relevant to their branch of specialization, after getting proper approval from the Head of the Institution.

On the completion of the industrial training for the specified period, the student has to submit the industrial training report (at least 25-30 pages) containing the following details, along with the certificate obtained from the industry for the period of training undergone.

1. Introduction of the industry.
2. Industry layout and its various operations with its infrastructure facilities.
3. Formulation of practical problems, data required to formulate the problems and its analysis.
4. Suggestions and recommendations for the above problems

During the period of training, the student has to abide the rules and regulations enforced by the organization and to ensure FULL attendance during the period of industrial training and uphold the discipline and decorum of the institution.

On the completion of the industrial training, the End Semester Examinations shall be conducted by the Office of the Controller of Examinations at the end of the fifth semester. A three-member committee constituted by the Head of the Institution, consisting of (1) a senior faculty member at the Professor level, (2) senior faculty member at the Associate Professor and (3) faculty member from outside the department, will evaluate the industrial training undergone by the student. The evaluation shall be made based on the report submitted along with the presentation and a Viva voce Examination.

		TOTAL PERIODS :30
COURSE OUTCOMES At the end of the course, the students will be able to		**BT MAPPED** (Highest level)
CO1	apply theoretical concepts of food technology to practical industrial operations and processes.	Applying (K3)
CO2	apply standard operating procedures (SOP) and regulatory practices such as GMP GLP in a real-time industrial setting.	Applying (K3)
CO3	demonstrate technical and professional skills required for teamwork communication, and reporting in an industrial environment.	Applying (K3)
CO4	prepare and present a comprehensive industrial training report with critical observations and recommendations.	Applying (K3)

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	-	-	-	1	-	-	1	3	2
CO2	2	3	2	3	2	-	-	1	1	-	-	1	3	2
CO3	1	-	2	-	1	1	2	2	3	3	1	-	2	2
CO4	2	2	2	1	1	-	1	1	3	3	1	2	2	3

GE23501	PROFESSIONAL DEVELOPMENT III	0	0	2	1

COURSE OBJECTIVES

To enable students to

1.	enhance their Resume writing skills and improving corporate vocabularies to survive in the corporate world.
2.	evaluate their interview skills and improve their interview presentation.
3.	solve the quantitative aptitude problems and improve their mental ability.
4.	improve critical thinking and reasoning skills.

UNIT I	RESUME WRITING SKILLS	6

Updated Resume Building III – Self Introduction III – Dressing Etiquette – JAM V – Corporate Vocabulary.

UNIT II	INTERVIEW SKILLS	6

Interview skills – General guidelines - Work Ethics – Group Discussion III – JAM VI – Presentation Competence – Mock Interview.

UNIT III	QUANTITATIVE APTITUDE	9

Cube Root and Square Root - Time and Work - Ages - Permutation and Combination - Probability – Calendar.

UNIT IV	LOGICAL REASONING	9

Series Completion - Blood Relations - Coding and Decoding - Data Sufficiency - Statements and Assumptions.

TOTAL PERIODS:	30

COURSE OUTCOMES Upon completion of the course, the students will be able to		BT MAPPED (Highest Level)
CO1	excel in drafting Resumes and speaking.	Applying (K3)
CO2	demonstrate the participative skills in group discussions and Interviews.	Applying (K3)
CO3	solve problems based on quantitative aptitude.	Applying (K3)
CO4	enhance their logical and verbal reasoning.	Analyzing (K4)

TEXTBOOKS

1. Aggarwal, R. S. A Modern Approach to Verbal & Non-Verbal Reasoning. Revised ed., 2024–25, S. Chand & Company Ltd., 2024.
2. Aggarwal, R. S. Objective General English: Fully Revised Video Edition. S. Chand & Company Ltd., 2022.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hil1.2015.
2. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications.2016.
3. Johnson, D.W. Reaching out — Interpersonal Effectiveness and self- actualisation. Boston: Allyn and Bacon.2019.
4. Infosys Campus Connect Program — students' guide for soft skills.2015.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3

PAVAI ENGINEERING COLLEGE, NAMAKKAL
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FT23151	MEAT FISH POULTRY PROCESSING TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	learn the basics of muscle to meat
2.	develop the knowledge in the area of meat processing and its technology
3.	learn the processing of fish from harvesting to its value-added products
4.	know the principles behind poultry processing and egg processing through industrial procedures
5.	appreciate the application of scientific principles in the processing of these materials

UNIT I	INTRODUCTION	9

Recent trends in meat processing; Types of Meat and its sources, composition, structure, of meat and meat products; Introduction to Halal - Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products.

UNIT II	MEAT PROCESSING	9

Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meat aging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT III	FISH PROCESSING	9

Types of fish, composition, structure, characteristics of fresh fish and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, chilling of fish, Freezing and Individual quick freezing. Canning and smoking operations, Salting and drying of fish, pickling. Radiation processing of fish and fish products. Seafood quality Assurance; Fish products-Fish muscle protein, surimi production, fish sauce and paste; Advances in fishery by products technology.

UNIT IV	POULTRY AND EGG PROCESSING	9

Introduction, Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products. Unit operation involved in poultry processing. Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing.

UNIT V	HYGIENE AND SANITATION	9

Handling and maintenance of tools and core equipment. Meat plant layout. Meat processing hygiene. Cleaning and sanitation in meat plants. Food safety measures - GMP and GHP.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	elaborate the overall concept in meat processing	Understanding (K2)
CO2	elaborate handling and processing of meat	Understanding (K2)

CO3	recommend fish processing and preservation techniques	Analyzing(K4)
CO4	select appropriate techniques for egg processing and poultry	Analyzing(K4)
CO5	adapt hygiene and sanitation procedures in meat industry	Applying (K3)

TEXT BOOKS

1. Govindan. T.K, Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2. Lawrie, R.A. Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.

REFERENCES

1. Stadelmen, W.J. and Cotterill, O.J., Egg Science and Technology, Second Edition, AVI, Westport, 1977.
2. Joseph Kerry, John Kerry and David Ledwood., Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
3. Mead, G., Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
4. Wheaton, F.W. and Lawson, T.B., Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	2	-	2	2	1	-	3	3	2
CO2	3	3	-	2	2	-	-	-	-	1	-	3	3	3
CO3	3	3	2	2	-	3	-	2	2	1	-	3	3	2
CO4	3	3	-	2	1	-	-	-	-	1	-	3	3	3
CO5	3	2	3	2	-	1	-	2	2	1	-	3	2	3

FT23152	COLD CHAIN TECHNIQUES	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	impart the basic concepts of refrigeration systems.
2.	learn the components of refrigeration systems.
3.	evaluate simple vapour compression and absorption system.
4.	analysis low temperature storage systems.
5.	gain theoretical knowledge on cold chain management.

UNIT I **INTRODUCTION TO REFRIGERATION** 9

Introduction to refrigeration, unit of refrigeration capacity, Review of Second law of thermodynamics and interpretation. Production of low temperatures - principles and process. Refrigerants - classification and thermodynamic properties. Ozone depletion potential. Reversed Carnot cycle. Limitations of reversed Carnot systems.

UNIT II **REFRIGERATION SYSTEMS** 9

Refrigeration cycle – simple vapor compression, vapor absorption cycle, p-h and T-s diagrams, COP. Energy ratios and Power consumption of a refrigerating machine. Standard rating cycle and effect of operating conditions. Air refrigeration system – reversed Brayton cycle.

UNIT III **COMPONENTS OF REFRIGERATION SYSTEMS** 9

Evaporator- dry and flooded type, liquid cooling evaporator. Condenser- water cooled, air cooled and evaporative condenser. Compressor - Reciprocating type compressors. Expansion valve - thermostatic expansion valve

UNIT IV **LOW TEMPERATURE STORAGE SYSTEMS** 9

Pre-cooling systems, Cold storage- construction, insulation and operation. Design of cold storage unit. Calculation of refrigeration load in cold store. Prefabricated systems, walk-in-coolers. Storage of frozen foods, Freezer types, Cryogenics – Linde and Claude system for liquefaction of air.

UNIT V **COLD CHAIN** 9

Introduction, Components of cold chain. Refrigerated distribution and transport systems, Cold chain in retail, Traceability- Application of RFID in cold chain. Role of refrigeration in food production - candy manufacture, beverage processing, bakery products, meat products, poultry products, fishery products, fruit /vegetables and dairy products.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	demonstrate the operations in different refrigeration	Understanding (K2)
CO2	prepare the various types of components	Applying (K3)
CO3	analysis the effect on energy ratios and power consumption	Applying (K3)
CO4	execute the calculation of refrigeration load in cold store	Understanding (K2)

CO5	design the cold storage systems.	Applying (K3)

TEXT BOOKS

1. Rajput R.K., Refrigeration and Air-conditioning, 3rd Edition, S.K. Kataria and Sons (Publishers), Delhi, 2012.
2. Dellino C.V.J., Cold and Chilled Storage Technology, 2ndEdition, Springer, US, 2011.

REFERENCES

1. Arora, C.P., Refrigeration and Air Conditioning, 2ndEdition, Tata McGraw- HillPublishing Company Ltd., Delhi, 2008.
2. Khurmi, R.S. and Gupta J.K., Textbook of Refrigeration and Air Conditioning, 5th Edition, S. Chand Publishers, New Delhi, 2006.
3. Narayanan, K.V., A Textbook of Chemical Engineering Thermodynamics, 2ndEdition, PHI Learning Pvt. Ltd., New Delhi, 2013.
4. Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell, 2008.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	-	-	3	-	3	-	-	2	3	3	2
CO2	2	3	3	-	-	1	3	3	-	-	-	3	3	3
CO3	-	1	2	-	-	3	-	3	-	-	2	3	3	2
CO4	1	-	-	3	-	2	3	3	-	-	-	-	3	3
CO5	-	1	2	-	-	3	-	3	-	-	2	3	3	2

FT23153	TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. provide the basic understanding of cereals and pseudocereals.
2. impart knowledge about the new technologies in oil seed processing.
3. make students able to implement their knowledge about cereals and dry milling
4. comprehend bread baking technology
5. study about other food products from cereals

UNIT I	CEREALS AND PSEUDOCEREALS	9

Introduction to cereals and pseudocereals and their production - Cereals and pseudocereals; Characteristics of cereal types - Maize, Rice, Wheat, Sorghum, barley; Millet - pearl millet, kodo millet, little millet; Pseudocereals - Buck wheat origin and types, uses and global production.

UNIT II	LEGUMES AND OIL SEED PROCESSING	9

Pretreatment of pulses for milling; Methods of milling pulses, pulses based processed products; Oil seeds processing - Sesame, Coconut, Groundnut, Mustard, Soybean, Sunflower, Safflower; Oil seeds extraction traditional methods, New Technologies in oil seed processing, Calculation of extraction efficiency, new technologies in oilseed processing.

UNIT III	CEREALS AND DRY MILLING	9

Production, uses and trade of cereals by continental regions - Maize(corn), Rice, Barley, Sorghum, Millet, Oats, rye, triticale, Buckwheat and Quinoa; Dry-Milling Technology - Milling process, Process in which the main process is decortication, Dry milling in which the main process is roller milling Flour Treatments, applications, Quality, Storage and transport of flour.

UNIT IV	BREAD BAKING TECHNOLOGY	9

Bread-Baking Technology - Principle of baking for making white bread, other kind of bread, Bread staling and preservation, use of cereals other than wheat in bread; Breakfast cereals - Cooking of cereals, hot cereals, flaked production from maize, wheat and rice, puffed products, shredded products, granular products and sugar coated products; Quality and nutritive value of breakfast cereals.

UNIT V	OTHER FOOD PRODUCTS	9

Other food products - Products made from wheat, maize, sorghum and rice, Parboiled rice and its recent trends; Malting, brewing, fermentation and distilling, by products of brewing and distilling; Soya bean, Tofu, Temph, Peanut- butter and curd.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	explain the structure of the cereal and pseudocereals, its components of commercial flour.	Understanding (K2)
CO2	demonstrate the cereal grain production and oil seed processing.	Analyzing (K4)

CO3	interpret the cereals and dry milling technology.	Analyzing (K4)
CO4	demonstrate bread baking technology	Applying (K3)
CO5	identify other food products from cereals	Understanding (K2)

TEXT BOOKS

1. Kent, Technology of Cereal, 5th ED. Pergamon Press, 2003.
2. Chakraverty A., "Post-Harvest Technology of Cereals, Pulses and Oil Seeds", 3rd Edition, Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, 2017.

REFERENCES

1. Rao, P. V. (2015). Postharvest Technology of Cereal Grains and Pulses. CRC Press.
2. Mujumdar, A. S., & Devahastin, S. (2000). Drying Technology in Food Processing. CRC Press.
3. Haug, W., & Lantzsch, H. J. (2012). Oilseeds: Processing and Utilization. Springer.
4. Kulp K. & Pont J.G., "Handbook of Cereal Science and Technology", 2nd Edition, Marcel Dekker Inc, New York, 2000

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	-	2	2	2
CO2	-	2	3	-	2	-	2	-	-	-	-	1	2	2
CO3	2	2	3	2	-	-	1	-	-	-	-	-	2	2
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	1	2	3

FT23154	FAT AND OIL PROCESSING TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	understand the fundamentals of fats and oils processing
2.	describe the different types of fats and oils and their processing technology
3.	analyze the quality and safety aspects of fats and oils processing technology
4.	apply process optimization and control principles of fats and oils processing
5.	design and develop new products and processes in fats and oil processing

UNIT I	INTRODUCTION	9

The Major Sources of Oils and Fats Introduction, Animal fats - butter, lard, tallow, chicken fat and fish oils, sunflower seed oil, other vegetable oils, Lipids- Fatty acids, Triacylglycerols, Ester waxes, phospholipids, lauric oils (coconut and palm kernel), cocoa butter and cocoa butter alternatives, repressed (canola) oil, soya bean oil, palm oil, olive oil, extraction of crude vegetable oil, virgin oil, cold pressed oil.

UNIT II	EXTRACTION AND REFINING	9

Extraction, Refining, Modification process, blending, fractionation including dewaxing, oil seeds modified by conventional seed breeding or by genetic engineering, interesterification using enzymatic catalyst, animal fats modified through nutritional changes, extraction process-steps involved, batch and continuous-continuous solvent extraction process, oil quality and standard quality regulations, shelf life and oxidative stability of oil.

UNIT III	PHYSICAL AND CHEMICAL PROPERTIES	9

Polymorphism, crystal structure and melting point, glycerol esters, density, viscosity alkonoic and alkenoicacids solubility of gases in oils, atmospheric oxidation, thermal changes, reaction of the carbonyl and ester functions, Physical properties of fats and oils - color, Odor, consistency, melting point, flash point, smoke point and refractive index. Chemical properties of fats and oils - iodine value, saponification value, free fatty acids, peroxide value.

UNIT IV	NUTRITIONAL PROPERTIES OF OILS AND FATS	9

EFA and fatty acids metabolism, Denovo synthesis of saturated acids, antioxidants, cholesterol and phytosterols, recommended intake of fats and fatty acids, Role of fats in health and disease, Obesity, diabetes, coronary heart disease, cancer, Reused oils.

UNIT V	MAJOR EDIBLE USES OF OILS AND FATS	9

Spreads – butter and ghee, Spreads – margarine, Vanaspati, and flavored spreads, Baking fats and shortenings, Frying oils and fats, Salad oils, mayonnaise and salad cream, French dressing, Chocolate and confectionery fats, Ice cream, Incorporation of vegetable fats into dairy products, Edible coating Emulsifying agents, Functional foods - fatty fishes, unsalted nuts, whole grains, etc.,

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	explain the principles of fats and oils processing technology	Understanding (K2)
CO2	analyze the quality and safety aspects of fats and oils processing	Analyzing (K4)
CO3	apply process optimization and control principle of fats and oils technology	Applying (K3)
CO4	design and develop new products and processes in oils and fats technology	Applying (K3)
CO5	evaluate the environment and economic impacts of fats and oils and oils processing operations	Analyzing (K4)

TEXT BOOKS

1. Gunstone F.D., "Vegetable Oils in Food Technology: Composition, Properties and Uses", 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681, 2011.
2. Oils and fats, I. Title: Industrial oil & fats products. II. Title: Bailey's industrial oil and fats products. III. Bailey, Alton Edward, 2007-2019

REFERENCES

1. Wolf Hamm & Richard J. Hamilton, "Edible Oil Processing", 2nd Edition, Wiley - Blackwell, UK, 2013.
2. Introduction to oils and fats - "Richard D.O' Brien" and "Watter. E.farr" : Peter. J. Wan". Seconnd edition
3. Harry Lawson, "Food oils and Fats - Technology, Utilization and Nutrition", CBS Publishers and Distributors, New Delhi, 1997.
4. Fereidoon Shahidi, "Baileys Industrial oil and fat products", 6th edition Wiley - Interscience, New Jersey, 2005.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	3	3	1	-	-	-	-	-	2	2	2
CO2	-	2	3	-	2	-	2	-	-	-	-	1	3	2
CO3	2	2	3	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	1	2	2

FT23155	PLANTATION AND SPICE PRODUCT TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	study about the various methods of processing tea, coffee products
2.	develop an awareness of various processing procedure for major spices and minor spices
3.	demonstrate a basic knowledge on process of herbs
4.	gain knowledge in processing of cocoa bean and also its value-added products.
5.	Study about advance in spice processing

UNIT I	PLANTATION CROPS	9

Plantation crops and Types of plantation crops; Processing of Tea - Manufacturing of diversified tea products - instant, herbal, functional tea; Coffee - occurrence Chemistry, Recent Trends in coffee technology, Quality grading of coffee, Chicory chemistry and Quality grading.

UNIT II	MAJOR AND MINOR SPICES	9

Major Spices: Post Harvest Technology, composition, processed products of - Pepper, Cardamom, onion, ginger and turmeric; Oleoresins and essential oils; Method of manufacture - Chemistry of the volatiles - Enzymatic synthesis of flavour identical - Quality control; Flavour of major spices - Spice oil and oleoresins.

Minor Spices: Post Harvest Technology, composition, processed products of Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove and Vanilla; Oleoresins and essential oils - Method of manufacture - Chemistry of the volatiles - flavour, Quality control, of volatiles micro-organisms; plant suspension cultures Present trends in synthesis.

UNIT III	PROCESSING OF HERBS	9

Description of various types of herbs - Basil, Cilantro, Dill, Coriander, Mint, Oregano, Borage, Thyme, Parsley, Curry leaves, bilva leaves, Bay leaves, Safflower, Rosemary, Lavender, Processing and post - harvest handling, Functional properties, Quality issues, Recent trends, health benefits and innovations of herbs in food Industry.

UNIT IV	PROCESSING TECHNOLOGY OF COCOA & ITS BYPRODUCT	9

Occurrence Chemistry of the cocoa bean changes taking place during fermentation of cocoa bean - Processing of cocoa bean cocoa powder cocoa liquor manufacture; Chocolates Types - Chemistry and technology of chocolate manufacture - Quality control of chocolates.

UNIT V	ADVANCES IN SPICE PROCESSING	9

Spice oil - advances in SCFE, novel solvent free extraction methods using microwave and ultrasound; Cryogenic grinding of spices; Extraction of oleoresins, concepts, and technology, desolventization methods, regulatory and statutory requirements for oleoresin processing; Spice encapsulation; Recent spice research-antioxidants, antimicrobial, and health benefits of spice compound.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	elucidate the recent trends in plantation crops processing	Applying (K3)
CO2	analyze functional properties of spices and condiments in product development	Analyzing (K4)
CO3	appraise different herbs and their processing	Understanding (K2)
CO4	acquire the knowledge about cocoa processing	Understanding (K2)
CO5	apply the appropriate technique for extraction of spice oil and oleoresin with quality standards	Applying (K3)

TEXT BOOKS

1. Handbook of spices, seasonings and flavorings 2nd edition
2. Minifie Bemard W. "Chocolate, Cocoa and Confectionery Technology", 3rd Edition, Aspen publication, USA, 1999.

REFERENCES

1. Panda H, Handbook on Spices and Condiments (Cultivation, Processing and Extraction)", 2nd Edition, National Institute of Industrial Research, New Delhi, 2010
2. Peter K.V... "Handbook of Herbs and Spices", 2nd Edition, Wood head Publishing, USA, 2012
3. Kumar N., "Introduction to spices, plantation crops, medicinal and aromatic plants", 2nd Edition, Oxford and IBH Publishing, New Delhi, 2006.
4. Tainter, D.R. Grenis, A.T. Spices and Seasonings – A food technology hand book. 2nd edition. John Wiley and Sons, Inc., Canada. 2001. ISBN: 978-0-471-35575-5

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	2	1	-	-	1	2	1	-	-	2	2	1
CO2	1	1	2	1	-	-	1	1	2	-	-	1	2	2
CO3	1	1	2	1	-	-	1	2	2	-	-	-	2	2
CO4	1	1	2	-	-	-	1	2	2	-	-	2	2	1
CO5	1	1	2	-	-	-	1	2	1	-	-	2	2	1

FT23156	FOOD FLAVOUR PROCESSING TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	provide the basic understanding aroma and its extraction.
2.	impart knowledge about taints and off-flavour.
3.	make students able to implement their knowledge about aroma release and flavour.
4.	comprehend approaches to production of natural flavour
5.	study about perception of flavour

UNIT I	AROMA AND ITS EXTRACT ANALYSIS	9

Introduction of aroma and sensomics; occurrence of compounds containing carbon, hydrogen, nitrogen and sulfur compounds; Extraction techniques for analysis of aroma compounds: solvent assisted flavour evaporation and solid phase extraction; Aroma extract analysis - Gas chromatography, mass spectrometry and olfactometry.

UNIT II	TAINTS AND OFF-FLAVOURS	9

Analysis of taints and off-flavour: the origin of taints and off-flavour in food; consumer perception and sensory evaluation, method of analysis; Chemical sensor - perspectives for application of chemical sensors in food and beverage industries.

UNIT III	AROMA RELEASE AND FLAVOUR	9

Aroma release - physicochemical properties of aroma and flavour compounds, Equilibrium partitioning of aroma and flavour compounds, Non equilibrium partitioning of aroma and flavour compounds, aroma release during oral processing; Generation of aroma - Biosynthesis of aroma compounds - general aspects, maturation and ripening processes, formation pathways for flavour compounds.

UNIT IV	APPROACHES TO PRODUCTION OF NATURAL FLAVOURS	9

Introduction – classical fermentation from a sugar source, microbial conversion of natural precursor molecules, enzymatic conversion of natural precursor molecules using a plant homogenate; fermentation from a sugar source using GMO; lipid oxidation mechanism, impact of lipid oxidation on flavor, analysis of lipid oxidation, prevention of lipid oxidation and novel approaches for the prevention of oxidation.

UNIT V	PERCEPTION OF FLAVOUR	9

Perception of flavour - Interaction of aroma compounds with food matrices; Thermodynamic and kinetic properties of aroma compounds; physiochemical interaction in simple and multiphasic systems; aroma matrix interactions on aroma release; Taste receptors - tastants, G protein-coupled receptors, ion channels, taste modulators.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	elucidate the aroma and its extraction.	Analyzing (K4)
CO2	acquire the knowledge about taints and off-flavour	Understanding (K2)

CO3	interpret aroma release and flavour release	Analyzing (K4)
CO4	appraise approaches to production of natural flavour	Applying (K3)
CO5	provide knowledge about perception of flavour	Understanding (K2)

TEXT BOOKS

1. Flavour Development, Analysis and Perception in Food and Beverages - J.K. Parker, J.S. Elmore and L.Methven
2. Reineccius G. and Heath H.B., "Flavo Chemistry and Technology", Taylor and Francis group, CRC Press, II Edition,2006.

REFERENCES

1. Socaciu C., "Food Colorants – Chemicaland Functional Properties", CRC Press, Taylor and Francis group,LLC, ISBN No., 9780849393570, 2008.
2. Mujumdar, A. S., & Devahastin, S. (2000), Drying Technology in Food Flavour Processing. CRC Press.
3. Haug, W., & Lantzsch, H. J. (2012). flavour: Processing and Utilization. Springer.
4. Rowe D.J., "Chemitry and Technology of flavors and Fragrances", Blackwell Publihing Ltd., U.K., ISBN No., 1405114509, 2005.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	1	-	2	2	3	-	-	-	-	3	2
CO2	-	1	-	1	-	2	2	3	-	-	-	-	3	2
CO3	-	1	3	-	1	1	-	-	1	1	-	3	3	3
CO4	1	3	3	3	-	-	3	1	-	-	2	-	3	3
CO5	-	1	3	3	-	-	3	3	2	2	-	3	3	3

FT23157	FOOD PLANT AND PROCESS EQUIPMENT DESIGN	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. learn the basic law of thermodynamics and properties of fluid
2. knowledge on the energy balance of equipment and control parameter in food
3. understand the heat transfer operation in Food Processing
4. analysis the preservation process and food freezing using design of equipment
5. apply the Extrusion Processes for Foods and packing concepts of food using modern equipment.

UNIT I MATERIALS AND PROPERTIES 9

System- state of system - Density - moisture content - perfect gas law - Law of Thermodynamics - Laws of Thermodynamics- First Law of Thermodynamics - Second Law of Thermodynamics -Energy- energy balance -Energy Balance for a Closed System -Heat Work -Energy Balance for an Open System-Energy Balance for Steady Flow Systems -Power.

UNIT II ENERGY AND CONTROLS IN FOOD PROCESSES 9

Generation of Steam -Steam Generation Systems -Thermodynamics of Phase Change -Steam Tables - Steam Utilization-Fuel Utilization- Mass and Energy Balance Analysis - Burner Efficiencies- Electric Power Utilization, Electrical Terms and Units, Ohm's Law-Electric Circuit- Electric Motors-Electrical Controls, Electric Lighting; Process Controls in Food Processing - Processing Variables and Performance Indicators.

UNIT III HEAT TRANSFER IN FOOD PROCESSING 9

Heat Transfer in Food Processing - Systems for Heating and Cooling Food Products -Plate Heat Exchanger -Tubular Heat Exchanger -Scraped-surface Heat Exchanger- Steam-infusion Heat Exchanger-Epilogue - Thermal Properties of Foods - Specific Heat -Thermal Conductivity -Thermal Diffusivity - Modes of Heat Transfer - Conductive Heat Transfer -Convective Heat Transfer-Radiation Heat Transfer.

UNIT IV PRESERVATION PROCESS 9

Preservation Processes - Processing Systems - Pasteurization and Blanching Systems - Commercial Sterilization Systems - Ultra-High Pressure Systems - Pulsed Electric Field Systems - Alternative Preservation Systems - Microbial Survivor Curves - Influence of External Agents - Thermal Death Time - Spoilage Probability - General Method for Process Calculation - Applications to Pasteurization - Commercial Sterilization - Aseptic Processing and Packaging; Mathematical Methods - Pouch Processing.

UNIT V EXTRUSION PROCESSES AND PACKAGING CONCEPTS 9

Extrusion Processes for Foods: Introduction and Background-Basic Principles of Extrusion -Extrusion Systems -Cold Extrusion -Extrusion Cooking - Single Screw Extruders - Twin-Screw Extruders-Extrusion System Design-Design of More Complex Systems. Packaging Concepts: Introduction- Food Protection- Product Containment - Product Communication -Product Convenience.

TOTAL PERIODS: 45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	analyze the engineering properties of different materials for the development of food plant equipment	Applying (K3)
CO2	determine the steam generation systems	Understanding (K2)
CO3	design the heat exchanger in the food process equipment design	Analyzing (K4)
CO4	design the preservation process and food freezing extruders	Analyzing (K4)
CO5	demonstrate the extrusion and packaging process in industries and safety measures in equipment design	Applying (K23)

TEXT BOOKS

1. R. Paul Singh and Dennis R. Heldman. Introduction to Food Engineering, 6th Edition. Elsevier, Amsterdam, The Netherlands.2025.
2. Albert Ibarz and Gustavo V. Barbosa-Canova's, Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.2003.

REFERENCES

1. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 2013, Principles of Fermentation Technology, 3rd Edition. Elsevier Science Ltd., Burlington, MA, USA.
2. J.F. Richarson and D.G. Peacock. Coulson &Richardsons's Chemical Engineering, Vol.2 Chemical &Biochemical Reactors & Process Control, 5th Edition. Elsevier Butterworth Heinemann, Amsterdam, The Netherlands. 2002
3. James R. Couper, W. Roy Penney, James R. Fair and Stanley M. Walas Chemical Process Equipment Selection and Design. Elsevier Inc. 2012.
4. Mahajani, V. V. and Umarji, S. B., Process equipment design, 4th edition, 2009, Macmillan publishers.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	2	3	3	3	-	-	-	1	2	2	2
CO2	3	2	3	2	3	3	3	-	-	-	1	3	2	2
CO3	3	2	3	2	3	3	3	-	-	-	1	3	2	2
CO4	3	2	3	2	3	3	3	-	-	-	2	2	2	2
CO5	3	2	3	2	3	3	3	-	-	-	2	3	2	2

FT23251	CELL AND MOLECULAR BIOLOGY FOR FOOD ENGINEERS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. understand key molecular and cellular biology concepts
2. apply biological principles to engineering challenges, particularly in bioengineering and biotechnology
3. analyze how cells and molecular systems function in engineered applications
4. develop essential laboratory skills and familiarize themselves with techniques used in molecular biology
5. understand key molecular and cellular biology concepts

UNIT I	INTRODUCTION TO CELL AND MOLECULAR BIOLOGY	9

Overview of molecular biology and its relevance to engineering; Structure of cells - prokaryotic and eukaryotic cells; Basic biochemistry - proteins, nucleic acids, lipids, and carbohydrates; The central dogma - DNA → RNA → Protein.

UNIT II	GENETIC INFORMATION AND MOLECULAR GENETICS	9

Structure and function of DNA and RNA; DNA replication, transcription, and translation; Gene expression and regulation in prokaryotes and eukaryotes; Techniques for analyzing genetic material: PCR, gel electrophoresis.

UNIT III	CELL SIGNALING AND BIOTECHNOLOGY APPLICATIONS	9

Principles of cellular communication and signal transduction; Receptor types and mechanisms (GPCRs, RTKs); Applications of cell signaling in biotechnology - biosensors, drug design, and therapeutic targets; Bioengineering applications in gene therapy and synthetic biology.

UNIT IV	CELLULAR METABOLISM AND BIOENGINEERING	9

Metabolic pathways - glycolysis, citric acid cycle, oxidative phosphorylation; Role of ATP in energy transfer within cells; Engineering applications - metabolic engineering, microbial fermentation, and biofuel production; Bioreactors and industrial applications of metabolic processes.

UNIT V	TISSUE ENGINEERING, AND BIOMATERIALS	9

Cytoskeletal dynamics, ECM and Adhesion, Cell communication; Biomaterials - types, applications, and biocompatibility; Applications in regenerative medicine, prosthetics, and medical implants.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the fundamentals of genetic modification	Understanding (K2
CO2	analyze the techniques of genetic engineering	Analyzing (K4)
CO3	evaluate the safety and regulation of gm foods	Understanding (K2)

CO4	assess the environmental and socioeconomic impacts of gm food	Analyzing (K4)
CO5	apply case study analysis to real-world gm food scenarios	Applying (K3)

TEXT BOOKS

1. Cell biology third edition by Thomas D. Pollard
2. Cells molecules and Mechanisms by Charles S. Brennan

REFERENCES

1. Brown, T. A. (2010). Genomes (3rd ed.). Garland Science.
2. Goodwin, P. (2018). Introduction to Bioengineering (2nd ed.). Springer.
3. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010
4. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols in Molecular Biology "Greene Publishing Associates, NY, 1998

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	3	3	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
CO4	2	-	-	-	-	3	2	2	-	-	-	3	3	3
CO5	3	3	2	2	-	-	-	-	-	-	-	3	3	3

FT23252	FOOD PHYTOCHEMICALS	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	identify and classify phytochemicals in food sources
2.	understand the mechanisms of action of bioactive phytochemicals
3.	master techniques for extracting and analyzing phytochemicals
4.	evaluate the health benefits and potential applications of phytochemicals
5.	formulate and incorporate phytochemicals into functional foods

UNIT I	INTRODUCTION TO PHYTOCHEMICALS IN FOODS	9

Definition of phytochemicals and their role in plants, Classification of phytochemicals; primary vs. secondary metabolites, Types of phytochemicals - flavonoids, carotenoids, alkaloids, terpenoids, polyphenols, saponins, and glucosinolates; Sources of Phytochemicals - Phytochemicals in fruits, vegetables, legumes, nuts, seeds, and grains, Herbal sources; medicinal plants and their bioactive compounds.

UNIT II	BIOACTIVE PROPERTIES AND MOA OF PHYTOCHEMICALS	9

Antioxidant Properties; Mechanism of antioxidant action; free radical scavenging, prevention of oxidative stress, Phytochemicals with antioxidant activity - flavonoids, polyphenols, carotenoids; Anti-inflammatory Effects: Role of phytochemicals in modulating inflammation and immune response; Antimicrobial and Antiviral Properties; Phytochemicals as natural antimicrobials, Examples: essential oils, garlic compounds, flavonoids, alkaloids.

UNIT III	EXTRACTION AND ANALYSIS OF PHYTOCHEMICALS	9

Extraction Methods - Solvent extraction, steam distillation, supercritical fluid extraction, Selection of appropriate methods based on the type of phytochemical; Isolation and Purification Techniques - Chromatographic techniques TLC, HPLC, GC; Spectroscopic techniques for phytochemical analysis-UV-Vis, FTIR, NMR; Quantification of Phytochemicals - Methods to quantify bioactive compounds: antioxidant capacity assays, spectrophotometric methods.

UNIT IV	HEALTH BENEFITS OF PHYTOCHEMICALS I	9

Phytochemicals and Chronic Diseases; Role in cardiovascular health - lowering cholesterol, improving blood pressure, protecting blood vessels; Phytochemicals in diabetes management - insulin sensitivity, glycemic control; Phytochemicals and neuroprotection - preventing cognitive decline, neurodegenerative diseases like Alzheimer's and Parkinson's.

UNIT V	HEALTH BENEFITS OF PHYTOCHEMICALS II	9

Phytochemicals in Skin Health - Role of phytochemicals in skin aging, sun protection, and wound healing; Phytochemicals used in dermatological treatments - polyphenols, vitamin C, carotenoids; Phytochemicals and Gut Health - Role of dietary fiber, polyphenols, and prebiotics in gut microbiota modulation; Phytochemicals for gut health - flavonoids, lignans, and fibers.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the role and classification of phytochemicals	Understanding (K2)
CO2	evaluate the bioactive properties of phytochemicals	Analyzing (K4)
CO3	apply extraction and analysis techniques for phytochemicals	Applying (K3)
CO4	assess the health benefits of phytochemicals	Analyzing (K4)
CO5	incorporate the phytochemicals into functional foods	Applying (K3)

TEXT BOOKS

1. Handbook of Plant food phytochemical sources, stability & extraction by B.K.Tiwari & Charles S
2. "Phytochemicals – A Global perspective of their role in nutrition and health" Venkateshwer Rao, 2012

REFERENCES

1. Phytochemical as functional foods Ian Johnson and Gary Williamson, 2003.
2. Phytochemical: Dietary Sources, Innovative Extraction and Health Benefits, Yolanda Aguilera, Gutierrez Vanesa, Bentez Garcia, 2021.
3. Handbook of Dietary phytochemicals, Jianbo Xiaon, Satyajit D. Sarker, Yoshinori Asakawa, 2021.
4. Lau, J. T., & Seto, S. H. (2019). Bioactive Phytochemicals in the Prevention of Chronic Diseases. Journal of Food Science, 84(5), 1254-1261.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	1	-	-	3	-	1	-	-	-	-	1	1
CO2	-	-	2	-	2	2	-	2	-	2	3	-	-	2
CO3	-	-	-	-	-	2	-	2	-	2	-	-	-	3
CO4	-	1	-	-	-	3	-	3	-	3	-	-	-	3
CO5	-	2	2	-	-	3	-	3	-	3	-	-	-	3

FT23253	FOOD FERMENTATION TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	impart knowledge and skills related to process technologies in fermented food products
2.	learn about the different equipment used for the production of various fermented food products
3.	study about fermentation and fermenter
4.	understanding about recovery and purification of fermented products
5.	learn about the fermented food products

UNIT I	INTRODUCTION AND FOOD FERMENTATION	9

Introduction - Basic principles of food fermentation; Properties of fermented foods; Food Fermentation: Origin and history of food fermentation, Microorganisms for fermentation, Starter Cultures and fermented products, Inoculum development for industrial fermentations, Criteria for transfer of Inoculums.

UNIT II	FERMENTATION MEDIA	9

Fermentation media: Natural and Synthetic media, Basic components of media, Role of buffers in media; Sterilization; Starter culture microorganisms - bacteria, yeast and mold starter cultures, Culture composition, Manufacture of starter cultures, Evaluation of culture performance; Types of fermentation process.

UNIT III	TYPES OF FERMENTATION & DESIGN OF FERMENTER	9

Types of Fermentation - submerged, solid state, batch, fed batch and continuous fermentations; Design of Fermenter - Fermenter construction, materials for construction, Temperature controls, Aeration and agitation systems, Oxygen requirement, Oxygen supply.

UNIT IV	RECOVERY AND PURIFICATION OF FERMENTED PRODUCTS	9

Recovery and Purification of Fermentation products; Removal of microbial cells and other solid matter; foam separation; precipitation; Filtration; centrifugation; cell disruption; membrane process; chromatography; drying and crystallization.

UNIT V	FERMENTED FOOD PRODUCTS	9

Cultured dairy products – yogurt, cheese and its types, kefir and other cultured dairy products; Fermented meat, fish, vegetable, bread, vinegar, beer and wine.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	get a comprehensive understanding of basic principle of fermentation	Understanding (K2)
CO2	acquire knowledge about fermentation media	Understanding (K2)
CO3	have a thorough understanding on fermentation and fermenter	Understanding (K2)
CO4	gain knowledge about recovery and purification of fermentation products	Analyzing (K4)
CO5	develop fermented food products	Applying (K3)

TEXT BOOKS

1. Wood, Brian J. B. "Microbiology of Fermented Foods Volume 1 & 2. II Edition. Blackie Academic & Professional, 1998
2. Hui Y.H., Lisbeth Meunier Goddik, Jytte Josephsen, Wai Kit Nip and Peggy S. Stanfield, "Handbook of Food and Beverage Fermentation Technology", 2nd Edition, CRC Press, UK, 2004.

REFERENCES

1. Farnworth, Edward R. "Handbook of Fermented Functional Foods" II Edition. CRC Press, 2008.
2. Ramesh C. Ray and Didier Montet, "Fermented Foods, Part II Technological Interventions", CRC Press, 2017.
3. Robert W. Hutkins, "Microbiology and Technology of Fermented Foods", 2nd Edition, CRC Press, UK, 2004.
4. Lea, Andrew G. H & John R. Piggott "Fermented Beverage Production" II Edition. Kluwer Academic/ Plenum Publishers, 2010

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	-	1	-	2	2	1	-	-	2	3
CO2	3	3	3	1	2	-	-	2	1	1	1	1	3	3
CO3	1	2	3	3	-	-	3	1	-	1	-	1	3	3
CO4	2	3	2	2	-	1	3	2	-	2	-	2	3	3
CO5	-	3	3	1	-	2	3	3	-	1	-	3	3	2

FT23254	GENETICALLY MODIFIED FOODS	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand the basic principles and methods of genetic modification in food production
2.	analyze the applications of gm foods and their role in improving agricultural practices and food security.
3.	evaluate the regulatory frameworks, approval processes, and labeling requirements for gm foods.
4.	examine the environmental, ethical, and societal implications of gm foods.
5.	investigate future advancements in gm foods, including biotechnology and sustainability challenges.

UNIT I	INTRODUCTION TO GENETICALLY MODIFIED FOODS	9

Genetic Engineering - Purpose of Genetically Engineered Organisms, Genetic Engineering Versus Hybridization Techniques; Genetically Modified Plants - Bacillus thuringiensis (Bt) Berliner Crops; Recombinant DNA Technology, RNAi (Silencing), Tissue Culture and Transformation, Infiltration, Silicon Carbide-Mediated Transformation.

UNIT II	BIOTECHNOLOGY IN FOOD PRODUCTION	9

Approved Genetically Engineered Foods - Properties and Economic Concerns; Advantages of Genetically Modified Foods, Strategies for the Improvement of Microorganisms in Foods and Beverages, Baking Products, Beer, Wine; Dairy Products and Nutritional Additives for the Dairy Industry; Probiotics, Meat Products, Fermented Vegetable Products, Other Industrial Enzymes and Food Additives.

UNIT III	DNA TECHNOLOGY	9

Detection of Prevented DNA Damage by Therapeutic Foods; DNA Damage and Aging, Types of DNA Damage, Detection of DNA Damage, Repair of DNA Damage, Therapeutic Foods (Nutraceuticals); Detection of Prevented DNA Damage. Phenolic Compounds, B-Glucan, Vitamin E, Vitamin C, Carotenoid, Multicomponent Genetically Engineered Crops: Opportunities, Constraints, and Food Security at a Glance of Human Health, Environmental Impact, and Food Quality Contents, GM Crops.

UNIT IV	FISHY BUSINESS & SOCIETAL IMPLICATIONS OF GM FOODS	9

Fishy Business; Genetic Engineering and Salmon Aquaculture Discussion Residues of Pesticides in the Soy; Increases in MRL of Glyphosate in Food Feed Toxicity and Health Relevance of Pesticide/ Glyphosate Residues Salmon Decline from Wild to Farmed Fish, Nutritional Components; The Social and Economic Context of Genetically Modified Salmon.

UNIT V	FUTURE TRENDS AND CHALLENGES IN GM FOODS	9

New Frontiers in GM Foods - Gene Editing (CRISPR) Precision Agriculture; Developing Crops for Drought and Pest Resistance; Biosafety concerns for genomic manipulated crops, Global regulations of CRISPR edit crops, The United States regulation policies for genome edit crops, Pakistan regulation policies for genome edit crops, India regulation policies for genome edit crops.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the fundamentals of genetic modification	Understanding (K2)
CO2	analyze the techniques of genetic engineering	Analyzing (K4)
CO3	evaluate the safety and regulation of gm foods	Analyzing (K4)
CO4	assess the environmental and socioeconomic impacts of gm food	Applying (K3)
CO5	apply case study analysis to real-world gm food scenarios	Applying (K3)

TEXT BOOKS

1. Genetically Modified Foods: A Short Guide for the Confused* by M. J. M. Alon.
2. Genetically Modified Organisms in Agriculture and the Food Chain* by A. C. B. Mills

REFERENCES

1. Nano biotechnology for Plant Protection CRISPR and RNAi Systems Edited by Kamel A. Abd-Elsalam
2. GMOs and the Politics of Regulation by P. W. Singh
3. S. B. Primrose and R.M. Twyman., Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing, 2006.
4. Industrial microbiology, Prescott and Dunn, CBS Publishers.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	2	2	-	-	-	-	-	1	3	3
CO2	3	-	-	-	3	-	-	2	-	-	1	3	3	3
CO3	1	2	3	2	2	2	-	-	-	-	-	-	3	3
CO4	2	3	1	2	1	-	-	-	-	-	-	2	2	3
CO5	1	2	2	3	2	1	-	-	-	-	1	2	2	2

FT23255	FOOD ALLERGENS AND TOXICOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	familiarize with hazards, allergic reactions.
2.	study about food sensitivity.
3.	understand food related toxicological compounds in different foods.
4.	understand the protocols of sampling techniques in food toxicology measurements
5.	creates an awareness to choose food with safety concern.

UNIT I	INTRODUCTION	9

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources.

UNIT II	FOOD ALLERGY AND SENSITIVITY	9

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

UNIT III	PRINCIPLES OF TOXICOLOGY	9

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, toxin absorption in theG.I.track, Industrial microflora, blood, brain barrier, storage and excretion of toxins

UNIT IV	DETERMINATION OF TOXICANTS IN FOOD SAMPLING	9

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity

UNIT V	TOXICANT FORMED DURING FOOD PROCESSING	9

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand about the basics of immune system and its response	Understanding (K2)
CO2	understand about food sensitivity and allergy.	Understanding (K2)

CO3	analyze the different types of allergens and Natural toxins associated with food	Analyzing (K4)
CO4	evaluate food toxin in food samples.	Applying (K3)
CO5	prepare zero toxic food by adapting toxin formed during processing and controlling	Applying (K3)

TEXT BOOKS

1. Helferich, William and Carl K.Winter, Food Toxicology, CRC Press, 2001.
2. Shibamoto, Taka yuki and Leonard F.Bjeldanzes, Introduction to Food Toxicology, 2nd Edition, Academic Press, 2009.

REFERENCES

1. Alluwalia and Vikas, Food Hygiene and Toxicology, Paragon International Publishers, 2007.
2. Maleki, Soheila J. A.Wesley Burks, and Ricki M.Helm, Food Allergy, ASM Press, 2006.
3. Cliver, Dean O. and Hans P.Riemann, Food Borne Diseases, 2nd Edition, Academic Press/Elsevier, 2002.
4. Riemann, Hans P. and Dean O. Cliver, Food Borne Infections and Intoxications, 3rd Edition, Academic Press/Elsevier, 2006.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	2	-	-	2	-	-	-	1	2	2
CO2	2	-	2	-	2	-	-	2	-	-	2	3	2	2
CO3	2	-	2	-	2	-	-	2	-	-	2	3	3	3
CO4	2	-	2	-	2	-	-	2	-	-	2	3	3	3
CO5	2	-	2	-	2	-	-	2	-	-	2	3	3	3

FT23256	ENZYMES IN FOOD PROCESSING	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	learn about enzymes and their application in processing and development of food products
2.	study about enzymes in milk processing
3.	understand about enzyme in bread and non-bread making
4.	impart knowledge on enzymes in brewing
5.	make use of enzymes in processing of meat and meat products

UNIT I	ENZYME KINETICS AND INDUSTRIAL PRODUCTION OF ENZYMES	9

History of Enzymes in food technology, Nomenclature of enzymes, Enzymology; Functions, chemistry, specificity, mechanisms, substrate complex and chemical equilibrium; Enzyme kinetics- Enzyme and substrate concentration, allosteric, cofactors, coenzymes and inhibitors; food enzymes, enzyme allergy.

UNIT II	ENZYMES IN DAIRY PRODUCTS	9

Enzyme in dairy product manufacture - Introduction, milk clotting enzymes, nature and identity of rennet's and coagulants; main characteristics of rennet's and coagulants from different source, production; formulation and standardization of rennet and coagulants; types of enzyme - enzyme addition technology, enzyme modified cheese technology, lysozyme, transglutaminase, lipase and lactase.

UNIT III	ENZYMES IN BREAD AND NON-BREAD MAKING	9

Enzymes in bread making and non-bread wheat based foods - Wheat, wheat flour constituents, starch, gluten, non-starch polysaccharides and lipase; Enzyme in bread making (Amylases, classification, amylases in bread making, other amylases and anti-staling enzymes), xylanases, lipases, oxidoreductases, proteases and other enzymes; functionalities of enzymes in wheat-based, non-bread products.

UNIT IV	ENZYMES IN BREWING	9

Brewing with enzymes - Introduction, malting, brew house processing (milling, mashing, biological acidification during mashing, enzymes in lautering/ mash filtration, cellulose and starch); Pectin degrading enzymes, commercial pectinases, enzymes for fruit processing, fruit firming, vegetable processing and new trends.

UNIT V	ENZYMES IN MEAT PROCESSING	9

Enzyme in meat processing - Introduction, meat as raw materials, enzymes used for meat processing (proteases, peptidases, lipases, transglutaminase, oxidative enzymes and glutaminase); Meat tenderization with added enzymes, enzymatic generation of flavour in meat products; structure engineering by cross-linking enzymes and other applications.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	infer the enzyme kinetics and production of industrial enzymes	Understanding (K2)

CO2	select suitable enzymes for dairy products	Applying (K3)
CO3	choose appropriate enzymes for bread and non-bread products	Analyzing (K4)
CO4	apply and relate the effect of enzymes in brewing process	Applying (K3)
CO5	select suitable enzymes for meat processing	Understanding (K2)

TEXT BOOKS

1. Robert J. Whitehurst & Maarten van cort, 'Enzymes in Food Technology", 2nd Edition, John Wiley & Sons, UK, 2009
2. Robert Rastall, 'Novel Enzyme Technology for Food Applications", 1st Edition, Wood head Publications, USA, 2007.

REFERENCES

1. Muthusamy Chandrasekaran, "Enzymes in Food and Beverage Processing", 1st Edition, CRC Press, USA, 2016.
2. Singh, N., & Kaur, L. (2006). Technology of enzymes: An Introduction for Students of Food Science and Agriculture. Elsevier.
3. Trevor Palmer, Enzymes IInd Horwood Publishing Ltd
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	1	3	2
CO5	3	3	-	-	1	-	-	-	-	-	-	-	3	2

FT23257	FUNCTIONAL FOOD AND NUTRACEUTICALS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	familiarize with classification and significance of nutraceuticals
2.	study about flavonoids and carotenoids
3.	understand omega 3 fatty acids and cla
4.	understand the lycopene, probiotics and prebiotics
5.	gain knowledge on standards, regulations and herbs as functional food.

UNIT I	CLASSIFICATION AND SIGNIFICANCE	9

Introduction to Nutraceutical Industry Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, classification of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes. Scope involved in the industry, Indian and global scenario.

UNIT II	FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS	9

General background on phytochehemicals as antioxidants - Flavonoids and Lipoprotein oxidation - Evidence for specific Antioxidant mechanisms of Flavonoids - Dietary carotenoid and carotenoid absorption - Approaches to measurement of absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents.

UNIT III	OMEGA-3 FATTY ACIDS AND CLA	9

Introduction to Lipoprotein metabolism – PUFA and Cardiac Arrhythmias - Preventative role of n-3 fatty acids in cardiac arrhythmias -Mechanism of action on n-3 PUFA's - ω – 3 fish oils and their role in Glycemic control- ω –3 fatty acids and rheumatoid arthritis - Chemistry and Nomenclature of CLA – Analysis of CLA in food and biological samples – CLA in food products and biological samples – Biological actions and potential health benefits of CLA – Mechanisms of CLA action – Potential adverse effects of CLA

UNIT IV	LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS	9

Lycopene overview – lycopene and disease - Garlic – Chemistry – Implication in Health - Olive oil – CHD – Cancer - Nuts – Nutrient components and Composition – Nut Consumption and CHD epidemiological evidence, Human nutritional studies on nut consumption and serum lipid changes, Mechanism of action- Probiotics- criteria – products on market – probiotic products – Microbiology of the gastrointestinal tract - Prebiotics – future for probiotics and prebiotics.

UNIT V	HERBS AS FUNCTIONAL FOODS, STABILITY, TESTING AND MARKETING ISSUES FOR NUTRACEUTICALS & FUNCTIONAL FOODS	9

Herbal medicine – Herbs as ingredients in functional food – actions of herbal and evidence of efficacy - Kinetic modelling of chemical reactions – Accelerated shelflife testing - Evolution of marketing

environment for Functional foods and nutraceuticals - Regulatory background - Introduction to consumer marketing issues for nutraceuticals - Potential product positioning.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the basics of nutraceuticals and phytochemicals.	Understanding (K2)
CO2	evaluate the methods used for assess the activity of antioxidants	Analyzing(K4)
CO3	analyze the soluble component of food products using qualitative and quantitative methods	Analyzing(K4)
CO4	apply and analyze the role of nutraceuticals and functional foods in health aspects	Analyzing(K4)
CO5	to develop methods for extraction and identification of nutraceuticals significant molecules.	Applying (K3)

TEXT BOOKS

1. Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2007.
2. Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC, 2006.

REFERENCES

1. Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.
2. Gibson, G.R. and C.M.Willams. "Functional Foods: Concept to Product". Woodhead, 2000.
3. Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, CRC, 2001.
4. Clare M. Hasler., "Regulation of Functional Foods and Nutraceuticals: A Global Perspective", 1st Edition, Wiley, Chicago, 2008.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	-	-	-	-	1	2	2	2
CO2	3	2	3	3	3	3	-	-	-	-	1	3	2	2
CO3	2	2	3	3	3	3	-	-	-	-	2	3	2	2
CO4	3	3	1	2	3	2	-	-	-	-	1	2	2	2
CO5	2	2	1	2	3	2	-	-	-	-	2	2	2	2

FT23351	MEAT PROCESSING TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	understand the basic principles of meat processing
2.	describe the various processing technologies including slaughtering, cutting, deboning, grinding, mixing and packaging
3.	evaluate the impact of processing conditions on the quality and safety of meat products
4.	develop skills in meat processing equipment operations and maintenance
5.	understand the importance of sanitation and hygiene in meat processing

UNIT I	INTRODUCTION	9

Types of Meat and its sources, composition, structure, of meat and meat products. Definition of muscle and Composition of muscle. Different types of stunning methods., Chemical and biochemical constitution of muscle Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products, Poultry Meat Tenderness, Pale, Soft, and Exudative Poultry Meat. Poultry dressing - ante and postmortem examination. Transportation to slaughterhouse.

UNIT II	SLAUGHTERING AND CUTTING	9

Meat: Basic preparatory procedures. Cured and smoked meats. Ante mortem handling, slaughtering of animals, modern abattoirs, Abattoir – Definition and construction. Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Meat tenderization – natural and artificial.

Poultry: Slaughterhouse Building and Facility Requirements, Slaughtering Equipment and Operations, Poultry Carcass Evaluation and Cutting, Official Control of Slaughterhouses and Processing Plants

UNIT III	NOVEL PROCESSING TECHNIQUES	9

Theory of irradiation of foods, Irradiation equipment, Future role for irradiation in the preservation of foods, High-pressure processing of meat and meat products, High-pressure applications, High-pressure equipment, Future role for high pressure in the preservation and decontamination of foods.

UNIT IV	NOVEL PACKAGNG AND MEAT FUNCTIONALITY	9

Case-ready packaging, Theory of MAP/oxygen scavenging technology for meat products, Future role for novel packaging systems in the preservation of meat, Probiotic functionality in meat, Selection of probiotics, Probiotic meat products, Disease prevention by probiotics

UNIT V	ASSESMENT TECHNIQUES FOR MEAT QUALITY AND SAFETY	9

Theory of high rapid methods, Rapid method tools, The use of hyperspectral techniques in evaluating quality and safety of meat and meat products, Applications in evaluating quality and safety of meat and meat products, Advantages and disadvantage of hyperspectral techniques in meat application

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the meat processing principles and technologies	Understanding (K2)

CO2	analyze the quality and safety aspects of meat processing including HACCP and SSOP	Analyzing (K4)
CO3	apply process optimization and control principles to meat processing, including temperature control and packaging	Applying (K3)
CO4	analyze and describe about the different types of meat processing equipment and their applications	Analyzing (K4)
CO5	understanding the quality and safety aspects of meat processing	Understanding (K2)

TEXT BOOKS

1. Advances in Meat Processing Technologies: Modern Approaches to Meet Consumer Demand Authors: Daneysa L. Kalschne, Marinês P. Corso and Cristiane Canan 2020
2. Emerging Technologies in Meat Processing Production, Processing and Technology edited by Enda J. Cummins

REFERENCES

1. Mead, G., Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
2. Lawrie, R.A., Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3. Isabel Guerrero- Legarreta, "Handbook of Poultry Science and Technology", Wiley, 2010. 4. Jhari Sahoo, "Textbook on Meat, Poultry and Fish technology", Daya Publishing House, 2016.
4. Joseph Kerry, John Kerry and David Ledwood., Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	-	2	2	1	-	3	3	2
CO2	3	3	-	2	2	-	-	-	-	1	-	3	3	2
CO3	3	3	2	2	-	3	-	2	2	1	-	3	3	2
CO4	3	3	-	2	1	-	-	-	-	1	-	3	3	2
CO5	3	2	-	2	-	1	-	2	2	1	-	3	3	2

FT23352	MANAGEMENT OF HALAL FOODS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	provide an insight for better explanation about the principles, theories and Islamic rule for halal
2.	equip students with skills to ensure the sharia conformity of products and services in halal industries.
3.	provide a framework of the professional disciplines such as Islamic values, halal certification, halal supply chain management.
4.	develop the students' ability to analyse the halal food and solve problems
5.	allow individuals to develop their knowledge for resolving the halal food issues relating to the production and marketing the foods

UNIT I	INTRODUCTION OF HALAL FOOD	9

Introduction to Halal, Halal and Holy Quran, Sources of Halal instructions, Halal foods in Islam, Difference between halal and haram foods, principles of Halal food, International role of Halal administration, five ruling in Islamic jurisprudence, Halal slaughtering process

UNIT II	HALAL MANAGEMENT SYSTEM	9

Halal control system, Halal Standards, Procedures, Policies, HCCP, and internal committee, Local and Global Halal Food Authority, Contemporary issues in Halal affairs, Halal Platform, Kosher and Halal food product certification

UNIT III	HALAL CERTIFICATION & ACCREDITATION SYSTEM	9

Halal Food Interpretation, Halal Pharmaceuticals, Role of Halal Integrity, Relationship between Halal, Hygienic and Safeness of Food/Consumables, Halal supply chain, International and Indian Certification bodies, WHFC, Jamiat Ulama-i-Hind Halal Trust

UNIT IV	GUIDLINES PREPARATION	9

Sources of Halal food and drinks; Land animals, Water animals, Plants, Drinks, Usage of Halal labels, Hygiene/Sanitation of Halal food preparation, Presentation and Storage of Halal food.

UNIT V	HALAL FOOD MARKETS AND ITS PROSPECTS	9

Market Size and major Market Development for Halal Industry, Global Halal Market, Major Market development, Increasing Global Competition, Halal Banking and Finance, Difference between conventional financing and Islamic financing, Halal Auditing Procedures, Halal Monitoring, Traceability & Verification

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand skills and knowledge in the field of halal products	Understanding (K2)
CO2	use Islamic principles to analyse the juridical opinions on halal products	Applying (K3)
CO3	use relevant skills learned about halal products	Applying (K3)

CO4	analyse issues and demonstrate skilfulness in planning, executing and evaluating strategies and action plans.	Analyzing (K4)
CO5	demonstrate commitment to ethics, autonomy, and professionalism in the workplace and everyday life.	Understanding (K2)

TEXT BOOKS

1. Yunes Ramadan Al-Teinaz, Stuart Spear, Ibrahim H. A. Abd El-Rahim, The Halal Food Handbook, Ist Edition, John Wiley & Sons Ltd., 2020.
2. Mian N. Riaz, Muhammad M. Chaudry, Handbook of Halal Food Production, Ist Edition, CRC Press, 2019.

REFERENCES

1. Azhar ul-Haq Lodhi. Understanding Halal Food Supply Chain, Kindle Edition, HFRC UK Ltd., 2013.
2. Khan MI, Aabid H (2016) Understanding "Halal" and "Halal Certification" and Accreditation System"-A Brief Review, Saudi Journal of Business and Management Studies, Volume 1, Issue 5, Page number 32-42.
3. Qureshi SS, Jamal M, Qureshi MS, Rauf M, Syed BH, Zulfiqar M, Chand Naila (2012). A Review of Halal Food with special reference to Meat and its trade potential. Issue 22, Page number 79-83.
4. Nooreen NAA, Nurul AAA, Nurul AAA, Omar Z, Hassan, WHAH (2015). A review on the Emergence and Growth of Halal Studies. Procedia Economics and Finance, Issue 31, Page number 325-332.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	-	3	3	-	2	-	2	-	-	-	-	1	3	2
CO3	2	2	3	3	-	-	3	-	-	-	-	-	2	2
CO4	3	2	2	-	-	1	-	-	1	-	-	-	2	3
CO5	2	2	3	2	-	1	-	-	1	-	-	-	2	3

FT23353	POULTRY PRODUCTION I	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	familiarize with anatomy and physiology of poultry
2.	study about different breeds and breeding methods
3.	understand egg and egg products
4.	understand the incubation and hatchery systems
5.	gain knowledge on brooding and feeding

UNIT I	ANATOMY, PHYSIOLOGY OF POULTRY AND POULTRY PLANT	9

External anatomy of chicken duck and turkey; Feathers of fowl; Skeleton system of fowl; Respiratory system of fowl; Digestion system of fowl; Reproduction system of fowl; Endocrine system of fowl; Laying cycle, regulation of laying cycle; Broodiness; Poultry industry in India; Design and construction of small poultry plant.

UNIT II	BREEDS AND BREEDING OF POULTRY	9

Characteristics of poultry; Classification of birds; Breeds of chicken: American class, Plymoth Rock, Rhode Island, New Hampshire; Mediterranean class: Leghorn, Anconas; Indian Breeds: Assel, Busra, Karaknath; Breeds of duck: Pekin, Aylesbury, Indian Runner; Genetics; Inheritance of plumage colour and quantitative characters; selection of breeders, heritability, pressure; Breeding methods; System of breeding; Modern methods of breeding; Slaughtering Process.

UNIT III	INCUBATION AND HATCHERY MANAGEMENT	9

Development of chick; Selection, care and storage of hatchery eggs; Methods and factors for incubation; Moder hatcheries; incubators; testing of eggs; photoacceleration and embryonic growth; Hatchery hygiene; Hatchery business.

UNIT IV	POULTRY BROODING AND FEEDING	9

System of brooding; Brooder house: preparation schedule upto 4 weeks age; Brooding requirements; Feeding: Composition of poultry feed; Nutrition requirements of poultry; Feed formulation; Quality control and ISI specification for poultry feed and rations; Methods of feeding poultry; management of growers layers and broilers.

UNIT V	EGGS, BROILERS, TURKEY	9

Structure and Composition of Egg; Egg Formation; Regulation of female reproduction; Grading; Preservation; Management of egg production; Marketing of eggs; Egg powder Processing; Broiler chicken meat and its production; turkey meat.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand about the different anatomical and physiological systems in poultry	Understanding (K2)

CO2	identify different breeds of poultry and breeding systems.	Understanding (K2)
CO3	assess the structures and products of egg	Analyzing(K4)
CO4	identify the pros and cons of incubation and hatchery systems	Analyzing(K4)
CO5	understand the brooding and feeding systems.	Understanding (K2)

TEXT BOOKS

1. RA Singh, Poultry Production, Kalyani Publishers, New Delhi, 2012
2. Colin G Scanes, George Brant, M.E.Ensminger, Poultry Science, 5th Edition, Waveland Press, 2020

REFERENCES

1. Lawrie, R.A., Meat Science, 9th edition. Pergamon Press, Oxford, UK.2022
2. Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
3. Mead, G., Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
4. Stadelmen, W.J. and Cotterill, O.J., Egg Science and Technology, Second Edition, AVI, Westport, 1977.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	2	2	2	1	-	-	-	1	2	2	2
CO2	3	3	2	3	3	3	2	-	-	-	1	3	2	2
CO3	3	2	2	2	3	3	1	-	-	-	1	3	3	2
CO4	3	3	2	3	3	2	2	-	-	-	1	2	2	2
CO5	3	3	2	3	3	2	2	-	-	-	1	2	2	2

FT23354	POULTRY PRODUCTION II	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. familiarize with housing and equipment's.
2. study about production and processing of poultry meat.
3. understand preservation and packaging techniques of meat.
4. understand the meat ingredients and alternatives.
5. gain knowledge on food safety and economics of poultry farming.

UNIT I	HOUSING AND EQUIPMENTS	9

Location of Poultry farms; Factors influencing design of poultry house; Requirement for floor space, feeders and waterers; Orientation of house; Light in poultry house, Poultry house, hatchery, brooder house, broiler house, layer house; poultry processing unit; feed mill; cage house, equipment feeders, catching equipment's, hatchery equipment's

UNIT II	PRODUCTION AND PROCESSING OF POULTRY MEAT	9

Introduction; Broiler industry in India; Processing of poultry meat; Factors affecting poultry meat yields; Microorganisms in poultry meat; Inspection and grading of poultry meat; Composition and nutritive value of poultry meat;

UNIT III	PRESERVATION AND PACKAGING	9

Biochemical Changes During Onset and Resolution of Rigor Mortis Under Ambient Temperature, Physicochemical Changes During Freezing and Thawing of Poultry Meat, Low-Temperature Storage of Poultry; Smoking; Curing; Fermentation; Dehydration; Packaging Materials used for fresh meat and muscle based products.

UNIT IV	INGREDIENTS: PAST & FUTURE ROLE IN PROCESSED MEAT MANUFACTURE& MEAT ALTERNATIVES	9

Past Role: Scientific modelling of blended meat products; Blood by-products as ingredients in processed meat, Utilization of hydrocolloids in processed meat systems, Use of cold-set binders in meat systems.
Future Role: Using natural and novel antimicrobials to improve the safety and shelf-life stability of processed meat products, The use of nutraceuticals in processed meat products and their effects on product quality, safety and acceptability Use of probiotics and prebiotics in meat products; History of meat alternatives, Plant based meat, Market for plant-based alternatives, Meat alternatives health benefits.

UNIT V	FOOD SAFETY AND ECONOMICS OF POULTRY FARMING	9

Food safety aspects of egg and poultry meat; Role of USDAs Food safety and Inspection Service; Irradiations; Antibiotics; benefits and limitation of poultry farming, planning of poultry projects; economics of egg production; factors affecting economic returns; efficient marketing; Economics of broiler production; Cost of broiler production, economics of duck production.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand about the housing and equipment's.	Understanding (K2)
CO2	identify the meat and the process of meat.	Understanding (K2)
CO3	identify the exact preservation and packaging methods.	Analyzing(K4)
CO4	understand meat alternatives.	Understanding (K2)
CO5	identify the pros and cons to setup poultry farm.	Applying (K3)

TEXT BOOKS

1. RA Singh, Poultry Production, Kalyani Publishers, New Delhi, 2012
2. Colin G Scanes, George Brant, M.E.Ensminger, Poultry Science, 5th Edition, Waveland Press, 2020

REFERENCES

1. Lawrie, R.A., Meat Science, 9th edition. Pergamon Press, Oxford, UK.2022
2. Joseph Kerry, John Kerry and David Ledwood., Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
3. Mead, G., Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
4. Stadelmen, W.J. and Cotterill, O.J., Egg Science and Technology, Second Edition, AVI, Westport, 1977.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	2	2	1	-	-	-	1	2	2	2
CO2	3	3	2	3	3	3	2	-	-	-	1	3	2	2
CO3	3	2	2	2	3	3	1	-	-	-	1	3	3	2
CO4	3	3	2	3	3	2	2	-	-	-	1	2	2	2
CO5	3	3	2	3	3	2	2	-	-	-	1	2	2	2

FT23355	MARINE FOOD PROCESSING TECHNOLOGY I	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. understand the fundamentals of marine food processing technology
2. describe the different types of marine food processing technologies
3. analyze the quality and safety aspects of marine food processing and the technologies involved
4. ensure consistent product quality and efficient processing operations
5. design and develop new products and processes that meets industry needs and consumer demands

UNIT I	INTRODUCTION	9

Introduction to sea food, seafood spoilage, seafood hazards, optimum quality of raw materials- premortem handling, post- mortem handling, seafood processing, quality, safety and authenticity assurance, future trends health hazards associated with molluscan shellfish, shellfish harvesting, growing area, temperature control, bivalve shellfish reputation.

UNIT II	FISH PROCESSING	9

Chilling and freezing of fish- Post-mortem changes at chilled storage temperatures, Effect of freezing temperature on quality-related processes, Fresh fish chain, Handling and processing on board fish vessels, Landing, sorting and first sale, Transport and wholesaler/central storage Heat processing of fish- Basic principles, best available technology for thermal processing of fish, Quality changes during heat treatment of fish.

UNIT III	IRRADATION OF FISH AND SEA FOOD	9

Quality of irradiated fish and fishery products and shelf-life extension, Shellfish, crustaceans and mollusks, Microflora of irradiated fish and fishery products, preservation of fish by curing- salting, marinating, smoking.

UNIT IV	DRYING OF FISH AND FERMENTATION	9

Principles of drying, drying methods, changes in fish muscle during drying, packaging and storage of dried fish products, Fish fermentation- fermented foods worldwide, lactic acid fermentation, traditional fish fermentation, future trends in fish fermentation technology.

UNIT V	PACKAGING OF FISH AND FISHERY PRODUCTS	9

MAP principles and importance for packaging fresh fish, Non microbial effects of MAP, Effects of MAP on fish spoilage, Application of MAP on fish and fishery products, Packaging materials and future developments

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	have knowledge on the principles of fish handling and storage	Understanding (K2)
CO2	analyze the quality and safety aspects of sea food processing	Analyzing (K4)

CO3	analyze and describe about the quality and safety aspects of sea food processing	Analyzing (K4)
CO4	apply haccp principles to sea food processing and their technologies	Applying (K3)
CO5	evaluate the economic and environmental impacts on sea food processing	Applying (K3)

TEXT BOOKS

1. Seafood processing: technology, quality and safety, Ioannis S. Boziaris. School of Agricultural Sciences, University of Thessaly, Volos, Greece, published 2014
2. Innovative technologies in sea food processing Yesim Ozogul, 2019.

REFERENCES

1. The sea food industry - spices, products and processing Linda Ankenman Granata, George J. Flick, Jr., Roy E. Martin · 2012
2. Venugopal, V. "Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methods" (Food Science and Technology Vol. 13) , CRC press, 2006.
3. Ioannins S boziaris, "Seafood Processing – Technology, Quality and Safety", Wiley Blakwell, 2014.
4. Seafoods: Chemistry, Processing Technology and Quality, Fereidoon Shahidi, J.R. Botta, 2012

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	-	2	2
CO2	2	3	3	2	3	-	2	-	-	-	-	2	3	2
CO3	2	2	3	2	-	-	1	-	-	1	-	2	2	2
CO4	3	2	2	1	-	1	-	-	-	-	2	-	2	3
CO5	3	3	3	1	1	3	-	-	-	1	2	2	3	3

FT23356	MARINE FOOD PROCESSING TECHNOLOGY II	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand the principles of quality assessment and safety of fish processing, including the importance of GMPs and HACCP
2.	know the different types of fish processing technologies
3.	understand the microbiological chemical and physical hazards associated with fish processing
4.	get the familiarity about the regulatory requirements and standards for fish processing
5.	understand the principle of sensory evaluation and quality control in fish processing

UNIT I	QUALITY ASSESMENT AND SAFETY	9

Categories of fish species, fish muscle, nutritional composition, fish freshness and quality relationship, sensory methods- EU quality grading schemes, the tory scheme for cooked fillets, quality index method, chemical methods, physical methods, instrumental methods and automation, imaging technologies and machine vision.

UNIT II	MICROBIAL EXAMINATION OF SEA FOOD	9

Seafood microbiology- indigenous microbiota, contamination (exogenous) microbiota, spoilage microbiota, pathogenic microorganisms, Microbial parameters in seafood analysis- microbiological analysis using conventional culture techniques, microbial examination using indirect rapid methods, microbiology based rapid methods, immune- based techniques- molecular methods for microbial determination, detection and quantification of microorganisms.

UNIT III	FISH AND SEAFOOD AUTHENTICITY	9

Molecular techniques applied to food authentication – molecular markers, reference material, databases, molecular techniques based on protein analysis – electrophoretic techniques, HPLC, immunological techniques, Molecular techniques based on DNA analysis – PCR, PCR- Restriction fragment length, polymorphism, real time PCR.

UNIT IV	ASSURING SEAFOOD SAFETY- RISK ASSESMENT	9

Hazards, risks and food safety risk assessment, Hazard identification/ risk analysis, exposure assessment, hazard characterization, Methods for risk assessment- semi- quantitative risk assessment, reality check, uncertainty and variability, risk management approaches.

UNIT V	FISH WASTE MANAGEMENT SYSTEM	9

Treatment methods- hydrolysis, bioremediation, anaerobic treatment, filtration/ screening, miscellaneous/ multifunctional methods, Uses of fish waste- animal feed, biodiesel/ biogas, natural pigments, food industry/ cosmetics, waste management, miscellaneous waste.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understanding the role of quality control in ensuring sustainability of fish processing technologies	Understanding (K2)
CO2	analyze the importance of the quality assessment and safety in fish processing	Analyzing (K4)
CO3	apply critical thinking and problem-solving skills to quality assessment and safety issues in fish processing	Applying (K3)
CO4	analyze and identify the controlling hazards in fish processing	Analyzing (K4)
CO5	understand the quality control, food safet, and regulatory compliance in fish processing industry	Understanding (K2)

TEXT BOOKS

1. Seafood processing: technology, quality and safety, Ioannis S. Boziaris. School of Agricultural Sciences, University of Thessaly, Volos, Greece, published 2014
2. Innovative technologies in sea food processing Yesim Ozogul, 2019.

REFERENCES

1. The sea food industry - spices, products and processing Linda Ankenman Granata, George J. Flick, Jr., Roy E. Martin · 2012
2. Venugopal, V. "Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methods" (Food Science and Technology Vol. 13) , CRC press, 2006.
3. Ioannins S boziaris, "Seafood Processing – Technology, Quality and Safety", Wiley Blakwell, 2014.
4. Seafoods: Chemistry, Processing Technology and Quality, Fereidoon Shahidi, J.R. Botta, 2012

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	-	2	2
CO2	2	3	3	2	3	-	2	-	-	-	-	2	3	2
CO3	2	2	3	2	-	-	1	-	-	1	-	2	2	2
CO4	3	2	2	1	-	1	-	-	-	-	2	-	2	3
CO5	3	3	3	1	1	3	-	-	-	1	2	2	3	3

FT23357	HACCP IN MEAT, POULTRY AND FISH PROCESSING	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand principles of HACCP and its applications in meat, poultry and fish processing
2.	identify hazards in meat, poultry and fish processing
3.	create HACCP plans that identifies critical control points, and establishes critical limits
4.	apply HACCP principles to prevent foodborne illness
5.	develop food safety management system based on HACCP principles, policies and procedures

UNIT I	INTRODUCTION	9

The origin and concept of HACCP, Development of the HACCP concept, HACCP- A new approach, HACCP- A preventative system, Acceptance of HACCP by the food industry, Establishment of HACCP by other companies, industrial responsibility and HACCP, critical control point for various methods, In-plant testing of HACCP methods, current HACCP issues, quadrilateral discussions on food safety.

UNIT II	IMPLEMENTATION OF HACCP PROGRAMS	9

Livestock quality assurance programs, purpose of HACCP, development of the HACCP programs, implementation of the HACCP programs, reasons for using HACCP, developing HACCP plans, Critical control points for critical limits, monitoring, HACCP in seafood industry, HACCP in seafood safety, NMFS HACCP programs, FDA's HACCP program, general sanitation and control procedures.

UNIT III	RISK ANALYSIS, HACCP AND MICROBIAL CRITERIA	9

Risk analysis- how risk analysis and HACCP contribute to food safety, HACCP versus end product microbial testing, sampling procedures, deposition of products, statistical process control, importance of quality, total quality management, modern quality management, Implementation of HACCP and TQM.

UNIT IV	HACCP DELICATESSENS, AND FOOD SERVICE OPERATIONS	9

Potential hazards- raw materials and ingredients, handling and storage, hazard controls- controls at receiving, storage, food preparations, thawing frozen foods, cooking, cooling, reheating, display and sanitation, monitoring, verification, the safety assurance component of quality, food science and HACCP principles, food operations hazard analysis.

UNIT V	HACCP PROGRAM AND THE CONSUMER	9

The HACCP program, HACCP and the consumer, applications of HACCP principles for consumers, documentation of HACCP systems, predictive modelling and HACCP, examples and applications of predictive models In HACCP programs, agencies and functions, domestic interest and cooperation, international interests and cooperation, opportunities to increase cooperation.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understanding the impact of processing on the quality and nutritional value of meat, poultry and fish products	Understanding (K2)

CO2	know the industrial trends and development in meat, poultry and fish processing	Understanding (K2)
CO3	ability to operate and maintain meat, poultry and fish processing equipment	Applying (K3)
CO4	implement and maintain HACCP and SSOPS in meat, poultry or fish processing plant	Analyzing (K4)
CO5	understanding and the ability to conduct sensory evaluation of meat, poultry and fish	Understanding (K2)

TEXT BOOKS

1. HACCP in meat, poultry and fish processing edited by A.M. PEARSON and T.R. DUTSON Oregon states university 2012
2. Textbook on meat poultry and fish technology Jhari Sahoo, Manish Kumar Chatli 2015

REFERENCES

1. HACCP in meat industry by M. Brown
2. Fisheries processing- biotechnological applications A.M. Martin · 2012
3. The science of poultry meat processing Shai Barbut · 2016
4. HACCP and ISO 22000: Applications of animal origin Ioannis S. Arvanitoyannis · 2009

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	3	-	-	-	2	-	-	-	1	1
CO2	3	2	2	2	2	2	-	1	2	-	-	-	-	3
CO3	3	2	-	2	-	3	2	2	2	-	-	-	-	-
CO4	2	2	2	-	-	1	-	1	-	2	-	-	-	2
CO5	3	2	-	2	1	1	1	-	-	3	-	-	-	2

FT23451	PRINCIPLE OF NUTRITION	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	understand the fundamentals and history of nutrition science and RDAs.
2.	learn the structure, functions, and metabolism of carbohydrates and dietary fiber.
3.	study lipids, energy balance, and methods of energy estimation.
4.	understand proteins, amino acids, and protein-energy malnutrition.
5.	gain knowledge about macro and micro minerals and their health impacts.

UNIT I	NUTRITION SCIENCE AND DIETARY ALLOWANCES	9

Nutrition science Definitions and History; Nutrition Research in India; Recent Findings; Future Research; Factors Affecting RDA; General Principles of Deriving RDA; Determination of RDA of Different Nutrients Requirements and RDA; Indian Standards for Heights and Weights; Reference Man and Woman; Practical Applications of RDA; Food Guide.

UNIT II	CARBOHYDRATES AND DIETARY FIBRE	9

Classification; Functions; Digestion; Absorption; Glycaemic Index; Metabolism; Maintenance of Blood Glucose Levels; Recommended Dietary Allowances and Sources; Physiological and Metabolic Effects; Components of Dietary Fibre and Sources; Role of Fibre in the Prevention of Diseases.

UNIT III	LIPIDS AND ENERGY BALANCE	9

Classification; Chemical Composition; Fats in the Body; Fats in the Food; Functions; Digestion and Absorption; Transport and Metabolism; Essential Fatty Acids; Recommended Dietary Allowances and Sources; Dietary Fat and Coronary Heart Disease; Recommendation on Fat Components of Diet; Direct and Indirect Calorimetry; Determination of Energy Value of Food; Total Energy Requirement; Factors Affecting Physical Activity; Factors Affecting Basal Metabolic Rate and Sources; Factors Affecting Thermic Effect of Food Recommended Dietary Allowances.

UNIT IV	PROTEINS AND PROTEINS MALNUTRITION	9

Proteins - Chemical Composition; Properties; Classification; Nutritional Classification of Proteins; Nutritional Classification of Amino Acids Functions; Specific Functions of Amino Acids; Digestion and Absorption; Requirements and Sources; Metabolism; Quality of Proteins; Complementary Value of Proteins; Recommended Dietary Allowances (RDA); Protein Energy Malnutrition – Prevalence, Aetiology, Clinical Features, Prevention; Secondary PEM.

UNIT V	MICRO AND MACRO MINERALS	9

Macro Minerals – Calcium, Functions, Absorption, Metabolism, Osteoporosis, Hypocalcaemia, Hypercalcaemia, Excess Intake of Calcium, Recommended Dietary Allowances, Sources; Phosphorus – Functions, Absorption and Metabolism, Deficiency, Recommended Dietary Allowances, Sources, Magnesium; Micro Minerals-Distribution, Functions, Absorption and Metabolism, Factors Affecting Absorption of Non-Haeme Iron, Overload, Requirements, Recommended Dietary Allowances;

Nutritional Anaemia; Iron Deficiency Anaemia; Micro Minerals-Functions, Absorption and Metabolism, Iodine Deficiency Disorders, Recommended Dietary Allowances.		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand nutrition science, RDA concepts, and practical applications.	Understand (K2)
CO2	know carbohydrate and fiber types, functions, and disease prevention roles.	Apply (K3)
CO3	explain lipids, energy metabolism, and energy requirement estimation.	Analyse (K4)
CO4	understand protein functions, digestion, and protein malnutrition management.	Apply (K3)
CO5	identify the roles and requirements of key minerals in human health.	Analyse (K4)

TEXTBOOKS

1. Srilakshmi B. *Nutrition Science*, New Age International Publishers, Fifth Edition.
2. Mudambi S.R. & Rajagopal M.V. *Fundamentals of Foods, Nutrition and Diet Therapy*, New Age International, Latest Edition.

REFERENCES

1. Krause's Food & the Nutrition Care Process by Mahan & Raymond
2. Wardlaw G.M. & Smith A.M. *Contemporary Nutrition*, McGraw Hill Education.
3. Shubhangini A. Joshi *Nutrition and Dietetics*, Tata McGraw-Hill Education.
4. WHO/FAO Reports *Human Vitamin and Mineral Requirements*, WHO, FAO

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	-	-	-	-	-	3	-	2	3
CO2	3	2	2	3	1	-	-	-	-	3	2	-	2	2
CO3	3	3	3	3	2	-	-	-	-	-	3	3	1	2
CO4	3	3	2	3	1	1	-	-	-	-	-	3	2	1
CO5	3	2	2	3	2	1	-	-	2	1	-	-	3	2

FT23452	NUTRITION LIFE CYCLE	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	introduce the basic principles of nutrition science and the role of nutrients in maintaining health.
2.	understand the nutritional and food requirements of individuals at different stages of life, from infancy to old age.
3.	study nutrition-related health problems and appropriate interventions across age groups.
4.	explore the physiological changes and dietary needs of pregnant and lactating women.
5.	promote awareness about national feeding programs and dietary guidelines in India.

UNIT I	INTRODUCTION TO NUTRITION SCIENCE	9

Principles of the Science of Nutrition–Essential and non-essential nutrients – Macronutrients and micronutrients: Nutrition labelling: Nutrition Facts Panel, ingredient list, dietary supplements – Functional foods and herbal remedies – Nutrition across the life stages:

UNIT II	NUTRITIONAL AND FOOD REQUIREMENTS OF ADULTS TO INFANTS	9

Nutritional Requirements, Food Requirements for Adults; Growth And Development During Infancy; Nutritional Requirements, Food Requirements for Infants; Low Birth Weight; Preterm Baby; Weaning.

UNIT III	NUTRITIONAL AND FOOD REQUIREMENTS OF 1-12 YEARS	9

Nutritional and Food Requirements For 1-6; Nutritional Related Problems Of Pre-Schoolers; Feeding Programmes; Nutritional and Food Requirements For 6-12 Years; Packed Lunches; School lunch Programmes.

UNIT IV	NUTRITIONAL AND FOOD REQUIREMENTS OF MOTHERS AND LACTATING WOMEN	9

Physiological Changes; Preconceptual Nutrition; Nutritional Requirements Food Requirements; General Dietary Problems; Complications; Indian Pregnant Woman; Role of Hormones in Milk Production; Nutritional Requirements; Food Requirements; Indian Nursing Mothers.

UNIT V	NUTRITIONAL AND FOOD REQUIREMENTS DURING OLD AGE	9

Process of Ageing; Food Requirements; Nutritional Requirements; Nutrition Related Problems of Old Age; Degenerative Diseases; Exercise and Old Age; Drugs and Old Age.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the basics of nutrition, essential nutrients, and food labelling.	Understand (K2)
CO2	know the food and nutrition needs of adults and infants.	Apply (K3)

CO3	learn the dietary needs and problems of children aged 1–12 years.	Analyse (K4)
CO4	understand nutrition during pregnancy and lactation in Indian women.	Apply (K3)
CO5	know the nutrition needs and health issues of the elderly.	Analyse (K4)

TEXTBOOKS

1. Brown, J.E. – *Nutrition Through the Life Cycle*, Cengage Learning, Latest Edition.
2. B. Srilakshmi – DIETETICS, Seventh Edition.

REFERENCES

1. Nutrition in the Life Course: A Tool for Understanding and Action.
2. Dietary Guidelines for Indians – A Manual.
3. *Nutrition: Concepts and Controversies* (15th edition) Cengage Learning.
4. *Nutrition Through the Life Cycle* (6th edition) Cengage Learning.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	1	-	-	-	-	2	1	3	2
CO2	3	2	3	3	1	-	-	-	3	2	-	2	3	3
CO3	3	2	2	3	1	-	-	-	-	3	-	2	2	3
CO4	3	3	2	3	1	1	-	-	-	-	3	1	2	2
CO5	3	2	2	2	2	1	-	-	-	-	3	1	3	3

FT23453	DIETETICS I	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	understand the principles of dietetics, responsibilities of dietitians, and dietary modifications.
2.	analyse nutritional requirements during infection, fever, and post-surgical conditions.
3.	evaluate obesity-related health risks and formulate dietary and lifestyle strategies.
4.	assess nutritional management strategies for Diabetes Mellitus and apply them to real-life scenarios.
5.	understand and interpret food sensitivities and diet plans for genetic metabolic disorders.

UNIT I	INTRODUCTION TO DIETETICS AND DIET THEORY	9

Dietetics - Classification, Code of Ethics, Responsibilities, Dietitian in India, Indian Dietetics Association; Diet Theory - Glycaemic Index, Dietary Supplement, Adjuncts to Diet theory, Food Nutrition and Drug Interaction.

UNIT II	THERAPEUTIC DIET AND DIET IN INFECTIONS AND FEVER	9

Routine Hospital Diets, Nutrition Support Services, Malnutrition in Hospitalised patients, Pre and post Operative Diets, Immuno nutrition, Nutrition Support in Burn Patients; Diet in Infectious Disease- Host Defence Mechanism; Cause, Types, General Dietary Consideration, Typhoid, Influenza, Malaria, TB, AIDS.

UNIT III	DIET IN OBESITY	9

Consequences and comorbidities associated with obesity; Aetiology of Obesity- Genetics and epigenetics, food intake and appetite, gut microbiome, obesogenic environment and behaviour, physicl activity; Weight Management- meal replacement, formula diets, fad diets and fasting; Surgical Management of weight loss in obesity.

UNIT IV	DIET IN DIABTES MELLITUS	9

Prevalence, Types, Aetiology, Symptoms, Diagnosis, Treatment, Complications, Gestational Diabetes Mellitus, Alcohol and Diabetes, Case studies.

UNIT V	FOOD SENSITIVITY AND DIET IN GENETIC DISAORDER	9

Types of Reaction (I, II, III, IV), Foods involved in sensitivity, Symptoms, Diagnosis, Treatment; Diet in Genetic Disorder- Phenylketonuria, Galactosaemia, Fructosuria, Fructose 1,6 Bisphosphate Deficiency.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	define and classify dietetics and its professional responsibilities.	Remember (K1)

CO2	analyse dietary recommendations for infections such as TB, AIDS, and malaria.	K4 (Analyze)
CO3	analyse the influence of genetics, microbiome, and environment on obesity	Analyze (K4)
CO4	apply nutritional guidelines for various types of diabetes	Apply (K3)
CO5	apply dietary modifications for metabolic disorders like PKU and Galactosaemia	Apply (K3)

TEXTBOOKS

1. B Srilakshmi (2018) Dietetics Seventh edition, New Age International Publishers.
2. Mary Hickson, Sara smith (2018), Advanced Nutrition and Dietetics in Nutrition Support, Wiley.

REFERENCES

1. Catherine Hankey, Kevin Whelan (2018), Advanced Nutrition and Dietetics in Obesity, Wiley Blackwell.
2. Dr. Fred Pender, (2008), Clinical cases in dietetics, Blackwell Publishing.
3. Esthr A. Winterfel (2022) Fundamdt, Margaret L. Bogle, Lea L. Ebro Third edition (2011), Dietetics Practice and Future Trends, Jones and Bartlett Publishers.
4. Food Safety Handbook – Ronald H. Schmidt, Gary E. Rodrick.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	-	3	2	2	-	2	-	2	3	2
CO2	2	3	2	2	-	3	-	2	-	-	-	2	3	2
CO3	2	3	3	2	-	3	3	2	-	-	-	3	3	3
CO4	2	3	3	2	-	3	2	2	-	2	-	3	3	3
CO5	2	3	2	2	-	3	-	2	-	2	-	3	3	2

FT23454	DIETETICS II	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand the role of nutrition and dietary management in chronic and metabolic diseases.
2.	identify risk factors, physiological changes, and treatment plans for cardiovascular, GI, hepatic, renal, and cancer-related conditions.
3.	develop dietary strategies specific to diseases of the liver, kidney, pancreas, and gastrointestinal system.
4.	evaluate the impact of medical therapies (e.g., dialysis, cancer treatment) on nutritional status.
5.	apply knowledge to create diet plans for disease management and explore emerging nutritional approaches in chronic illnesses.

UNIT I	DIET IN CARDIOVASCULAR DISEASE	9
Prevalence, Clinical Effect, Risk Factors, Role of Fat in the development of Atherosclerosis, Dietary Management, Hypertension, Hypercholesterolemia, Physical activity and heart disease.		

UNIT II	DIET IN GASTROINTESTINAL DISEASE	9
Indigestion, Peptic ulcer, Carcinoma of the stomach, Gastric surgery, Dumping syndrome, constipation, Lactose intolerance, Coeliac Disease, Irritable bowel syndrome.		

UNIT III	DIET IN DISEASES OF LIVER, PANCREAS, KIDNEY	9
Function of Liver, Agents responsible for liver damage, Infective Hepatitis, Cirrhosis of Liver, Hepatic Encephalopathy, Cholecystitis and Cholelithiasis, Pancreatitis.		

UNIT IV	DIET IN DISEASES OF KIDNEY	9
Kidney- Function of kidney, Glomerulonephritis, Acute renal failure, chronic renal failure, Dialysis, Urolithiasis.		

UNIT V	DIET IN CANCER	9
Risk Factor, Symptoms, General Systemic Reactions, Nutritional problems of Cancer Therapy, Nutritional Requirements, Dietary Management, Role of food in prevention of Cancer, Physical Activity and Cancer; Recent studies on specific cancer;		

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to,		BT MAPPED (Highest Level)
CO1	develop dietary recommendations and physical activity plans for heart disease	Analyse (K4)

CO2	develop nutrition therapy plans based on specific GI disorders	Analyse (K4)
CO3	analyse symptoms and diet therapy for pancreatitis and gallbladder disorders	Analyse (K4)
CO4	classify renal diseases and stages of kidney failure	Remember (K1)
CO5	analyse emerging dietary strategies for managing cancer	Analyse (K4)

TEXTBOOKS

1. B Srilakshmi (2018) Dietetics Seventh edition, New Age International Publishers.
2. Mary Hickson, Sara smith (2018), Advanced Nutrition and Dietetics in Nutrition Support, Wiley

REFERENCES

1. Catherine Hankey, Kevin Whelan (2018), Advanced Nutrition and Dietetics in Obesity, Wiley Blackwell
2. Dr. Fred Pender, (2008), Clinical cases in dietetics, Blackwell Publishing.
3. Esthr A. Winterfel (2022) Fundamdt, Margaret L. Bogle, Lea L. Ebro Third edition (2011), Dietetics Practice and Future Trends, Jones and Bartlett Publishers.
4. Food Safety Handbook – Ronald H. Schmidt, Gary E. Rodrick

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	3	3	2	-	3	2	2	-	2	-	2	2	2
CO2	2	3	3	2	-	3	-	2	-	2	-	2	2	2
CO3	2	3	2	2	-	3	-	2	-	-	-	2	2	2
CO4	3	2	1	-	-	2	-	-	-	-	-	1	2	2
CO5	2	3	2	2	-	3	2	2		2	-	3	2	2

FT23455	PUBLIC HEALTH NUTRITION	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	understand the role of nutrition in public health and disease prevention.
2.	learn about the Sustainable Development Goals (SDGs) and their impact on nutrition.
3.	gain knowledge of key public nutrition programs and interventions.
4.	understand the concept of food security and its link to public health.
5.	explore policies, ethics, and emerging issues in public nutrition.

UNIT I	INTRODUCTION TO TRADITIONAL & ORGANIC FOODS	9

Definition, history, and evolution of traditional and organic foods; Comparison: Organic, conventional, natural, functional, and traditional foods; Traditional knowledge systems and cultural heritage; Importance of biodiversity and native crop varieties; Socioeconomic role of traditional foods in rural and tribal communities.

UNIT II	SUSTAINABLE DEVELOPMENT GOALS (SDGS)	9

Introduction SDGs: Overview of the 17 Sustainable Development Goals, Transition from Millennium Development Goals (MDGs) to SDGs, Importance of SDGs in global nutrition and health; Key Nutrition-Related SDGs: Goal 2, Goal 3, Goal 6, Goal 12; Nutrition-Specific and Nutrition-Sensitive Interventions; Monitoring and Evaluation.

UNIT III	NUTRITION PROGRAMS AND INTERVENTIONS	9

Principles of program planning, implementation, and evaluation, Key Public nutrition programs: ICDS, Mid-Day Meal Scheme, Food fortification and supplementation programs, Behaviour change communication and social marketing in nutrition, public participation and empowerment strategies.

UNIT IV	FOOD SECURITY AND PUBLIC HEALTH	9

Introduction to Food Security: Definition and dimensions of food security: availability, access, utilization, and stability, Relationship between food security and public health, Concept of nutrition security; Determinants of Food Security; Global and National Status; Government Programs and Schemes; Impact on Public Health: Strategies for Ensuring Food Security.

UNIT V	ETHICS AND EMERGING ISSUES IN PUBLIC NUTRITION	9

National Nutrition Policy and Nutrition Mission, Role of public-private partnerships and NGOs, Food security and sustainability, Ethical issues in public nutrition practice, Emerging trends: climate change, urbanization, nutrition transition.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	explain the nutrition in public health and causes of malnutrition.	Understand (K2)
CO2	understand SDGs and national nutrition goals.	Apply (K3)
CO3	identify and describe major public nutrition programs and community interventions.	Apply (K3)
CO4	analyse the relationship between food security and public health outcomes.	Apply (K3)
CO5	recognize key policies, ethical concerns, and emerging challenges in public nutrition.	Analyse (K4)

TEXT BOOKS

1.Community Nutrition, By Nnakwe, Nweze Eunice Nnakwe, 2017.

2. Public Health Nutrition: Rural, Urban, and Global Community-Based Practice, edited by M. Margaret, 2020.

REFERENCES

1. Nutrition Science and Everyday Application, By Alice Callahan, Heather Leonard, Tamberly Powell · 2020.
2. Community Nutrition: Planning Health Promotion and Disease Prevention - BOOK ONLY, By Nweze Nnakwe, 2012.
3. Community Nutrition for Developing countries, Norman J. Temple, Nelia Steyn · 2016.
4. Public Nutrition for Developing Countries, edited by Norman J. Temple, Nelia Steyn, 2016.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	1	-	-	-	2	-	1	2	3	2
CO2	3	3	3	2	1	-	-	-	-	1	-	-	3	2
CO3	3	3	3	2	2	-	2	-	-	1	2	-	3	2
CO4	3	3	3	3	2	1	-	1	-	2	3	-	3	3
CO5	3	3	2	2	2	1	-	-	3	3	-	-	3	3

FT23456	SPORTS NUTRITION	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	understand the role of nutrition and energy requirements in sports performance.
2.	learn about macronutrient needs and metabolism for athletes.
3.	know the importance of vitamins, minerals, and hydration in athletic health.
4.	understand how to plan balanced diets and address special dietary needs of athletes.
5.	gain knowledge about sports supplements and doping regulations.

UNIT I	INTRODUCTION TO SPORTS NUTRITION	9

History; Organisations Working for Sports Nutrition; Importance of Nutrition in Sports; Recommended Dietary Allowances and Energy Requirements of Athletes; Recommended Dietary Allowances, Energy -Energy Metabolism in Athletes, Factors Affecting Energy Requirement of Athletes, Requirements, Sources.

UNIT II	MACRO NUTRIENTS FOR ATHLETES	9

Macro Nutrients for Athletes Carbohydrates – Classification, Functions. Digestion and Absorption, Maintenance of Blood Glucose Levels, Metabolism, Glycaemic Index and Glycaemic Load, Carbohydrate Loading, Resynthesis, Carbohydrate Ingestion and the Inflammatory Response, Requirements, Strength/Power Athletes, Sources, Supplements; Macro Nutrients of Atheletes-Proteins and Lipids – Proteins, Nutritional Classification of Amino Acids, Nutritional Classification of Proteins, Digestion and Absorption.

UNIT III	MINERALS AND VITAMINS FOR ATHLETES	9

Minerals, Calcium, Recommended Dietary Allowances; Fluid and Electrolytes for Athletes - Distribution of Water and Electrolytes, Water and Electrolyte Balance in Non-athletes; Fluid Balance and Thermoregulation; Requirements; Effects of Dehydration; Water Excess (Water Intoxication); Measuring Hydration Status, Sports Drinks.

UNIT IV	BALANCED DIETS FOR ATHLETES	9

Balanced Diets: Determinants of Food Choice, Balanced Diet, Vegetarian Diets, Planning Balanced Diets, Food Guide Pyramid (USDA), Diets for Athletes, Diets for Child/Junior Athlete, Ageing Athletes, Recommendations by NIN and SAI; Diets for Competition- Diets of Different Groups, Diets for Different Sports, Diets before the Competition, Diets on the Day, Nutrient Timing, Pre Event Meals; Diet Related Problems of Athletes: The Female Athlete Triad, Weight Control, Adjuncts of Weight Management, Travelling Athlete, Diabetic Athletes, Disabled Athletes, GI Stress and Athletes, Cramps and Stitches.

UNIT V	SUPPLEMENTS - SPORTS FOODS	9

Supplements: Creatine, Beta-alanine, Branched-chain Amino Acids (BCCAs), Beta-hydroxy Beta-methylbutyrate (HMB), 3 Fatty acids, Whey Protein, Casein, Bovine Colostrum., Soya Protein,

Glutamine, Ephedra, Caffeine, Glucoronolactone, Nitric Oxide, Sodium Bicarbonate, Spirulina, Hormonal Supplements, Antioxidants, Minerals, Herbals, Energy Gels, Protein Supplements, Meal Replacement Products (MRP), World Anti-Doping Agency (WADA).		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	explain the role of nutrition, energy metabolism and RDA in sports.	Understand (K2)
CO2	understand carbohydrate and protein, needs for athletic.	Apply (K3)
CO3	describe the role of minerals, vitamins, fluids in athletes.	Apply (K3)
CO4	plan balanced diets for different types of athletes situations.	Analyse (K4)
CO5	identify common supplements and legal status.	Evaluate (K5)

TEXTBOOKS

1. Srilakshmi B. *Exercise physiology fitness and sports nutrition*, New Age International Publishers, First Edition 2016.
2. Williams, Melvin H. *Nutrition for Health, Fitness and Sport* McGraw Hill Education, Latest Edition.

REFERENCES

1. Krause's Food & the Nutrition Care Process Mahan & Raymond, Elsevier, 14th or latest edition.
2. Clark, Nancy *Nancy Clark's Sports Nutrition Guidebook*
3. ICMR – NIN Reports *Nutrient Requirements for Indians – Recommended Dietary Allowances*
4. WADA Publications *World Anti-Doping Agency Guidelines and Prohibited Substances List*

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	1	-	-	-	-	-	-	3	2	2
CO2	3	3	2	2	1	-	-	-	-	2	2	1	3	2
CO3	3	2	3	2	2	-	-	-	2	-	-	3	1	2
CO4	3	3	2	3	2	1	2	-	-	-	-	3	2	1
CO5	3	2	2	2	2	2	1	-	-	-	-	2	2	3

FT23457	TRADITIONAL AND ORGANIC FOODS	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	explore the diversity and health significance of traditional and organic food systems.
2.	gain insights into organic farming practices and certification processes.
3.	study the food culture, processing, and preservation techniques used in traditional systems.
4.	understand quality, safety, and labelling aspects of organic and heritage foods.
5.	examine national policies and global trends in the traditional and organic food sectors.

UNIT I	INTRODUCTION TO TRADITIONAL & ORGANIC FOODS	9

Definition, history, and evolution of traditional and organic foods; Comparison: Organic, conventional, natural, functional, and traditional foods; Traditional knowledge systems and cultural heritage; Importance of biodiversity and native crop varieties; Socioeconomic role of traditional foods in rural and tribal communities.

UNIT II	TRADITIONAL FOODS OF INDIA AND GLOBALLY	9

Regional traditional foods in India (North, South, East, West, Northeast); Traditional grains: millets, ancient rice varieties, pseudocereals; Tribal foods and lesser-known indigenous ingredients; Global traditional diets: Mediterranean, Japanese (Washoku), Korean, African, Latin American; Traditional processing methods: smoking, sun drying, pickling, stone grinding; Ethnic beverages: buttermilk, kanji, toddy, kombucha.

UNIT III	TRADITIONAL FOOD PATTERNS	9

Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods.

UNIT IV	COMMERCIAL PRODUCTION OF TRADITIONAL FOODS	9

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V	HEALTH ASPECTS OF TRADITIONAL FOODS	9
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments and illnesses.		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	classify traditional food systems from Indian and global contexts.	Understand (K2)
CO2	explain organic farming principles and certification protocols.	Apply (K3)
CO3	nutritional and therapeutic roles of traditional and organic diets.	Apply (K3)
CO4	demonstrate knowledge of food safety, hygiene, and quality standards.	Apply (K3)
CO5	opportunities in the organic/traditional food sector.	Analyse (K4)

TEXT BOOKS

1. Ramesh C. Ray – *Nutritional and Health Benefits of Traditional Indian Foods*, Springer, 2016
2. Shashank Kumar – *Organic and Functional Food*, Studium Press, 2019

REFERENCES

1. Peter V. Fossel – *Organic Farming: Everything You Need to Know*, Storey Publishing
2. Ronald R. Watson – *Traditional Foods: History, Preparation, and Health*, Academic Press
3. OECD – *Organic Agriculture: Sustainability, Markets and Policies*, 2003
4. FAO – *The Future of Food and Agriculture*, UN Report Series

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	1	-	-	-	-	-	2	3	3
CO2	3	3	2	2	-	-	-	1	-	-	2	-	3	2
CO3	2	2	2	1	-	-	2	-	-	2	-	-	2	2
CO4	3	-	2	-	-	1	-	-	-	-	3	-	3	3
CO5	3	2	-	2	-	1	-	-	2	-	-	2	3	3

FT23551	FLAVOUR CHEMISTRY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	introduce the principles and standards of food and flavor analysis.
2.	understand the physical and chemical properties relevant to food flavor.
3.	explore the application of flavor compounds in various food products.
4.	learn about different types of flavor enhancers and their functions.
5.	understand the development and characteristics of flavorings in various dairy products.

UNIT I	INTRODUCTION TO FLAVOUR AROMA	9

Aroma Chemicals -Alcohol, Acids, Esters, Aldehydes, Ketones, Hydrocarbons; Heterocycles- Introduction to heterocyclic compounds, Terminology of heterocycles, non-aromatic heterocyclic compounds, Oxygen-containing heterocyclic aroma chemicals, Heterocyclic compounds containing nitrogen; Sulfur Compounds- Thiols and thioesters, Acyclic sulfides and polysulfides, Saturated heterocyclic sulfur compounds.

UNIT II	FLAVORINGS IN BEVERAGE AND BAKERY PRODUCTS	9

Introduction - Categories of Beverages, Types of Flavorings for Beverages, Methods of Extraction, Solubilization and Concentration of Flavorings, Beverages Based on Ginger, Formulation of Beverages; Introduction to Confectionery Flavorings, Basic Confectionery Types, Recipes, Inherent Flavors, Flavors from Ingredients, Flavors Developed During Processing, Selection of Flavorings, Ingredients of Bakery Products, Bakery Products, Bakery Fillings.

UNIT III	FLAVOUR APPLICATIONS IN FOOD PRODUCTS	9

Liquid flavorings – Water-soluble liquid flavorings, Solvents for special uses, Oil-soluble liquid flavorings, Emulsion liquid flavoring; Powder flavors– Plating, Spray drying, Spray cooling, Yeast encapsulation, Coacervation, Melt extrusion, Molecular encapsulation; Formulation issues for the flavorist – Flavor creation, Influence of foodstuff to be flavored, Influence of legislation, Influence of customer requirements; The basic structure of fragrances; Personal care applications – Emulsions, Surfactants.

UNIT IV	FLAVOR MODIFIERS AND ENHANCERS	9

Introduction to flavor modifiers – Functional role and chemical nature of monosodium glutamate (MSG), purine 5'-ribonucleotides, and related compounds – Maltol and ethyl maltol as sweet and caramel-like enhancers – Structure and role of furanones and cyclopentenolones – Vanillin and ethyl vanillin: sources, sensory properties, and applications.

UNIT V	THE DEVELOPMENT OF DAIRY FLAVORINGS	9

Introduction dairy flavorings - Milk and Cream, Yogurt and Fermented Products, Butter, Cheese, Manufacturing Considerations.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	identify food analysis techniques and interpret lab data effectively.	Understand (K2)
CO2	explain physical and chemical analysis methods used in flavor evaluation.	Apply (K3)
CO3	apply flavoring techniques in beverages, bakery, and snack products.	Apply (K3)
CO4	recognize and use common flavor modifiers and enhancers in food.	Apply (K3)
CO5	development of dairy flavorings food products	Analyze (K4)

TEXT BOOKS

1. Edited by David J. Rowe De Monchy Aromatics Ltd Poole, UK, Chemistry and Technology of Flavors and Fragrances
2. Ashurst, P.R. – *Food Flavorings*, Aspen Publishers. Third Edition

REFERENCES

1. Flavor Chemistry and Technology (2nd ed.). CRC Press
2. Food Chemistry (4th ed.). Springer
3. Chemistry and Technology of Flavors and Fragrances. Blackwell Publishing.
4. Flavor Ingredients Handbook.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	1	-	-	-	-	-	2	3	3
CO2	3	3	2	2	-	-	-	1	-	-	2	-	2	3
CO3	3	2	2	2	-	-	2	-	-	2	-	2	2	2
CO4	3	-	2	-	-	1	-	-	-	-	3	-	2	3
CO5	3	3	-	2	-	1	-	-	1	-	-	2	3	2

FT23552	BEVERAGE TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	impart knowledge on scope and importance of beverage industries
2.	understand the principal facts behind non-alcoholic beverage production
3.	impart knowledge on the processing aspects of beverage production.
4.	know quality parameters of fermented beverages.
5.	study the food laws and regulations of beverages.

UNIT I	INTRODUCTION	9

Classification of beverages and their importance. Scope of food beverages & its processing units in India. Ingredients details in carbonated beverages, History of Soft Drinks, Findings and Development of carbonation apparatus, Transformation of health drinks to common beverages, Product timeline and marketing. Non-carbonated beverages.

UNIT II	ALCOHOLIC & NON-ALCOHOLIC BEVERAGES	9

Brewing techniques, nutritional value of alcoholic beverages, Processing aspects (Distillation techniques) of beer, wine, and other non – alcoholic beverages like vodka, rum, gin, whisky, brandy and toddy. Distilled spirits. Tea - Processing of different types of tea and its importance, coffee processing – introduction, biological activity of coffee, flavoured milk, cereal-based non-alcoholic beverages.

UNIT III	FRUIT AND VEGETABLE BASED BEVERAGES	9

Nutritional properties and health benefits of fruit-based beverages. Nutritional composition and functional activity of vegetables-based beverages, Cereal based beverages. Indigenous beverages: Processing of coconut water, sugarcane juice, cashew apple extract, Neera – coconut palm sap.

UNIT IV	CARBONATED SOFT DRINKS- MANUFACTURING	9

Source of carbon dioxide, chemical and physical properties of carbon dioxide, carbonating process, Machineries and equipment used. Preparation of syrups; Dilution systems; Filling system; Packaging-containers and closures; Effective application of quality controls, brix, acidity to brix ratio, single strength of product- sanitation and hygiene in beverage industry.

UNIT V	HEALTH AND REGULATORY ISSUES	9

Quality control of beverage: Quality standards for beverages, chemical, microbial and sensory evaluation, product shelf life. FSSAI, CODEX, FDA and EU regulations- Labelling and packaging; Ingredients according to PFA, EFSA and FDA – Absolute requirements of soluble solids and titrable acidity in beverages.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	formulate the beverages using selected ingredients	Applying (K3)

CO2	apply Unit operations involved in the carbonated beverage manufacturing	Analyzing (K4)
CO3	explain the various production techniques in non-carbonated beverages	Analyzing (K4)
CO4	evaluate the quality parameters of fermented beverages	Applying (K3)
CO5	implement the food laws and regulations of beverages	Understanding (K2)

TEXT BOOKS

1. Varnam, A., Sutherland, J. (2012). Beverages: Technology, Chemistry and Microbiology. United Kingdom: Springer US.
2. Shankunthala Manay, N. and Shadakdharaswamy, M, Foods – Facts and Principles, New Age International Pvt. Ltd, 2000.

REFERENCES

1. Non-alcoholic Beverages: Volume 6. The Science of Beverages. (2019). United Kingdom: Elsevier Science.
2. Natural Beverages: Volume 13: The Science of Beverages. (2019). United Kingdom: Elsevier Science.
3. Ashurst, P.R, Chemistry and technology of Soft drink and fruit juices, 2nd edition, Blackwell Publishing Ltd. 2005.
4. Steen, D.P and Ashurst, P.R, Carbonated soft drinks – Formulation and manufacture, Blackwell Publishing Ltd. 2000.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

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CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	1	3	-	-	1	2	-	2	3
CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	3	-	-	2	2	-	3	2

FT23553	EMERGING FOOD PROCESSING TECHNIQUES	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	learn about processing operations of non-thermal technology.
2.	acquire knowledge on the importance of ultrasound, microwave and its processes.
3.	understand the importance of pulsed electric field and ohmic heating.
4.	know the processing of magnetic field and radiation.
5.	study the tools for processing of ozone, cold plasma, RF.

UNIT I	PRESSURE AND HEAT TREATMENT	9

Non thermal technologies in preservation of foods – necessity and advantages–status and trends of non - thermal technologies in preservation of foods-high pressure treatment of food – governing principles – process equipment, processing and effect on microorganisms - combined pressure heat treatment on quality attributes of foods – effect on microorganism, texture, enzyme activity, nutrients – processing of salads and ready meals, high pressure freezing – ultra high static pressure, High hydrostatic pressure processing of cereals and pulses; high pressure CO2 processing of foods.

UNIT II	ULTRASOUND, LIGHT AND MICROWAVE	9

Ultrasound–principle of operation–mechanism of inactivation of microorganisms and enzymes; UV light and pulsed light preservation–principles of operation–microbial inactivation mechanism; microwave technology - principle – application – sterilization, tempering, drying, puffing, coagulation and other processing applications, ultrasonic assistance of food freezing - power ultrasonic processing; electron beam processing of food

UNIT III	PEF AND OHMIC HEATING	9

Pulsed electric field – principles of operation – equipment – processing - control parameters – microbial inactivation mechanism–enzyme inactivation - effects on solid and fluid food - nutritional and quality parameters; ohmic heating – principle – equipment – effect on food quality and microbes inactivation-modelling of ohmic heating-ohmic heating application to specific foods.

UNIT IV	MAGNETIC FIELD AND RADIATION PROCESSING	9

Introduction to irradiation technologies–general modification–equipment and operational parameters–food safety and shelf life of irradiated liquid foods-oscillating magnetic fields magnetic fields-generation- mechanisms- inactivation of microorganisms – magnetic fields in food preservation, infra-red– mechanism of IR absorption by food–IR emitters and spectral bands – applications. induced electric field (IEF) – mechanism and application-oscillating magnetic field processing.

UNIT V	OZONE, COLD PLASMA AND RF PROCESSING	9

Generation of ozone–batch and continuous process of ozone for inactivation–factors affecting efficacy of ozone processing–effect on food quality–methods of generation of cold plasma – control parameters-batch and continuous method of cold plasma treatment for decontamination. radio wave frequency–principle–factors influencing RF heating process–applications

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the principles of high-pressure treatment and its effect on microorganisms, texture, enzyme activity, and nutrients in food.	Applying (K3)
CO2	analyse the effect of sound, light and electro-magnetic waves on processing and preservation of solid and liquid food.	Analyzing (K4)
CO3	demonstrate principle, significance of electric current on microbial inactivation mechanism, and its effects on solid and fluid foods.	Analyzing (K4)
CO4	describe and apply the principles of irradiation technologies, describe on mechanism of preservation, operational parameters, and the impact on food safety and shelf life of foods.	Applying (K3)
CO5	describe and demonstrate principles and significance of ozone, UV and RF for microbial inactivation.	Understanding (K2)

TEXT BOOKS

1. Gustavo V. Barbosa-Canovas, María S. Tapia and M. Pilar Cano, Novel Food Processing Technologies, special Indian edition, CRC Press, 2018.
2. Howard Q. Zhang "Non – Thermal technologies for food" Wiley-Blackwell, 2011.

REFERENCES

1. Sun D, Emerging Technologies for Food Processing ,2nd edition, Academic Press, 2014.
2. Snehasis Chakraborty, Rishab Dhar "Fundamentals of Non-Thermal process of food preservation" CRC press 1st edition 2022.
3. Gaurav Tewari and Vijay K. Juneja, Advances in Thermal and Non- Thermal Food Preservation, 2ND edition, Blackwell Publishing. 2020.
4. Enrique Ortega-Rivas "Nonthermal Food Engineering Operations, CRC Press, 1st Edition 2012.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	1	3	-	-	1	2	-	2	3
CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	3	-	-	2	2	-	3	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
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Food Technology
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FT23554	TECHNOLOGY OF SNACKS AND EXTRUDED FOODS	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	gain knowledge about various physiology behind snack foods.
2.	know the potato and rice-based snacks with various technology.
3.	understand the processing of com and its products.
4.	learn extrusion technology used in food industries and the working principles of extruders.
5.	acquiring knowledge about the snack food of animal and pretzel products.

UNIT I	INTRODUCTION	9

Introduction -Formed dough products from potato and maize derivatives, Half Products, directly expanded extruded snack, Puffed Snacks and others. Types and Functions of ingredients - structure fanning materials, dispersed phase /filling materials, plasticizers/lubricants, soluble solids, nucleating substances, coloring and flavoring substances.

UNIT II	POTATO AND RICE BASED SNACKS	9

Potato Chip - Pre cleaning and peeling, slicing, drying/frying, salting and seasoning, quality control. Fabricated potato snacks - potato flakes, potato granules, potato starch, ground and crushed dehydrated potato. Rice based Snacks - Products using whole grains - Gun puffed rice. Products using flours.

UNIT III	CORN BASED SNACKS	9

Tortilla chip - Corn soaking and smoking, Grinding, Masa flour, Sheeting and Cutting, Baking and Frying. Popcorn- Popping methods, oil popping and dry popping. Commercial and industrial popcorn processes. Flavorings and Applicators

UNIT IV	EXTRUSION BASED SNACKS	9

Extruder-Hardware-Drive and bearing assembly; extruder barrel, extruder screws-single; twin; die and knife; conveying equipment; drying systems and applicator; Software-independent, dependent variables and critical parameters; Extruder product- Second generation and Third generation snacks, Co extruded snacks, Masa based snacks, Flat bread, Crisp bread.

UNIT V	SNACK FOOD OF ANIMAL AND PRETZEL	9

Introduction -Jerky products; formed Jerky products; extrudered starch snack products containing meat; expanded fish and shrimp chips; pickled snacks foods; dairy and egg-based snacks foods; dried and marinated fish and shellfish snacks; Pretzel - Types - Formulation and Processing - mixing, extrusion, proofing, cooking, surface salting, baking and drying. Problems in pretzel manufacture.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to,		BT MAPPED (Highest Level)
CO1	choose appropriate ingredient based on their functionality.	Understanding (K2)
CO2	infer the production of potato and rice-based snacks.	Analyzing (K4)
CO3	apply suitable techniques for com-based snacks production.	Analyzing (K4)

CO4	elaborate the production of extruded snack foods.	Understanding (K2)
CO5	categorize and formulate pasta products.	Applying (K3)

TEXT BOOKS

1. Edmund W. Lusas and Lloyd W. Rooney, -Snack Food Processing, 1st Edition, CRC Press, Florida,2001.
2. Robin Guy, -Extrusion cooking: Technologies and Application, 1st Edition, CRC Press, Florida, 2000.

REFERENCES

1. Panda H., -The Complete Technology Book on Snack Foods, National Institute of Industrial Research, New Delhi, 2003.
2. Sergio O. Serna-Saldivar, -Industrial Manufacture of Snack Food, Woodhead Publishing, New Delhi,2008.
3. Mian N. Riaz., Extruders in Food Application, CRC Press, Florida, 2000.
4. Marshall, Rice Science and Technology. Wadsworth Ed., Marcel Dekker, New York. 1994.

CO/PO MAPPING:

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CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	1	2	3	3
CO2	3	2	2	1	-	-	-	-	-	-	1	2	3	3
CO3	3	2	2	1	-	-	-	-	-	-	1	2	3	3
CO4	3	2	2	1	-	-	-	-	-	-	1	2	3	3
CO5	3	2	2	1	-	-	-	-	-	-	1	2	3	3

FT23555	FOOD PLANT SANITATION AND LAYOUT	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1. learn about the introduction of Sanitation in food industries.
2. understand the importance of quality assurance and handling techniques in food industries.
3. know about the different types of sanitization methods in different food industries.
4. learn about different types of overall design regarding Plant layout.
5. learn about preparation methods of Plant layout design.

UNIT I	SANITATION AND FOOD INDUSTRY	9

Definition of sanitation; Sanitation laws and regulations and guidelines; Establishment of sanitary practices; The Relationship of Biosecurity to Sanitation - Potential risks of foodborne bioterrorism, Bioterrorism protection measures, The role of pest management in biosecurity; The Relationship of Microorganisms to Sanitation - Microorganisms relate to food sanitation, Causes and effects of microorganisms to grow and its spoilage, Foodborne illnesses and its effects, Microbial destruction and growth control.

UNIT II	PERSONAL HYGIENE AND QUALITY ASSURANCE IN FOOD HANDLING	9

Personal hygiene, Sanitary food handling; The Role of HACCP in Sanitation – Definition of HACCP, HACCP development, Interface with GMPs and SSOPs, HACCP principles, Organization, implementation and maintenance; Quality Assurance for Sanitation - The role of total quality management, Quality assurance for effective sanitation, Organization for quality assurance, Establishment of a quality assurance program.

UNIT III	HYGIENE AND SANITATION IN FOOD PLANT AND FOOD SERVICE ESTABLISHMENTS	9

Dairy Processing Plant Sanitation; Meat and Poultry Plant Sanitation; Seafood Plant Sanitation; Fruit and Vegetable Processing Plant Sanitation; Beverage Plant Sanitation; Food service Sanitation

UNIT IV	OVERALL DESIGN OF AN ENTERPRISE	9

Introduction to plant design – Types of manufacturing process, plant design; Sales planning for plant design; Plant Location; Industrial building and grounds.

UNIT V	PREPARATION OF A PLANT LAYOUT	9

The plant layout problem; Data collection and organization; Development and presentation of layout; Evaluation of layout. Common problems in Plant layout – The employee, Materials, Materials handling, Storage.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to,		**BT MAPPED (Highest Level)**
CO1	identify to understand the basic introduction regarding sanitation, laws related to sanitation and microbial factors	Understand (K2)
CO2	apply the acquired knowledge on quality factors and personal handling in food industries	Apply (K3)
CO3	infer the technical aspects of different types different types of sanitization methods in different food industries	Apply (K3)
CO4	understand the different types of plant design for an enterprise	Apply (K3)
CO5	infer the process of preparation of plant layout and its associated problems	Analyze (K4)

TEXT BOOKS

1. Principles of Food Sanitation. N. G. Marriott, Springer, 5th Edition, 2006.
2. Plant Layout and Design, James M Moor, Macmillan, New York.

REFERENCES

1. Food Safety and standards Act 2006, Rules 2011, Regulations, 2011, 10th Edition, ILBCO India, Indian Law Book Company, 2013.
2. Hobbs Food Poisoning and Food Hygiene. Jim Mclauchlin and Christine Little (Eds), 7th Edition, 2007.
3. Facility Planning and Layout Design, Chandrashekar Hiregoudar, 2017.
4. Applied guide to process and plant design, Sean moran, Elsevier, 2015.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	2	-	3	2	-	2	2	-	-	-	-	2	3	2
CO3	2	2	-	-	2	2	2	-	-	-	-	2	2	3
CO4	3	1	2	2	1	2	-	1	2	2	2	2	2	3
CO5	2	3	1	-	-	2	2	1	-	2	2	2	2	3

FT23556	FOOD WASTE MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable students to,

1.	have a basic outline of food waste, its characterisation and treatment methods.
2.	understand the effective utilization of food waste from rice mil, dairy, sugar mill and fruits and vegetable industries.
3.	utilize the waste from meat, fish and poultry industries.
4.	know about different treatment methods and recycling of waste water produced from food industry.
5.	have a knowledge on emerging food waste management strategies.

UNIT I	INTRODUCTION TO WASTE MANAGEMENT	9

Principles of food waste management; Classification and characterization of food waste; impact of food waste; ISO14000; Treatment of food waste - Anaerobic digestion, composting, pyrolysis, gasification, incineration.

UNIT II	UTILIZATION OF WASTE - I	9

Management of waste in dairy industry; Utilization of waste in rice mill; Utilization of waste in sugar mill; Fruits and vegetable waste management- citric acid production, production of alcohol.

UNIT III	UTILIZATION OF WASTE -II	9

Meat, Fish, Poultry waste management; Waste management in packaging industries; Wine waste management.

UNIT IV	WASTE WATER TREATMENT	9

BOD, COD; Treatment process of waste water; Treatment methods - Activated sludge process, aerated lagoons, trickling filter, anaerobic digestion, biofilters, RO, Ion exchanger, Electrodialysis.

UNIT V	SUSTAINABLE FOOD WASTE MANAGEMENT TECHNOLOGIES	9

Mushroom cultivation; Bioremediation; Biofuel production; Recovery of bioactive compounds; Utilization of fly ash; Digital knowledge ecosystem

	TOTAL PERIODS:	45

COURSE OUTCOMES

Upon completion of the course the students will be able to,		BT MAPPED (Highest Level)
CO1	aware the importance in treating waste product from food industry.	Applying (K3)
CO2	project the food waste in valorise perspective	Analyzing (K4)
CO3	acquire knowledge on treatment methods and recycling of waste product from food industry	Analyzing (K4)
CO4	apply various methods to treat waste waster	Applying (K3)
CO5	get an overview on emerging food waste management strategies	Understanding (K2)

TEXT BOOKS

1. Monika Thakur, V K Modi, Renu Khedhar, Karuna Singh "Sustainable Food Waste Management Concepts and Innovation". 1t Edition, Springer, 2020
2. Ioannis S Arvanitoyannis, "Waste Management for the Food Industries", Academic Press, 2008.

REFERENCES

1. Chandrasekaran M, "Valorisations of Food Processing By-products", 1s Edition, CRC Press, 2016.
2. Vasso Oreopoulou and Winfried Russ. "Utilization of by-products and Treatment of Waste in the Food Industry", Springer, 2007.
3. A.D. Patwardhan," Industrial waste water treatment", 2nd Edition, PHI learning private limited, Delhi,2017
4. K. Waldron, 'Handbook of Waste Management and Co-Product Recovery in Food Processing', Woodhead Publishing, 2007.

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(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	2	3	2	-	3	-	2	-	3
CO2	2	3	-	-	-	2	2	-	-	2	-	-	2	3
CO3	2	2	-	-	-	-	2	3	-	-	1	-	2	-
CO4	2	3	-	-	-	2	-	2	-	-	-	2	-	3
CO5	2	3	-	-	-	2	3	2	2	2	-	2	-	3

FT23557	AI FOR FOOD TECHNOLOGIST	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	learn about innovation in food technology.
2.	know AI in fats and oil products and their prediction.
3.	understand the tools for processing and quality detection of fish and fisheries products.
4.	acquire knowledge on the importance of artificial neural network in food processing industry.
5.	study the tools for amalgamation of nano sensor and AI technology for food safety.

UNIT I	INNOVATION IN FOOD TECHNOLOGY	9

Introduction; Emerging AI Technologies in Food Processing and Packaging; Automation in Food Production; Computer Vision for Detecting Defects and Assessing the Quality of Foods; Exploring AI-powered Smart Packaging Solutions; Evolutionary Trends in Food Packaging; Smart Labels and RFID Technology for Tracking and Traceability; The Impact of AI on Sustainability and Food Security; The Way Forward for AI in Food Processing

UNIT II	ARTIFICIAL INTELLIGENCE IN FAT AND OIL PRODUCTS	9

Introduction on Artificial Intelligence; Several Processes in the Production of Fats and Oils; Implementation of Artificial Intelligence-Rheological Analysis for Characterization, Identification of Non-halal Components, Fraud Using Waste Cooking Oil, Thermal Oxidation Prediction, Quantification of Trans Fatty Acid, Shelf-life Prediction.

UNIT III	ARTIFICIAL INTELLIGENCE TOOLS FOR PROCESSING AND QUALITY DETECTION OF FISH AND FISHERIES PRODUCTS	9

AI in the Seafood Processing Industry; Mechanism of Action of AI Tools; Applications of AI in Fish and Fisheries Product Processing; Challenges and Limitations; Future Directions and Opportunities; Role of AI in Fish Processing Plants; Overall Challenges and Prospects.

UNIT IV	APPLICATION OF ARTIFICIAL NEURAL NETWORK IN FOOD PROCESSING INDUSTRY	9

Introduction; Biological and Artificial Neural Networks-Biological Neural Network, Artificial Neural Network (ANN), Biological vs. Artificial Network; Development of the ANN Project; Network Models of ANNS; Optimization Methods Used Along with ANNS; Application of ANN in Food Processing Operations-Drying and Dehydration, Extraction, Baking, Extrusion, Fermentation, Filtration, Soaking and canning, Shelf life extension.

UNIT V	AMALGAMATION OF NANOSENSOR AND AI TECHNOLOGY FOR FOOD SAFETY	9

Introduction; Nano sensors; Classification of Nano sensors, Nano sensor Configurations and Their Hybrid Techniques; Application of Nano sensors in Food Safety-Detection of Fertilizer and Pesticide Analytes, Detection of Adulterants, Detection of Pathogens, Detection of Toxins, Detection of Antibiotics, Detection of Heavy Metals; Application of Artificial Intelligence for Advancing Nano sensing Strategies to Ensure Food Safety.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the principles of Automation in food processing and packaging.	Applying (K3)
CO2	analyse the production, prediction and quantification of fat and oil.	Analyzing (K4)
CO3	appraise the techniques of quality detection of fish and fisheries products	Analyzing (K4)
CO4	elaborate the ANN techniques in food processing industry.	Applying (K3)
CO5	demonstrate AI technology for food safety	Understanding (K2)

TEXT BOOKS

1. Daniel ingo heft, Charles Oluwaseun Adetunji "Sensing and artificial intelligence solution for food manufacturing "CRC Press, 2023.
2. Ashutosh Kumar Shukla - AI Applications in Food Processing and Packaging, The Royal Society for Chemistry 2025

REFERENCES

1. Rajeev Bhat, Chandrasekar Venkatesh "Artificial Intelligence in Food Processing and Agriculture" Academic Press (Elsevier), 2021.
2. Ramesh C. Ray and Purnima Kaushik "Artificial Intelligence in the Food Industry: Smart Manufacturing and Quality Control" CRC Press, 2023.
3. Charis M. Galanakis "Food Industry 4.0: AI, Big Data, and IoT for Smart Food Systems" Academic Press, 2020.
4. Pradeep Kumar, Hitesh Vasudevan "Artificial Intelligence and IoT for Food Processing: Smart Processing Technologies" Springer, 2023.

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CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	3	-	-	2	2	-	3	2

FT23651	INTRODUCTION TO FOOD SAFETY ANALYSIS AND QUALITY RISK MANAGEMENT	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	learn about food hazards and its regulation.
2.	acquire knowledge on the importance of new technologies involved in food safety.
3.	understand the importance of management and safety of food.
4.	know different risk control management technique of food products.
5.	study the regulation, certification of international organization.

UNIT I	CHARACTERIZATION OF FOOD SAFETY AND RISK	9

Definition of Food Safety-Regulatory, Industrial, and International Implications, Characterization of Food Hazards- Scientific basis and Implications, Food Safety Standards, Dose-Response Modeling for Microbial Risk; Exposure Assessment of Microbial Food Hazards-, Exposure and Dose-Response Modeling for Food Chemical Risk Assessment; Economic Consequences of Foodborne Hazards.

UNIT II	TECHNOLOGIES AND FOOD SAFETY	9

Thermal Treatment-Fundamentals of Thermal Death of Microorganisms, Heat Resistance of Microorganisms, Determination of Heat Process Requirement, Factors Determining Heat Treatment, Non-thermal Processing Technologies-Non-Thermal Treatments for Food Preservation, Verification and Validation Methods for Non-Thermal Technologies, Acids and Fermentation Chilling and Freezing – Effects.

UNIT III	FOOD SAFETY ASSURANCE SYSTEMS	9

Principles and Systems for Quality and Food Safety Management, Hygiene in Primary Production-Quality-Foodborne Diseases, Hygiene in Food Processing and Manufacturing, Hygienic Design and Maintenance of Equipment. Hazard Analysis and Critical Control Point System (HACCP), HACCP Misconceptions, Human Factors in Food Safety Management.

UNIT IV	RISK AND CONTROL IN THE FOOD SUPPLY CHAIN	9

Management of Safety in the Feed Chain, Naturally Occurring Toxicants of Plant Origin Allergens, Poultry and Eggs, Seafood, Fruits and Vegetables (including Herbs), Coffee, Cocoa and Derived Products, Edible Nuts, Oilseeds and Legumes, Oils and Fats, Food Contact Materials, Pet Food, Bottled and Drinking Water.

UNIT V	WORLD-WIDE FOOD SAFETY ISSUES	9

International Organization for Standardization ISO 9000 and Related Standards, Impact of Food Safety on World Trade Issues, United States Import/Export Regulation and Certification, FAO/WHO Food Standards Program: Codex Alimentarius.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to,		**BT MAPPED (Highest Level)**
CO1	make the student to understand about food hazards.	Understanding (K2)
CO2	make the student to understand about the safety concerns in industry.	Analyzing (K4)
CO3	facilitate them in understanding the overall food quality controls.	Analyzing (K4)
CO4	perform risk assessment.	Applying (K3)
CO5	assess various safety and quality analysis	Applying (K3)

TEXT BOOKS

1. Food Safety Management: A Practical Guide for the Food Industry – Yasmine Motarjemi, Huub Lelieveld, 2014 published in Elsevier.
2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick, 2003 Published in John Wiley & Sons.

REFERENCES

1. Food Safety Sanitation and Personal Hygiene: A Practical Guide for the Food Industry.
2. Food Safety Implementation from farm to fork – Puja Dudeja, Amarjeeth Singh, Sukhpal Khaur, CBS Publishers and distributors, 2016.
3. Naomi Rees, David Watson, International standards for food safety, An Aspen Publications, 2000.
4. Inteaz Alli, Food quality assurance - Principles & practices. CRC Press. New York, 2004.

CO/PO MAPPING:

Mapping of Course Outcomes with Program Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programs Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	1	1	-	3	-	1	-	1	3	2
CO2	3	2	-	2	1	1	2	3	-	1	2	1	2	3
CO3	2	2	-	1	-	2	-	2	-	1	2	2	2	3
CO4	2	-	2	-	1	2	2	2	-	2	2	1	3	2
CO5	1	2	-	3	1	2	-	3	-	2	2	2	3	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
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Food Technology
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FT23652	FOOD LAWS - INDIAN AND INTERNATIONAL	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	understand the food laws and regulations at both national and international levels
2.	familiarize students with the legal framework governing food safety, quality, and labelling in India and key international jurisdictions
3.	analyze the roles and responsibilities of regulatory authorities and industry stake holders in ensuring compliance with food regulations
4.	explore emerging issues and trends in food regulation and their implications for global food safety and trade
5.	develop critical thinking skills and the ability to apply legal principles and standards to real world food industry scenarios

UNIT I	INTRODUCTION	9

Food Safety and Standards Act of India, 2006: Provision, definitions and different sections of the Act and implementation, FSS Rules and Regulations, Overview of other relevant national bodies (e.g. APEDA, BIS, EIC, MPEDA, Spice Board etc.), International Food Control Systems/Laws, Regulations and Standards/Guidelines with regard to Food Safety – Overview of CODEX Alimentarius Commission (History, Members, Standard setting and Advisory mechanisms: JECFA, JEMRA JMPR): WTO agreements (SPS/TBT), Important national and international accreditation bodies

UNIT II	GLOBAL REGULATORY AUTHORITIES	9

Food Regulatory Affairs: Introduction to global regulatory authorities for food Industry, Food GMP and its regulations, From Farm to Fork: Understanding the Food Regulatory Cycle [International perspective of USA, Europe, UK, Canada, UAE, South Africa, Australia & New Zealand].

UNIT III	REGULATORY GUIDELINES	9

Documentation for launch of a new food product and regulatory filing in US, Europe, UK, India, Canada and Japan, Food Industry IPR, Patents, Copyrights and Trademarks, Food Product Marketing, Import and Export regulations, Compliance guidelines, Govt. Audits (FSSAI, BIS, etc), Food Regulations & Guidelines in India, Food Licensing & Registration in India, Industry based case studies

UNIT IV	EVOLUTION OF FSSAI	9

FSSAI – Role, Functions, Initiatives (A General Understanding) Genesis and Evolution of FSSAI, Structure and Functions of Food Authority, Overview of systems and processes in Standards, Enforcement, Laboratory ecosystem, Imports, Third Party Audit etc., Promoting safe and wholesome Food (Eat Right India, Food Fortification, Clean Street Food Hub, RUCO and various other social and behavioral change initiatives)

UNIT V	FOOD BUSINESS OPERATORS	9

Training and capacity building, Role of State Food Authorities. Food Safety Compliance System, Food Safety Training and Certification, Food Licensing and Registration System, food business operators,

Food Import Clearance System, Indian Food Laboratory Network, RUCO, Detect Adulteration with Rapid Test (DART) FSSAI e-Books on Food Safety (pink, purple, Yellow, Orange etc.,)		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand about the Food Safety and Standards Act and its associated regulations, including labelling requirements, food additives, etc.,	Understand (K2)
CO2	understand about the regulations and training of food safety	Apply (K3)
CO3	facilitate them in understanding the overall view of FSSAI laws and regulations	Apply (K3)
CO4	make the student understand the unification of various food laws under FSSAI	Apply (K3)
CO5	facilitate the students to understand the processes to be followed by a food business operator	Analyze (K4)

TEXT BOOKS

1. Proshanta Guha & Basudeb Guha. (2022) Fundamentals of Indian Food Laws: University Book House Pvt. Ltd
2. Gabriela Steier & Kiran K. Patel. (2017) International Food Law and Policy: Springer Gabriela Steier & Kiran K. Patel. (2017) International Food Law and Policy: Springer

REFERENCES

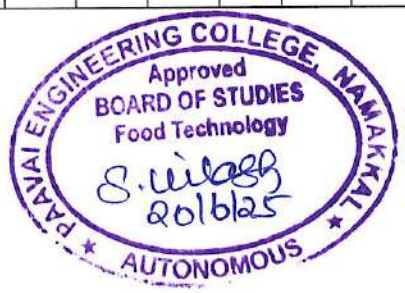
1. Seth & Capoor (2023) Commentary on the Food Safety and Standards Act, 2006: Delhi Law House
2. Bhatnagar 8th Edition (2024), Commentary on Food Safety Law: Whytes and Co.
3. Food Safety Management: A Practical Guide for the Food Industry.
4. Food Safety Hand Book – Ronald H. Schmidt, Gary E. Rodrick.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	-	-	-	-	2	2	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	-	2	2	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	-	-	-	-	-	2	2	-	2	3	3



FT23653	FOOD SAFETY IN HOSPITALITY INDUSTRY AND GLP IN FOOD INDUSTRIES	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	understand food safety hazards and hygiene in hospitality services.
2.	learn about food safety management systems and haccp.
3.	gain knowledge of food safety laws, audits, and inspections.
4.	understand good laboratory practices and standard procedures.
5.	explore food testing methods, reporting, and quality assurance.

UNIT I	FOOD SAFETY IN THE HOSPITALITY INDUSTRY	9

Food safety hazards – Common food-borne microorganisms: viruses, bacteria, fungi; Characteristics of microorganisms and Growth of bacteria, Factors affecting microbial growth, Control of microbial growth in foods, Beneficial role of microorganisms in food, Types of food contaminant; Natural toxins in food; Toxic metals and chemical contaminants, Pesticide residues in food, Presence of extraneous materials in food, Residues from processing and packaging materials, Causes of food spoilage, Criteria for judging food fitness for consumption, Classification of foods based on shelf life, Conditions leading to food spoilage, Signs of spoilage in fresh, dry, and preserved foods.

UNIT II	FOOD BORNE DISEASES	9

Introduction of Borne Diseases- Diseases and their Classification, Mode of Transmission of Disease, Food-Borne Illness, Bacterial Food Poisonings or Intoxications, Bacterial Food Infections, Listeriosis, Viral Infections, Parasitic Infestations, Food Allergies, Control of Food-Borne Illnesses.

UNIT III	FOOD LAWS AND REGULATIONS	9

Introduction-Regulatory Agencies, Control of Food Quality, The Food Safety and Standards Act, 2006, General Provisions as to Articles of Food, Provisions Relating to Import Special Responsibilities for Food Safety, Enforcement of the Act, The Atomic Energy (Control of Irradiation of Food) Rules, 1996, The Plastics Manufacture, Sale and Usage Rules, 1999, Local Health Authority.

UNIT IV	GOOD LABORATORY PRACTICES IN FOOD INDUSTRIES	9

Introduction - Cleaning and Sanitising, Necessity for an Efficient Cleaning Programme, Types of Soil, Water, Cleaning Agents and Equipment, Types of Cleaning Equipment — Manual and Mechanical, Three Methods to Wash, Rinse and Sanitise Food Contact Surfaces, Post Cleaning Storage, Dish Cloth, Cleaning of Premises and Surroundings; Pest Control- Introduction, Importance of Pest Control, Classification of

Pests, Pesticides; Storage and Disposal of Waste- Introduction, Solid Wastes, Liquid Wastes or Sewage, Gaseous Wastes.		
UNIT V	**QUALITY AND FOOD STANDARDS**	**9**
Quality; Hazard Analysis and Critical Control Point (HACCP), Steps in HACCP, Application Stages of HACCP, HACCP Benefits, Sanitation Risk Management, Standards; ISO 9000 Quality Management Systems; ISO 14000 Environmental Management Systems; ISO 22000 Food Safety Management Systems.		
	TOTAL PERIODS:	**45**

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	identify and control food safety hazards in the hospitality industry.	Understand (K2)
CO2	apply FSMS and HACCP principles in food service operations.	Apply (K3)
CO3	comply with FSSAI regulations and manage food safety audits.	Apply (K3)
CO4	follow good laboratory practices and maintain lab documentation.	Apply (K3)
CO5	perform food testing and ensure quality assurance in labs.	Analyse (K4)

TEXT BOOKS

1. Food hygiene and sanitation Second edition by Sunetra Roday, Published in Oxford University Press (20007).
2. Sandy Weinberg, Good Laboratory Practice Regulations, Wiley 1995.

REFERENCES

1. *HACCP: A Practical Approach* (3rd ed.). Springer.
2. *The Microbiology of Safe Food* (2nd ed.). Wiley-Blackwell.
3. OECD Principles of Good Laboratory Practice (GLP).
4. Laboratory Quality Management System Handbook.

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	2	-	3	2	-	2	2	-	-	-	-	2	3	2
CO3	2	2	-	-	2	2	2	-	-	-	-	2	2	3
CO4	3	1	2	2	1	2	-	1	2	2	2	2	2	3
CO5	2	3	1	-	-	2	2	1	-	2	2	2	2	3

FT23654	FOOD ANALYSIS, TESTING AND MICROBIAL SAFETY ANALYSIS	3	0	0	3

COURSE OBJECTIVES

To enable students to

1.	introduce fundamental and advanced food processing technologies ensuring safety and quality.
2.	equip students with analytical techniques for assessing macronutrients in foods.
3.	familiarize students with instrumental methods like spectroscopy and chromatography.
4.	develop skills in sensory evaluation and interpretation of food quality metrics.
5.	understand food hazard identification, risk assessment, and food safety management.

UNIT I	TECHNOLOGIES AND FOOD SAFETY	9

Introduction, Heat Processing, Fundamentals of Thermal Death of Microorganisms, Heat Resistance of Microorganisms, Determination of Heat Process Requirement, Conventional Heat Preservation, Factors Determining Heat Treatment, Non-Traditional Heat Treatment, Combined Treatments; Non-thermal Processing Technologies - Introduction, Identification of Risks in Non-Thermal Processes, Non-Thermal Treatments for Food Preservation, Verification and Validation Methods for Non-Thermal Technologies; Acid and Fermentation.

UNIT II	CARBOHYDRATE, PROTEIN AND LIPID ANALYSIS	9

Carbohydrates - Composition and Occurrence, Determination of Water-Soluble and Water-Insoluble Solids, Qualitative Detection of Carbohydrates, Determination of Mono and Oligosaccharides, Determination of Hexosamines; Lipids - Sources of Information, General Procedures for Extracting Lipids, Extraction of Lipids in Selected Foods, Indirect Methods of Lipid Determination, Fractionation of Extracted Lipids, Automated Lipid Analyses, Fat Stability and Rancidity; Nitrogenous Compounds – Proteins.

UNIT III	INSTRUMENTAL ANALYSIS	9

Spectroscopic techniques - UV-Vis and IR Spectrophotometry, Mass spectroscopy and their instruments components, Quality measurement, Recent applications; Chromatographic Techniques - Basic principles and types, Paper Chromatography, Thin layer Chromatography, Column Chromatography.

UNIT IV	QUALITY AND SENSORY EVALUATION OF FOODS	9

Introduction - Unified approach to difference and similarity testing, Triangle test, Duo test, Two out of five test, Same\Different test, A not A test, Difference from control Test, Sequential Test and their scope and application, principle of the test, analysis and interpretation of results.

UNIT V	HAZARDS SAFETY OF FOODS	9

Introduction - Hazards Associated with Meat and Meat Products, Contamination Frequency and Incidence of Disease, Control of Hazards at Different Stages of the Meat Chain, Meat Safety Process Management; Poultry and Eggs - Microbial Hazards, Chemical Hazards, Physical Hazards, HACCP Generic Model, Importance of Equipment/Process Selection, Advantages of Implementing HACCP.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	apply thermal and non-thermal methods to preserve and ensure food safety.	Understand (K2)
CO2	perform qualitative and quantitative analysis of carbohydrates, proteins, and lipids.	Apply (K3)
CO3	operate modern instruments to analyze food composition and contaminants.	Apply (K3)
CO4	conduct and interpret sensory and physical tests for food quality evaluation.	Apply (K3)
CO5	identify food hazards and implement suitable risk assessment strategies.	Analyze (K4)

TEXT BOOKS

1. Yasmine Motarjemi, "Food Safety Management: A Practical guide for the food industry", Huub Lelieveld.
2. Pomeranz, Yeshajahu, "Food Analysis: Theory and Practice", 3rd Edition, Aspen Publishers / Springer, 2000.

REFERENCES

1. Pomeranz, Yeshajahu, "Food Analysis: Theory and Practice", 3rd Edition, Aspen Publishers /Springer, 2000.
2. Meilgard, "Sensory Evaluation Techniques", 5th Edition., CRC Press LLC, 2016.
3. Schmidt, Ronald H., and Rodrick, Gary E. Food Safety Handbook. Germany, Wiley, 2005.
4. Food Safety Hand Book – Ronald H. Schmidt, Gary E. Rodrick

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	2	2	2	3	2	-	3	3	3	3
CO2	3	2	1	-	2	2	1	3	2	-	3	3	3	2
CO3	3	3	2	-	3	2	2	3	2	-	3	3	3	3
CO4	3	1	1	-	-	1	-	3	3	-	2	2	3	3
CO5	3	2	3	2	2	2	2	1	1	-	-	1	3	3

FT23655	FOOD QUALITY ASSURANCE AND QUALITY CONTROL	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	learn about the Food Quality Assurance and Quality Control.
2.	understand the importance of Food Safety required for Industry.
3.	know about the quality assurance and delivery to end users.
4.	learn about different types of food safety management.
5.	learn about overall concept of Food safety standards and regulations.

UNIT I	INTRODUCTION	9

Fundamentals of Food Quality Assurance and Quality Control, Quality Assurance in Food Industry Validation and Verification, Quality Control and testing procedures, Documentation, Good Documentation Practices, SOPs & Protocols, Establishing Quality Control Checks Inspection & Audits.

UNIT II	ROLES IN QUALITY ASSURANCE AND QUALITY CONTROL	9

Role of Good Manufacturing Practices and their regulations in Quality Assurance and Quality Control, Total Quality Management in Food Industry, Quality Assurance- A risk-based approach (Possible problems & Fixes), Quality Certifications, Govt. Regulations, ISO, FSSAI & FDA Guidelines, Emerging trends in quality related aspects of food industry, Quality Systems in major segments of food industries, Laboratory demonstration, practical's and instrument handling

UNIT III	QUALITY ASSURANCE AND DELIVERY OF SAFE TO END USERS	9

Introduction to Food GMPs, cGMPs (US FDA & WHO), HVAC Systems, Food HVAC Rules and Design, Validation of HVAC Systems, HVAC Audit and Inspection, WIP, CIP, Sanitation and Hygiene Practices and In-Process, Good Laboratory Practices (GLP), Physical & Chemical analysis of food, Molecular and Elemental Analysis of Food, Microbial Analysis of Food.

UNIT IV	FOOD SAFETY MANAGEMENT	9

Guidelines for Sample preparation, Instrument operation and Interpretation of results, laboratory demonstration and requirements, Lay Out and Design of Lab, ISO requirement for food testing lab (ISO 17025), Microbiological analysis of food, Swab Analysis in-Process and Off – Line Process, FSSAI Regulations for food laboratory.

UNIT V	FOOD SAFETY STANDARDS AND REGULATIONS	9

Introduction of FSSAI, Recent update in FSSAI, Location, Layout & Facilities (Pre-Requisite Program), Receiving and storage, Types of cross-contamination, Pre-Production (Vegetable washing, thawing),

Production (Cooking, Cooling, and Reheating), Holding, serving/catering/dining/transportation, Personal hygiene, Pest control, Cleaning and maintenance, Waste Handling, Record Keeping, Consumer Awareness.

	TOTAL PERIODS:	**45**

COURSE OUTCOMES

At the end of this course, the students will be able to,		**BT MAPPED (Highest Level)**
CO1	identify to understand the basic introduction Food Quality Assurance and Quality Control	Understand (K2)
CO2	apply the acquired knowledge about Food Safety required for Industry	Apply (K3)
CO3	comprehend the quality assurance and delivery of safe to end users	Apply (K3)
CO4	evaluate the overall food safety management	Apply (K3)
CO5	explain various Food safety standards and regulations	Analyze (K4)

TEXT BOOKS

1. Food Safety Management: A Practical Guide for the Food Industry, edited by Yasmine Motarjemi, Hubb Kelieveld Academic press Elsevier 2014
2. Food Safety Hand Book - Ronald H. Schmidt, Gary E. Rodrick, 2003.

REFERENCES

1. Food Safety Management: A Practical Guide for the Food Industry.
2. Food Safety Hand Book – Ronald H. Schmidt, Gary E. Rodrick.
3. Food Safety Management: A Practical Guide for the Food Industry.
4. www.fssai.gov.in.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	2	-	3	2	-	2	2	-	-	-	-	2	3	2
CO3	2	2	-	-	2	2	2	-	-	-	-	2	2	3
CO4	3	1	2	2	1	2	-	1	2	2	2	2	2	3
CO5	2	3	1	-	-	2	2	1	-	2	2	2	2	3

FT23656	MODELING AND SIMULATION OF FOOD PROCESSES	3	0	0	3

COURSE OBJECTIVES	
To enable students to,	
1.	understand the basic concept of modeling and simulation in food process industries.
2.	develop working models for fermentation and modified atmospheric packaging.
3.	develop models for cooling and freezing processes.
4.	create models for thermal process.
5.	learn soft tools for modeling in various food processes.

UNIT I	INTRODUCTION TO MODELING	9

Introduction to Modeling: Definition of terms: System, Entity, attributes, activity, state of systems. Physical, Mathematical and Chemical Systems. Modeling - Principles of model formulation, Representation of Model, Fundamental Laws, Types of Modeling Equations, Black Box Principles, Boundary Condition, Validation of model; Benefits of modeling in food processing.

UNIT II	MODELS IN FERMENTATION AND MODIFIED ATMOSPHERIC PACKAGING	9

Models in Fermentation: Introduction, Biological models - Genetic models, growth models, killing-off models and productions models. Technological models - heat transfer models, oxygen transfer models and mixing models. Economic models and mixed models. Models in Modified Atmospheric Packaging: Principle and methods, macro, micro and meso level models.

UNIT III	MODELING OF COOLING AND FREEZING PROCESSES	9

Modeling of Cooling and Freezing Processes: Introduction, modeling product heat load during cooling - single tank model and tank network model. Modeling product heat load during freezing. Numerical solution of heat conduction equation with phase change. Finite different models and element model. Modeling of combined heat and mass transfer - porous, non-porous foods, foods with impermeable skin and frozen foods.

UNIT IV	MODELING OF THERMAL PROCESS	9

Modeling of Thermal Process: Types, basic equations - Microbiological and quality kinetics, thermal transport equations. Conduction equations, complex models for non-uniformity and convective flows, sterilization of liquids foods and foods containing particulates. Models for microwave and ohmic heating. Models for heat transfer equipments – evaporators, heat Exchangers.

UNIT V	SOFT TOOLS FOR MODELING OF FOOD PROCESSES	9

Soft Tools for Modeling of Food Processes: Soft tools for Sensory analysis, Mathematical analysis, data treatment tools, design tools, Simcad Pro simulation software, COMSOL, gPROMS.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to,		**BT MAPPED (Highest Level)**
CO1	interpret the concepts of modeling in food processing.	Understand (K2)
CO2	illustrate the modeling concepts in fermentation and MAP.	Understand (K2)
CO3	choose suitable mathematical models in cooling and freezing processes of foods.	Apply (K3)
CO4	select the models to be used in thermal processing of foods.	Apply (K3)
CO5	make use of appropriate software for modeling processes.	Apply (K3)

TEXT BOOKS

1. Tijskens L.M.M., Hertog T.M. & Nicolai B.M., "Food Process Modeling", 1st Edition, CRC Press, UK, 2001.
2. Babu B.V., "Process Plant Simulation", 1st Edition, Oxford University Press, New Delhi, 2004.

REFERENCES

1. Da-Wen Sun. Computational Fluid Dynamics in Food Processing. CRC Press, Boca Raton, FL, USA. 2007
2. National Instruments Corporation. Introduction to LabVIEW: 3-Hour Hands-On. NI, Austin, Texas. 2005
3. William J. Palm III. Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA. 2011.
4. R. Paul Singh. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis. Academic Press, London. 2014.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programmes Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	-	-	-	-	-	-	-	1	1	2
CO2	3	3	2	2	1	-	-	-	-	-	-	1	2	2
CO3	3	3	2	2	1	-	-	-	-	-	-	1	2	2
CO4	3	3	2	2	1	-	-	-	-	-	-	1	2	2
CO5	3	3	2	3	2	-	-	-	-	-	-	3	3	2

BA23152	TOTAL QUALITY MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the importance of quality management, customer perception and retention.
2	acquaint with the principles and philosophies of quality management
3	understand the significance of statistical process control for quality management.
4	ascertain quality management tools and techniques
5	gain knowledge of quality management system standards and their implementation across sectors

UNIT I	INTRODUCTION TO QUALITY MANAGEMENT	9

TQM: definitions, framework, benefits – Quality: vision, mission and policy statements- Customer Focus: customer perception of quality, translating needs into requirements- Dimensions of product and service quality, cost of quality - Service and Product quality - Foundation of TQM

UNIT II	PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT	9

Principles of Juran, Crosby, Ishikawa, Taguchi techniques: loss function, parameter and tolerance design - Quality circle - Japanese 5S principles - 8D methodology - SMART Goal Setting for Quality - Deming's principles - PDCA Cycle

UNIT III	STATISTICAL PROCESS CONTROL AND TQM TECHNIQUES	9

Meaning and significance of statistical process control (SPC) – Control charts for variables and attributes - Process capability: meaning, significance and measurement – Business process re-engineering (BPR) - ERP: Role of ERP –Cause and Effect Diagram-Root Cause Analysis- New 7 QC Tools - Benchmarking

UNIT IV	TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT	9

Process capability- Quality Function Development (QFD): concepts, improvement needs and performance measures - Poka Yoke and Fool proofing Techniques - Quality Management Systems (QMS): frameworks, documentation-Quality Auditing: Purpose and process- AI in Total Productive Maintenance

UNIT V	QUALITY SYSTEMS AND IMPLEMENTATION	9

ISO 9000: Need, Concepts, Documentation- Elements of ISO 9001:2015 – System Elements and Audit Process - QS 9000, ISO 14000: Requirements and Benefits - ISO Certification Process -TQM Implementation in Manufacturing and Service Sectors- Quality Assurance vs Quality Control - Quality Awards - Six sigma concepts - AI based Quality Inspection Systems

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	construct effective quality policies	Synthesis (K5)
CO2	apply the quality philosophies and practices in business	Applying (K3)

CO3	implement the statistical process control and process capability to enhance quality.	Applying (K3)
CO4	examine the quality tools to enhance organization's quality performance	Analyzing (K4)
CO5	understand the role of quality auditing and ISO standards in quality management	Understanding (K2)

TEXT BOOKS

1. Total Quality Management, by Dale H. Besterfield, 5th Edition, 2021, Pearson Education
2. Quality Management for Organizational Excellence: Introduction to Total Quality by David L. Goetsch & Stanley Davis, 9th Edition, 2021, Pearson.

REFERENCE BOOKS

1. Fundamentals of Quality Control and Improvement by Amitava Mitra, 5th Edition, 2021, Wiley
2. Total Quality Management by P.N Mukherjee 2nd Edition, 2024, PHI Learning
3. Total Quality Management: Key Concepts and Case Studies by D.R. Kiran 2nd Edition, 2020, Butterworth-Heinemann
4. Fundamentals of quality control and improvement by Mitra, *A* ,5th Edition, 2021, Wiley

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	-	1	-	-
CO2	-	1	-	1	1	1
CO3	-		1	-	1	1
CO4	1	1	1	-	-	-
CO5	-	1	1	-	1	1
AVG.	1	1	1	1	1	1

FT23851	POST HARVESTING AND FOOD SPOILAGE	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. study about physiological changes occurring in foods after harvesting
2. gain knowledge in the storage of harvested food
3. understand quality improvement techniques in post harvesting process
4. have knowledge on cleaning
5. learn about the factors involved in food spoilage

UNIT I	INTRODUCTION	9

Basic post-harvest physiology, definition, respiration and gas exchange, hormonal changes during post-harvest physical and chemical changes; transpiration; water stress; Pre-harvest nutritional factors; harvesting and handling injuries, storage conditions-temperature, RH, composition and its modification, ethylene biosynthesis and action.

UNIT II	STORAGE CHARACTERISTICS	9

Changes during ripening, hormones, enzymes associated, change in color, texture, flavor during storage, vole of vitamins and carbohydrates, Maturity and maturity indices; storage types, post-harvest treatments, bio regulators, Measurement of product quality methods- destructive and non-destructive tests, physical, chemical, biological, visual methods.

UNIT III	QUALITY IMPROVEMENT TECHNIQUES	9

Improve quality-harvesting, handling techniques, coatings and treatments, insect control and microbial control, quality control measures GAP, GMP, HACCP, Water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture.

UNIT IV	CLEANING	9

Cleaning of grains- washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screen vibrating screens, machinery for cleaning of fruits and vegetables (air, cleaners, washers), cleaning efficiency, care and maintenance; Peeling.

UNIT V	FOOD SPOLIAGE	9

Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting); destructive agents (rodents, birds, insects, etc.) sources of infestation and Control, Factors involved with spoilage - Biotic, abiotic factors, temperature, insects, microbes, fungi, bacteria.

	TOTAL PERIODS:	45

COURSE OUTCOMES

At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	acquire knowledge on basics of post-harvest physiological changes	Applying (K3)
CO2	Interpret different storage conditions and parameters	Analyzing (K4)

CO3	work on various quality concepts	Analyzing (K4)
CO4	inculcate cleaning techniques	Applying (K3)
CO5	basics of factors involve in food spoilage	Understanding (K2)

TEXT BOOKS

1. Post harvest physiology and pathology of vegetables, by Jerry A Bartz, Jeffrey K Brecht, 2nd edition Marcel Dekker Inc. NY
2. RH.H. Wills et al. An introduction to the post-harvest physiology and handling of fruits and vegetable

REFERENCES

1. Amalendu Chakraverty et al. "Handbook of post-harvest technology", Ed: Marcel Dekker Inc, (Special Indian Edition), 2000.
2. Post Harvest Technology of Horticulture crops, by Sudheer K P and Indira V, New India Publishing Agency
3. Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci
4. Pantastico B. 1975. Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fam and Vegetables. AVI Publications.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	1	-	-	-	-	-	2	3	2
CO2	-	3	3	-	2	-	2	-	-	-	-	1	3	3
CO3	2	2	3	3	-	-	3	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	-	2	1	2	2

FT23852	APPLICATION OF RENEWABLE ENERGY IN FOOD PROCESSING	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	understand the concepts of renewable resources
2.	know about solar energy in food industries
3.	learn about the biomass in food industries
4.	have knowledge on biogas in food industries
5.	acquire concepts of other renewable resources

UNIT I	INTRODUCTION	9
Introduction to energy sources - Classification of renewable energy sources, Utilization of these sources in food processing sector.		

UNIT II	SOLAR ENERGY	9
Solar radiation - Measurement of solar radiation, Types of solar collectors and their uses, Familiarization with solar energy gadgets - Solar cooker, Solar concentrates, Solar dryer, Solar steam generator, Utilization of solar thermal energy in food processing-Solar photovoltaic cells, Modules, Arrays, Conversion process of solar energy into electricity, Applications in food industry.		

UNIT III	BIOMASS	9
Biomass and its characterization-Briquetting of biomass, Biomass combustion, Pyrolysis, Gasification and Uses of gasifiers in food industry and Biodiesel preparation.		

UNIT IV	BIOGAS	9
Importance of biogas technology, Production mechanism, Types of biogas plants, Uses of biogas, Handling and Utilization of digested slurry: Use of food waste for biogas generation and its applications.		

UNIT V	OTHER RENEWABLE RESOURCES	9
Brief introduction to wind energy-Wind energy conversion, wind generator, wind into electricity, wind turbine; Hydroelectric energy; Hydrogen energy – advantages, application. Benefits, disadvantages and problems; Ocean energy; Ocean thermal energy-Ocean thermal energy conservation (OTEC); Offshore Wave Dragon System.		

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	gain the knowledge on renewable resource	Applying (K3)
CO2	apply solar energy resource in food industries	Analyzing (K4)
CO3	have a outline on biomass and techniques to manage biomass	Analyzing (K4)
CO4	explain the importance of biogas in food industries	Applying (K3)
CO5	have a depth knowledge on other renewable resources	Understanding (K2)

TEXT BOOKS

1. Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers, Delhi, 2013.
2. Rai, G.D. "Solar Energy Utilization", Khanna Publishers, Delhi

REFERENCES

1. Rathore N. S. Kurchania A. K., Panwar N. L," Non-Conventional Energy Sources", Himanshu Publications, 2007.
2. Tiwari, G.N. and Ghoshal, M.K., "Renewable Energy Resources. Basic Principles and Applications", Narosa Pub House. Delhi, 2005
3. Rathore N. S. Kurchania A. K., Panwar N. L. "Renewable Energy, Theory and Practice", Himanshu Publications, 2007.
4. Khandelwal, K.C. &SS Mahdi. "Biogas Technology- A Practical Handbook", 1990.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	-	1	2	-	-	3	3	2
CO2	2	1	3	-	2	1	-	1	2	-	-	3	3	3
CO3	2	2	2	1	2	1	-	1	2	-	-	3	3	3
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	2
CO5	2	2	2	1	2	1	-	-	-	-	2	2	3	2

FT23853	ENVIRONMENTAL ISSUES IN FOOD INDUSTRIES	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	learn about the cleaner production strategies
2.	have the environmental issues in plant-based food companies.
3.	understand the environmental issues in animal-based food companies.
4.	know the environmental issues in water from food companies.
5.	gain about the environmental management systems (EMS)

UNIT I	CLEANER PRODUCTION STRATEGIES FOR THE FOOD INDUSTRY	9

Cleaner production: principles and methodology for food industry. Environmental improvement in the food industry- Water efficiency, Energy efficiency and Raw material efficiency. Performance and environmental indicators, Future perspectives, food industry.

UNIT II	ENVIRONMENTAL ISSUES IN FOODS OF PLANT ORIGIN	9

Treatment Methods and Potential Uses of Treated Waste: Fruit/Fruit Juice Waste, Vegetable Waste, Olive of Waste and Cereal Waste.

UNIT III	ENVIRONMENTAL ISSUES IN FOODS OF ANIMAL ORIGIN AND PACKAGING MATERIALS	9

Treatment Methods and Potential Uses of Treated Waste: Meat Waste, Dairy Waste Management and Fish Waste. Waste Management in Food Packaging Industries, Environmental aspects of packaging materials for food use and Impact of food wastes on the overall sustainability.

UNIT IV	ENVIRONMENTAL ISSUES ON WASTE WATERS FROM FOOD INDUSTRIES	9

Food industry wastewaters, Characteristics of food industry wastewaters, Treatment methods biological methods, Physicochemical methods, Electrochemical methods, constructed wetlands and Hybrid systems. Case studies of food industry wastewater treatment, Reuse of treated food industry wastewaters.

UNIT V	ENVIRONMENTAL MANAGEMENT SYSTEMS	9

Current state of Environmental Management System (EMS)- Emissions and wastewater management, Food industry and agricultural waste, Beverage industry, Fruit and vegetable industry, Meat and poultry processing industry. Environmental attitudes and politics and Environmental impact assessment. Life Cycle Assessment (LCA)- concept and structure of LCA, Examples of LCA studies on food production system.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	identify the basic cleaner production strategies in food industries	Applying (K3)
CO2	analyze the environmental issue in plant-based food companies	Analyzing (K4)

CO3	use the environmental issues in animal-based food companies	Analyzing (K4)
CO4	clearly know the environmental issues in water from food companies	Applying (K3)
CO5	know about environmental management system (EMS)	Understanding (K2)

TEXT BOOKS

1. Chris Galanakis, The Interaction of Food Industry and Environment", Charlotte Cockle Publishers, 2021
2. Joannis S. Arvanitoyannis, "Waste Management for the Food Industries", 1st Edition, Elsevier, 2008.

REFERENCES

1. Herzka A and Booth, R.G "Food Industry and Frade: Recycling Waste" Applied Science Publishers 1981.
2. Wali Handbook of Waste Management and Co-Product Recovery in Food Processing". Woodhead Publishing, 2007.
3. P.N Chereminoff A.C. Morresi, "Energy from Solid Wastes", Naw Tork, Dekker, 1976.
4. Fellows P.J., Food processing Technology: Principles and Practice, 3rd Edition, Wood Head Publishing Limited, New Delhi, 2009.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	-	-	2	3	2	-	3	-	2	-	3
CO2	2	3	-	-	-	2	2	-	-	2	-	-	2	3
CO3	2	3	-	-	-	-	2	3	-	-	1	-	2	-
CO4	2	3	-	-	-	2	-	2	-	-	-	2	-	3
CO5	2	3	-	-	-	2	3	2	2	2	-	2	-	3

FT23854	BASICS OF FOOD SCIENCE	3	0	0	3

COURSE OBJECTIVES	
To enable students to	
1.	learn about principles of carbohydrates and Various chemical and physical changes of carbohydrates.
2.	acquire knowledge on the importance of protein structure and enzymatic reactions of protein in food.
3.	understand the importance of composition of Lipids, properties of fats & oils.
4.	know different mineral & vitamin content of foods.
5.	study colors, flavor & aroma components.

UNIT I	CARBOHYDRATES	9

The principle carbohydrates in the human diet; Various chemical and physical changes of carbohydrates in food during processing, cooking, and storage -dehydration, hydrolysis, fermentation, caramelization, Maillard reaction, and gelatinization; Preparation of Glucose syrup, fructose syrup, Sugar alcohols, and Chemistry of Artificial sweeteners; Use of starch in foods; Fiber Cellulose & hemicellulose, Pectin's, Gums & seaweeds- gel formation.

UNIT II	PROTEINS	9

The principal proteins in the human diet; Review of protein structure & conformation; Various chemical and physical changes of protein in food during processing, and cooking-solubility, hydration, swelling, denaturation, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, Maillard reaction, denaturation; Enzymatic reactions of protein in food, Food enzymes and their role in food spoilage, application of food enzymes; Texturized proteins; Functional role and uses in foods.

UNIT III	LIPIDS	9

Structure, composition and nomenclature of Lipids. Properties of fats & oils, melting points, plasticity, isomerization, Saponification number, iodine value, Reichert-Meissl number, and hydrolysis of triglycerides. Types of fatty acids; Edible oil refining processes, winterization; Shortening power of fats, tenderization, frying - smoke point, auto-oxidation, polymerization, lipids having emulsifying properties, its application in food industry and detergents; Shortening power of fats, types of fat substitute.

UNIT IV	WATER AND MICRONUTRIENTS	9

Chemistry, physical properties, free, bound & entrapped water, water activity; Drinking water, mineral water, water hardness, water quality for food processing; Mineral & vitamin content of foods- Food and Pharmaceutical grades; Recommended daily intake, toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

UNIT V	AROMA	9

Naturally occurring colors/pigments in food and impact on antioxidant level, Synthetic food grade Colors, flavor & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables &fermented products; and naturally similar /artificial flavors, Threshold values.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	understand the structure and properties of carbohydrates	Applying (K3)
CO2	summarize the structure and properties of proteins	Analyzing (K4)
CO3	review the structure and properties of lipids	Analyzing (K4)
CO4	elaborate the properties of water and micronutrients	Applying (K3)
CO5	analyse the aroma in food	Understanding (K2)

TEXT BOOKS

1. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, Kluwer-Academic, Springer, 2003.
2. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.

REFERENCES

1. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
2. Gropper, Sareen S. and Jack L. Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.
3. Meyer, Lillian Hoagland. "Food Chemistry". CBS Publishers, 1987.
4. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	-	3	-	-	1	2	-	2	3
CO3	2	2	2	1	1	-	-	-	-	1	2	1	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	1	2	-	3	-	-	2	2	-	3	2

PAVAI ENGINEERING COLLEGE NAMAKKAL
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FT23855	FUNDAMENTALS OF FOOD PRESERVATION	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. learn about Importance of Food Preservation.
2. acquire knowledge on the preservation of food by low temperature.
3. understand the importance of preservation of food by high temperature.
4. know different methods of concentration and food dehydration.
5. study household preservation methods.

UNIT I	FOOD PRESERVATION	9

Introduction to Food Preservation-Historical Development in food; Processing and preservation; Objectives-Importance of Food Preservation; Food Spoilage- What spoils Food; Intermediate moisture food (IMF)-History of Intermediate Moisture Foods, Water Activity, Purpose of IMF; Perishability of Food; Wastage of Food-Cause of Food Wastage, Effects of Food wastage.

UNIT II	PRESERVATION OF FOOD BY LOW TEMPERATURE	9

Introduction to chilling-Consideration relating to storage of food at chilling temperature, Chilling equipment, Chilling with liquid secondary agents, Application and procedure of chilling, Process chilling application; Controlled atmosphere storage (CAS); Modified atmospheric packaging/storage (MAS); Freezing and Frozen storage- Initial freezing point, Freezing curve, changes during freezing, rate of freezing; Methods of freezing; Thawing.

UNIT III	PRESERVATION BY HIGH TEMPERATURE	9

Heat preservation of foods-Sterilization, Filtration, Gas Sterilization, Exposure to ionizing radiation, Pasteurization-Methods of pasteurization, Blanching, Canning; Thermal preservation of foods- Thermal Destruction of Microorganisms, Death rate curve (D value), Thermal Death Time (TDT) curve, Z-value F-value, 12-D concept; Thermal Processing Technologies-Microwave heating, Radio frequency heating, Infrared heating; Non-thermal preservation of food, Food Irradiation, Pulsed electric field.

UNIT IV	FOOD DEHYDRATION AND CONCENTRATION	9

Food Dehydration; Heat and Mass Transfer; Effects on food properties on dehydration; Porosity; Drying methods and equipment; Food Concentration-Methods of Concentration; Ultrafiltration and Reserve Osmosis; Changes during concentration

UNIT V	HOUSEHOLD PRESERVATION METHODS	9

Cooking/boiling; Prevention of colour changes in fruit, Preservation of off flavours; Freezer storage; Sun drying; Smoking; Pickling; Dehydrating; Jams and jellies; Root cellar; Salting; Sugar in food preserving; Preserving food with salt-Curing; Effects of meat preservation on health; Oiling; Bio-preservation; Nutritional value; Food Frying-Dry frying, Shallow Frying, Deep Fat Frying, Nutritional aspects of frying.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	adapt the Importance of Food Preservation.	Understanding (K2)
CO2	infer the concepts of preservation by low temperature	Analyzing (K4)
CO3	appraise the preservation by high temperature.	Analyzing (K4)
CO4	elaborate the techniques of food dehydration and concentration	Applying (K3)
CO5	appraise the techniques of household preservation methods	Applying (K3)

TEXT BOOKS

1. Ananya Gaur and Shivani Bansal "Food Preservation" published by onlinegatha, The – Endless Tale

2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.

REFERENCES

1. Singh, M.K. "Food Preservation" Discovery Publishing, 2007.

2. New Methods of Food Preservation by G. W. Gould, Unilever research laboratory Bedford first edition 1995 Springer Science + business media Dordrecht.

3. N.J Russell and G.W Gould "Food Preservatives" second edition Library of congress Cataloging, Kluwer Academic/Plenum publishers.

4. Rajeev Bhat, Abd Karim Alias, Gopinadhan Paliyath " Progress in Food Preservation" First edition published by John Wiley and Sons Ltd.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	3	2	1	3	-	-	1	-	3	3	2
CO2	-	2	2	3	1	1	3	-	-	1	2	-	2	3
CO3	2	2	3	1	-	-	-	-	1	1	2	3	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	2	-	-	2	-	3	3	2

FT23856	FOOD PRODUCT TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable students to

1. understand the basic concepts of confectionery products.
2. understand the role of the Goat, Yak, Sheep, Buffalo milk products.
3. explore the techniques for assessing the methods of Butter, Ghee, and cream products.
4. know the role of bread and special bakery products.
5. provide a depth knowledge of developing the suitable functional food product.

UNIT I	CONFECTIONERY PRODUCTS	9

Grained sugar products-Fondant, Fudge, chocolate-covered Liqueur sweets; Toffees and Caramels-Cooking Toffees, A Typical Toffee, The Process, Toffee as an Ingredient of other products. Chewing Gum- Gum Base Characteristics, Texturisers, Antioxidants, Sugars, Loss or Gain of Moisture, Flavours; Aerated Products- Marshmallows, Nougat.

UNIT II	MILK PRODUCTS	9

Goat Milk- Introduction; Composition of goat milk; Effects of feeding and management of goat milk composition; The contribution of goat milk to human nutrition and health; Buffalo Milk- Introduction; Major milk constituents and their nutritional importance; Nutritional and health benefits of buffalo milk and its products; Sheep milk; Camel Milk; Horse and donkey milk; Sow milk; Yak milk.

UNIT III	MILK BYPRODUCTS	9

Butter, Ghee, and cream products-Introduction, Manufacture of Butter, Ghee and cream products; Nutritive values of butter, Ghee and cream; Human health benefit components; conjugated linoleic acid; short and medium chain fatty acids; New approach on cholesterol removal; conclusion. Fermented milk and yogurt- General aspects of fermented milk; standards and regulations; health benefits of fermented milk products; Future aspects.

UNIT IV	BREAD AND SPECIAL BAKERY PRODUCTS	9

Bread- Manufacture, Quality Control, Enzymes in Breadmaking, Sourdough, Frozen dough; Cake Manufacture, Cracker Manufacture, Nonenzymatic browning for Cookies, Crakers, and Biscuits; Specialities from all over the world; Dietetics Bakery Products, Gluten-Free Cereal- Based Products; Muffins and bagels; Pretzel Production and quality control; Italian Bakery.

UNIT V	FUNCTIONAL FOOD PRODUCT	9

Maximising the functional benefits of plant foods- Functional effects deliverable by plants, Plant sources of functional compounds, the delivery of functional effects, enhancing functional effects, macronutrient quality, micronutrient quality, Functional fats and spreads-Functional ingredients and chronic diseases: applications in fats and spreads, Fatty acids, Spreads containing fish oil, Modified fats and oils, Phytosterol.

	TOTAL PERIODS:	45

COURSE OUTCOMES		
At the end of this course, the students will be able to		**BT MAPPED (Highest Level)**
CO1	understand the basics of confectionery products.	Understanding (K2)
CO2	analyse the Goat, Yak, Sheep, Buffalo milk products and their nutritional importance.	Analyzing (K4)
CO3	evaluate the methods of Butter, Ghee, and cream products and their nutritional value.	Analyzing (K4)
CO4	apply and analyse the role of bread and special bakery products.	Applying (K3)
CO5	create the suitable functional food product and their functional benefits.	Creating (K5)

TEXT BOOKS

1. The Science of Sugar Confectionery by William P Edwards, Bardfield consultants, Essex, UK, The Royal society of chemistry 2000.
2. The Sensory Evaluation of Dairy Products edited by Stephanie Clark, Michael Costello, Maryanne Drake, Flayd bodyfelt second edition, Springer science +Business media LLC - 2009

REFERENCES

1. Milk and Dairy Products in Human Nutrition: Production, Composition and Health edited by Young W. Park and George F.W Haenlien Wiley blackwell first edition published in 2013.
2. Bakery Products: Science and Technology edited by Y. H. Hui, Harold Corke, Ingrid De Leyn, Wai-Kit Nip, Nanna A. Cross Blackwell publishing 2006.
3. Sugar and Sugar derivatives changing consumer preferences edited by Narendra Mohan and Priyanka, Singh published in springer nature Singapore pvt ltd 2020.
4. Baked products science, technology and practice by Stanley P, Cauvain, Linda S young, Wiley blackwell publishing 2006.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programs Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	-	3	1	1	-	3	-	1	2	1	3	2
CO2	2	2	-	2	1	1	3	3	-	1	2	2	2	3
CO3	2	2	-	1	1	2	-	2	-	1	2	2	2	3
CO4	2	1	-	-	1	2	3	2	-	2	2	2	3	2
CO5	1	2	-	3	2	2	-	3	2	-	3	2	3	2