B.Tech. (Food Technology)

Revised 2018 Regulations, Curriculum & Syllabi

(Candidates admitted during Academic Year 2021-2022)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Acquire theoretical and practical knowledge of food engineering and technology to become a qualified food process engineer.

II. Apply the skills of food technology in research, industry and entrepreneurship to ensure food safety and nutrition security.

III. Improve the standard of living and economy of the nation through convenience and novel food products with professional ethics.

PROGRAMME OUTCOMES (POs)

a. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

l. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

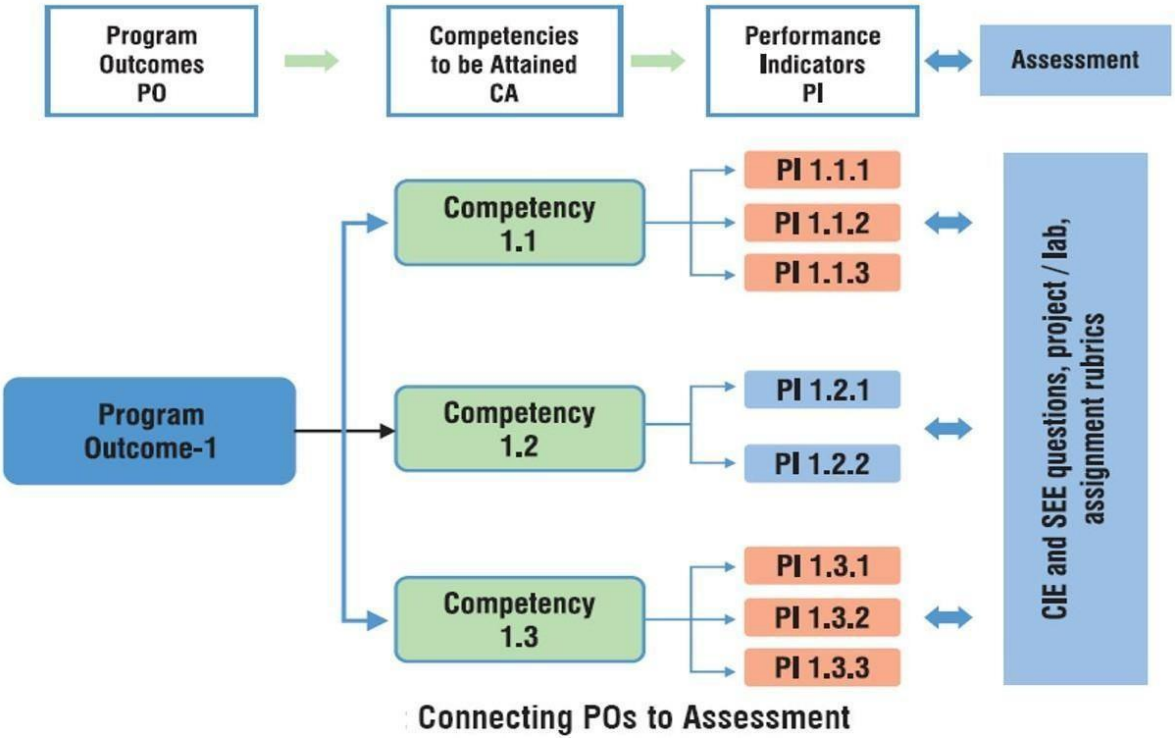
1. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

2. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
I	X	X	X	X							X	
II		X		X	X		X	X				X
III						X	X	X	X	X		

Connectivity chart



Connecting POs to Assessment

DEPARTMENT OF FOOD TECHNOLOGY

Minimum Credits to be Earned: 161

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18FD101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18FD102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18FD103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18FD104	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HS
18FD106	ENGINEERING DRAWING	1	0	4	3	5	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**24**	**-**	**-**	**-**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18FD201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18FD202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18FD203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18FD204	COMPUTER PROGRAMMING	1	0	4	3	5	50	50	100	ES
	LANGUAGE ELECTIVE	-	-	-	2	2	100	0	100	HS
18FD206	FUNDAMENTALS OF MICROBIOLOGY	3	0	0	3	3	40	60	100	ES
18FD207	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	100	0	100	ES
Total		**12**	**1**	**14**	**20**	**27**	**-**	**-**	**-**	**-**

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18FD301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18FD302	FOOD MICROBIOLOGY	3	0	0	3	3	40	60	100	PC
18FD303	FOOD CHEMISTRY	3	0	2	4	5	50	50	100	PC
18FD304	UNIT OPERATIONS IN FOOD PROCESSING	3	0	0	3	3	40	60	100	PC
18FD305	DATA STRUCTURES	2	0	2	3	4	50	50	100	ES
18FD306	THERMODYNAMICS	2	1	0	3	3	40	60	100	PC
18FD307	FOOD MICROBIOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18FD308	UNIT OPERATIONS IN FOOD PROCESSING LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS – VERBAL ABILITY	2	0	0	-	2	100	0	100	EEC
Total		**18**	**2**	**10**	**23**	**30**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18FD401	HEAT AND MASS TRANSFER	3	0	2	4	5	50	50	100	ES
18FD402	PRINCIPLES OF FOOD PROCESSING AND PRESERVATION	3	0	0	3	3	40	60	100	PC
18FD403	REFRIGERATION AND COLD CHAIN MANAGEMENT	3	0	0	3	3	40	60	100	PC
18FD404	FOOD ANALYSIS	3	0	0	3	3	40	60	100	PC
18FD405	JAVA PROGRAMMING	2	0	2	3	4	50	50	100	ES
18FD406	FLUID MECHANICS	3	1	0	4	4	40	60	100	PC
18FD407	PRINCIPLES OF FOOD PROCESSING AND PRESERVATION LABORATORY	0	0	2	1	2	100	0	100	PC
18FD408	FOOD ANALYSIS LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**19**	**1**	**12**	**23**	**32**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21FD501	BAKING AND CONFECTIONERY TECHNOLOGY	3	0	0	3	3	40	60	100	PC
21FD502	PLANTATION AND SPICE PROCESSING	3	0	2	4	5	50	50	100	PC
21FD503	FOOD ADDITIVES	3	0	2	4	5	50	50	100	PC
21FD504	DAIRY TECHNOLOGY	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
21FD507	BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
21FD508	DAIRY TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS – APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**0**	**14**	**24**	**32**	**-**	**-**	**-**	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HS
21FD602	FOOD EQUIPMENT DESIGN	3	1	0	4	4	40	60	100	PC
21FD603	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
21FD607	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS – APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**1**	**6**	**20**	**24**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21FD701	WASTE MANAGEMENT IN FOOD INDUSTRIES	3	0	0	3	3	40	60	100	PC
21FD702	FOOD PROCESSING PLANT DESIGN AND LAYOUT	3	1	0	4	4	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
21FD707	WASTE MANAGEMENT IN FOOD INDUSTRIES LABORATORY	0	0	4	2	4	100	0	100	PC
21FD708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**18**	**1**	**10**	**24**	**29**	-	-	-	-
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21FD801	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**0**	**0**	**18**	**9**	**18**	-	-	-	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
ONE CREDIT COURSES										
18FD0XA	HALAL COMPLIANCE IN FOOD AUDIT	0	0	0	1	1	100	0	100	OC
18FD0XB	FOOD FERMENTATION TECHNOLOGY	0	0	0	1	1	100	0	100	OC
18FD0XC	FABRICATION OF FOOD PROCESSING EQUIPMENT	0	0	0	1	1	100	0	100	OC
18FD0XD	FOOD SAFETY AND QUALITY MANAGEMENT SYSTEMS	0	0	0	1	1	100	0	100	OC
18FD0XE	HACCP CERTIFICATION	0	0	0	1	1	100	0	100	OC
18FD0XF	FSSAI-FOOD SAFETY TRAINING AND CERTIFICATION (FoSTaC)	0	0	0	1	1	100	0	100	OC
18FD0XG	ISO-17025 FOR ACCREDITED LABORATORY	0	0	0	1	1	100	0	100	OC
18FD0XH	FOOD ADDITIVES AND INGREDIENT FUNCTIONALITY	0	0	0	1	1	100	0	100	OC
18FD0XI	TRANSLATIONAL RESEARCH AND TECHNOLOGY COMMERCIALIZATION	0	0	0	1	1	100	0	100	OC
18FD0XJ	FORMULATION OF PLANT BASED FOODS	0	0	0	1	1	100	0	100	OC
18FD0XK	PHYSICOCHEMICAL STUDIES OF BAKED PRODUCTS	0	0	0	1	1	100	0	100	OC
OPEN ELECTIVES										
21OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	BS
21OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	BS
21OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	BS
21OFD04	CEREAL, PULSES AND OILSEED TECHNOLOGY	3	0	0	3	3	40	60	100	BS
ADDITIONAL ONE CREDIT COURSES										
18GE0XA	ETYMOLOGY	1	0	0	1	1	100	0	100	EEC

18GE0XB	GENERAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC
18GE0XC	NEURO BEHAVIOURAL SCIENCE	1	0	0	1	1	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	1	0	0	1	1	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLANCE	1	0	0	1	1	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	1	0	0	1	1	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	1	0	0	1	1	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	1	0	0	1	1	100	0	100	EEC
18GE0XI	BLOG WRITING	1	0	0	1	1	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	1	0	0	1	1	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	1	0	0	1	1	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	1	0	0	1	1	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	1	0	0	1	1	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	1	0	0	1	1	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	1	0	0	1	1	100	0	100	EEC

PROFESSIONAL ELECTIVES

VERTICAL 1- INNOVATIONS IN FOOD PACKAGING

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD001	FOOD PACKAGING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD002	FOOD PACKAGING DESIGN AND DEVELOPMENT	3	0	0	3	3	40	60	100	PE
21FD003	DIVERSE MATERIALS IN FOOD PACKAGING	3	0	0	3	3	40	60	100	PE
21FD004	EMERGING TRENDS AND INNOVATIONS IN PACKAGING TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD005	PACKAGING PERFORMANCE TESTING AND MACHINERY	3	0	0	3	3	40	60	100	PE
21FD006	NEXT GENERATION PACKAGING	3	0	0	3	3	40	60	100	PE

VERTICAL 2- ADVANCED FOOD PROCESSING

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	

21FD007	RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS	3	0	0	3	3	40	60	100	PE
21FD008	NON- THERMAL PROCESSING TECHNIQUES	3	0	0	3	3	40	60	100	PE
21FD009	THERMAL PROCESSING TECHNIQUES	3	0	0	3	3	40	60	100	PE
21FD010	FOOD SENSORS	3	0	0	3	3	40	60	100	PE
21FD011	3D PRINTING OF FOODS	3	0	0	3	3	40	60	100	PE
21FD012	APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING	3	0	0	3	3	40	60	100	PE

VERTICAL 3- BAKERY AND CONFECTIONERY TECHNOLOGY

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD013	TRADITIONAL CONFECTIONERIES	3	0	0	3	3	40	60	100	PE
21FD014	RHEOLOGICAL PROPERTIES OF BAKERY AND CONFECTIONERY PRODUCTS	3	0	0	3	3	40	60	100	PE
21FD015	DESIGN OF BAKERY AND CONFECTIONERY EQUIPMENT	3	0	0	3	3	40	60	100	PE
21FD016	INDUSTRIAL PRODUCTION OF BAKED GOODS	3	0	0	3	3	40	60	100	PE
21FD017	SUGAR TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD018	BAKERY SCIENCE AND INGREDIENT TECHNOLOGY	3	0	0	3	3	40	60	100	PE

VERTICAL 4- SPICES, PLANTATION AND HERBS TECHNOLOGY

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD019	TEA AND COFFEE PROCESSING	3	0	0	3	3	40	60	100	PE
21FD020	AROMATIC SPICES PROCESSING	3	0	0	3	3	40	60	100	PE
21FD021	PROCESSING OF CHOCOLATE AND ITS PRODUCTS	3	0	0	3	3	40	60	100	PE
21FD022	VALUE-ADDED SPICE PRODUCTS	3	0	0	3	3	40	60	100	PE
21FD023	PROCESSING OF COCONUTS AND ITS PRODUCTS	3	0	0	3	3	40	60	100	PE

21FD024	AROMATIC HERBS PROCESSING	3	0	0	3	3	40	60	100	PE

VERTICAL 5 - FOOD SAFETY AND QUALITY MANAGEMENT

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD025	NATIONAL AND INTERNATIONAL FOOD LAWS	3	0	0	3	3	40	60	100	PE
21FD026	RISK ANALYSIS	3	0	0	3	3	40	60	100	PE
21FD027	FOOD ADULTERATION AND ITS CONTROL	3	0	0	3	3	40	60	100	PE
21FD028	FOOD SAFETY MANAGEMENT SYSTEMS	3	0	0	3	3	40	60	100	PE
21FD029	FOOD SUPPLY CHAIN MANAGEMENT AND LOGISTICS	3	0	0	3	3	40	60	100	PE
21FD030	QUALITY ASSURANCE AND QUALITY CONTROL IN FOOD INDUSTRIES	3	0	0	3	3	40	60	100	PE

VERTICAL 6- FOOD BIOTECHNOLOGY

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD031	MICROBIAL PRESERVATION AND PROCESSING	3	0	0	3	3	40	60	100	PE
21FD032	BIOPROCESS TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD033	FOOD ALLERGENS AND TOXICOLOGY	3	0	0	3	3	40	60	100	PE
21FD034	ENZYME TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD035	FOOD FERMENTATION TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21FD036	CELLULAR AGRICULTURE	3	0	0	3	3	40	60	100	PE

VERTICAL 7- FRUIT AND VEGETABLE TECHNOLOGY

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
21FD037	FRUIT SCIENCE	3	0	0	3	3	40	60	100	PE
21FD038	POST-HARVEST MANAGEMENT OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	PE
21FD039	FRUITS AND VEGETABLES PROCESSING	3	0	0	3	3	40	60	100	PE
21FD040	BEVERAGE TECHNOLOGY	3	0	0	3	3	40	60	100	PE

21FD041	VALUE-ADDED PRODUCTS FROM FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	PE
21FD042	FRUIT AND VEGETABLE WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	-	-	-	-	-	24	15	15%	20%
2	ES	6	8	3	7	-	-	-	-	24	15	15%	20%
3	HSS	2	2	-	-	-	2	-	-	6	3.7	5%	10%
4	PC	-	-	16	16	18	9	9	-	68	42.2	35%	45%
5	PE	-	-	-	-	6	9	12	-	27	16.7	15%	20%
6	EEC	-	-	-	-	-	-	3	9	12	7.4	5%	10%
Total		18	20	23	23	24	20	24	9	161	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18FD101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	-											
2	3	1	-											
3	1	-	-											
4	2	-	3											
5	-	3	-											

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit

differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, LHopitals Rule.

Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas, Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.

18FD102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1												
4	2	1							-					
5	2	1							-					

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight - Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum – Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem -determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection - image formation:concave mirrors - convex mirrors - thin lenses - compound microscope -human eye. Conditions of interference - Youngs double slit experiment -intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution -diffraction grating - applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011

3. H C Verma, Concepts of Physics (Vol I & II), BharathiBhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012
6. D.S. Mathur, Elements of Properties of Matter, S.Chand& Co. Publishers, New Delhi, 2010.

18FD103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Explain the periodic trends in modern periodic table and structural parameters of chemical compounds based on periodic properties
- Summarize the fundamentals of chemical equilibrium and buffer action
- Explain the basic concepts of colligative properties and abnormalities in colligative properties
- Outline the concept of organic reactions mechanism with suitable examples

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the periodic trends in modern periodic table and structural parameters of chemical compounds based on periodic properties
2. Identify the bonding nature and structure of chemical compounds
3. Identify the chemical reactions in solutions and apply it for different solution phase reactions
4. Summarize the colligative properties of solution and analyze the molecular mass of solute
5. Outline the three dimensional orientation of organic molecules and explain the suitable organic reaction mechanisms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2													
5	2	1												

UNIT I **6 Hours**

PERIODIC CLASSIFICATION OF ELEMENTS

Brief history of periodic classification - modern periodic law and the present form of periodic table - periodic trends in properties of elements: Atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy and electronegativity.

UNIT II **6 Hours**

CHEMICAL BONDING AND MOLECULAR STRUCTURE

Valence electrons - ionic bond - covalent bond - bond parameters. Lewis structure. Polar character of covalent bond and covalent character of ionic bond. Valence bond theory - resonance - geometry of covalent molecules - VSEPR theory - concept of hybridization involving s, p and d orbitals - shapes of some simple molecules. Hydrogen bond.

UNIT III **6 Hours**

CHEMICAL EQUILIBRIUM

Equilibrium in physical and chemical processes - law of mass action - equilibrium constant - factors affecting equilibrium - Le Chatelier s principle. Ionic equilibrium: Ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polyhydroxy acids, acid strength. Concept of pH - hydrolysis of salts - buffer solutions - Henderson equation - solubility product - common ion effect.

UNIT IV **6 Hours**

COLLIGATIVE PROPERTIES

Types of solutions - expression of concentration of solutions of solids in liquids - solubility of gases in liquids - solid solutions. Colligative properties of relative lowering of vapour pressure - Raoult`s law - elevation of boiling point - depression of freezing point - osmotic pressure - determination of molecular mass using colligative properties - abnormalities in colligative properties - Vant Hoff factor.

UNIT V **6 Hours**

STRUCTURE AND REACTIVITY OF ORGANIC COMPOUNDS

IUPAC nomenclature of organic compounds - electronic displacements in a covalent bond: Inductive effect, electromeric effect, resonance and hyper conjugation - homolytic and heterolytic fission of a covalent bond: Free radicals, carbocations, carbanions - electrophiles and nucleophiles - types of organic reactions.

FURTHER READING

Identification of adulteration by simple chemical test. Application of chemistry in food packing. Chemistry of artificial food additives.

1 **3 Hours**

EXPERIMENT 1

Detection of nitrogen, sulphur, chlorine, bromine and iodine in the given samples: Lassaignes Test

2 **3 Hours**

EXPERIMENT 2

Determination of percentage purity of baking soda

3 **3 Hours**

EXPERIMENT 3

Estimation of calcium in milk by complexometric method

4 **3 Hours**

EXPERIMENT 4

Determination of strength of a given hydrochloric acid solution by titrating it against standard sodium carbonate solution

5 **3 Hours**

EXPERIMENT 5

Determination of pH and titratable acidity of fruit juice solutions using pH meter

6 **4 Hours**

EXPERIMENT 6

Determination of dissolved oxygen in water by Winklers method

7 **3 Hours**

EXPERIMENT 7

Determination of molecular weight of given sample by depression of freezing point method and identify the given sample by comparing the experimental molecular weight with theoretical value

8 **4 Hours**

EXPERIMENT 8

Preparation of simple organic compounds: acetanilide and 2-naphthol aniline dye

9 **4 Hours**

MANDATORY GUIDELINES

Lab safety rules and guidelines for students

Preparation of N/10 oxalic acid and M/10 sodium carbonate solution

Total: 60 Hours

Reference(s)

1. J. D. Lee, Concise Inorganic Chemistry, 5th Edition, John Wiley & Sons, 2008.
2. P.S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International, 2005.
3. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
4. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. B S Bahl, Arun Bahl, Advanced Organic Chemistry, S.Chand, 5th Edition, 2012.

18FD104 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the concepts of electrical measuring units, sensors and transducers.
- To understand the selection of electric drives for food processing industry.
- To organize the electric heating methods and earthing techniques of electrical equipments.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Recognize the measuring devices and characteristics.
2. Explain different types of Sensors, transducers and actuators.
3. Classify the Electric Drives for various applications.
4. Differentiate the Heating techniques used in food processing.
5. Attribute the different types of earthing and electrical Safety.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1										
2	1	2		1										
3	1	1												
4	1	2												
5	1	2		1										

UNIT I **5 Hours**

MEASUREMENT AND PROPERTIES

AC, DC Supply, Current, Voltage, Power, frequency, Resistance, Inductance and Capacitance, electromagnetism, Transformer: step up, step down and high frequency transformer.

UNIT II **6 Hours**

SENSORS TRANSDUCERS AND ACTUATORS

Principles of transducers, strain guage, Thermistor, bridge type and crystal type, di-electric sensors - LVDT-Non Drive: solenoid and linear type.

UNIT III **8 Hours**

ELECTRICAL MACHINES AND DRIVES

Torque speed characteristics of single phase and three phase Induction motors, Universal motor, PM DC motor and Servo motor - Selection of motors for drives based on torque speed characteristics, rating and supply system of drives.

UNIT IV **5 Hours**

HEATING EQUIPMENT

High frequency power conversion (AC-AC and DC-AC), Resistance heating -Induction heating -Dielectric heating

UNIT V **6 Hours**

SAFETY AND ACESSARIES

Wires, Cables, Earthing: Necessity- Types of Earthing, Measurement of Earth Resistance- Types of fuses, MCB, ELCB, Types of switches, Plugs and Sockets.

1 **6 Hours**

EXPERIMENT 1

Measurement of power, voltage, current, frequency using digital meters.

2 **6 Hours**

EXPERIMENT 2

Measurement of temperature using thermistors and LVDT.

3 **6 Hours**

EXPERIMENT 3

Fabrication the prototype model of induction heater.

4 **6 Hours**

EXPERIMENT 4

Fuse replacement and earthing of equipment.

5 **6 Hours**

EXPERIMENT 5

Study the speed control of stepper motors and servo motors.

Total: 60 Hours

Reference(s)

1. Vedam Subramanyan,Electric Drives: Concepts and Applications, Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. A.L.Anwari,Basic of Electrical Engineering,Dhanpat Rai,2016.
3. Open Shaw Taylor,Utilization of Electrical Energy, University Press,2017.
4. Alan.S.Moris, Reza Langari,Measurement and Instrumentation, Elsevier,2011.
5. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write formal, routine letters of factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3														
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18FD106 ENGINEERING DRAWING 1 0 4 3

Course Objectives

- Provide knowledge on projection of points and lines.
- Impart skill in drawing projection of simple solids.
- Familiarize creation of orthographic views from isometric projections of simple solids and vice versa.
- Build the proficiency to create two dimensional sketches using software.
- Provide the skill to build three dimensional models and its orthographic views using software.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Illustrate the projection of points and lines in different quadrants.
2. Construct orthographic projections of simple solids.
3. Create the orthographic and isometric projections of simple solids.
4. Sketch the two dimensional views of engineering components using software.
5. Construct three dimensional models of engineering components and its orthographic views using software.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2	-	-	-	-	-	-	-	-	-	-		
3	1	2	-	-	-	-	-	-	-	-	-	-		
4	1	2	-	-	-	-	-	-	-	-	-	-		
5	1	2	-	-	-	-	-	-	-	-	-	-		

UNIT I **10 Hours**

PROJECTION OF POINTS

Practices on lettering, numbering and dimension of drawings. Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - parallel, perpendicular and inclined to anyone plane.

UNIT II **10 Hours**

PROJECTION OF SOLIDS

Orthographic projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

UNIT III **10 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTION

Conversion of isometric to orthographic projection and vice versa. Perspective projection of simple solids.

UNIT IV **10 Hours**

CREATION OF 2D SKETCHES USING SOFTWARE

Sketch Entities - line, circle, arc, rectangle, slots, polygon, text, snap, and grid. Sketch Tools-fillet, chamfer, offset, convert entities, trim, extend, mirror, move, copy, rotate, scale, stretch, sketch pattern. Geometrical constraints, Dimensioning - smart, horizontal, vertical, ordinate.

UNIT V **10 Hours**

PART MODELING AND DRAFTING USING SOFTWARE

Part Modeling - extrude, cut, revolve, creation of planes, fillet, chamfer, shell, rib, pattern, mirror, loft, draft and swept. Drafting - Converting 3D models to orthographic views with dimensions.

1 **3 Hours**

EXPERIMENT 1

Lettering and Numbering

2 **4 Hours**

EXPERIMENT 2

Projection of Points

3 **4 Hours**

EXPERIMENT 3

Projection of Lines

4 **5 Hours**

EXPERIMENT 4

Projection of Simple solids

5 **4 Hours**

EXPERIMENT 5

Isometric and Orthographic Projections

6 **2 Hours**

EXPERIMENT 6

Basic Commands in Autocad

7 **3 Hours**

EXPERIMENT 7

Isometric and Orthographic Projections in Autocad

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18FD201 ENGINEERING MATHEMATICS II **3 1 0 4**

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas, Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18FD202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- infer the surface and electrical properties of food materials
- impart the knowledge in thermal and electromagnetic properties of food materials
- understand the importance of nanotechnology in food processing and packing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. exemplify the surface properties and measurement techniques of surface tension and interfacial tension
2. explain the relationship between rheological properties and fluid behavior of solid and liquid food materials
3. apply the knowledge of thermal conductivity and thermodymanics in calculating heat requirement for food preparation process
4. Outline the response of food materials to electromagnetic radiation in the range of optical frequencies and assess the quality of food materials based on dielectric properties
5. Assess the role of nanoparticles in food processing and efficiency of four types of food packing techniques using nanotechnology

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1							2					
4	2	1							2					
5	2													

UNIT I **6 Hours**

SURFACE PROPERTIES

Cohesive and adhesive forces - surface tension - temperature effects - capillary action - surface activity - interfacial tension - emulsions - detergency - foaming - wettability and solubility- colloidal systems in foods - applications.

UNIT II **6 Hours**

RHEOLOGICAL PROPERTIES

Classification of rheology - viscosity: measurement of viscosity in fluid food, shear stress and shear rate - Newtonian fluids and dynamic viscosity - Non-Newtonian behaviour: Time dependent fluids and time independent fluids - methods for measuring viscosity of fluid food -texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis.

UNIT III **6 Hours**

THERMAL PROPERTIES

Thermal conductivity of food materials - Fouriers law of heat conduction - methods to measure thermal conductivity of food materials - conservation and conversion of energy in foods - energy value of food - specific heats of food - enthalpy and latent heat of food - thermal diffusivity in food materials.

UNIT IV **6 Hours**

ELECTROMAGNETIC PROPERTIES

Electromagnetic spectrum - interaction of radiation with matter - effects of incident radiation -dielectric properties of foods: basic principles of microwave heating, dipolar rotation - effect of moisture content - temperature - salt and sugar composition of food materials on dielectric properties - quality of food materials

UNIT V **6 Hours**

NANOSCIENCE IN FOOD TECHNOLOGY

Classification of nanoparticles - nanoparticles in food technology: nanodispersions - nanocapsules - nanoemulsions nanolaminates - nanosensors - food processing- types of food packing: improved packing- active packing- antimicrobial packing - smart packing

1 **4 Hours**

EXPERIMENT 1

Determination of critical velocity and coefficient of viscosity of the given liquid using Poiseuilles method by maintaining stream line flow in the capillary tube.

2 **4 Hours**

EXPERIMENT 2

Determine the velocity of ultrasonic waves in the given liquid.

3 **5 Hours**

EXPERIMENT 3

Determine the coefficient of thermal conductivity of a bad conductor by Lees disc method.

4 **4 Hours**

EXPERIMENT 4

Determine the capacitance of a capacitor connecting capacitors in series and in parallel

5 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given material

6 **5 Hours**

EXPERIMENT 6

Using the laws of reflection, refraction and transmission, determine the wavelength of the prominent lines of mercury spectrum through spectrometer

7 **4 Hours**

EXPERIMENT 7

Draw a hysteresis loop for a given ferromagnetic specimen and calculate the energy loss using the B_H curve

Total: 60 Hours

Reference(s)

1. Ludger O. Figura and Arthur A.Teixeira, Food Physics Physical Properties -Measurements and Applications, Springer-Verlag Berlin Heidelberg 2007.

2. Serpil Sahin and Servet Gulum Sumnu, Physics properties of food, Springer Science and Business Media, LLC, 2006.
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. https://www.researchgate.net/publication/51568480 The Applications of Nanotechnology in Food Industry

18FD203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Indicate the effect of water hardness and their softening processes
- Identify the need of colloidal chemistry in food processing
- Explain the terminologies of electrochemistry and acquire the basic knowledge of electrode potentials and electrochemical cells
- Summarize the fundamentals of corrosion, its types and protection methods
- Outline basic concepts of polymers, preparation and its processing methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Compare the internal and external treatment methods for the removal of hardness in water for domestic as well as industrial applications
2. Summarize the concept of colloidal chemistry and its application in food processing
3. Construct an electrochemical cell and measure its potential using selected reference electrode
4. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion protection method
5. Differentiate polymers based on its source, properties and applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2	1												
3	2	2												
4	2						1							
5	3	2												

UNIT I **6 Hours**

WATER TREATMENT TECHNOLOGY

Water quality parameters: Physical, chemical and biological impurities of water. Hardness of water - classification of hardness - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA method. Requirements of boiler feed water - disadvantages of using hard water in industrial boilers. Internal conditioning and external conditioning. Municipal water treatment. Water quality parameters for food industry.

UNIT II **6 Hours**

COLLOIDAL CHEMISTRY

Colloids- types of colloids - lyophilic and lyophobic colloids - preparation of colloidal solution - properties of colloids - Tyndall effect, Brownian effect, electrical properties. Stability of colloids - electrostatic stabilization and steric stabilization. Coagulation methods. Application of colloids in foods and medicines - emulsions, emulsifiers, gels, foams.

UNIT III **6 Hours**

ELECTROCHEMISTRY

Electrode potential: Single and standard electrode potential - half-cell reactions - Nernst equation - determination of single electrode potential. Cell - representation - types. Electrodes: Metal-metal ion electrode, metal-metal insoluble salt electrode and redox electrode - reference electrodes: Calomel electrode - silver-silver chloride electrode and glass electrode - measurement of pH using glass electrode- electrochemical series and its importance. Potentiometric titration (redox).

UNIT IV **6 Hours**

CORROSION SCIENCE

Chemical corrosion and electrochemical corrosion. Types of electrochemical corrosion: Galvanic corrosion and differential aeration corrosion. Galvanic series and its applications. Factors influencing corrosion rate: Nature of metal and environment. Corrosion control methods. Organic coating - paint, constituents and functions. Influence of Corrosion in food containers and control measures.

UNIT V **6 Hours**

POLYMER CHEMISTRY

Monomers - polymers - functionality - degree of polymerization - classification of polymers based on source and applications. Molecular weight determination - Ostwald viscometer method. Types of polymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting and thermoplastics, Biodegradable polymer and its application in food packing. Compounding of plastics - injection and extrusion moulding.

FURTHER READING

Application chemistry in food processing.

1 **4 Hours**

EXPERIMENT 1

Analysis the qualityof given sample of water with respect to hardness, TDS and pH.

2 **4 Hours**

EXPERIMENT 2

Estimation of chromium content in tannery effluent.

3 **4 Hours**

EXPERIMENT 3

Preparation of colloidal solution using emulsifier
(i) Oil in water emulsion
(ii) Water in oil emulsion

4 **4 Hours**

EXPERIMENT 4

Determination of the strength of Fe (II) in the given sample by potentiometric method.

5 **4 Hours**

EXPERIMENT 5

Conductometric titration of mixture of acids (HCl and CH3COOH).

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on mild steel by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Measurement of rate of corrosion on mild steel in aerated, neutral, acidic and alkaline medium by Tafel polarization method.

8 **2 Hours**

EXPERIMENT 8

Determination of molecular weight of a polymer by Ostwald viscometer.

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
4. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
5. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
6. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, 7th edition, 2012.

18FD204 COMPUTER PROGRAMMING 1 0 4 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Design applications using functions in C.
5. Apply the concepts of structures and files in writing C programs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2			3									
2	1	2			3									
3	1	2			3									
4	1	2			3									
5	1	2			3									

UNIT I **3 Hours**

INTRODUCTORY CONCEPTS

Introduction to C- Planning and writing a C program- Operators and Expressions- Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator Precedence and order of evaluation.

UNIT II **3 Hours**

CONTROL STATEMENTS

Decision Making and Branching- Decision Making and Looping -Jump Statements.

UNIT III **3 Hours**

ARRAYS AND STRINGS

Arrays- Introduction, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays. Strings- String handling functions.

UNIT IV **3 Hours**

FUNCTIONS

User Defined Functions- Elements of user defined functions - categories of function - call by value and call by reference - recursion

UNIT V **3 Hours**

STRUCTURES AND FILES

Structures - Introduction - defining a structure - declaring structure variables - accessing structure members -File Management in C.

FOR FURTHER READING

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles - magic triangles - magic squares - alphabetic puzzles - Cross number puzzles.

1 **3 Hours**

EXPERIMENT 1

Implement a C program which include a Fundamental Data types Integer, Float, double and Character.

2 **3 Hours**

EXPERIMENT 2

Implement a C program to perform the Arithmetic Operations using primitive data types.

3 **6 Hours**

EXPERIMENT 3

Implementation of logical, relational, bitwise, increment/decrement and conditional Operators in C.

4 **3 Hours**

EXPERIMENT 4

Implementation of Simple if else Conditional Statement.

5 **3 Hours**

EXPERIMENT 5

Implementation of nested if else Conditional Statement.

6 **3 Hours**

EXPERIMENT 6

Implementation of Switch Case Statement.

7 **3 Hours**

EXPERIMENT 7

Implement a C program using for Looping Statement.

8 **3 Hours**

EXPERIMENT 8

Implement a C program using Do-While Looping Statement.

9 **3 Hours**

EXPERIMENT 9

Implement a C program using While Looping Statement.

10 **3 Hours**

EXPERIMENT 10
Implementation of Jumping Statements

11 **9 Hours**

EXPERIMENT 11
Implementation of One Dimensional Array and Two Dimensional Array.

12 **3 Hours**

EXPERIMENT 12
Implement a C program to perform String Manipulation Functions.

13 **9 Hours**

EXPERIMENT 13
Implement a C program using structures and files

14 **3 Hours**

EXPERIMENT 14
Implement a C program which includes four categories of functions and recursive functions.

15 **3 Hours**

EXPERIMENT 15
Implement a C program for Call by value and Call by Reference.

Total: 75 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2017
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising,

reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri, 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18FD206 FUNDAMENTALS OF MICROBIOLOGY 3 0 0 3

Course Objectives

- Understand the microbial classification and growth
- Apply the plating and staining techniques to identify the microbes
- Evaluate the role of microbes in food spoilage and food borne illness.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Assess the structure and nutritional requirements of microbes
2. Apply the growth characteristics and reproduction of microbes to predict their multiplication and destruction
3. Analyze the microbial structure by plating, staining and microscopic methods
4. Compare the microbial spoilage of different foods and their control measures
5. Evaluate the toxicity of microbes in food-borne illness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			2	1	2								
2	1			2	1	2								
3	2			2	2	2								-
4	2			2	1	1								
5	2			3	3	2								

UNIT I **9 Hours**

CLASSIFICATION AND STRUCTURE OF MICROBES

Evolution and scope of microbiology. Microbial classification, nomenclature, structural organization and multiplication of bacteria, viruses, algae and fungi. Taxonomic groups and general methods of classifying bacteria. Nutritional requirements and nutrient transport phenomenon: passive diffusion, facilitated diffusion, group translocation and active transport. Types of media used for growth and detection for microbes

UNIT II **9 Hours**

GROWTH AND MULTIPLICATION OF MICROBES

Microbial growth and reproduction,Binary fission, Generation time, Specific growth rate, growth curve, methods of measuring microbial growth; Nature of microbial growth, mixed population, Sequence of growth, diauxic growth, Symbiotic growth, synergistic growth antagonistic growth. Physical, chemical and biological factors influencing the growth and destruction of microorganisms including concepts of Z, F and D values; Bacterial Genetic recombination - transformation, transduction, conjugation

UNIT III **9 Hours**

PLATING, STAINING AND MICROSCOPY

Plating methods-Pour plate, Spread plate, Streak plate, slat, stab. Principles of staining techniques ÃƒÂ¢?? simple staining, gram staining, acid fast, negative staining, capsular staining, flagellar staining, spore staining. Microscopy and microscopes: Types of microscope ÃƒÂ¢?? Simple microscope, Compound microscope, Bright field microscope, Phase contrast microscope, Scanning electron microscope, Transmission electron microscope.

UNIT IV **9 Hours**

ROLE OF MICROBES IN SPOILAGE OF FOODS AND THEIR CONTROL

Causes of food spoilage, Factors affecting kinds, numbers and growth of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients , redox potential and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere, Chemical changes caused by microorganisms. Microbial flora associated with various food groups and their spoilage potential. Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, Benzoates, Sorbates / Propionates naturally occurring antimicrobials; Physical methods- Low and high temperatures, drying, radiation and high pressure

UNIT V **9 Hours**

MICROBIAL AGENTS OF FOOD BORNE ILLNESS

Food borne infections and food poisoning. Microbial toxins - types, Gram Negative and Gram positive food borne pathogens, Salmonella, Coliforms, E. coli, Shigella, Vibrio cholerae, Staphylococcus aureus, Clostridium Botulinum, Lysteria monocytogenes. Toxigenic algae and fungi. Food borne viruses - Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases. Helminths, nematodes and protozoa - Types of food involved, toxicity and symptoms

FURTHER READING

Recent trends in microscopy and staining methods, Prevention of water-borne and food-borne illness, Mutation in microbes. Microbiology of air and water. Hurdle technology

Total: 45 Hours

Reference(s)

1. Banwart, G, Basic food microbiology. Springer Science & Business Media, 2012.
2. Tauro, P., Kapoor, K. K., & Yadav, K. S. Microbiological methods. An Introduction to Microbiology,1986.

18FD207 ENGINEERING PRACTICES LABORATORY

0 0 4 2

Course Objectives

- To provide training for fabricating the components using carpentry, sheet metal, fitting and welding equipments/tools.
- To develop the skills for preparing the green sand mould using foundry tools and to make simple electrical & pipe line connections using suitable tools.
- To understand the procedure of dismantling and assembling of home appliances & petrol engine.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Apply simple components using carpentry, sheet metal, fitting & welding equipments/tools.
2. Analyse the basic pipe line connections for house hold applications
3. Evaluate the performance of basic household wiring connections
4. Implement a Boolean arithmetic operations
5. Analyse the efficacy of Multimeter, Shaping, Lathe and drilling equipments

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-		
2	2	1	-	-	-	-	-	-	-	-	-	-		
3	2	1	-	-	-	-	-	-	-	-	-	-		
4	2	1	-	-	-	-	-	-	-	-	-	-		
5	2	1	-	-	-	-	-	-	-	-	-	-		

1 **6 Hours**

EXPERIMENT 1

Forming of simple object using sheet metal tools -Model making (Trays, frame for solar drier).

2 **6 Hours**

EXPERIMENT 2

Welding-spot welding, Gas welding Practice, SS welding, arc welding of butt joints, lap joints, tee joints, making simple objects. Welding frame for solar drier

3 **6 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example - electrical switch box, Tool box, Letter box)

4 **6 Hours**

EXPERIMENT 4

Making basic pipe line connections using PVC pipe, valves, Tee joint , taps, coupling, unions, Reducers, Elbow, Pipes, Bend, Gate valve, Flanges (with threads) for making a pipe connections for house application. Symbols used for the identification in plumbing line sketches.

5 **6 Hours**

EXPERIMENT 5

Resistance color coding and usage of multimeter for V, I, R, C measurements and terminal identification of active devices.

6 **6 Hours**

EXPERIMENT 6

Study of electronic components and equipment - Basic household wiring using switches, fuse, indicator Ã*ƒ*??Ã*ƒ*?Ã‚¢?? lamp etc.

7 **6 Hours**

EXPERIMENT 7

Implementation of boolean arithmetic operations and two way switch using logic gates.

8 **6 Hours**

EXPERIMENT 8

Bending and Flaring of pipes

9 **6 Hours**

EXPERIMENT 9

Shaping, Lathe and drilling

10 **6 Hours**

EXPERIMENT 10

Soldering simple electronic circuits and checking continuity.

Total: 60 Hours

18FD301 ENGINEERING MATHEMATICS III **3 1 0 4**

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series
2. Formulate a function in frequency domain whenever the function is defined in time domain.
3. Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
4. Classify a partial differential equation and able to solve them.
5. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	1	3												
3	2	3												
4	2	2												
5	2	2												

UNIT I **10 Hours**

FOURIER ANALYSIS

Fourier series for periodic functions. Orthogonal functions. The Euler coefficients. Fourier transforms. Properties of Fourier transform. Applications of Fourier series and transform analysis.

UNIT II **5 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT III **11 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations. One-dimensional wave equation. Method of separation of variables. . De Alemberts solution of the wave equation. Heat equation. Laplaces equation. Telegraph equations. Laplace transform method of solution.

UNIT IV **9 Hours**

MATHEMATICAL STATISTICS AND DATA ANALYSIS

Sample mean and variance. Sampling distributions. Statistical estimation of parameters, confidence intervals. Testing of hypotheses, T-test, DMRT, simple linear regression, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis. Data Sampling, Random Sampling, Reliability of Data, Testing of Hypothesis, RMSE, chi-square, Confidence Interval, Quality Control.

UNIT V **10 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. OÃ¢??Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
5. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995

18FD302 FOOD MICROBIOLOGY 3 0 0 3

Course Objectives

- Provide an idea about the general principles of food microbiology.
- Explain the interactions between microorganisms and food and factors influencing their growth and survival.
- Acquire knowledge about pathogens causing food borne infections and their detection methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Classify the microorganism and identify the microorganism associated with foods
2. Analyse the microorganism responsible for spoilage of foods and its assessments
3. Apply the preservation methods to control the spoilage and assess the microbial growth in foods
4. Analyze the importance of microorganism in food fermentation and fermented products
5. Assess the cause for food borne illness and Understand the quality control for safety of foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			3	-	2								
2	1			2	-	3								
3	2			2	2	3								
4	2			2	1	1								
5	1			2	2	3								

UNIT I **9 Hours**

MICROBES IN CEREALS, FRUITS AND VEGETABLES

Microbiology of cereal and cereal products, Microbiology of fruits and vegetables and canned foods, Microbiology of sugar and sugar products and salts and spices

UNIT II **9 Hours**

MICROBES IN MILK, MEAT, FISH AND POULTRY

Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods

9 Hours

UNIT III

MICROBES IN FOOD FERMENTATIONS

Microbes of importance in food fermentations, Homo & hetero-fermentative bacteria,yeasts & fungi; Biochemistry of fermentations - pathways involved, Lactic acid bacteria fermentation and starter cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, Fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idly, soy products, fermented vegetables and meats.

UNIT IV **9 Hours**

CONTROL OF MICROBES IN FOODS

Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

UNIT V **9 Hours**

MICROBIAL EXAMINATION OF FOODS

Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulinum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

Total: 45 Hours

Reference(s)

1. Banwart, G.J., Basic Food Microbiology, 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. Food Microbiology. MJP Publishers, Chennai, 2007.
3. Jay, J.M. Modern Food Microbiology. 4th Edition. CBS Publishers, 2003
4. Adams, M.R. and M.O. Moss. Food Microbiology. New Age International, 2002
5. Khetarpaul, Neelam. Food Microbiology, Daya Publishing House, 2006.

18FD303 FOOD CHEMISTRY 3 0 2 4

Course Objectives

- Understand the properties and composition of food
- Assess the role of nutrients in food
- Evaluate the effect of processing on nutrients in food

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the metabolic process of food and recommended dietary allowances of nutrients
2. Apply the structural changes in carbohydrates during processing and predict their physiological effects in the body
3. Analyze the functional and nutritional properties of proteins
4. Evaluate the properties and physico-chemical changes of fats and oil during processing and their industrial importance
5. Justify the importance of vitamins and minerals and their physiological role in the human body

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	1	2	2	3	2						2		
2	-	1	2	2	2	1						2		
3	-	1	2	2	2	-						2		
4	-	1	2	2	2	1						2		
5	-	1	2	2		-						2		

UNIT I **9 Hours**

INTRODUCTION TO FOOD COMPONENTS AND IMPORTANCE OF NUTRITION

Nutrients: Sources and functions; Food groups: classification and importance; Metabolism -Digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Energy Balance: Basal metabolism- BMR; Body surface area and factors affecting BMR. Water intake and losses; Diet: balanced diet, recommended dietary allowances; Malnutrition

UNIT II **9 Hours**

CARBOHYDRATES IN FOOD

Carbohydrates -Definition, classification, sources, structure, reducing and non-reducing sugars, properties of sugars-sweetness index, caramelization, Maillard reaction. Starch-sources, structure and composition, gelatinization and retrogradation. Modified starches: methods of starch modification; dietary fibers and carbohydrates digestibility

UNIT III **9 Hours**

PROTEINS IN FOOD

Proteins: Sources, Amino acids - classification, structure of protein, Nutritional Aspects: essential amino acids, biological value, Protein Efficiency Ratio (PER), Amino acid score, Protein digestibility; Functional properties of proteins in food and industrial importance. Processing induced functional and nutritional changes in protein.

UNIT IV **9 Hours**

FATS AND OILS IN FOOD

Fats -Sources, structure and classification of fatty acids,Nomenclature, Isomerism, essential fatty acids; Properties: Crystal formation, polymorphism, melting point, smoke point, Flash point, fire point and emulsification. Deep fat frying: physical, chemical and nutritional changes. Hydrolytic and Oxidative rancidity. Quality analysis: Iodine value, Peroxide value, Saponification value, Free fatty acid test. Fat Modification: Hydrogenation, Winterization and Inter-esterification.

UNIT V **9 Hours**

MICRONUTRIENTS, VITAMINS AND MINERALS

Vitamins and Minerals - Classification, Sources, Physiological role and Deficiency disorders, RDA, Losses of vitamins and minerals during processing, restoration and fortification.

FURTHER READING

Biological role of dietary fibers, plasticizing properties of fats, malnutrition, nutrient supplementation, food composition database, Fat replacers and Artificial sweeteners.

1 **3 Hours**

EXPERIMENT 1

Estimation of pH and titratable acidity

2 **3 Hours**

EXPERIMENT 2

Estimation of protein by colorimetric methods

3 **3 Hours**

EXPERIMENT 3

Estimation of protein by kjeldahl method

4 **3 Hours**

EXPERIMENT 4

Estimation of reducing sugars by titrimetric method

5 **3 Hours**

EXPERIMENT 5

Estimation of invert sugars by titrimetric method

6 **3 Hours**

EXPERIMENT 6

Estimation of starch by (a) titrimetric method (b) colorimetric method

7 **3 Hours**

EXPERIMENT 7

Estimation of fat by Soxhlet apparatus

8 **3 Hours**

EXPERIMENT 8

Estimation of Total Ash by muffle furnace

9 **3 Hours**

EXPERIMENT 9

Estimation of crude fiber

10 **3 Hours**

EXPERIMENT 10

Estimation of Vitamin C

Total: 75 Hours

Reference(s)

1. Cox, M.M. and Nelson, David L. Lehininger, Principles of Biochemistry. 5thEdition.H.Freeman, 2008
2. Murray, Robert K. et al.,Harper Illustrated Biochemistry, 27th Edition. McGraw-Hill, 2006.
3. Satyanarayanan, U. Biochemistry Books and Allied. 2005
4. Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 3rd Revised Edition, Springer-Verlag, 2004.
5. H.D.Belitz, W.Grosch,P.Schieberle,Food Chemistry,Springer,2009
6. Vaclavik, V. A. and Christian E. W. Essentials of Food Science. 2nd Edition, Kluwer-Academic, Springer, 2003.

18FD304 UNIT OPERATIONS IN FOOD PROCESSING

3 0 0 3

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the principle and operation of different types of evaporators and explain the drying of principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different kind of particles present in foods.
3. Differentiate the operation of different kind of mixing and size reduction equipment
4. Implement the leaching and extraction techniques to transform raw materials into value added products
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		1									1
2	1		2				2							1
3	2		1											1
4	2				1	2								2
5	2				2								1	

UNIT I **8 Hours**

DRYING AND EVAPORATION

Unit operations in food processing - Drying - principles, theory of drying, equilibrium moisture content, methods of moisture determination and source of heat. Evaporation - definition - single and multiple effect evaporation-types, application and performances of evaporators and boiling point elevation - steam economy, mass and heat balance.

UNIT II **11 Hours**

MECHANICAL AND MEMBRANE SEPARATION

Velocity of particles moving in a fluid- terminal velocity, drag coefficient. Sedimentation, Stokes' law, sedimentation equipment, flotation, sedimentation of particles in a gas, settling under combined forces. Centrifugal Separation, centrifuge equipment. Filtration, filter cake resistance, constant - rate filtration, constant - pressure filtration, filtration graph. Filtration equipment, plate and frame filter press, rotary filters, centrifugal filters, air filters. Air Separators and Sieving: Cyclones - optimum shape efficiency, impingement separators, classifiers, rates of throughput, standard sieve sizes, cumulative analysis, particle size analysis, industrial sieves. Membrane Separation: osmotic pressure, ultra filtration, reverse osmosis, rate of flow through membranes.

UNIT III **7 Hours**

MIXING AND SIZE REDUCTION

Mixing - theory of solid and liquid mixing- equipment - effect on foods. Size reduction - grinding and cutting - principles of comminuting - characteristics of comminuted products - particle size distribution in comminuted products - energy and power requirements in comminuting - crushing efficiency - Rittinger"s, Bond"s and Kick"s laws for crushing-size reduction equipment - crushers - jaw crusher, gyratory crusher-crushing rolls - grinders -hammer mills - rolling compression mills - attrition, rod, ball and tube mills - construction and operation.

UNIT IV **9 Hours**

EXTRACTION AND LEACHING

Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment. Leaching: Principles of continuous leaching, counter-current leaching, leaching equipment.

UNIT V **10 Hours**

CRYSTALLIZATION, DISTILLATION AND LEACHING

Crystallization - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-Distillation: Distillation process - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch and fractional distillation - operation and process - advantages and limitations-distillation equipment -construction and operation - factors influencing the operation.

FURTHER READING

other unit operations baking, frying, pasteurization, sterilization, blanching

Total: 45 Hours

Reference(s)

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd; 2nd Revised edition, Pergamon Press, 1983.
2. C.J.Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.
4. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2005

5. K. M. Sahay and K.K.Singh, Unit Operation of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
6. Albert Ibarz, Gustavo V. Barbosa-Canovas, Unit Operations in Food Engineering, Food Preservation Technology Series, CRC Press, London, 2003.

18FD305 DATA STRUCTURES 2 0 2 3

Course Objectives

- Understand the various techniques of sorting and searching
- Design and implement arrays, stacks, queues, and linked lists
- Understand the complex data structures such as trees and graphs

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Compute the time and space complexity of searching and sorting algorithms with asymptotic notations
2. Implement all the operations of linear data structures to store and retrieve the given data.
3. Create a hierarchical data structure to represent the given data using tree data structure.
4. Design graph algorithms to compute the shortest path of the given graph and to identify the minimum spanning tree.
5. Implement heap and hash functions for dynamic extension of storage space.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	2	1	3	1	2	2					
2	2	2	3	1	1	1	2	2	2	2	2	1		
3	1	1	2	2	2	1	3	2			1		2	3
4	2	1	3	1	1	2	2	2						
5	1	2	1		2		2	3	2		2		2	

UNIT I **5 Hours**

INTRODUCTION

Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices- Sorting Techniques-Selection, Bubble, Insertion, Merge, Heap, Quick, and Radix sort-Linear Search -Binary Search.

UNIT II **7 Hours**

LINEAR DATA STRUCTURES

Linked Lists - Linked stacks and queues - Operations on polynomials - Doubly linked lists - Circularly linked lists- Applications of Stack and Queue.

UNIT III **5 Hours**

NON LINEAR DATA STRUCTURES

Binary Trees - Binary search trees - Tree traversal - Expression manipulation

UNIT IV **7 Hours**

GRAPH ALGORITHMS

Graphs - Representation of graphs - BFS, DFS - Topological sort - Shortest path problems- DijkstraÃ¢??s Algorithm- Minimum Spanning Tree- PrimÃ¢??s and KrushkalÃ¢??s Algorithm

UNIT V **6 Hours**

DYNAMIC STORAGE MANAGEMENT

Dynamic storage management - Binary Heap - Heap sort - Hash functions - separate chaining, open addressing - rehashing - Extendible hashing.

FURTHER READING

AVL, Splay Trees, Tries, Backtracking.

1 **3 Hours**

EXPERIMENT 1

Implementation of searching algorithms
a) Linear Search
b) Binary Search

2 **3 Hours**

EXPERIMENT 2

Implementation of sorting algorithms
a) Insertion sort
b) Selection sort
c) Quick sort
d) Merge sort

3 **3 Hours**

EXPERIMENT 3

Design a Singly linked list and perform insertion, deletion and searching.
a) Array implementation of List ADT
b) Linked list implementation of List ADT

4 **4 Hours**

EXPERIMENT 4

Construct a stack ADT and perform push and pop operations.
a) Array implementation of Stack ADT
b) Linked list implementation of Stack ADT

5 **4 Hours**

EXPERIMENT 5

Construct a Queue ADT and perform enqueue and dequeue operations.
a) Array implementation of queue ADT
b) Linked list implementation of queue ADT

6 **3 Hours**

EXPERIMENT 6

Develop a program to create a Binary Search Tree and to traverse the tree

7 **3 Hours**

EXPERIMENT 7

Compute the shortest path from a single source node using Dijikstras Algorithm.

8 **3 Hours**

EXPERIMENT 8

Construct a graph and perform graph traversal

9 **4 Hours**

EXPERIMENT 9

Develop a program to construct a minimum spanning tree with the given graph using:
a) Prims Algorithm
b) Krushkals Algorithm

Total: 60 Hours

Reference(s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, MIT Press, 2014.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
4. Gilberg, Data Structures: A Pseudocode Approach with C, Second Edition, Cengage Learning, 2007.

18FD306 THERMODYNAMICS 2 1 0 3

Course Objectives

- Study the fundamentals of thermodynamics and First law.
- Provide knowledge on application of first law of thermodynamics.
- Impart knowledge on second law of thermodynamics and entropy.
- Study the thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
- Study the working principle of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the laws, concepts and principles of thermodynamics.
2. Apply first law of thermodynamics to closed and open systems.
3. Solve problems related to cycles and cyclic devices using second law of thermodynamics.
4. Calculate the thermodynamic properties of pure substances, its phase change processes and understand the working of steam boilers.
5. Understand the working of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-												
2	-	-												
3	-	-												
4	-	-												
5	-	-												

UNIT I **9 Hours**

BASIC CONCEPTS AND FIRST LAW

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. First law of
thermodynamics - Limitations of first law of thermodynamics.

UNIT II **9 Hours**

APPLICATION OF FIRST LAW OF THERMODYNAMICS TO NON-FLOW AND FLOW PROCESSES

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 **9 Hours**

SECOND LAW OF THERMODYNAMICS

Kelvin planck 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 **9 Hours**

STEAM PROPERTIES AND BOILERS

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.

UNIT V **9 Hours**

REFRIGERATION SYSTEMS AND COMPONENTS

Principles of refrigeration, choice of refrigerants, components of refrigeration cycle. Types of refrigeration: Carnot refrigeration, vapour compression cycle, air refrigeration cycle, absorption refrigeration cycle.

FOR FURTHER READING

Heat engine and heat pump, Air standard Otto cycle, Air standard Diesel cycle, Air-standard Brayton cycle

Total: 45 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2003.
2. P.K.Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
3. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi,2011.
4. R.S.Khurmi, Steam table with Psychometric chart,S.Chand Publications, New Delhi,2009.
5. J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2002.
6. C.P.Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003.

18FD307 FOOD MICROBIOLOGY LABORATORY 0 0 4 2

Course Objectives

- Expose various microbial aspects of Food Processing
- Impart knowledge on identification of microbes using different technique and its enumeration methods
- Recognize the role of microbes in Food spoilage and preservation

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the sources of microorganism and its spoilage in food
2. Select the appropriate equipment for Microbiological works
3. Practice the different sterilization methods throughout the experiment
4. Inoculate, isolate and identify the microorganism from both liquid and solid samples
5. Understand the Principles of CCP(Critical Control Points) in Food safety

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				1									
2	2				2									
3	2		3		3	2	1							
4	1		-		2	3								
5					2	2	1							

1 **2 Hours**

EXPERIMENT 1

Introduction to equipments commonly used in microbiology laboratory and Guidelines for safety in food microbiology laboratory work

2 **2 Hours**

EXPERIMENT 2

Sterilization of glasswares used in microbiology laboratory

3 **4 Hours**

EXPERIMENT 3

MicroscopyÃƒÂ¢?? Working and care of Microscope

4 **4 Hours**

EXPERIMENT 4

Simple staining: monochrome staining and negative staining

5 **4 Hours**

EXPERIMENT 5

Differential staining: GramÃƒÂ¢??s staining

6 **4 Hours**

EXPERIMENT 6

Preparation of culture media and Broth, slants, stabs

7 **8 Hours**

EXPERIMENT 7

Microbiological quality of milk- Sampling, Serial Dilution and enumeration

8 **8 Hours**

EXPERIMENT 8

Isolation and enumeration of microorganisms using pour plate method

9 **12 Hours**

EXPERIMENT 9

Isolation and enumeration of microorganisms using spread plate method

10 **12 Hours**

EXPERIMENT 10

Isolation of microorganisms using streak plate method

Total: 60 Hours

Reference(s)

1. James G.Cappuccino,Natalie Sherman,Microbiology: A laboratory Manual,5th edition,Benjamin/Cummings Science,1998

18FD308 UNIT OPERATIONS IN FOOD PROCESSING LABORATORY

0 0 2 1

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Find the application of different types of evaporators and understand the drying principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different particles present in foods.
3. Select the mixing equipment for dry powders, low or high viscosity liquids and acquire knowledge on importance of size reduction and energy requirement.
4. Organize the transformation of raw materials to quality food products using different processing technologies.
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2												1	
2	2				1									
3			2											
4	1												1	
5	1				2									2

1 **2 Hours**

EXPERIMENT 1

Determination of economy and thermal efficiency of evaporator

2 **2 Hours**

EXPERIMENT 2

Solving problems on single effect evaporator

3 **2 Hours**

EXPERIMENT 3
Solving problems on multiple effect evaporators

4 **2 Hours**

EXPERIMENT 4
Determination of separation efficiency of centrifugal separator

5 **2 Hours**

EXPERIMENT 5
Determination of collection efficiency in cyclone separator

6 **2 Hours**

EXPERIMENT 6
Determination of efficiency of liquid solid separation by filtration

7 **2 Hours**

EXPERIMENT 7
Determination of particle size of granular foods by sieve analysis

8 **2 Hours**

EXPERIMENT 8
Performance evaluation of a sieve

9 **2 Hours**

EXPERIMENT 9
Determination of performance characteristics in size reduction using the burr mill

10 **2 Hours**

EXPERIMENT 10
Determination of energy requirement in size reduction using ball mill

11 **2 Hours**

EXPERIMENT 11
Determination of energy requirement in size reduction using hammer mill

12 **2 Hours**

EXPERIMENT 12
Performance evaluation of pin mill

13 **2 Hours**

EXPERIMENT 13
Performance evaluation of a hammer mill

14 **2 Hours**

EXPERIMENT 14
Performance evaluation of a steam distillation process

15 **2 Hours**

EXPERIMENT 15
Visit to extraction and sugar industry

Total: 30 Hours

18GE301 SOFT SKILLS - VERBAL ABILITY 2 0 0 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To read and understand unabridged text
- To help students become proficient in basic writing skills related to work place communication

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2											2			
3									2					

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

18FD401 HEAT AND MASS TRANSFER 3 0 2 4

Course Objectives

- Impart the knowledge of conduction heat transfer mechanisms
- Provide the knowledge on the principles of free and forced convection
- Impart the knowledge on black body radiation and grey body radiation
- Study the performance of various types of heat exchangers
- Learn about diffusion mass transfer

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Understand the Conduction mode of heat transfer in simple and composite systems
2. Determine the parameters associated with free and forced convection
3. Calculate the radiation heat transfer in black and grey bodies
4. Compare the performance of various types of heat exchangers
5. Understand the concept of diffusion mass transfer

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-											
2	-	-												
3	-	-	-											
4	-	-	-											
5	-	-												

UNIT I **9 Hours**

UNIT I CONDUCTION

Introduction to unsteady state heat transfer by conduction and transient flow. Basic transfer processes - heat, mass and momentum - heat transfer process - conductors and insulators - Steady state heat - conduction - Fourier's law of heat conduction - thermal conductivity and thermal resistance - linear heat flow - heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and spheres - extended surfaces (fins).

UNIT II **9 Hours**

UNIT II CONVECTION

Newton law of cooling - film coefficient of heat transfer - convection - Forced convection- external flow, flow over plates, cylinders, bank of tubes, internal flow- Free convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer - overall heat transfer coefficient.

UNIT III **9 Hours**

UNIT III RADIATION

Radiation heat transfer - concept of black and grey body - monochromatic total emissive power - Kirchoff's law - Planck's law - Stefan-Boltzman's law - Black body radiation- Grey body radiation - Shape factor

UNIT IV **9 Hours**

UNIT IV HEAT EXCHANGERS

Heat exchangers - Logarithmic Mean Temperature Difference (LMTD) - Classification - overall coefficient of heat transfer - tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger - applications of heat exchangers, NTU - Effectiveness - NTU methods.

UNIT V **9 Hours**

UNIT V MASS TRANSFER

Mass transfer - introduction - Fick's law for molecular diffusion - molecular diffusion in gases - equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases - molecular diffusion in liquids, biological solutions and gels. Concept of mass transfer coefficients, Interphase mass transfer and over all mass transfer coefficients in binary systems.

FOR FURTHER READING

Application of Heat and mass transfer in food processing operations. Heat exchangers for solid, liquid and semi-solid foods.

1 **2 Hours**

EXPERIMENT 1

Determination of thermal conductivity in a composite wall

2 **2 Hours**

EXPERIMENT 2

Determination of thermal conductivity by lagged pipe method

3 **4 Hours**

EXPERIMENT 3

Determination of heat transfer coefficient in a parallel flow heat exchangers

4 **2 Hours**

EXPERIMENT 4

Determination of heat transfer coefficient in a counter flow heat exchangers

5 **4 Hours**

EXPERIMENT 5

Determination of heat transfer coefficient in free convection

6 **4 Hours**

EXPERIMENT 6

Determination of emissivity of the given test surface

7 **2 Hours**

EXPERIMENT 7

Determination of Stefan-BoltzmannÃ¢??s constant in radiation heat transfer

8 **2 Hours**

EXPERIMENT 8

Determination of effectiveness of heat transfer in a coiled type heat exchanger

9 **4 Hours**

EXPERIMENT 9

Experiment on diffusion

10 **4 Hours**

EXPERIMENT 10

Mass transfer with or without chemical reaction

Total: 75 Hours

Reference(s)

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2010.
2. Yunus A.Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2007.
3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009.
4. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014.
5. Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007.
6. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2009.

18FD402 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

3 0 0 3

Course Objectives

- Understand the principles of food processing and their impact on the shelf life and quality of food materials and products
- Learn various methods of food processing viz., drying, milling, freezing, thermal treatments etc.
- Introduce novel food processing techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply different methods of high and low temperature processing techniques over raw foods and analyze the process time of that food properties of food
2. Understand and apply the suitable dryers to different food to increase the shelf life and analyse the working of extrusion process and their features
3. Analyze the shelf life of foods processed and preserved by natural and chemical agents
4. Understand the operations and features of different non-thermal processing techniques and applying to improve the shelf life of product
5. Apply the principle of advanced novel techniques in food processing industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2									1	
2	2	2		2										1
3	2	2												1
4	2	2											1	
5	2	2	2						2				1	

UNIT I **10 Hours**

UNIT I HIGH AND LOW TEMPERATURE PROCESSING OF FOODS

Methods of applying heat to food - Blanching, Pasteurization, Sterilization - thermo bacteriology, commercial sterility, calculation of process time - methods of sterilization - equipment. Methods of low temperature preservation - Chilling, Freezing, freeze drying and freeze concentration - theory and principles.

UNIT II **10 Hours**

UNIT II DRYING, DEHYDRATION AND EXTRUSION

Drying - types of dryers. Dehydration-Osmotic dehydration-theory and principles. Water activity - sorption behaviour of foods - water activity and food stability - Relationship between water activity and moisture - Equilibrium moisture content. Extrusion cooking - principles and types of extruders - single and double screw extruder- construction and working. Effect of different parameters - quality of the extruded products.

UNIT III **10 Hours**

UNIT III PROCESSING AND PRESERVATION OF FOODS BY CHEMICALS

Food preservation by sugar, salt, acid - Principles - mechanism- antimicrobial activity. Preservation by chemicals- type of chemical preservatives- sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc. Factors affecting antimicrobial activity of preservatives.

UNIT IV **7 Hours**

UNIT IV NON THERMAL PROCESSING

Food Irradiation - High Pressure Processing- Pulsed electric field processing, pulsed light treatment and Ultrasound - Theory and Principles - effect on microorganisms- Application in Processing of foods.

UNIT V **8 Hours**

UNIT V NOVEL METHODS OF FOOD PROCESSING

UV treatment, Ozone treatment, dielectric heating- microwave, radio frequency, ohmic and infrared heating theory, equipment, applications and effect on foods. Hurdle technology and Nano-technology - principle - application in food processing.

FOR FURTHER READING

Electrical resistance heating of foods - Electrically Processed Foods. Effect of heat and ultrasound on microorganisms and enzymes. Oscillating magnetic fields in Food Preservation.

Total: 45 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press, 1st Edition, 2004

18FD403 REFRIGERATION AND COLD CHAIN MANAGEMENT

3 0 0 3

Course Objectives

- Learn the principles and the components involved in domestic and commercial refrigeration systems
- Impart knowledge on application of Refrigeration & Air conditioning systems in food industries
- Provide knowledge on handling and transport of food materials by ensuring the superior quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Select appropriate components of the refrigeration unit and analyze the effect of different refrigerants on environment
2. Differentiate various refrigeration cycles and its applicability
3. Apply knowledge of psychrometry for air conditioning & various food processing operations
4. Apply the knowledge of refrigeration and air conditioning in persevering foods using domestic and industrial refrigeration systems
5. Choose appropriate refrigerated transport facilities for ensuring the product quality

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1	2	3	-	2			1							
2	3	-	-				1	1						
3	2	-	2	1	-		1						1	1
4	2	1	1	1	-	1		1					2	1
5	3	1	3	-	-	1			1				1	1

UNIT I **10 Hours**

UNIT I REFRIGERATION PRINCIPLES AND COMPONENTS

Refrigeration-principles - refrigeration effect-coefficient of performance-units of refrigeration - Refrigeration components-compressor-classification-principle and working- condensers-types-construction, principle and working. Evaporators-types-principle and working. Expansion device-types construction, principle and working. Refrigerants-properties-classification comparison and advantages-chloroform carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

UNIT II **9 Hours**

UNIT II VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

Simple vapour compression cycle- T-S diagram - p-h chart- vapour compression system-different types- vapour absorption cycle - simple and practical vapour absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator-Lithium bromide refrigeration-construction and principles

UNIT III **9 Hours**

UNIT III PSYCHROMETRY

Psychrometry-terms-psychrometric chart- sensible heating- sensible cooling process -by-pass factor-humidification- dehumidification-sensible heat factor- evaporative cooling-cooling and dehumidification- cooling and humidification process-heating and dehumidification - heating and humidification- adiabatic mixing of air streams

UNIT IV **9 Hours**

UNIT IV AIR CONDITIONING SYSTEM

Air conditioning systems- equipment used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning system- application of refrigeration and air conditioning-domestic refrigerator and freezer-refrigerated trucks- ice manufacture- cold storage-freeze drying

UNIT V **8 Hours**

UNIT V COLD CHAIN MANAGEMENT

Cold chain, Refrigerated Transport-Refrigerated container trucks, Handling and Distribution, Traceability and barcode. Product Temperature and Moisture monitoring

FOR FURTHER READING

Eco friendly refrigerants, types of compressors and its selection, Industrial and domestic refrigerants

Total: 45 Hours

Reference(s)

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2002
2. R.S. Khurmi and J. K. Gupta, A text book of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002

3. Manohar Prasad, Refrigeration and Air conditioning, New Age International (P) Ltd, New Delhi, 1999
4. W. F. Stoecker, and J. W. Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1986
5. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th edition, 2001
6. S. C. Arora and S. Domkundwar, A course in Refrigeration and Air conditioning, DhanpatRai (P) Ltd., New Delhi, 1997

18FD404 FOOD ANALYSIS 3 0 0 3

Course Objectives

- Expose the principles of chemical and instrumental methods of food analysis
- Expose the methods of chemical and instrumental methods of food analysis
- Expose the techniques of chemical and instrumental methods of food analysis

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the principles behind analytical techniques in food analysis.
2. Know the methods of selecting appropriate techniques in the analysis of food products.
3. Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products
4. Implement food quality control in food industries
5. Familiarize with the current state of knowledge in food analysis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	1										2	
2		2						2				2	2	
3		2			1			2				2	2	
4			2		2			1				2	2	
5		2										2		2

UNIT I **10 Hours**

UNIT I INTRODUCTION

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude fiber and dietary fibre.

UNIT II **10 Hours**

UNIT II LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

UNIT III **10 Hours**

UNIT III SPECTROSCOPIC TECHNIQUES

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; IR Spectroscopy in online determination of components of food- FT-IR tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer and ICP-AES in analysis of mineral elements and fluorimeter in vitamin analysis.

UNIT IV **10 Hours**

UNIT IV CHROMATOGRAPHIC TECHNIQUES

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; Column chromatography for purification analysis- Ion exchange and affinity chromatography; HPLC and GC in food analysis; Significance of MS detectors in HPLC and GC; FAME analysis in oils and fats

UNIT V **5 Hours**

UNIT V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY

Basic principles; application of the electrophoresis in food analysis; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars; Estimation of simple sugars and disaccharides by polarimeter.

FOR FURTHER READING

Advanced Food analytical techniques, equipments and Instruments

Total: 45 Hours

Reference(s)

1. Pomeranz, Yeshajahu. Food Analysis: Theory and Practice 3rd Edition. Aspen Publishers / Springer, 2000
2. Nielsen, S. Suzanne. Food Analysis 3rd Edition. Springer, 2003
3. Otles, Semih. Methods of Analysis of Food Components and Additives, CRC Press, 2005
4. Nollet, Leo M.L. Hand Book of Food AnalysisII Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004

18FD405 JAVA PROGRAMMING 2 0 2 3

Course Objectives

- Design, write, debug and run java programs using JDK tools
- Develop applications to manipulate the data available in databases using database connectivity and Java library
- Develop applications to manipulate the data available in databases using Java and SQL

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Apply object oriented programming concepts to implement basic IT related problems using NetBeans tool
2. Develop applications using suitable data structures on collection classes and Java I/O classes and interfaces
3. Develop applications to manipulate the data available in databases using Java and SQL
4. Create event-driven GUI applications using event handling mechanisms and swings
5. Build programs that run on multi-core environments using multi-threaded programming concepts

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-										
2	-	-	-	-										
3	-	-	-		-									
4	-	-	-								-			
5	-	-	-											

UNIT I **8 Hours**

UNIT I BASICS OF JAVA

Overview of Java - Data Types, Variables, and Operators - Control Structures - Arrays - Classes - Objects Methods - Nested Classes - Primitive type Wrappers - Inheritance - Method overriding - Abstract Classes - Interfaces - Packages and Exception Handling.

UNIT II **5 Hours**

UNIT II GENERIC PROGRAMMING AND I/O STREAMS

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure - Restrictions on Generics - Collection classes: Array List, HashMap, HashTable, Linked List, Vector, Garbage Collection - I/O Classes and Interfaces - File - The Byte Streams - The Character Streams - Using Stream I/O - Serialization.

UNIT III **7 Hours**

UNIT III JAVA LIBRARY

Enumerations - Autoboxing - Annotations- Assertion - Lambda Expressions - String Handling - Special String operations and Methods - String Buffer, String Builder - System - Math - Date and Time - Formatter - Database Connectivity - Basics of Networking.

UNIT IV **5 Hours**

UNIT IV EVENT HANDLING

Applets - Event Handling Listener interfaces - Event Classes - Event Listeners - Adapter classes - AWT Controls

UNIT V **5 Hours**

UNIT V CONCURRENT PROGRAMMING

Multi-threaded programming - Life Cycle of a Thread - Creating Threads - Synchronization - Deadlock - Inter-thread Communication - Interrupting Threads - Concurrency Utilities

FURTHER PROCESSING

Note pad application- Standalone applications using java - Implementing algorithms using java - Reflection

1 **4 Hours**

EXPERIMENT 1

Programs using class and methods

2 **3 Hours**

EXPERIMENT 2

Inheritance implementation

3 **3 Hours**

EXPERIMENT 3

Inheritance via Interface and Abstract class

4 **4 Hours**

EXPERIMENT 4

Programs on Package implementations

5 **4 Hours**

EXPERIMENT 5

Applications using Generic collections

6 **4 Hours**

EXPERIMENT 6

File Handling using IO streams

7 **4 Hours**

EXPERIMENT 7

Desktop applications using Swing

8 **4 Hours**

EXPERIMENT 8

Multi-threaded Programming

Total: 60 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, 9th Edition, McGraw Hill Education, 2014.
2. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals,9th Edition, Prentice Hall, 2013.
3. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features,9th Edition, Prentice Hall, 2013.
4. Kathy Sierra, Bert Bates, OCA/OCP Java SE 7 Programmer I and II Study Guide, First edition, McGraw Hill Education, 2014.
5. Rajkumar Buyya, S Thamarai Selvi, Xingchen Chu, Object Oriented Programming with Java: Essentials and Applications, Tata McGraw Hill Education Private Limited, 2009.
6. Bert Bates, Kathy Sierra, Head First Java, 2nd Edition, OReilly Media, 2005.

18FD406 FLUID MECHANICS 3 1 0 4

Course Objectives

- Understand the basic properties of fluids and pressure measurement devices.
- Make familiar with calculation of forces in fluid structure interaction.
- Familiar with all the basic working and calculation based on flow measurement devices.
- Derive the unit for any parameter using dimensional analysis.
- Understand the basic working principles of pumps and its application.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Understand the properties of fluids and calculations on pressure measurement devices
2. Demonstrate the calculation of forces in fluid structure interaction.
3. Implement the working and calculations on flow measurement devices.
4. Derive the units for any parameter using dimensional analysis.
5. Assess the working principles of pumps and its application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-		-										
2	-	-		-										
3	-	-		-										
4	-	-		-										
5	-	-		-										

UNIT I **12 Hours**

UNIT I PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENT

Continuum - Fluid - Types of fluid - Laws of fluid mechanics - Properties of Fluids - densities - kinematic viscosity, dynamic viscosity, capillarity - Surface tension, vapour pressure, measurement of pressure, manometers, U-tube manometer, differential manometer, inverted U-tube manometer.

UNIT II **12 Hours**

UNIT II FLUID FLOW

Classification of Flow - velocity and acceleration of a fluid particle - Rotational - irrotational - circulation and vorticity - one dimensional, two dimensional, three dimensional flows, continuity equation in Cartesian co-ordinates. Flow pattern - stream line - equipotential line - stream tube - path line - steak line - flow net - velocity potential - stream function. Principles of conservation of mass - energy - momentum - Euler"s equation of motion.

UNIT III **12 Hours**

UNIT III FLOW MEASUREMENTS

Bernoulli"s equation - applications - Venturimeter -Orifice. Flow through pipes - Navier stokes equation. Reynold"s experiment - Darcy - Weisbach equation for friction head loss - Chezy"s formula - minor losses in pipes - hydraulic gradient line - energy gradient line.

UNIT IV **12 Hours**

UNIT IV DIMENSIONAL ANALYSIS AND SIMILITUDE

Dimensional analysis - Principle of dimensional homogeneity - the Buckingham"s Pi theorem - non-dimensional action of the basic equations- concept of geometries, kinematic and dynamic similarity. Important non-dimensional numbers - Reynolds, Froude, Euler dimensional analysis for scale up studies. Similitude - relationship between dimensional analysis and similitude.

UNIT V **12 Hours**

UNIT V PUMPS

Fluid machines, Classification, Positive displacement, centrifugal pump, Gear pump, Diaphragm pumps, vacuum pump, metering pump, peristaltic pump, principles and application characteristics. Performance; selection and specification. Fans, blowers, aspirators and compressors. Selection, types and applications.

FOR FURTHER READING

Classification of models- characteristic curve for pumps

Total: 75 Hours

Reference(s)

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

18FD407 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION LABORATORY

0 0 2 1

Course Objectives

- Understand the basic principles involved in food process engineering
- Apply the concept of mass and energy balances during processing of food
- Perform calculations on unit operations involved in food Processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the important quality characteristics of both solid and liquid foods
2. Assess the moisture content and drying rate for both porous and non-porous food materials
3. Evaluate the efficiency of different types dryers for the food materials
4. Analyze the changes occur during thermal processing of foods
5. Assess the microbial quality of foods by applying novel processing methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2			2									2	
2	2			2									2	
3	2	2												2
4	2	1	2											2
5		1											2	

1 **2 Hours**

EXPERIMENT 1

Determination of textural characteristics of foods

2 **4 Hours**

EXPERIMENT 2

Determination of flow behavior of Newtonian and Non-Newtonian fluids

3 **4 Hours**

EXPERIMENT 3

Determination of Thermal Death Time

4 **2 Hours**

EXPERIMENT 4

Determination of Water activity of processed food products

5 **2 Hours**

EXPERIMENT 5

Determination of drying rate of fruits and vegetables in Tray dryer

6 **2 Hours**

EXPERIMENT 6

Determination of colour characteristics of curry leaves during Fluidized bed dryer

7 **4 Hours**

EXPERIMENT 7

Determination of textural characteristics by Extrusion cooking

8 **2 Hours**

EXPERIMENT 8

Retention of ascorbic acid during Microwave drying of leafy vegetable

9 **2 Hours**

EXPERIMENT 9

Dehydration and rehydration of vegetables in rotary dryer

10 **2 Hours**

EXPERIMENT 10

Determination of freezing point of food materials

11 **2 Hours**

EXPERIMENT 11

Effect of UV treatment on microbial quality of liquid foods

12 **2 Hours**

EXPERIMENT 12

Effect of ohmic heating on microbial quality of liquid foods

Total: 30 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.

2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press, 1st Edition, 2004

18FD408 FOOD ANALYSIS LABORATORY 0 0 4 2

Course Objectives

- Familiarize the students on estimation of food composition by different methods
- Understand physicochemical properties of food components
- Analyze the changes in composition of foods with respect to carbohydrates, lipids, protein and water on processing.

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the various experimental procedures for different food constituents
2. Explain the quality of food
3. Analyze the changes in food composition during processing and storage
4. Implement the process protocol for quality food production
5. Evaluate and generate food formulation with longer shelf life

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	1	3								2		2
2		1	1	1								2		2
3		2		2	2								2	
4		2		2								2	2	
5		2	1	2	2							2	2	

1 **4 Hours**

EXPERIMENT 1

Estimation of pH and Titratable acidity

2 **4 Hours**

EXPERIMENT 2
Determination of moisture content and water activity

3 **4 Hours**

EXPERIMENT 3
Estimation of total sugars by titrimetric method.

4 **4 Hours**

EXPERIMENT 4
Estimation of starch by (a) titrimetric method (b) calorimetric method.

5 **4 Hours**

EXPERIMENT 5
Estimation of total polyphenols.

6 **4 Hours**

EXPERIMENT 6
Determination of Free Fatty Acids

7 **4 Hours**

EXPERIMENT 7
Estimation of oil in oil seeds

8 **4 Hours**

EXPERIMENT 8
Estimation of protein by kjehdal method

9 **4 Hours**

EXPERIMENT 9
Estimation of crude fibre.

10 **4 Hours**

EXPERIMENT 10
Determination of antioxidant activity by DPPH Method

11 **4 Hours**

EXPERIMENT 11
Extraction and estimation of curcumin.

12 **4 Hours**

EXPERIMENT 12
Extraction and estimation of lycopene.

13 **4 Hours**

EXPERIMENT 13
Extraction and estimation of carotene.

14 **4 Hours**

EXPERIMENT 14
Determination of Reducing sugar by Nelson Somogyi method.

15 **4 Hours**

EXPERIMENT 15

Determination of adulterants in food

Total: 60 Hours

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods Ã¢?? earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights:Biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2										2				

UNIT I **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information

Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organising a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 30 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

21FD501 BAKING AND CONFECTIONERY TECHNOLOGY 3 0 0 3

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and cakes
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the principles of baking and analyze the role of ingredients in baking
2. Compare the processing method for the production of biscuits and cookies
3. Apply the production process for different types of confectionery products
4. Illustrate and analyze the processing parameters of baking machineries
5. Assess the standards and quality control for bakery and confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2									2			2
2			2							2				2
3			2	2									2	
4	2				2						2			2
5		2	2										2	

UNIT I **9 Hours**

BAKING PRINCIPLES AND BREAD

Introduction to wheat- Structure, types, quality evaluation. Dough rheology. Baking principles, Bread- role of ingredients and its chemistry, additives, varieties of bread. Methods of bread preparation-

advantages and disadvantages, bread spoilage and remedies. Cake- types of cakes, role of ingredients, cake mixing methods, Preparation, faults and remedies.

UNIT II **9 Hours**

BISCUIT AND COOKIES

Biscuits and cookies - role of ingredients. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Classification and Production of biscuits and cookies. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **9 Hours**

CONFECTIONERY PRODUCTS

Introduction - Role of ingredients and additives used in confectionery. Cocoa products and its uses in confectionery. Stages of Sugar cookery. Types of confectionery products and manufacturing process - chocolate, caramels, toffees, fondants, fudges and flour confectionery.

UNIT IV **9 Hours**

BAKERY EQUIPMENTS

Equipments and machineries for a bakery unit - Light Equipments, Heavy/ Bulk handling Equipments - Dough mixers, Dividers, rounding, sheeting and laminating machines. Ovens and Slicers. Packaging equipment.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT

Packaging requirements and materials. FSSAI Standards and regulations for bakery and confectionery products. Quality control and Good Manufacturing Practices (GMP). Layout for Baking and Confectionery plant.

FOR FURTHER READINGS

Millet based biscuit and cookies, Eggless cake, different types of bakery oven, different types of dough kneaders.

Total: 45 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment,Academic Press, Elsevier, 2018
6. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009

21FD502 PLANTATION AND SPICE PROCESSING 3 0 2 4

Course Objectives

- Understand Coffee and Tea Processing Techniques and its quality grading
- Analyze the methods of processing for Cashew, Coconut, Vanilla and Cocoa
- Evaluate the Processing and Extraction Techniques of Major and Minor spices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

Course Outcomes (COs)

1. Assess the unit operations and processing steps involved in the manufacture of tea and coffee
2. Apply the processing techniques of cashew and coconut to develop value added products
3. Analyze the chemistry and manufacturing techniques of Vanilla and cocoa products
4. Compare the processing methods and extraction techniques of major spices
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2									1	
2	1	2		2										
3	2	1		2										
4	3	2	1	2									1	
5	3	2	1	2									1	

UNIT I **9 Hours**

COFFEE AND TEA PROCESSING

Coffee- Occurrence - chemical constituents - harvesting - fermentation of coffee beans fermentation- drying- roasting- Process flow sheet for the manufacture of coffee powder- Instant coffee, technology- Chicory chemistry- Quality grading of coffee- Tea - occurrence- chemical constituents- harvesting - types of tea- green, oolong and CTC - Chemistry and technology of CTC tea - Manufacturing process - Green tea manufacture- Instant tea manufacture - Grading of tea.

UNIT II **9 Hours**

CASHEW AND COCONUT PROCESSING

Cashew-Importance - harvesting- products - uses of cashew & CSNL- cashew nut processing -methods of roasting - shelling - grading- packaging- infestation- Hygiene and safety. Coconut- harvesting - Processing technology of Virgin Coconut oil- Desiccated Coconut, Milk Cream,Nata-de-Coco, Packed Tender Coconut Water- Vinegar and Activated Carbon.

UNIT III **9 Hours**

VANILLA AND COCOA PROCESSING

Vanilla- Occurrence -chemistry of vanilla -stage of harvesting - different curing techniques -quality control and grading of cured beans -vanillin extraction methods - super critical fluid extraction of vanillin]- Cocoa - Occurrence - Chemistry of the cocoa bean - changes taking place during fermentation of cocoa bean - Processing of cocoa bean - cocoa powder - cocoa liquor manufacture- Chocolate - Types - Chemistry and technology of chocolate manufacture - Quality control of chocolates.

UNIT IV **9 Hours**

MAJOR SPICE PROCESSING

Importance for spices - production and export status - stages and methods of harvest of important spices- equipment used for threshing, shelling, decortications of spices-Processing of cardamom-stage of harvest-processing of pepper-harvesting- packaging-processing of white pepper - wet and dry pulping and retting methods - drying; Processing of turmeric - Processing of chilli - harvesting and drying - packaging and grinding - low temperature grinding - advantages - refrigerant used - construction and working

UNIT V **9 Hours**

MINOR SPICE PROCESSING

Minor Spices - processing of Cumin, Coriander, Cinnamon, fenugreek, Garlic and Clove- Oleoresins and essential oils- Method of manufacture - Chemistry of the volatiles- Enzymatic synthesis of flavor identicals - Quality control - Processing of ginger -harvesting, washing, drying, and packaging - quality aspects - processing of clove, nutmeg and other minor spices- Packaging and storage of spices - quality analysis- AGMARK and ASTA standards.

FURTHER READING

Value addition of spices, turmeric, areca nut, oil palm processing, chemistry of different spice flavours, adulteration in spices.

1 **3 Hours**

EXPERIMENT 1

Development of Instant coffee powder

2 **3 Hours**

EXPERIMENT 2

Quality testing of various types of tea

3 **3 Hours**

EXPERIMENT 3

Quality evaluation of dessicated coconut powder

4 **3 Hours**

EXPERIMENT 4

Study on various quality attributes of virgin coconut oil

5 **3 Hours**

EXPERIMENT 5
Quality testing of cocoa powder

6 **3 Hours**

EXPERIMENT 6
Development of chocolate product and its quality parameters

7 **3 Hours**

EXPERIMENT 7
Drying of turmeric and its powder properties

8 **3 Hours**

EXPERIMENT 8
Drying of chilli and its powder properties

9 **3 Hours**

EXPERIMENT 9
Development of garlic powder and its powder property studies

10 **3 Hours**

EXPERIMENT 10
Development of products from minor spices and its quality studies

Total: 75 Hours

Reference(s)

1. Chakraverty, A, Arun S. Mujumdar, G.S.Vijayaraghavan, and Hosahalli. S. Ramaswamy.Handbook of Post Harvet Technology: Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker. Inc. New York.2003
2. Board, N. I. I. R.Hand Book on herbs cultivation & processing. Asia Pacific Business Press, 2004
3. Kader, A. A. Postharvest Technology of Horticultural Crops, third Edition, Division of Agriculture and National Resources, California University. 2011
4. Minifie Bernard W, Chocolate, Cocoa and Confectionery Technology, Third Edition, Aspen Publication, 2014.

21FD503 FOOD ADDITIVES **3 0 2 4**

Course Objectives

- Expose the use of different chemical additives in foods during food processing
- Understand the different kind of additives and their role in food preservation
- Learn the safety use of additives and regulations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Course Outcomes (COs)

1. Understand the principles of chemical preservation of foods
2. Understand the role of different food additives in the processing of different foods
3. Analyse the specific functions of different food additives in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
4. Evaluate the different food additives in improving the physical and sensory characteristics of foods
5. To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-													
2	-													
3	-													
4	-													
5	-													

UNIT I **9 Hours**

INTRODUCTION

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws

UNIT II **9 Hours**

ACIDITY REGULATORS AND PRESERVATIVES

Acidity Regulators definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations

UNIT III **9 Hours**

EMULSIFIERS, STABILIZERS AND THICKENERS

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB

values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners Ã¢?? definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

UNIT IV **9 Hours**

ANTIOXIDANTS AND ANTI-CAKING AGENTS

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anti-foaming and propellants, Anti-caking agents Ã¢?? definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.

UNIT V **9 Hours**

COLOR AND ARTIFICIAL SWEETENERS

Color Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Artificial Sweeteners list, structure, taste profile, permitted list, usage levels and food applications.

1 **3 Hours**

EXPERIMENT 1

Estimation of adulterants in dairy products

2 **3 Hours**

EXPERIMENT 2

Estimation of adulterants in spices

3 **3 Hours**

EXPERIMENT 3

Estimation of adulterants in oil and fats

4 **3 Hours**

EXPERIMENT 4

Estimation of adulterants in sweetening agent

5 **3 Hours**

EXPERIMENT 5

Determination of antioxidant activity by DPPH method

6 **3 Hours**

EXPERIMENT 6

Determination of MSG in food

7 **3 Hours**

EXPERIMENT 7

Determination of colour by using paper chromatography

8 **3 Hours**

EXPERIMENT 8

Detection and estimation of aspartame

9 **3 Hours**

EXPERIMENT 9

Determination Sulphur di oxide by iodine titration

10 **3 Hours**

EXPERIMENT 10

Identification and isolation of lycopene content

Total: 75 Hours

Reference(s)

1. Mahindru, S. N. Food Additives- Characteristics Detection and EstimationTATA McGraw Hill, 2000
2. Wilson, R. Ingredient Handbook SweetenersBlackwell, 2007
3. Emerton, V. Food ColorsBlackwell, 2008
4. Branen, A. L. Food Additives2nd Edition, CRC press, 2002
5. Peter A Williams and Glyn O PhilipsGums and stabilizers for the Food Industry RSC, 2006.

21FD504 DAIRY TECHNOLOGY 3 0 0 3

Course Objectives

- Analyse the physico-chemical and functional properties of milk constituents
- Understand the steps involved in the processing of milk and milk products
- Apply the technologies for the production of different dairy products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the composition of milk and physical and chemical properties of milk
2. Apply the principles of different thermal processing of milk
3. Apply the principles and process of Homogenization and cream separation in milk processing
4. Analyse the process flow for the preparation of different dairy products
5. Analyse the process and equipments used for the manufacturing of ice-cream and milk powder production

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2												2	1
2	2	2		1	3		2						1	3
3	2	1		2	1	1							2	2
4	1	2		2				1					2	1
5	2	2		3	1	1							2	3

UNIT I **9 Hours**

MILK PROPERTIES AND PRESERVATION

Milk- Composition and Nutritional value- physico chemical properties, Macro components - Micro components. Milk reception- Platform test - Cooling and storage of raw milk -principles and methods transfer of milk -transport and storage tanks - Standardization-cleaning and sanitization of Dairy equipment- CIP systems - Can washers - types - working principle and maintenance.

UNIT II **9 Hours**

PASTEURIZATION AND FILLING OF MILK

Pasteurization - principles and objectives - methods- batch / LTLT method - equipments - HTST method - process and equipments- plate heat exchanger - regeneration efficiency - milk flow diagram - UHT pasteurization- principles and methods - vacreation - form fill seal machines- aseptic filling.

UNIT III **9 Hours**

HOMOGENIZATION AND CREAM SEPARATION

Homogenization - theory - effect on milk properties - working principle of homogenizers - valves -pumps-homogenization efficiency - cream separation - principles - gravity and centrifugal separation - clarifiers and separators - centrifugal separator- parts -construction and working principle - separation efficiency - fat loss in skim milk - bactofugation.

UNIT IV **9 Hours**

BUTTER AND CHEESE PROCESSING

Butter - composition- method of manufacture- churning of cream - theory of churning - operation of butter churn- over run -batch and continuous methods of butter making- cheese - composition classification - cheddar and cottage cheese - equipments- cheese vats and press- construction details.

UNIT V **9 Hours**

ICE CREAM AND MILK POWDER PRODUCTION

Ice cream - ingredients - preparation of ice cream mix - overrun- freezing - calculation of freezing point and refrigeration requirements of mixes- ice cream freezers -batch and continuous freezers - drying of milk - drying equipments - drum drier and spray drier - components - construction and working principles.

FOR FURTHER READING

Introduction to traditional milk products. Types of milk (Standardized milk, toned milk and double toned milk, etc), waste management in dairy industry

Total: 45 Hours

Text Book(s)

1. De Sukumar Outlines of Dairy Technology, Oxford University press, New Delhi, 2002.

Reference(s)

1. R.K. Robinson, Modern dairy technology Vol. I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
2. Gerrit Smit, Dairy processing Improving quality, Published by Woodhead Publishing Limited, CCR PRESS, 2000.
3. H.G. Kessler, Food engineering and dairy technology, Verlag A. Kessler, Freising, (F.R.Germany.) 1981.
4. A.W. Farrall, Engineering for dairy and food products, John Wiley and Sons, New York, 1963.

21FD507 BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Understand the basic terms and principles involved in baking
- Impart training on baking and confectionery methods
- Assess the role of ingredients in bakery and confectionery products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the ingredients and demonstrate the equipments and tools used for baking
2. Evaluate the dough characteristics for the preparation of bakery products
3. Analyse different types of bakery and confectionery products and their quality parameters
4. Assess the preparation of sugar confectionary products
5. Apply baking skills and understand the scope of baking industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2	2								2
2	2				2	2								2
3	2	2												2
4	-	2											2	
5	2	2												1

1 **5 Hours**

EXPERIMENT 1

Estimation of gluten content in wheat and refined flour

2 **5 Hours**

EXPERIMENT 2

Quality analysis of wheat and maida flour

3 **3 Hours**

EXPERIMENT 3

Determination of protein quality in wheat and maida flour

4 **4 Hours**

EXPERIMENT 4

Experiment on the preparation of Cookies

5 **5 Hours**

EXPERIMENT 5

Experiment on the preparation of Muffins

6 **5 Hours**

EXPERIMENT 6

Determination of Dough characteristics using farinographic and extensographic

7 **5 Hours**

EXPERIMENT 7

Experiment on preparation of Bun and bread rolls

8 **4 Hours**

EXPERIMENT 8

Preparation and analysis of baking and quality parameters in plain and fancy cakes

9 **3 Hours**

EXPERIMENT 9

Identification of different stages of sugar boiled confectionery

10 **3 Hours**

EXPERIMENT 10

Experiment on preparation of Fudge

11 **2 Hours**

EXPERIMENT 11

Experiment on Preparation of Fondant

12 **3 Hours**

EXPERIMENT 12

Experiment on Preparation of Soft candy

13 **4 Hours**

EXPERIMENT 13

Experiment on preparation of Hard candy

14 **3 Hours**

EXPERIMENT 14

Preparation of fruit candies

15 **6 Hours**

EXPERIMENT 15

Visit to bakery / confectionery units

Total: 60 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment,Academic Press, Elsevier, 2018
6. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009

21FD508 DAIRY TECHNOLOGY LABORATORY 0 0 4 2

Course Objectives

- Understand physico-chemical and colloidal properties of milk
- Assess the quality of raw milk and their implications on safety standards of milk and milk products
- Apply the unit operations in milk processing: separation, standardization, homogenization, pasteurization methods, spray drying

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the presence of macro components in milk and detect the adulterants in milk
2. Find the pasteurization efficiency of milk using different methods of pasteurization.
3. Demonstrate the construction details and milk flow pattern of plate heat exchanger
4. Evaluate the efficiency of various equipment for the processing of milk
5. Determine the drying efficiency of different dryers for the production of milk powder

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2			2	3	1						2	3
2		2				1	1						1	2
3		2			3	1	2						3	2
4	2	2	1					2					2	1
5					2			2					2	1

1 **4 Hours**

EXPERIMENT 1

Estimation of specific gravity of milk

2 **4 Hours**

EXPERIMENT 2

Determination of fat content of milk by Gerber's method

3 **4 Hours**

EXPERIMENT 3

Standardization of milk by Pearson square method

4 **4 Hours**

EXPERIMENT 4

Study on (Low temperature low time) LTLT process vat

5 **4 Hours**

EXPERIMENT 5

Study on construction details and milk flow pattern in Plate heat exchanger.

6 **4 Hours**

EXPERIMENT 6

Construction of parts and working of cream separator

7 **4 Hours**

EXPERIMENT 7

Problem solving - Skimming efficiency of cream separator

8 **4 Hours**

EXPERIMENT 8

Construction and operation of butter churning and butter working accessories

9 **4 Hours**

EXPERIMENT 9

Construction and working of homogenizer for reduction of fat globules

10 **4 Hours**

EXPERIMENT 10

Construction and operation of Spray dryer for the production of milk powder

11 **4 Hours**

EXPERIMENT 11

Preparation of ice cream

12 **4 Hours**

EXPERIMENT 12

Problem solving- calculations for the preparation of Ice cream mix

13 **4 Hours**

EXPERIMENT 13

Detection of Adulteration of milk

14 **4 Hours**

EXPERIMENT 14
Quality analysis of raw milk

15 **4 Hours**

EXPERIMENT 15
Visit to Dairy processing industry

Total: 60 Hours

Reference(s)

1. De Sukumar Outlines of Dairy Technology, Oxford University press, New Delhi, 2002.
2. R.K. Robinson, Modern dairy technology Vol. I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
3. Gerrit Smit, Dairy processing Improving quality, Published by Woodhead Publishing Limited, CCR PRESS, 2000.
4. H.G. Kessler, Food engineering and dairy technology, Verlag A. Kessler, Freising, (F.R.Germany.) 1981.
5. A.W. Farrall, Engineering for dairy and food products, John Wiley and Sons, New York, 1963.

21GE501 SOFT SKILLS - APTITUDE I **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)
Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility-Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.

2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21HS002 HUMAN VALUES AND ETHICS **2 0 0 2**

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3	2	2				
2								3	2	2				
3								3	2	2				
4								3	2	2				
5								3	2	2				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

1.Importance of Human Values & Ethics in 21st Century

2.Understanding the theory of basic human values and ethics

Openness to change

Self-enhancement

Conservation

Self-transcendence

3. Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism – Integrity -Freedom -Justice -Honesty -Truthfulness -Responsibility -Compassion

6 Hours

UNIT III

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life -Embracing self-love and wellness -Understanding harmony in the family and society

6 Hours

UNIT IV

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence.
Understanding the challenges in cultural, personal, social, political, and economic environment

6 Hours

UNIT V

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. (2011). The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin.
2. Gupta, N. L. (2002). Human Values For The 21St Century. India: Anmol Publications Pvt. Limited.
3. Mishra, A. (2017). Happiness Is All We Want. India: Bloomsbury Publishing.
4. Universal Human Values. (2023). (n.p.): Booksclinic Publishing.
5. A Textbook On Professional Ethics And Human Values. (2007). India: New Age International (P) Limited

21FD602 FOOD EQUIPMENT DESIGN 3 1 0 4

Course Objectives

- Impart knowledge on basic principles of designing equipment for food processing
- Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc.
- Provide an idea about devising cold storage units, freezers etc.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze the process parameters of equipment and design pressure vessels, storage tanks and pulper.
2. Select the suitable products and materials for designing heat exchangers and evaporator.
3. Design and analyze the performance of dryers and extruders.
4. Estimate the cooling load of cold storage and design a cold storage for fruits and vegetables.
5. Analyze and determine the parameter for designing size reduction and conveying equipment.
6. **Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	1		1			1				1	
2	3		2								1		1	
3	3		2	1							1			1
4	2		2			1	1				1		2	
5	2		2			1							1	

UNIT I **12 Hours**

DESIGN OF PRESSURE VESSELS, STORAGE TANKS AND PULPER

Introduction to design - principles and selection of food processing equipment - design of pressure vessels - design aspects of storage tanks, design of sterilizers and process vats - design of pulper - design considerations - materials of construction - installation and operation.

UNIT II **12 Hours**

DESIGN OF HEAT EXCHANGERS AND EVAPORATORS

Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators- entrainment separators-installation and maintenance.

UNIT III **12 Hours**

DESIGN OF DRYERS AND EXTRUDERS

Design of dryers - cabinet dryer, fluidized bed dryer, heat pump dryer, foam mat dryer - freeze dryer - Spray dryer - design considerations, installation, operation and maintenance - design considerations of food extruders - single and twin screw extruders - installation, operation and maintenance of food extruders.

UNIT IV **12 Hours**

DESIGN OF COLD STORAGE AND FREEZERS

Design of cold storage - estimation of cooling load - construction, operation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables - design of freezers - types of freezers - design considerations - construction and operation-design of frozen storage.

UNIT V **12 Hours**

DESIGN OF SIZE REDUCTION AND CONVEYING EQUIPMENTS

Design consideration of size reduction equipments- installation and maintenance-design consideration of material conveying equipments- belt conveyor- screw conveyor - bucket elevator- pneumatic conveyor.

FOR FURTHER READING

Factor of safety, Poisson's ratio, Food grade stainless steel, hygienic design of equipments, hygienic practices during maintenance operation

Total: 75 Hours

Reference(s)

1. P.S. Phirke, Processing and conveying equipment design, Jain Brothers, New Delhi, 2004.
2. M.V. Joshi and V.V. Mahajani, Process Equipment Design (3rd edition), New India Publishing Agency, New Delhi, 2004.
3. K.M. Sahay and K.K. Singh, Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
4. Jasim Ahmed and Mohammad Shafiur Rahman (Editors), Handbook of Food Process Design, John Wiley and Sons, Ltd., U.K., 2012.
5. Kennath. J. Valentas and R.Paul Singh (Editors), Handbook of Food Engineering Practice, CRC Press, London, 1997.
6. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A, 2003.

21FD603 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Impart the processing technologies and equipment used for meat, fish and Poultry
- Understand the preservation and value addition of meat, egg and poultry products
- Assess the quality assurance, sanitation and Packing techniques for meat,fish and Poultry products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze the scope, challenges, nutritive value and processing techniques of meat and its products
2. Assess the nutritive value, processing and quality parameters of Poultry, egg and its products
3. Apply the appropriate processing and preservation methods for fish and its products
4. Evaluate the quality and suitable packaging for meat, fish and poultry products
5. Apply the effective processing methods for waste/By-product utilization from meat and poultry industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				3	1							2	2
2	2				3	2							3	3
3	3				3	2							2	2
4	2				3	3							2	2
5	2				3	3							2	2

UNIT I **12 Hours**

MEAT PROCESSING

Meat processing industries- status and scope- Structure, composition and nutritive value of meat, Common and commercially important meats, pre -slaughter care-stunning methods-slaughtering method- evisceration and dressing of carcasses-refrigeration and transport, Meat tenderization and Meat quality evaluation. Rigor mortis - changes of meat, carcass chilling, ageing; storage of fresh meat. Processing and preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT II **12 Hours**

POULTRY AND EGG PROCESSING

Composition and nutritive value of poultry meat, Types of poultry, production, classification & grading. Slaughtering, bleeding, scalding, defeathering, evisceration, chilling, packaging; storage. Egg structure, composition, nutritive value and functional properties of eggs and its preservation by

different methods. Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing. Egg quality assessment

UNIT III **9 Hours**

FISH AND FISH PROCESSING

Fish-composition and nutrition value, commercially important fish and shell fish, Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; ready-to-eat fish and other sea food products, spoilage factors, ship board operations, storage and transport.

UNIT IV **5 Hours**

PACKAGING AND QUALITY STANDARDS

Modified atmosphere packaging, packaging of retail cuts, Indian regulation and quality standards, Kosher and Halal certification, HACCP, Good Manufacturing Practices, meat plant sanitation and safety.

UNIT V **7 Hours**

EQUIPMENTS AND BY-PRODUCT UTILIZATION

Meat processing equipment - Meat grinder, Sausage stuffer, Hand crank meat tenderizer, meat mixer, meat mincer and meat slicer. Poultry processing equipment - Chicken feather plucking machine, cutter, Slaughter machine, Bone and meat cutter. Fish processing equipment - Fish slicing machine, Fish gutting machine, fish grader, fish de-scaling machine, Solid waste, Liquid waste, Chicken rendering unit-Dry rendering, wet rendering, Effluent Treatment Plant, By product utilization.

FOR FURTHER READING

Non destruction quality assessment of egg, meat and poultry carcasses, Differences between country and leghorn eggs, carcasses.

Total: 45 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.
2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Dayapubliching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.
6. V.P. Singh and NeelamSachan, Principles of meat technology, New India publishing agency, New Delhi, 2012

21FD607 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY LABORATORY

0 0 4 2

Course Objectives

- Understand the properties of meat and meat products
- Evaluate the quality parameters of egg

- Gain Knowledge on preservation methods associated with meat, poultry and fish

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Demonstrate analytical methods of physical properties
2. Identify pathogenic microorganisms responsible for meat spoilage
3. Assess the quality of Egg
4. Execute the food laws of the country and their compliance
5. Implement the procedures to prepare value added products from meat

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2			3	1								
2		3		2										
3		2		1	1		1		1					
4						1			1	2		1		

5	1		2	1	2	1									

1 **8 Hours**

EXPERIMENT 1

Determination of meat colour

2 **4 Hours**

EXPERIMENT 2

Determination of water holding capacity in meat

3 **4 Hours**

EXPERIMENT 3

Detection of presence of glycogen in meat

4 **4 Hours**

EXPERIMENT 4

Microbial analysis of meat and meat products

5 **8 Hours**

EXPERIMENT 5

Quality Evaluation of Eggs: External Qualities

6 **8 Hours**

EXPERIMENT 6

Quality Evaluation of Eggs: Internal Qualities

7 **4 Hours**

EXPERIMENT 7

preservation of shelled eggs

8 **4 Hours**

EXPERIMENT 8

Curing of meat by different methods

9 **4 Hours**

EXPERIMENT 9

Dehydration of meat and meat products

10 **4 Hours**

EXPERIMENT 10

Canning technology of fish

11 **8 Hours**

EXPERIMENT 11

Preparation of chicken based products

Total: 60 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.

2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Dayapubliching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)
Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														
5														

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 Hours**

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **4 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **4 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **2 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.

6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21FD701 WASTE MANAGEMENT IN FOOD INDUSTRIES

3 0 0 3

Course Objectives

- Understand the importance of treating waste product from food industry
- Learn different solid and liquid management techniques
- Impart knowledge on different treatment methods and recycling of waste product from food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyse the impacts of food wastage and its causes in environment
2. Assess and analyse the different food industry wastes leads to environmental pollution
3. Apply the physical, chemical and biological principles for liquid waste treatment
4. Analyse the solid waste management techniques
5. Evaluate the by-product/waste utilization from different food processing industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						3	3	3				1		
2	1				2	3	3	1						
3	2		1		1	3	3	1		1	3			
4	2		1		2	3	3	2		2	3			
5	2		1		1	2					2			

UNIT I **6 Hours**

INTRODUCTION TO WASTE MANAGEMENT

Definition-Food wastage- food loss- global scenario- Sources of waste and pollutants, Classification and characterization of wastes - causes and prevention of food waste- impact of food losses and waste- food waste hierarchy-need for minimization of food waste

UNIT II **9 Hours**

FOOD INDUSTRY WASTES AND ENVIRONMENTAL POLLUTION

Food Industries- Environmental Pollution due to Food Industry wastes - characteristics and impact on soil, water, air pollution - Processes for waste utilization from fruit and vegetable industries, meat, fish, dairy, oil processing industries.

UNIT III **12 Hours**

LIQUID WASTE MANAGEMENT IN FOOD INDUSTRIES

Principles of Physical treatment - Screening, Sedimentation, Filtration, back washing, membrane separation. Principles of Chemical treatment- COD, BOD, VLSS, MLSS and ETP. Coagulation, flocculation, Precipitation, flotation, Disinfection and fluoridation. Principles of biological treatment, aerobic process, activated sludge process, trickling filters, anaerobic digestion, UASB reactor.

UNIT IV **6 Hours**

SOLID WASTE MANAGEMENT IN FOOD INDUSTRIES

Solid waste management techniques, Principles and practices, 3R concept, resource recovery. Composting methods of composting, vermicomposting- Incineration, pyrolysis- Briquetting - value addition, Pelletizing, SCP, enzymes, pectin.

UNIT V **12 Hours**

BY PRODUCT/WASTE UTILIZATION

Utilization of oil cake and defatted oil cake as cattle feed and industrial uses. Utilization of sugarcane tops, bagasse, molasses and press mud - animal feed from sugarcane tops and bagasse - Utilization of agro-industries - Utilization of furfural and activated carbon-Environmental Laws and Acts-Regulatory issues with food industry waste

FURTHER READING

Pollution control board, BOD, COD of water, Threshold level of solids present in water, Air pollution, mitigation measures for solid, liquid and air pollution. Case Studies and regulations on waste management.

Total: 45 Hours

Reference(s)

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. Wang, L. K., Lo, H. H., Hung, Y. T., & Yapijakis, C. Waste treatment in the food processing industry, CRC Press,2005
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Waldron, K. W, Handbook of waste management and co-product recovery in food processing, Elsevier,2009
5. Sylvan H Wittwer, Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995.
6. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (III ed), Himalaya Publishing House, New Delhi, 2010.

21FD702 FOOD PROCESSING PLANT DESIGN AND LAYOUT **3 1 0 4**

Course Objectives

- Impart basic knowledge in selecting a location as well as plant layout with respect to material handling, space utilization, future expansion etc.
- Understand the importance of availability of raw material and facilities for production of goods
- Integrate man, materials and machinery for optimum production

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Design layout for various types of food processing industries.
2. Construct project profile analysis and prepare project report
3. Design water storage systems and prepare electrical layout
4. Apply different methods for production planning
5. Demonstrate the repair and maintenance of equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2	2	1	2	1					

2	1	1	2	3	3	1		1	3	3	3			
3	3	3	2	2	3	3	1	1			3			
4	1	2	1	2	1	2	2	1		2	3			
5	1	3	2	1	2	2		1			1	1		

UNIT I **12 Hours**

PLANT LOCATION AND LAYOUTS

Introduction to food plant design - special features of food and agricultural process industry - plant location - location factors, site selection, location theory and models - layout - objectives, classical and practical layout - preparation of process chart and machinery layout - product layout and process layout - plant layout for size reduction machinery, evaporation plant, drying plant, bake ovens and frying plant, heat exchanger plant, refrigeration and air conditioning plant, boiler, packaging plant and ancillary equipments plant.

UNIT II **12 Hours**

PROJECT PROFILE ANALYSIS

Project profile, key aspects to consider in preparing a project profile and DPR (Detailed Project Report), Describing Project Operations, Categorizing Costs, Environmental Sustainability, completing and interpreting the profile, Project Profile Formats, Preparing model project report on fruit and vegetable processing unit.

UNIT III **12 Hours**

ELECTRICAL AND WATER SUPPLY

Estimation of services - peak and critical load - preparation of electrical layout - selection of fittings and accessories for electrical and water supply - provision of water supply - design of water storage system - selection of pipe, valves and safety devices - drainage - systems, pipeline, traps, safety devices - illumination and ventilation - materials, mounting, operation and maintenance - layout for effluent treatment plant - safe disposal of effluent.

UNIT IV **12 Hours**

PRODUCTION PLANNING AND CONTROL

Production planning and control - continuous and intermittent production - scheduling - routing and dispatching - activity chart and Gantt chart - net work planning methods - PERT and CPM - applications - method study - work study - methods - man-machine chart - time study - standard time of a job - inventory control - economic ordering quantity - inventory models.

UNIT V **12 Hours**

REPAIR AND MAINTENANCE OF EQUIPMENT

Repair and maintenance of equipment - preventive maintenance and breakdown maintenance - replacement of equipment - alternative methods and analysis - method of annual equivalence, present worth method and internal rate of returns.

FURTHER READING

PERT, CPM, Queuing theory, Break Even Point, DPR for fruit & Vegetable processing industry

Total: 75 Hours

Reference(s)

1. O.P.Kanna, Industrial Engineering and Management, DhanpatRai Publication (P) Ltd., New Delhi, 2003.
2. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014.
3. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A., 2003.

4. Antonio Lopez-Gomez and Gustavo V. Barbosa-Canovas, Food Plant Design, CRC, London, 2005.
5. C.S.Rao, Environmental Pollution Control Engineering, New age International (P) Ltd., New Delhi, 1999.
6. G.K. Agarwal, Plant layout and materials handling, Jain brothers, New Delhi, 2008.

21FD707 WASTE MANAGEMENT IN FOOD INDUSTRIES LABORATORY

0 0 4 2

Course Objectives

- Understand the basic concepts of waste management in food industries, their chemical nature and methods of extraction
- Apply the methods to identify the activity of antioxidants and assessing suitable food for formulation
- Understand the role of food wastage from food industries and developing into a value addition product from the waste

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Identify the basics of waste food from industries
2. Select the appropriate waste to develop product out of it
3. Evaluate the methods used for analysis of BOD in industries effluents
4. Apply and analysis the role of water in industry level
5. Apply the suitable food for the formulation of suitable fiber from waste food

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2		2										
3	2	2		3										
4	3	3		2										
5	1	2												

EXPERIMENT 1 **2 Hours**

Preparation of Extruded product from Edible fruit and vegetable wastes

EXPERIMENT 2 **2 Hours**

Formulation of Jelly from Banana peel juice bioavailability

EXPERIMENT 3 **4 Hours**

Preparation of protein concentrates from sea food waste

EXPERIMENT 4 **4 Hours**

Design and formulation of edible cutlery from fruit peels.

EXPERIMENT 5 **4 Hours**

Quantification of Whey from Dairy effluents.

EXPERIMENT 6 **4 Hours**
Analysis of BOD in the Food processing industrial effluent

EXPERIMENT 7 **2 Hours**
Analysis of COD in the Food processing industrial effluent

EXPERIMENT 8 **2 Hours**
Formulation of animal feed from unutilized fiber food

EXPERIMENT 9 **4 Hours**
Preparation of Fruit Jam from the Edible parts of Fruit waste

EXPERIMENT 10 **2 Hours**
Disposal methods and management of particular solid and liquid waste

Total: 30 Hours

Reference(s)

1. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005

21FD708 PROJECT WORK I **0 0 6 3**

Course Objectives

- To develop knowledge to formulate a real world problem and project"s goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 0 Hours

21FD801 PROJECT WORK II **0 0 18 9**

Course Objectives

- Develop knowledge to formulate a real world problem and project"s goals.
- Identify the various tasks of the project to determine standard procedures.
- Identify and learn new tools, algorithms and techniques.
- Understand the various procedures for validation of the product and analysis the cost effectiveness.
- Understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 0 Hours

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)
Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														
5														

UNIT I **9 Hours**

UNIT 1

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

UNIT 2

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

UNIT 3

1. What""s your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

UNIT 4

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

UNIT 5

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois.| Grammaire Les verbes s appeler,etre, avoir, les articles definis, indefinis | Communication - Saluer, s informer sur quelquun, demander de se presenter | Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites | Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu | Communication - Chercher un logement, d ecrire son voisin, s informer sur un logement | Lexique - L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche | Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie | Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT - OUVRIR -Ãƒ?Ã‚Â LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film | Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite | Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)
Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														
5														

UNIT I **9 Hours**

UNIT 1

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

UNIT 2

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

UNIT 3

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

UNIT 4

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

UNIT 5

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)
Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **9 Hours**

UNIT 1

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

UNIT 2

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

UNIT 3

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

UNIT 4

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

UNIT 5

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai

2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)
Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														
5														

UNIT I **9 Hours**

UNIT I

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

UNIT II

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

UNIT III

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka

- S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

UNIT IV

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

UNIT V

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri

5. The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18FD0XA HALAL COMPLIANCE IN FOOD AUDIT 0 0 0 1

Course Objectives

- Understand the basic terminologies, principles of Halal Auditing and the regulatory compliance in food industry and catering units

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Indicate the Halal standards
2. Apply for the Halal certification process and audit

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						
2								2						

Halal Regulations requirements and Halal Food Production standards

Introduction- A Benchmarking on International Halal Food Standards- Food Production, International Legislation, and Halal Requirements – Processed Meat- Halal Food Production, International Legislation, and Halal Requirements – Food Additives, Enzymes, Processing aids, Flavourings- Food Production, International Legislation and Halal Requirements – Beverages, Soy Sauce and Vinegar- Food Production, International Legislation, and Halal Requirements] – GMOs- Food Production, International Legislation and Halal Requirements – Dairy-Halal Animal Slaughtering- Halal Products Characteristics including Testing Techniques- Halal Products Conformity Assessment and International Certification Schemes-Auditing of the Halal products, service and process Inspection and Market surveillances requirements

Total: 20 Hours

Reference(s)

1. Riaz, M N. Chaudry, M M. Handbook of Halal Food Production. 2019 CRC PRESS.

18FD0XB FOOD SAFETY AND QUALITY MANAGEMENTS **0 0 0 1**

Course Objectives

- To evaluate the regulatory compliance in industrial and catering units and gain knowledge on food quality practicalities and its control measures

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Indicate the Quality standards
- Apply for the ISO audits and evaluate the retailers standard

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						
2						1		2						

Management Systems, Auditing and Accreditation - ISO 9001 : 2000 - ISO 22000: 2005- Laboratory Quality Management System - Requirements Specific to Food Testing Laboratories – Physical and Chemical Parameters - Requirements Specific to Food Testing Laboratories – Biological Parameters - General Topics: Related to Food Testing Laboratories- Retailer Standards- BRC Food and BRC IOP Standards : An Overview - International Food Standard -SQF :1000 SQF: 2000 - Global Gap and India Gap.

Total: 20 Hours

References

1. Fundamentals in Management of Food Safety in the Industrial Setting: Challenges and Outlook of the 21st Century

18FD0XC HACCP CERTIFICATION 0 0 0 1

Course Objectives

- To analyse implementation of HACCP in the organisation and evaluate other professionals on adopting HACCP

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Indicate and apply the types of hazards in HACCP plan, analyse the pre-requisite programs and evaluate the critical limit

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1		2						

Types of Hazards – Microbiological, Chemical, Physical, allergens- Principles of HACCP- Development of HACCP Plan- Describe the food and its distribution- Describe its intended use and consumers- Develop a flow diagram explaining the process- Common Pre-requisite Programs- Benefits of HACCP – Types of records-Challenges of HACCP implementation- Activities

Total: 15 Hours

References:

1. https://www.igmpiindia.org/industry-certificate-haccp.html

18FD0XD FSSAI FOOD SAFETY TRAINING AND CERTIFICATION **0 0 0 1**

Course Objectives

- Creating an improved environment of self-compliance to FSS Act, rules and regulations by the responsible Food Business.

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Evaluate the Food Safety Management System Plan (FSMS) incorporating HACCP

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2		2						

Introduction to food quality – FSSAI- Location, layout and facilities – cleaning and sanitation:maintenance of establishment-pest control- personal hygiene- food operation and controls – activities and tasks

Total: 20 Hours

References:

1. https://efaidnbmnnnibpcajpcglclefindmkaj/https://eatrightindia.gov.in/creativecatalogue/upload/books/PDF/520.pdf

18FD0XE ISO-17025 FOR ACCREDITED LABORATORY **0 0 0 1**

Course Objectives

- Understand the complete knowledge and information about ISO 17025
- Analyse implementation of ISO 17025 in the organisation
- Evaluate other professionals on adopting ISO 17025

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

- Implement ISO 17025 and evaluate the risk and opportunities in an organization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								2						

Introduction to ISO 17025 and initiation of a LMS- Plan the implementation of ISO 17025 - Analysis : structural requirement, and resource requirements- Calibration – Structure of documentation of a management system- risk analysis and management

Total: 15 Hours

References:

1. https://www.unido.org/sites/default/files/2010-08/Complying_with_ISO-IEC_17025_Update_May_2010_0.pdf

18FD0XF FOOD FERMENTATION TECHNOLOGY 0 0 0 1

Course Objectives

- Understand the fermentation process and industrial cultures
- Impart knowledge on primary and secondary metabolites
- Gain the knowledge on food fermentation

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the culture for microbial fermentation
2. Select the microbial culture for industrial fermentation process
3. Analyse the microbiological quality control in food fermentation process
4. Understand the role of microbes in fermented foods
5. Select the appropriate fermenters for fermentation process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					1		1							1
2						2	2							1
3			1				1							2
4			1				2	-						2
5			1			2	-							1

Total: 15 Hours

Introduction to Fermentation Technology: History, types of fermentation, examples of fermentation industry. Microbial Growth Kinetics: Growth, substrate utilization and product formation - Fermentation Media: Formulation, carbon, nitrogen, oxygen, minerals sources, etc.- Sterilization: Sterilization ofair and medium; sterilization of fermentor, thermal death kinetics of microorganisms- Bioreactor Design: Material and energy balances in bioprocess: open and closed systems, steady-state

and non-steady state systems, reacting and non-reacting systems, stoichiometry - Bioreactor Operation Systems: stirred tank reactor (batch, semi-batch, continuous), bubble column, airlift and packed bed - Physical Processes in Fermentation System: fluid flow and mixing, mass and heat transfer.

Reference(s)

1. Stanbury, P.E. and Whitaker, A., Principles of Fermentation Technology (1984), Pergamon Press.
2. Pirt, S.J., Principles of Microbial and Cell Cultivation. Blackwell Scientific Publication, London.
3. Biely, J.E. and Ollis, D.F. BioChemical Engineering Fundamentals (1986), Mcgraw

18FD0XG FABRICATION OF FOOD PROCESSING EQUIPMENT 1 0 0 1

Course Objectives

- To identify materials for fabrication of food processing equipment
- To understand the design details, fabrication, installation, operation and maintenance of equipment
- To impart knowledge on food plant design and layout

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics:Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course outcomes (COs)

1. Select the materials used in food processing equipment
2. Assess the design details and requirements of food processing equipment
3. Explain the equipment fabrication and compare with the design
4. Demonstrate the installation, operation and maintenance of food processing equipment
5. Generate the plan for food plant design and considerations, project management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					1		1							1
2						2	2							1
3			1				1							2
4			1				2	-						2
5			1			2	-							1

FUNDAMENTALS OF FOOD PROCESSING EQUIPMENT DESIGN

Introduction to food processing equipment – food processing unit operations -selection of materials - differences in design and fabrication of food processing and non-food processing equipment. Equipment design considerations – case study. Food processing equipment fabrication – design details and considerations – case study. Food process equipment installation, commissioning, operation and maintenance. Food Process plant design – location – decision – plant layout factors – layout design procedure – project management

Total: 15 Hours

18FD0XH FOOD ADDITIVES AND INGREDIENT FUNCTIONALITY

1 0 0 1

Course Objectives

- Understand the role and importance of food additives in food product development.
- Identify different types of food additives and their functionalities.
- Evaluate the safety, regulatory requirements, and limitations associated with food additives.

Course Outcomes (s)

1. Understand the role of food additives in food product development and their impact on sensory attributes, shelf life, and safety.
2. Identify and select appropriate food additives based on specific product requirements and quality parameters.
3. Apply knowledge and practical skills in formulating food products using different food additives.
4. Evaluate the sensory attributes, texture, and shelf life of food products containing food additives.
5. Assess the nutritional implications and consumer perceptions associated with food additives.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	2	3									
2	3	3												
3	3	2	3	2										
4	3	2	2											
5	3	1	2											

Definition and classification of food additives - Functions, limitations, Regulatory considerations and labeling requirements. Natural and artificial flavors - Flavor enhancers: MSG, nucleotides, and umami taste - Application of flavors in food products. Hands-on experience in formulating food products with various flavors - Sensory evaluation and optimization of flavor profiles.Role of preservatives in food preservation - Common preservatives: antimicrobials and antioxidants - Applications and limitations of preservatives. Hands-on experience in evaluating shelf life of food products - Application of antioxidants foroxidative stability Texture-enhancing additives: thickeners, stabilizers, and emulsifiers - Functions and applications of texture modifiers - Impact on texture and mouthfeel of food products. Hands-on experience in formulating food products with texture modifiers - Texture evaluation and optimization using Stabilizers. Natural and synthetic food colors - Sugar substitutes and artificial sweeteners - Impact on visual appeal and sensory attributes. Hands-on experience in formulating food products with food colors and sweeteners -Evaluation of color intensity and sweetness

Total: 15 Hours

Reference(s)

1. Reference Book: Title: Food Additives Handbook Author: Richard J. Lewis Publisher:CRC Press ISBN: 978-0367454820
2. Reference Book: Title: Food Chemicals Codex (FCC) Publisher: United States Pharmacopeial Convention ISBN: 978-0917330981
3. Journal Article: Title: Functional properties of food components and additives: A review Authors: Chibuike C. Udenigwe, Rotimi E. Aluko Journal: Journal of Food Biochemistry Volume: 34, Issue 5 Year: 2010 DOI: 10.1111/j.1745-4514.2010.00337.x
4. Journal Article: Title: Safety evaluation of food additives Author: Koji Araki Journal: Bioscience, Biotechnology, and Biochemistry Volume: 82, Issue 3 Year: 2018 DOI: 10.1080/09168451.2017.1402758

18FD0XI TRANSLATIONAL RESEARCH AND TECHNOLOGY COMMERCIALIZATION

Course Objectives

- To enable students to get an insight of translating Ideas and to evaluate and predict the roleof technology in creating wealth or value
- To empower graduates and researchers to distinguish between Abrasive/Breakthrough technologies and lay a foundation for productive research for societal transformation.

Course Outcomes (s)

1. Address the questions/challenges/problems/ pain statements of the society or demand area
2. Analyze the tools (Software and Legal instruments) for evaluating the technology
3. Build and stimulate a business model around ones idea/invention, which will enable to decide the best mode of translating idea/invention to value or wealth

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1		**2**		**3**		**2**				**2**				**2**	**3**
2	**3**		**1**						**3**					**2**	
3	**3**				**3**				**2**	**2**					

Basics of translational research, Research principles, Study Designs: Individual randomized trials, Group randomized trials, Case-control design, Multi-level designs. Stages of Technology Transfer**,**Basic Components of Translational Research - Stages of invention, Classifications of Inventions,Strategies for Protecting IPs, Licensing Strategy, Challenges in Healthcare Innovation, Go-to- Market, Presentation for Marketing Legal Instruments Involved in Technology Transfer.Ability towrite a model technology transfer/ translational document procedure

Total: 15 Hours

Reference(s)

1. Translational Research and Applied Psychology, Suman Sigroha Kamlesh singh, SAGE Publications India Pvt Ltd; First Edition (1 July 2019).
2. Technology Transfer: A Communication Perspective (1990), Eds. Frederick Williams and David V. Gibson, SAGE Publications (ISBN:0-8039-3741-5
3. Biotechnology Intellectual Property Manual (2001) Spruson and Ferguson Patent Attorneys. (ISBN:0-642-72129-7)

18FD0XJ FORMULATION OF PLANT-BASED FOOD

1 0 0 1

Course Objectives

- Understand the principles and importance of plant-based food formulation in the context of sustainability, health, and consumer demands.
- Identify and evaluate different plant-based protein sources, functional ingredients, and texturizers for use in food formulations.
- Develop skills in formulating plant-based food products, considering sensory attributes, nutritional profiles, and processing constraints.

Course Outcomes (s)

1. Understand the principles and concepts of plant-based foods
2. Identify various plant-based protein sources and ingredients
3. Apply various processing techniques for plant-based foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	2	3									
2	3	3												
3	3	2	2											

Overview of plant-based food industry- Importance of plant-based diets and sustainability - Market trends and consumer demands. Evaluation and selection of plant-based protein sources- Functional ingredients -Extrusion technology and texturization methods - Thermal and non-thermal processing techniques - Fermentation and culturing of plant-based products Developing Plant-Based Dairy Alternatives - Hands-on experience in formulating plant-based dairy alternatives - Texture optimization and sensory evaluation - Packaging considerations for dairy alternatives

Total: 15 Hours

Reference(s)

1. Plant-Based Food Technology: Principles and Applications Authors: Lih-Sheng Turng, Kuang-Hwa Chen, Joyce I. Boye Publisher: Wiley-Blackwell ISBN: 978-1119467628
2. Plant-Based Meat: Science, Technology and Nutritional Aspects Editors: Mahesh Kumar Padhee, R. K. Vishwakarma Publisher: CRC Press ISBN: 978-0367422973Development of plant-based meat analogues Authors: Atze Jan van der Goot, Atahan Aslan, Anke Janssen Journal: Current Opinion in Food Science Volume: 31 Year: 2020 DOI: 10.1016/j.cofs.2020.01.003
3. Extrusion processing of plant-based meat analogues Authors: Raphael P. V. S. Teixeira, Gonçalo Barroso, Rui Cruz, Susana M. Cardoso, Cátia Gonçalves, Olga C. Nunes, Paulo J. Sousa, Manuela Pintado, Jorge A. Saraiva, Isabel M. P. L. V. O. Ferreira Journal: Trends in Food Science & Technology Volume: 77 Year: 2018 DOI: 10.1016/j.tifs.2018.05.019

18FD0XK PHYSICOCHEMICAL STUDIES OF BAKED PRODUCTS

1 0 0 1

Course Objectives

- Apply the principles of baking and analyze the role of ingredients in baking.
- Introduce different baking techniques to prepare bakery products.
- Developing skills of analyzing different bakery products.

Course Outcomes (s)

1. Understand the principles and concepts of baking and bakery products.
2. Identification of various ingredients roles to prepare bakery products and equipment knowledge.
3. Get to know about different analyzing methods of the bakery products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	2	3									
2	3	3												
3	3	2	2											

Introduction to Baking Science - History of baking- Basic ingredients and their function. Flour - Types of flour - Flour quality and differences. Leavening agents and sweeteners - Chemical leavening - Yeast - Fermentation. Sweeteners - Sugar substitutes Fats and oils - Different types of oils and fats used in the baking industry.Baking Techniques - Different Baking Techniques - Oven temperature and calibration - Pan types and sizes - Convection and conventional baking - Mixing and kneading - Mixing techniques - Kneading methods - Gluten development and effects on the final product.Sensory profile analysis of the baked products developed using different fats - Hands-on experience in evaluating the organoleptic properties of baked goods.

Total: 15 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment, Academic Press, Elsevier, 2018
6. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009

21OFD01 TRADITIONAL FOODS 3 0 0 3

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2		1												
3	2	1	1											
4								2						
5								2						

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips.

Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

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 **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

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 /illnesses.

FOR FURTHER READING

Specific social contexts, religious festivals, breakfast, meal and snack foods of different regions of India, typical fast foods / junk foods, Street foods.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

21OFD02 FOOD LAWS AND REGULATIONS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2	1						
3		1												
4	1	2												
5	1	2												

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention

and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

FOR FURTHER READING

Food quality, Nutritional labeling, labeling regulations, Food composition analysis, Food adulteration and detection techniques, Hygienic practices, Novel food packaging, Food advertisement methods.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

21OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	2	1			1							
2	1	1												
3	1	2												
4	1		1											
5	2	1	1											

UNIT I **9 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage,

controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.

6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

21OFD04 CEREAL, PULSES AND OILSEED TECHNOLOGY

3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		2		2								
2	1	2		2		1								
3	2	2		1		2								
4	2	3		2		2								2
5	2	2		2		3								

UNIT I **9 Hours**

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry

milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut,rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

FOR FURTHER READING

Major growing areas of cereals and pulses in India, National and global scenario of millet processing and
products, Novel extruded millet and cereal products.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

Programme Outcomes (POs)
Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

NIL TOPIC

nil content for unit 2

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993

18GE0XC NEURO BEHAVIORAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds

NIL II

nil topic unit ii

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1												
2						2								

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles - Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film

NIL UNIT II

unit ii topic nil

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)
Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing;Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our healthand environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING **1 0 0 1**

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										1				
2										1				
3						2								
4							2							
5														

UNIT I **7 Hours**

UNIT I

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

UNIT II

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)
Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														
5														

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Ãƒ?Ã‚¢??Business stripped bareÃƒ?Ã‚¢??, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2					
2							1		2					
3							1		2					

UNIT I **7 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION

National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets.

DRILL AND WEAPON TRAINING

Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.

NATIONAL INTEGRATION AND SOCIAL AWARENESS

National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP

Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID

Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 15 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP **1 0 0 1**

Course Objectives

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)
Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure Ã¢?? roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership.Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES **1 0 0 1**

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Programme Outcomes (POs)

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3														
4														

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation Ã¢?? Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? Ã¢?? Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company"s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly Ã¢?? Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1														
2														
3									3					

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty andBody Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception,Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;PearsonEducation
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7thEd.New Dehi:Tata McGraw Hill.

21FD001 FOOD PACKAGING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Apply the functions of food packaging for socio-economic needs
2. Analyze the importance of Chemical alteration in Natural macromolecular compounds.
3. Find the importance of processing Non-renewable materials in traditional packaging.
4. Apply the new innovation in developing advanced packaging material
5. Analyze the response to the changes in processing foods by modern packaging techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	1	2	1	1				1			
2	1	2	2	1	2	1								
3	1	1	1	1	3	1	3				1			
4	2	2	2		2	1	2							
5	1	2	1								1			

UNIT I **9 Hours**

INTRODUCTION TO FOOD PACKAGING

Introduction,Definitions, Functions of packaging - Containment, Protection, Convenience, Communication. Packaging Environments - Physical Environment, Ambient Environment, Human Environment. Functions/ Environmental Grid, Socio-Economic Needs. Deterioration reactions in foods - Deteriorative reactions & Factors. Shelf life of Food.

UNIT II **9 Hours**

PLASTIC POLYMERS

Structure and Related Properties of Plastic Polymers-Factors influencing polymers structures and related properties(Molecular structure, Molecular weight , Density , Crystallinity, Physical Transitions in Polymers,Chemical structures , and Additives in plastics).Optical , Mechanical, and Barrier properties of Thermoplastic polymers. Processing and Converting of Thermoplastic Polymers.

UNIT III **9 Hours**

EDIBLE , BIOBASED

Edible Packaging materials- Polysaccharides, Lipids, Proteins, Composite materials, Film additives,Bionanocomposites. Biobased & Biodegradable Packaging materials- Classification, Degradability,Degradability of Biobased polymers,OBD Polymers, Category 1,2,3,4,Properties of Biobased packaging materilas (Barrier & Mechanical),Current Limitations, Methods to improve Functionality, Bionanocomposites,Applications. Environmental Aspects & Future trends.

UNIT IV **9 Hours**

ASEPTIC PACKAGING

Aseptic packaging- Introduction (History & Principles of Sterilization),Steerilization of packaging material food contact surface (Irradiation,Heat,Chemiccal Treatments,Verification of Sterilization process),Aseptic packaging systems(Carton systems,Bottle systems,Sachey & Pouch sytems , Cup systems) Integrity Testing of Aseptic Packages.Packaging of Microwavable Foods- Introduction,Basic principles,Effect of food Product, Packaging (Transparent, Absorbent, Shielding & Field modification, Doneness Indicators,Testing methods & Safety)

UNIT V **9 Hours**

ACTIVE AND INTELLIGENT PACKAGING

Active and Intelligent Packaging- Definitions,Active packaging systems (Sachets and Pads, Active packaging materials, Self- Heating and Self- CoOling Packages, Changing gas permeability, Widges), Intelligent Packaging (Indicating Product Quality, Convenience,Theft,counterfeiting & Tampering,safety& regulations). Modified atmospheric packaging- Introduction, Principles, Gas used in MAP, Methods of creating MA conditions, Equipment involved, Applications, Microbiology of MAP, Safety, Refrigerated & Pasteurized Foods with Extended durability and Sous vide.

Total: 45 Hours

Reference(s)

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Third Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2013
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.
4. Richard Coles and Mark J. Kirwan, Food and Beverage Packaging Technology, Second Edition, Wiley & Blackwell, 2011.
5. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
6. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, Food Packaging Science and Technology, CRC Press, 2

21FD002 FOOD PACKAGING DESIGN ANDDEVELOPMENT

3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Apply the functions of food packaging for food processing industries
2. Analyse the importance of 2D & 3D sketching of Packaging Design
3. Find the importance of fabrication techniques for food packaging materials
4. Analyse the importance of printing techniques in food packaging
5. Apply the new innovation in developing advanced packaging material

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1		1	1	2							
2	2	1	1	1	2	1								
3	2	2	2	1	2	1	3				1			
4	1	2	2	1	2	1	2							
5	1	2	1								1			

UNIT I **9 Hours**

INTRODUCTION

History-Past Innovations-Outline of traditional and modern food packaging system, Residual migration of food packaging system, Dyes- synthetic and non-synthetic.Types of Packaging materials used in food processing industry.

UNIT II **9 Hours**

PACKAGING DESIGN AND

Principles-2D and 3D sketching , Preparation of key line diagram- Primary, Secondary and Tertiary packaging materials , Basics of Computer Aided Engineering and Design.Food packaging design and simulation, CAD and CAM application in Food INdustry. Food packaging design as per FSSAI guidelines.

UNIT III **9 Hours**

PACKAGING MOULDING TECHNIQUES

Introduction-Paper & Paper Board, Cartons, Glass,Metals and plastic materials for food packaging system. Types of Moulding Techniques- Paper Pulping, Fabrication of corrugated Fiber board.Glass forming techniques, Thermostat & Thermopiles packaging materials. Processing of metal tin/can.

UNIT IV **9 Hours**

PRINTING TECHNIQUES IN PACKAGING MATERIALS

Introduction-Types of printing techniques involved in food packaging materials- Offset,Screen, Flexographic and Digital Printing

UNIT V **9 Hours**

NOVEL FOOD PACKAGING DESIGN

Introduction- Emerging packaging techniques, Design and principles of smart packaging system Design,Recent Innovation- Intelligent packaging, Application of Active packaging system-Anti-microbial,Anti-Oxidant, Anti- Freezeand Fortification in packed food via active materials . Development of packaging materials using novel biomaterials.

Total: 45 Hours

Reference(s)

1. W.Soroka, Fundamentals of packaging Technology, IoPP
2. Plastics: Materials and processing, pearson-prentice Hall
3. Paper and paperboard Packaging Technology, Mark J. Kirwan, Blackwell Publishing
4. Harald Johnson, Understanding Digital Printing, Thomson Publisher, Boston
5. Barnard & peacock, Hand book of print and production
6. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.

21FD003 DIVERSE MATERIALS IN FOODPACKAGING

3 0 0 3

Course Objectives

- Understand the properties and characteristics of glass, wood, metal, and cardboard as packaging materials.
- Analyze the advantages and disadvantages of each material for different packaging applications.
- Evaluate the sustainability issues related to packaging, including recyclability, biodegradability, and environmental impact.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Create an awareness of the historical and strategic dimensions of food packaging, understanding its protective function, logistic implications, and impact on shelf life in food marketing systems.
2. Evaluate the environmental impact of paper and paperboard packaging solutions by analysing and designing based on considerations such as fiber sources, manufacturing processes, and functional properties.
3. Understand the diverse facets of plastics in food packaging, encompassing manufacturing, and types, printing, sealing, and addressing environmental concerns.

4. Analyze market trends, container designs, raw materials, manufacturing processes, and corrosion challenges in metal packaging, gaining a deep understanding of its role in the food industry.
5. Apply knowledge in glass container packaging, recognizing glass as a marketing tool, by understanding its composition, manufacturing, closure techniques, thermal processing, and environmental considerations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	1	2	1					-	-	1
2	1	2	2	2	1	3	1						-	-
3	1	1	2	1	3	1	3				-			
4	2	1	2			3	1						-	
5	1	1	2	1	1	1	3	1			-		1	

UNIT I **8 Hours**

FUNDAMENTALS OF FOOD

Introduction, Packaging developments-an historic perspective, Food supply and the protective role of packaging, basic functions of packaging, packaging strategy, packaging design and development, food bio deterioration and methods of preservation, packaged product quality and shelf life, Logistic packaging for food marketing systems.

UNIT II **8 Hours**

PAPER AND PAPERBOARD PACKAGING

Introduction, Paper and Paperboard- fibre source and fibre separation, Paper and paperboard manufacture-methods and process involved. Packaging papers and paperboards, properties of paper and paperboard, Additional funcional properties of paper and paperboard, Design for paper and paperboard packaging, package types, systems, environmental profile.

UNIT III **10 Hours**

PLASTICS IN FOOD PACKAGING

Introduction, Manufacture of plastics packaging, types of plastic used in packaging, coating of plastic films-types and properties, secondary conversion techniques, printing, printing and labelling of rigid plastic containers, food contact and barrier properties, sealabilty and closure, cold seal, platic closures for bottles, jar and tubs, adhesive systems used with plastics, retort pouch, environmental and waste managment issue, plastic manufacuturing and life cycle assessment (CLA), plastic waste management.

UNIT IV **9 Hours**

METAL IN FOOD PACKAGING

Overview of market for metal cans, container performance requirements, container designs, raw materials for can making-steel, aluminium, recycling of packaging metal, can-making processes, end making processes, coatings, film laminates and inks, processing of food anf drinks in metal pacakages, shelf life of canned foods, internal corrosion, stress corrosion cracking, environmental stress cracking corrosion fo aluminium alloy beverage can ends, sulphur staining, external corrosion.

UNIT V **10 Hours**

PACKAGING OF FOOD IN GLASS CONTAINERS

Definition of glass, brief history, glass packaging, glass containers market sectors for foods and drinks, glass composition, attributes of food packaged in glass containers, glass and glass container manufacture, closure section, thermal processing of glass packaged foods, plastic sleeving and decorating possibilities, strength in theory and practice, glass pack design and specification,

packaging-due diligence in the use of glass containers, environmental profile, glass as a marketing tool.

Total: 45 Hours

Reference(s)

1. Food packaging technology by Richar coles, Derek MsDowelll and Mark J. Kirwan. Blackwell publishing, CRC press, 2003.
2. Food Packaging by Takashi Kadoya, Kanagawa University, Hiratsuka, Japan. Academic press,1990
3. Glass Packaging Technology" by Walter Sperling and Werner Holleis, Wiley-VCH, 2012.
4. Corrugated Packaging: The Essential Guide" by Neil McGuire, DEStech Publications, Inc., 2013.
5. Metal Packaging: Materials, Markets and Applications" by D.R. Gabe, Smithers Rapra Technology, 2010.
6. Cardboard in Architecture: Volume 7 of the Research in Architectural Engineering Series" edited by Reza Mokhtarian and Ali Araghi, CRC Press, 2018.

21FD005 PACKAGING PERFORMANCE TESTING AND MACHINERY

3 0 0 3

Course Objectives

- To provide an overview of the laws and regulations governing food packaging
- Impart knowledge about the regulatory framework for food packaging in different countries and regions, including the United States, the European Union, and other global markets.
- Learn about food safety, packaging materials and properties, labeling and claims, and emerging issues in food packaging regulations.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the regulatory framework for food packaging in different countries and regions
2. Identify the different types of food packaging materials and their properties
3. Explain the role of packaging in ensuring food safety
4. Analyze labeling and claims on food packaging
5. Evaluate emerging issues in food packaging regulations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2			1	2	1						
2	1	2	2			1	2	1						
3		2	2	1		1	3					-		
4		1		1	1	1		1						

5	2	2		2		1						-		1

UNIT I **8 Hours**

FOOD PACKAGING LAWS AND REGUALATIONS

History of Food Packaging regulations, Overview of global regulatory framework for food packaging, Types of food packaging materials and their properties. Food safety & packaging- Microbial hazards, Physical hazards & Chemical hazards associated with food packaging. Packaging as a control measure in HACCP.

UNIT II **8 Hours**

FOOD PACKAGING STANDARDS AND GUIDELINES

Overview of food packaging standards and guidelines, Food contact materials regulations, Standards for specific food packaging materials (Plastic,glass,metal,paper,etc.). Regulatory agencies and their roles in food packaging - FDA regulations & guidelines,USDA regulations & guidelines,EU regulations & guidelines and other global regulatory agencies & their roles.

UNIT III **11 Hours**

LABELING AND CLAIMS

Overview of global regulatory framework for labelling claims, Types of labeling claims and their definitions. Overview of food labeling requirements, Nutrition labeling requirements, Health and wellness claims, Environmental claims. The role of labelling claims in consumer behavior. Emerging issues in labelling claims-Novel foods & labelling claims, health claims for functional food & supplements, allergen labelling & claims, Sustainable packaging claims.

UNIT IV **10 Hours**

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP) IN FOOD PACKAGING

Introduction to HACCP in Food packaging - Historic development of HACCP, Overview of global regulatory framework for HACCP, principles of HACCP in food packaging. HACCP plan development & implementation - Overview of HACCP plan development, Hazard analysis & identification, Critical control points and critical limits, Monitoring, corrective actions & verification. Risk assessment in Food Packaging - Overview, Types of hazards in food packaging, Risk assessment methods for food packaging materials and processes.

UNIT V **8 Hours**

TESTING AND QUALITY ASSURANCE

Food packaging materials, shelf life of packed food & packaging functionality, testing of physical, optical, electrical, thermal, and rheological properties for plastic packaging materials, permeation testing of synthetic polymers, testing glass as a food packaging material, metal packaing: tesing and quality assurance, testing of paper as packaging material for food industry, testing and quality assurance of bioplastics, shock and vibration testing, testing migration, food package testing authorities & regualtions.

Total: 45 Hours

Reference(s)

1. Food Packaging: Principles and Practice" by Gordon L. Robertson, 3rd Edition, 2012.
2. Food Packaging and Shelf Life: A Practical Guide" by Gordon L. Robertson, 2nd Edition, 2011.
3. The Certified HACCP Auditor Handbook" by ASQ Quality Press, 3rd Edition, 2016.
4. Hazard Analysis and Critical Control Point (HACCP) - A Systematic Approach to Food Safety" by Sara E. Mortimore and Carol Wallace, 3rd Edition, 2013.
5. Nutrition Labeling Handbook" by Marion Greaser and Geraldine June, 2nd Edition, 2013.
6. Consumer Behavior in Action: Real-Life Applications for Marketing Managers" by Geoffrey P. Lantos, 4th Edition, 2016.

21FD006 NEXT GENERATION PACKAGING 3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on developing high barrier packaging materials to safe guard the quality of food products
- Learn about modern techniques in food packaging system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Apply the functions of food packaging for food processing industries
2. Analyse the importance of active and intelligent packaging materials in food preservation.
3. Find the importance of edible coating and film formation.
4. Analyse the importance of Nano technology in food packaging industry.
5. Apply the new innovation in developing advanced packaging material

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1		1	1	2							
2	2	1	1	1	2	1								
3	2	2	2	1	2	1	3				1			
4	1	2	2	1	2	1	2							
5	1	2	1								1			

UNIT I **9 Hours**
INTRODUCTION

History-Past Innovations in food packaging materials: Outline of recent techniques involved in the development of food packaging system: Active packaging, Intelligent Packaging - Freshness indicator, Sensor based - Temperature, Gas Scavengers. Traditional practice in the development of edible packaging matrix- Barrier enhancement via blends and multi-layer.

UNIT II **9 Hours**

ACTIVE PACKAGING

Introduction-Active Packaging: Types of active compounds migration studies from the packaging materials to food. Intelligent Packaging - mechanism and application in food industry. Application of RFID and Barcode in novel packaging materials.

UNIT III **9 Hours**

INTELLIGENT PACKAGING

Introduction-Intelligent Packaging: mechanism and application in food industry. Application of RFID and Barcode in novel packaging materials. Authentication using smart technologies, and Non-invasive biometric sensory tools.

UNIT IV **9 Hours**

EDIBLE COATING FILMS

Introduction- Molecular interaction of Edible source (polysaccharides, protein and lipids) during film matrix formation. Application of Nano materials in edible film and coatings. Biochemical aspects of edible packaging. Current research progress in the development of edible film coating.

UNIT V **9 Hours**

RECENT ADVANCEMENTS IN MULTI-LAYER PACKAGING

Introduction - multi-layer packaging. Emerging packaging techniques - Microwavable food packaging, Functional packaging materials - Fortification of active ingredients like flavour and color. Application of Nano techniques and Nano composite in food packaging materials.

Total: 45 Hours

Reference(s)

1. Innovations in Food Packaging. (2013). Netherlands: Elsevier Science.
2. Food Packaging: Advanced Materials, Technologies, and Innovations (2020). United Kingdom: CRC Press.
3. Trends in Packaging of Food, Beverages and Other Fast-Moving Consumer Goods (FMCG): Markets, Materials and Technologies. (2013). United Kingdom: Elsevier Science.
4. Food Packaging: The Smarter Way. (2022). Singapore: Springer Nature Singapore.
5. Ghosh, T., Katiyar, V. (2021). Nanotechnology in Edible Food Packaging: Food Preservation Practices for a Sustainable Future. Germany: Springer Nature Singapore.
6. Edible Food Packaging: Materials and Processing Technologies. (2017). United States: CRC Press.

21FD007 RADIATION PRESERVATION ANDPROCESSING OF FOOD PRODUCTS

3 0 0 3

Course Objectives

- Identify the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
- Understand the effect of radiation as a processing and preservation method.
- Learn the importance and safety issues of the irradiated foods.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Explain and apply the concept of Radiation chemistry on food preservation.
2. Analyze the effect of dosage of radiation on plant and animal foods.
3. Exemplify and analyze the effect of microwave in food processing.
4. Analyze the effect of Infra-red radiation in food processing.
5. Justify and assess the effect of radio frequency on foods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		2							1	1
2	2	1	2	1		2								2
3	2	3	1	2		3								
4	3	2	2	1		2							3	3
5	3	2	3	2		2							2	2

UNIT I **9 Hours**

BASICS OF RADIATION CHEMISTRY

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.

UNIT II **9 Hours**

RADIATION CHEMISTRY OF FOOD COMPONENTS

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

UNIT III **9 Hours**

MICROWAVES IN FOOD PROCESSING

Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.

UNIT IV **9 Hours**

INFRA RED RADIATION

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.

UNIT V **9 Hours**

RADIO FREQUENCY HEATING PRINCIPLES

RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

Total: 45 Hours

Reference(s)

1. Welter M. Urbain: Food Irradiation Academic Press, New York, 1986
2. Ohlsson and Bengtson, Microwave Processing Technologies Woodhead Publishing, Cambridge, UK, 2002.
3. Gould G.W., New Methods of Food Preservation, Aspen Publishers Inc., Maryland, 1999.
4. S.G.Llyasor and V.V. Krasnikov, Physical Principles of Infra Red Irradiation of Food Stuffs: Hemisphere Publishing Corporation, London, 1991.
5. Philip Richardson, Thermal Technologies for Food Processing, Wood head Publishing Limited, CRC Press, 2001.
6. Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

21FD008 NON- THERMAL PROCESSING TECHNIQUES

3 0 0 3

Course Objectives

- Understand and apply the different non-thermal techniques in processing of foods.
- Familiarize about the equipment used for the processing of foods in non-thermal techniques
- Compare the application of alternate non-thermal processing techniques on foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals and principles of High-pressure processing on foods.
2. Analyze the importance of Pulsed electric field processing of solids and liquid foods.
3. Analyze the methodology and equipments in Ultrasound processing methods.
4. Apply non-thermal technologies for inactivation of microorganisms.
5. Analyze non-thermal techniques by electromagnetic energy for food processing and preservation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3							1	1
2	1		2	2		3								
3	1	3				3							2	2
4	2	1				3							1	1
5	2		1			3							2	2

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles - Mechanism and applications of high-pressure processing to food systems - High pressure processing of salads, meats and seafoods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II **9 Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology -Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

UNIT III **9 Hours**

ULTRASOUND PROCESSING

Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultrasound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing.

UNIT IV **9 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High Intensity pulsed light technology:- principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ohmic Heating: Fundamentals of Ohmic Heating, Electrical Conductivity, Generic Configuration, Treatment of Products. Infrared Heating - Fundamentals, Basic laws for blackbody radiation; IR Heater, IR Emitters - Types and Selection Criteria, Applications and Effect on Foods

UNIT V **9 Hours**

PROCESSING TECHNIQUES BY ELECTROMAGNETIC ENERGY

Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave-vacuum drying, microwave freeze-drying - applications. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms.

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1 Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. Barbosa Canovas, CRC Press, 1st Edition, 2004.
3. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. Barbosa Canovas, CRC Press, 1st Edition, 2004.
4. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.

21FD009 THERMAL PROCESSING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals and principles of thermal processing foods.
2. Analyze the importance of various thermal applications using steam/water and their effects on food.
3. Analyze the methodology and equipment applied on thermal processing methods using hot air.
4. Apply alternate thermal techniques to a food and analyze their hygienic and safety aspects.
5. Analyze thermal resistance and its kinetics on micro-organisms and its resistance.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-		-	3							1	1
2	1	-	2	2	-	3								
3	1	3	-		-	3							2	2
4	2	1	-		-	3							1	1
5	2	-	1			3							2	2

UNIT I **9 Hours**

INTRODUCTION TO THERMAL PROCESSING TECHNIQUES

Introduction. Thermophysical Properties of Foods - Definition and Measurement. Dielectric Properties. Heat Transfer - Conduction, Convection and Radiation, Basic Heat transfer Modes, Heat Transfer with phase changes, Heat changes with Electromagnetic Waves, Mass Transfer - Molecular Diffusion, Convection Mass Transfer

UNIT II **9 Hours**

THERMAL PROCESSING USING STEAM OR WATER

Blanching - Theory, Methods, Equipment, Effect on Enzyme Inactivation, Testing the Effectiveness of Blanching. Pasteurization - Theory, Methods, Equipment, Effect on Foods. Sterilization - In-container sterilization (Retorting), Ultra High Temperature (UHT), canned foods, Process and Euipment, Effect on foods. Evaporation and Distillation - Theory, Equipment, Effect on Foods, Extrusion - Rheological Properties of food, Equipment, Applications, Effects on foods.

UNIT III **9 Hours**

THERMAL PROCESSING USING HOT AIR

Dehydration or Drying - Fundamental concepts, Drying characteristics, Moisture Sorption Isotherms, Method - Sun drying, Hot air Drying, Fludized bed drying, Spray drying, Freeze drying, Dielectric drying, Hybrid Drying technology. Baking and Roasting - Theory, Equipments, Effects on Physical properties and nutritional value

UNIT IV **9 Hours**

OTHER THERMAL PROCESSING METHODS

Frying - Shallow frying, Deep Frying, Equipment and design, Effect of Heat on oil, Effect of Heat on fried Foods. Cooking - Theory, Methods, Effect on nutritional value, Quality Retention. Safety Aspects of Thermal Processing - Legislation and codes of Practice, Implementation of GMP aseptic packaging, HACCP Techniques, Process Audit, Aspects of GMP, Thermal process Validation

UNIT V **9 Hours**

HEAT RESISTANCE OF MICROORGANISM

Introduction, Temperature Distribution and Heat Penetration, Kinetic of Reaction, Ball"s Formula, Thermal Death Time, Thermal Death Point, Heat Resistance of Microorganism, Heat Resistance of Enzyme, D value, Z value, F value, TDT curve & 12-D concept.

Total: 45 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Donald Holdsworth & Ricardo Simpson, Thermal Processing of Packaged Foods, Second Edition, Springer, 2015.
3. Da-Wen Sun, Thermal Food Processing, CRC Press, 2006.
4. P Richardson, Thermal Technologies in Food Processing, Woodhead Publishing Limited, Cambridge, 2001.

21FD010 FOOD SENSORS 3 0 0 3

Course Objectives

- Understand the need and scope of sensor based detection methods in the food processing industries.
- Impart theoretical knowledge on fundamental or basic sensors used in quantification and qualification of food
- Learn about modern development in the food based sensors in the industry.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the fundamentals and applications of the sensors in the food industry
2. Understand the different types of basic sensors used in the quantification and qualification of food compounds.
3. Understand the basic circuit and working principle of sensors with its construction
4. Analyze different types of quantification and qualification sensors used in finding the adulteration in food
5. Analyze and compare modern development and invention carried out in sensor based industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							1	
4	2	2	2		2	1								
5	1	2	1											

UNIT I **9 Hours**

INTRODUCTION TO SESNORS

Introduction. Need of sensors - Sea food Poisoning, Food Poisoning, Adulteration, and Qualification. Research challenges - Development and Troubleshoots. Sensors - Working and Principles. Applications - Food Industry, Pharma industry, Chemical Industries. Detection Methods

UNIT II **9 Hours**

BASIC SENSORS USED IN QUANTIFICATION AND QUALIFICATION

Quantification - Weighing Sensor, Measuring Sensor - Construction and working principles and methods used in sensors. Qualification - pH Sensor, Titratable Acidity Sensor, Color Sensor, Automatic Brix calculating sensor, biosensor, Amperometric Sensor, thermocouple sensor - construction and
working principles of each sensor.

UNIT III **9 Hours**

CIRCUIT ANALYSIS OF A SENSOR

Introduction to Planar Interdigital Sensors - Parallel plate capacitors, Planar Interdigital Sensor. Calculation of capacitance using circuit analysis. COSMOL Multiphysics - Modelling using cosmol Multiphysics Sensor Design and Fabrication - Design and Fabrication process, Conventional Interdigital Sensors, Novel planar interdigital Sensors.

UNIT IV **9 Hours**

QUNTIFICATION AND QUALIFICATION METHODS

Titratable Acidity, Brix and consistency, pH calculation, Color Prediction, Texture analysis - effect of sensors in analysis. Calorimetric and electrochemical quantification. Paper Chromatography - Workin procedure with sensor region

UNIT V **9 Hours**

MODREN INVENTIONS IN SENSORS

Gas chromatography with mass spectrometer - Construction and working procedure. Plasma Sensors - Plasma polymer film coated sensor, applications. Pattern Recognition in gas sensing - application of gas sensing in ripening process. Electronic Nose and Electronic tongue

Total: 45 Hours

Reference(s)

1. https://www.researchgate.net/publication/212324341_Novel_Sensors_for_Food_Inspections
2. https://www.mdpi.com/journal/sensors/special_issues/4725VY7882Da-Wen Sun, Thermal Food Processing, CRC Press, 2006.
3. https://www.sciencedirect.com/science/article/abs/pii/0925400594012792

21FD011 3D PRINTING OF FOODS 3 0 0 3

Course Objectives

- Understand the culinary potential of 3D food printing for personalized nutrition and creative food design.
- Analyze the printability of different food materials and optimize their properties for printing.
- Evaluate the current state of 3D food printing technology and its potential for future applications.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals and principles of thermal processing foods.
2. Analyze the importance of various thermal applications using steam/water and their effects on food
3. Analyze the methodology and equipment applied on thermal processing methods using hot air.
4. Apply alternate thermal techniques to a food and analyze their hygienic and safety aspects.
5. Analyze thermal resistance and its kinetics on micro-organisms and its resistance.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							1	
4	2	2	2		2	1								
5	1	2	1											

UNIT I **9 Hours**

INTRODUCTION TO 3D FOOD PRINTING

Overview of 3D food printing technology. History and evolution of 3D food printing. Applications of 3D food printing in the food industry, healthcare, and other sectors. Benefits and challenges of 3D food printing

UNIT II **9 Hours**

3D FOOD PRINTING HARDWARE AND SOFTWARE

Types of 3D food printers and their working principles. Key components of a 3D food printer, including extruder, build platform, and print head. Different food materials used in 3D printing and their properties. 3D food printing software for designing and slicing food models.

UNIT III **9 Hours**

3D FOOD PRINTING PROCESS AND DESIGN PRINCIPLES

Workflow of the 3D food printing process, from design to printing. Factors affecting the printability of food materials. Design principles for creating 3D printable food models. Techniques for optimizing food models for printability

UNIT IV **9 Hours**

CULINARY APPLICATIONS OF 3D FOOD PRINTING

Creating visually appealing and personalized food presentations. Customizing food textures and shapes for dietary needs and preferences. Enhancing nutritional value and incorporating functional ingredients. Exploring culinary creativity and developing innovative 3D-printed food products.

UNIT V **9 Hours**

FUTURE DIRECTIONS AND CHALLENGES IN 3D FOOD PRINTING

Advancements in 3D food printing technology and materials. Emerging applications of 3D food printing in personalized nutrition and healthcare. Regulatory and safety considerations for 3D-printed food products. Addressing challenges in scalability, cost-effectiveness, and consumer acceptance.

Total: 45 Hours

Reference(s)

1. C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika, 3D Printing of Foods, John Wiley & Sons Ltd., 2022.
2. Kamalpreet Sandhu, Sunpreet Singh, Food Printing: 3D Printing in Food Industry, Springer, 2022.
3. Xie, Y., Liu, Q., Zhang, W., Yang, F., Zhao, K., Dong, X., ... & Yuan, Y. (2023). Advances in the Potential Application of 3D Food Printing to Enhance Elderly Nutritional Dietary Intake. Foods, 12(9), 1842.
4. Ghilan, A., Chiriac, A. P., Nita, L. E., Rusu, A. G., Neamtu, I., & Chiriac, V. M. (2020). Trends in 3D printing processes for biomedical field: opportunities and challenges. Journal of Polymers and the Environment, 28, 1345-1367.
5. Belda-Perez, R., Heras, S., Cimini, C., Romero-Aguirregomezcorta, J., Valbonetti, L., Colosimo, A., ... & Coy, P. (2023). Advancing bovine in vitro fertilization through 3D printing: the effect of the 3D printed materials. Frontiers in Bioengineering and Biotechnology, 11.

21FD012 APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING **3 0 0 3**

Course Objectives

- Understanding of nanotechnology applications in food, covering Nano encapsulation, cryogenic methods, and their integration.
- Explore safety considerations, regulatory compliance, and ethical aspects associated with nanotechnology and cryogenics in food processing.
- Investigate emerging trends in sustainable food technologies, including the use of eco-friendly nanomaterials and cryogenic practices.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

g. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

h. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

i. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

j. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequentresponsibilities relevant to the professional engineering practice.

o. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

p. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1.Understand the basic principles of Nano Technology in enhancing the food qualityand standard

2. Understand the principles of cryogenics food processing and different techniques usedin cryogenic food processing

3. Analyze and integrating nanotechnology and cryogenics in food processing to designand implement synergistic approaches.

4. Analyze different types of applications including the ability to assess toxicologicalrisks in food processing

5. Analyze the advancements in sustainable nanomaterials, eco-friendly cryogenictechnologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	
2	1	2	2		2	1								

3					3	2		1	2	1			1	
4					2	1		2	1	1				1
5								1	2	1				

UNIT I **9 Hours**

NANOTECHNOLOGY IN FOOD PROCESSING

Introduction, Nano technology - application, needs and scope, different methods. Encapsulation - Need of Encapsulation, Advantages. Nanoencapsulation Techniques - Core Shell Nanoencapsules for controlled release, Lipid-based nanostructures. Nano Structured food ingredients - Nano emulsions and nanoscale delivery system. Nanomaterials for food packaging - Antimicrobial nanoparticle, Nano composite films.

UNIT II **9 Hours**

CRYOGENICS IN FOOD PROCESSING

Introduction, applications, advantages and disadvantages. Different techniques - Flash freezing - Rapid

Freezing, cryogenic freezing, Cryogenic grinding technique - application and working principles, cryopreservation of flash procedure - applications in food processing

UNIT III **9 Hours**

NANOTECHNOLOGY-CRYOGENICS INTEGRATION

Nanoparticle Assisted Cryopreservation - impact of nanomaterials and preservation efficiency. Nano Carriers - design, cellular integrity, nanoscale delivery. Smart Cryogenic packaging - Real time monitoring, intelligent packaging system. Synergistic effects on food quality - overall quality, interaction between two methods

UNIT IV **9 Hours**

SAFETY AND REGULATORY CONSIDERATIONS

Toxicology of nanoparticles in food - potential risks, safe exposure levels. FSSAI - standards and regulation for normal foods. Regulatory framework - Nanotechnology - food safety regulations, Labelling and consumer awareness

UNIT V **9 Hours**

FUTURE TRENDS AND CHALLENGES

Innovations in Nanomaterials - Development of novel nanoparticles - Extraction and isolation of nano particles. Biodegradable nanomaterials for sustainability. Advancements in Cryogenic Technologies - Integration and Energy Efficient cryogenic process. Addressing Ethical Concerns - Public Perception, Ethical considerations

Total: 45 Hours

Reference(s)

1. McClements, D. J. (2015). "Nanotechnology in the Food Industry: A Review." Comprehensive Reviews in Food Science and Food Safety, 14(4), 438-456.
2. Nanotechnology in the Food, Beverage, and Nutraceutical Industries by Qingrong Huang and Qin Wang
3. Sun, D. W. (2016). "Emerging Technologies for Food Processing." Academic Press.
4. Handbook of Frozen Food Processing and Packaging by Da-Wen Sun.
5. Nanoscience in Food and Agriculture 4 by Shivendu Ranjan, Nandita Dasgupta, and Eric Lichtfouse.

21FD013 TRADITIONAL CONFECTIONARIES 3 0 0 3

Course Objectives

- Understand the influence of sugar in confectionery
- Apply the principles of ingredients chemistry.
- Troubleshoot the problems faced during processing of various traditional confectioneries

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

Course Outcomes (COs)

1. Interpret the significance of bulk sweeteners used in confectionery
2. Assess the functional properties of confectionery ingredients.
3. Outline the production and quality parameters of sugar based confections
4. Analyse the ingredients and processing of aerated confections
5. Evaluate the stability of cocoa based products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		2			2				2		
2	2	2										2		
3	2	2	2	2								2		
4	2	2	2									2		
5	2			2									2	

UNIT I **7 Hours**

BULK SWEETENERS

Significance of bulk sweeteners and application- Types of bulk sweeteners- Monosaccharides, Disaccharides, Invert sugar, Glucose syrup- Natural and alternative sweeteners- High-intensity sweeteners- Physicochemical properties and applications.

UNIT II **11 Hours**

INGREDIENTS CHEMISTRY AND FUNCTIONALITY

Fats and Oils-chemical properties, lipid oxidation, polymorphism, phase behaviour- Crystallization of fats; Modification technologies- hydrogenation, fractionation, inter-esterification; Emulsifier-uses, types, and applications; Starches - separation of starches, property of starches and modified starches; Protein- chemistry, functional properties, application in confections; Pectin - chemistry and analyses; Gums - agar agar, alginates, carrageenan, gum arabica, gum tragacanth, guar gum; Other ingredients.

UNIT III **9 Hours**

SUGAR BASED CONFECTIONS

Compressed tablets and Lozenges-introduction, formulation and ingredients, processing, product characteristics, problem and trouble-shooting; Hard candy- formulations and ingredients, processing, product characteristics, trouble-shooting; Fondants and Creams- introduction, formulation, ingredients, manufacturing, product characteristics and potential problems; Caramel, Fudge and Toffee - ingredients, mixing, emulsification, cooking and browning, cooling and forming, colour and flavor generation, microstructure, shelf-life, trouble shooting.

UNIT IV **9 Hours**

AERATED CONFECTIONS

Introduction, Ingredients - sweeteners, stabilizers, humectants, emulsifiers, organic acids, gelation aids, active ingredients - processing, physical properties and shelf-life, problems and trouble-shooting; Jellies, Gummies, Licorices, Chewing and Bubble gums - ingredients, processing, product features. Sugar and Sugar free panned confections- pre-coat materials, colours, flavors, glaze and polish, Sugar shell application, special decoration, multicomponent layering, micro-stricture, soft panned and hard panned candies.

UNIT V **9 Hours**

CHOCOLATE AND COMPOUND COATINGS

Introduction, Cocoa bean production, composition and quality aspects; Chocolate processing- Tempering, Forming; Chocolate characteristics; Stability and shelf-life; Compound coatings- formulation, manufacturing, applications, coating characteristics, shelf-life; Chocolate panning- operation, types, finishing, storage and handling.

Total: 45 Hours

Reference(s)

1. Richard W. Hartel, Joachim H. von Elbe Randy Hofberger. (eds), Confectionery Science and Technology, Springer, 2017.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation. Academic Press, New York, 1965.
3. Martens, M.; Dalen, G.A.; Russwurm, H. (eds): Flavour Science and Technology. John Wiley and Sons, Chichester, 1987.

21FD014 RHEOLOGICAL PROPERTIES OF BAKERY AND CONFECTIONERY PRODUCTS

3 0 0 3

Course Objectives

- Understand the concepts of Food Rheology and various methods to measure rheological & textural properties of Food
- Exemplify the concepts of dough rheology and effects of various factors on rheological and textural properties of dough.
- Grasp knowledge regarding various instruments used in determination of food rheology.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Summarize the food rheology and role of ingredients in rheology of bakery products.
2. Analyze and interpret rheological properties of bakery products.
3. Select the appropriate techniques in assessing rheological properties of bakery products.
4. Evaluate the various factors and working of equipment in rheological properties of bakery products.
5. Apply the concepts of various testing methods to estimate the rheological properties of bakery products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2		2	2
2	2	2									2		2	2
3	2	2									2		2	2
4	2	2									2		2	2
5	2	2									2		2	2

UNIT I **9 Hours**

INTRODUCTION TO FOOD RHEOLOGY

Food rheology concept, scope of food rheology, texture of foods-types of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson"s ratio, definition and importance of texture, texture-related concepts. Determination of rheological properties and measuring methods: destructive and non-destructive measurements, creep recovery and stress relaxation, dynamic mechanical tests, Modeling food texture: introduction, factor affecting texture, models to predict texture.

UNIT II **9 Hours**

RHEOLOGICAL PROPERTIES OF SOLID FOOD

Rheological properties of solid food: deformation of material, viscoelastic behavior, Failure and glass transition in solid foods: failure in solid foods, glass transition of solid foods (measurement, factor affecting, importance), Texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis.

UNIT III **9 Hours**

BASIC APPROACHES TO RHEOLOGY OF DOUGH AND GLUTEN

Dough structure and basics of rheology. Creep and recovery, viscometry, stress relaxation, oscillatory measurements. Empirical and fundamental testing. Rheological behavior of dough and gluten. Rheological properties of dough from high extraction, whole wheat and composite flours. Importance of dough and gluten viscoelasticity in gas retention and bread making.

UNIT IV **9 Hours**

BAKERY INGREDIENTS, PROCESSING PARAMETERS AND DOUGH RHEOLOGY

Effects of water, yeast, oxidation and compounds with disulfide and thiol groups, sugar and emulsifiers on rheological properties of dough. Influence of proteins, gluten, starch, and enzymes on rheological properties of dough. Effects of mechanical work, mixing time and temperature on dough rheology.

UNIT V **9 Hours**

RHEOLOGICAL TESTING

Rheological methods- Fundamental testing and empirical methods, Rheological testing equipment, compression, penetration, modified penetrometers, transient tests, dynamic tests, extensional viscosity, dough testing instruments- farinograph, mixograph, extensograph, alveograph, amylograph.

Total: 45 Hours

Reference(s)

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. Engineering Properties of Foods: CRC Press.
2. Heldman, D. R. (2007). Food Process Engineering:AVI Publications.
3. Faridi, H. and Faubion, J. M. (1997). Dough Rheology and Baked Products: CBS Publications, New Delhi.

21FD015 DESIGN OF BAKERY AND CONFECTIONERY EQUIPMENT

3 0 0 3

Course Objectives

- Understand the working of Food Processing equipment and various parameters for designing Food processing equipment
- Analyze and evaluate the design concepts of both baking and confectionery equipment
- Simulating novel techniques and concepts to design an efficient baking and confectionery equipment.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Select food process equipment based on constructional and operational characteristics
2. Make use of sizing, construction and costing of food process equipment
3. Appraise the criteria for design of food process equipment
4. Evaluate the various factors and working of equipment in bakery and confectionery products.
5. Apply the concepts to design the equipment for bakery and confectionery products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2		2	2
2	2	2									2		2	2
3	2	2									2		2	2
4	2	2									2		2	2
5	2	2									2		2	2

UNIT I **9 Hours**

BASICS ABOUT FOOD PROCESSING EQUIPMENT

Construction characteristics. Operational characteristics- reliability, convenience, safety, instrumentation, ergonomics, efficiency, accuracy, environmental impact. Testing of equipment. Equipment specifications. Sizing and costing of Equipment, materials of construction, Fabrication of equipment- Strength of Construction, Fabrication and Installation of Equipment, Hygienic Design of Food Processing Equipment.

UNIT II **9 Hours**

DESIGN OF FOOD PROCESS EQUIPMENT

Heat exchangers- heat transfer factor. Baking oven - load of baking chamber, load by products, load by heat loss, total thermal load, types of heating source. Types of agitators. Power requirements for

agitation. Design of agitation system components-shaft design and agitator design. Challenges faced during design of equipment

UNIT III **9 Hours**

EQUIPMENT USED FOR BAKING

Measuring tools- dry measuring cup and liquid measuring cup, measuring spoon, scale thermometers-oven thermometers, candy thermometers, timer; Hand tools - rolling pin, whisk, cookie cutter; Baking pans-aluminum pan, insulated pan, disposable pan, muffin pan, loaf pan; Mixers - vertical mixers, spiral mixers, horizontal mixers, electric mixers - electric handheld mixers, electric stand up or table top mixer, dough sheeter, proofer, retarder, ovens- deck oven, rack oven, mechanical oven, convection oven; Kettles, fryers.

UNIT IV **9 Hours**

EQUIPMENT USED FOR CONFECTIONERY

Extruder, temper, enrober, pastry blender, pastry cutter, cooling simulator, chip depositor, rollers, frozen cone unit, feeder mixer, aeration and aroma system, filling and weighing station, melting tank, wafer & biscuit feeder, chocolate stringer, packaging equipment.

UNIT V **9 Hours**

ANALYSER FOR BAKING AND CONFECTIONERY PRODUCTS

Moisture test, grain hardness testing, viscograph, amylograph, farinograph, dough mixers, dividers, rounders, proofing, moulding, ovens, slicers, packaging materials and equipment, chocometer, chocoanalyser

Total: 45 Hours

Reference(s)

1. George D, Saravacos. Handbook of food processing equipment, 2nd Ed, Springer Science and Business Media, 2016.
2. Ed Bausbacher and Roger Hunt, Process plant layout and piping design, 1st Ed, New Jersey, 1993

21FD016 INDUSTRIAL PRODUCTION OF BAKED GOODS

3 0 0 3

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and crackers
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the principles of baking and analyze the role of ingredients in baking
2. Analyse the processing methods for the production of biscuits and cookies
3. Apply the production process for different types of puffs and crackers
4. Illustrate and analyze the processing parameters of breads and buns
5. Assess the standards and quality control for bakery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2									2			2
2			2							2				2
3			2	2									2	
4	2				2						2			2
5		2	2										2	

UNIT I **9 Hours**

INTRODUCTION TO INDUSTRIAL BAKING

Overview of Baking processes - Principles of Baking - Ingredients and Formulation : role of flour, yeast, fats, sugars and additives - Equipment and Machinery - Industrial scale baking equipment, ovens, mixers, proofers and their functions.

UNIT II **9 Hours**

BISCUITS AND COOKIES

Biscuits and cookies - role of ingredients. Industrial Production of biscuits - Hard biscuits, Soft biscuits. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **9 Hours**

CRACKERS AND PUFFS

Introduction - Types of crackers. Manufacturing process of Cream crackers, Soda crackers and Water Biscuits, Puff pastries - Methods, types: Vol-au-vent, palmiers, Napolean pastry. Quality test for Crackers and Puffs. Faults and remedies

UNIT IV **9 Hours**

BREADS AND BUNS

Bread and Bun - origin, varieties, characteristics, regional variations - Ingredient functionality - Dough mixing techniques. Baking Process and Technology - Fermentation and proofing, shaping and forming. Quality control and assurance - Quality parameters, Quality assurance practices, Troubleshooting in production.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY PRODUCTS

Packaging equipment, requirements and materials. FSSAI Standards and regulations for bakery products. Regulatory compliance and market trends. Operations management in baking industry - supply chain management, cost control and efficiency. Layout for Baking and Confectionery plant.

Total: 45 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
3. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment, Academic Press, Elsevier, 2018

21FD017 SUGAR TECHNOLOGY 3 0 0 3

Course Objectives

- Understand important unit operations involved in sugarcane processing
- Know the production of sugar from sugarcane, beet and palm
- Explore the large scale processing of sugar from sugarcane

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

Course Outcomes (COs)

1. Identify the suitable machineries for pre-processing and transportation of sugarcane
2. Select appropriate crushers for cane juice extraction and determine its efficiency
3. Assess the cane juice clarification using different clarifying agents
4. Explain and apply the filtration and evaporation in sugarcane processing
5. Attribute crystallization for the large scale production of sugar

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2		2										
2	2	2		2	2	2								
3	2	2		2	2	2								
4	2	2		2	2	2								
5	2	2		2										

UNIT I **7 Hours**

PRE PROCESSING OPERATIONS

Sugarcane - Constituents - Harvesting indices - Cane cutting - Manual, Mechanical - Transportation - loading - Unloading - Cane conveyor - Washing - Shredders - Types.

UNIT II **7 Hours**

JUICE EXTRACTION

Crushing - Crushers - Types, Crushing efficiency - Extraction of juice - methods, Accumulators - types - Maceration - Theory of cane diffusivity - different diffuser - ring diffuser - weighing of juice.

UNIT III **7 Hours**

CANE JUICE CLARIFICATION

Clarification - methods - clarifying agent - bleaching agent - Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice - CO2 P2O5 and its importance.

UNIT IV **12 Hours**

FILTRATION AND EVAPORATION PROCESS IN CANE INDUSTRY

Filtration of mud - Filter types - filter press, rotary vacuum filter - Rapi - Floc process. Filter cake washing. Evaporation - Evaporation rate - types of evaporators used in cane sugar industry - Cleaning of evaporators Entrainment separator - methods - Boiling in Vacuum pan - Footing magma - Massecuite. A,B,C - Mother liquor, Molasses A,B,C Molasses exhaustibility.

UNIT V **12 Hours**

SUGAR PRODUCTION

Crystallization - Super saturation - Crystallizers type - batch and continuous. Centrifuge - types. Drying of sugar - conveyors for sugar - by-product from sugar mills - utilization. sugar production from beet, palm and coconut. Physical & chemical properties of sugars, Manufacture of sugar-free, sugarless carbonated beverages, Sugars and sweetening agents, Sugar alcohols.

Total: 45 Hours

Reference(s)

1. Meade and Chen, Hand of book of cane sugar, 11th Ed , Wiley Interscience, New York, 2001
2. John H. Payne, Unit operation in cane sugar production, Sugar series book 4, Elsevier Pub. Co., New York, 1982.
3. Baikow, V.E. 1967. Manufacturing and refining of raw cane sugar. Elsevier Publishing Company, New York
4. McCabe, W.L. and J.e. Smith 1976. Unit operations in chemical engineering. McGraw Hill Kogakusha Ltd., Tokyo.
5. R B L Mathur, Hand Book of Cane Sugar Technology, 2 nd Ed, Oxford & IBH, 1978

21FD018 BAKERY SCIENCE AND INGREDIENT TECHNOLOGY

3 0 0 3

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce ingredients for the manufacturing of various bakery products
- Familiarize with advances and sustainability in the baking technology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to oneÃƒÂ¢??s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the bakery science principles and ingredient roles
2. Analyse the impact of ingredient selection and functionalities
3. Assess the technical competence in executing baking process, trouble shooting and ensuring quality
4. Apply innovative approaches to create specialty bakery products
5. Demonstrate critical analysis and problem solving skills in promoting sustainability practices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2									2			2
2			2							2	2			2
3			2	2							2		2	
4	2				2					2	2			2
5		2	2		2					2	2		2	

UNIT I **9 Hours**

INTRODUCTION TO BAKERY SCIENCE

Introduction to fundamentals of bakery science; Historical overview and evolution of baking techniques; role of bakery science in modern food production; basic principles of baking: heat transfer, mixing and fermentation.

UNIT II **9 Hours**

INGREDIENTS IN BAKING

Flour - types, properties and gluten formation. Yeast - functions, fermentation and types. Sugars and Sweeteners - effects on texture and taste; Fats and Oils: role in structure and flavour development; Leavening agents and their impact on baked goods

UNIT III **9 Hours**

BAKING TECHNIQUES AND PROCESSES

Dough development and handling techniques; Fermentation and Proofing; Baking equipment and their functions; Temperature control and its impact on baking; Troubleshooting common baking issues.

UNIT IV **9 Hours**

SPECIALITY BAKING AND PRODUCT DEVELOPMENT

Gluten-free and alternative ingredient baking; Artisanal and traditional baking techniques; Innovation and recipe development; Quality control and sensory evaluation in baking; Marketing and consumer trends in bakery products.

UNIT V **9 Hours**

ADVANCEMENT IN BAKING SCIENCE

Preservation techniques in baking; Enzymes and their role in baked goods; Nutritional aspects and health considerations; Food safety and hygiene in bakery operations; Sustainable practices in bakery.

Total: 45 Hours

Reference(s)

1. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
2. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
3. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment, Academic Press, Elsevier, 2018
4. Geoff Talbot, Science and technology of enrobed and filled chocolate, confectionery and bakery products, Woodhead Publishing, 2009
5. Hui, Y.H., De Leyn, I., Pagani, M.A., Rosell, C.M., Selman, J.D., Therdthai, N. Bakery Products Science and Technology, Wiley Blackwell, 2nd Edition, 2014

21FD019 TEA AND COFFEE PROCESSING 3 0 0 3

Course Objectives

- To gain knowledge in tea & coffee cultivation, harvesting, production, processing and packaging.
- o assess the classification of tea & coffee and tea - coffee pharmacology.
- To characterize quality assurance and quality control of tea & coffee processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the importance of tea & coffee as a beverage in India.
2. Assess the different tea & coffee processing and production methods.
3. Predict the role of tea & coffee in pharmacology.
4. Compute the health effects of tea and coffee.
5. Analyze the quality assurance and quality control of tea and coffee.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1	-	1			1	1
2	1		2	2	2	1		2		1		-		
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1	-	1				
5	1		1	2	-	-		1		1				

UNIT I **9 Hours**

INTRODUCTION OF TEA

Introduction - History of the tea & coffee trade and its origin - Chemical composition - Climates of tea & coffee cultivation and harvesting process - Geographical distribution of tea plantations. Production - Morphology and anatomy - Classification - Health effects - By Products utilization of tea & coffee - Economics.

UNIT II **9 Hours**

PRODUCTION AND PROCESSING OF TEA LEAVES

Black tea - Green tea - Oolong tea. Chemistry of tea manufacturing and tea quality - Tea processing - Picking - Withering - Rolling/ Bruising - Fermentation - Fixation - Drying - Packaging. Equipment used in tea processing - CTC machine - Orthodox Machine. Biochemical changes during fermentation. Instant tea - Tea concentrates - Decaffeinated tea - flavored tea - Herbal tea. Storage of tea - Sorting and Grading of Tea.

UNIT III **9 Hours**

PROCESSING OF COFFEE

Introduction - Coffee fruit and morphology - Chemical composition and Nutritional value of coffee- Green coffee processing - Harvesting the cherries - Types of coffee - Processing the cherries - Wet and dry processing - Sorting- pulping- fermentation- Drying - Milling - Storage. Physiochemical changes during drying - Decaffeination. Instant coffee - Extraction and aroma recovery- Evaporation- Freeze drying- Spray drying and agglomeration

UNIT IV **9 Hours**

TEA AND COFFEE PHARMACOLOGY

Chemical composition of tea leaf and coffee - Inorganic constituents - Enzymes, Polyphenols, aromatic compounds. Pharmacology of tea and coffee. Biochemical changes during chemical withering - volatile flavor compounds - Chlorophyll, caffeine, lipids, catechins and enzyme activity- carotenoids. Bioavailability of antioxidants in tea and coffee. Focus on international works regarding health values on tea and coffee

UNIT V **9 Hours**

TEA AND COFFEE QUALITY TESTING, INSPECTION AND CERTIFICATION

Introduction to tea & coffee quality testing and analysis - Quality testing of tea & coffee - Physical appearance- color- size- flavor- Taste. Chemical- Microbial- sensory analysis. Other analysis includes testing for presence of chemicals - heavy metals- toxins. Quality assurance in tea & coffee industry- Importance of tea and coffee quality testing and analysis - Tea & coffee import and export - National and International bodies of tea & coffee quality testing and analysis.

Total: 45 Hours

Reference(s)

1. K.C.Willson. 1999.Crop production science in horticulture.CABl publishing, UK, 231p.
2. Ramaswamy Ravichandran.2000. Lipid Occurrence, distribution and degradation to flavor volatiles during tea processing. Food chemistry.68:7-13.
3. Dr.Balasubramaniam. 1995.Tea processing. Academic press, New Yor
4. Tea, In Health and Disease Prevention Edited by V. R. Preedy, Elsevier.
5. Tea Science and Human Health, TRA.
6. Coffee Processing by Products Edited by Galanakis & Charis Michel

21FD020 AROMATIC SPICES PROCESSING 3 0 0 3

Course Objectives

- To understand the fundamentals of aromatic spices and herbs
- To analyze the methods of processing for different aromatic spices
- To evaluate the processing and extraction techniques of Major and Minor spices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

Course Outcomes (COs)

1. Understand the scope, uses and functional properties of aromatic spices
2. Assess the post-harvest handling and standards of aromatic crops
3. Analyze the processing techniques and active compounds of the value added products
4. Compare the processing methods and extraction techniques of major spices
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	2		-	-						1	
2	1	2	-	2		-	-							
3	2	1	-	2	-	-	-		-	-				
4	3	2	1	2	-	-		-	-				1	

5	3	2	1	2	-	-	-	-	-	-			1	

UNIT I **9 Hours**

INTRODUCTION TO AROMATIC SPICES

Aromatic spice crops - Introduction , importance of spice crops - Present status and future prospects- classification - Production, consumption and processing- Under-utilized herbs and spices- Active plant constituents- Functional properties - Use of aromatic herbs and spices- Role of commodity boards and developmental institutions in plantation crops.

UNIT II **9 Hours**

MAJOR AROMATIC SPICE PROCESSING

Importance of aromatic spices- production and export status - stages and method of harvest of important spices - equipment used for threshing, shelling, decortications of spices- Processing and classification of cardamom- stages of harvest- Industrial processing of pepper, chemical composition, functional properties. Harvesting- packaging- processing of white pepper- wet and dry pulping and retting methods - Drying and Processing of turmeric, active compounds, value added products, applications- Processing of chilli- harvesting, drying, packaging and grinding- culinary applications.

UNIT III **9 Hours**

MINOR AROMATIC SPICE PROCESSING

Minor spices- Cumin, coriander, cinnamon, fenugreek, Garlic and clove- Processing. Functional properties - chemical composition- Quality issues- applications of minor spices. Processing of ginger- harvesting, washing, drying and packaging- quality aspects- processing and toxicology of clove, nutmeg and other minor spices. Packaging and storage of aromatic spices.

UNIT IV **9 Hours**

PRODUCTION TECHNOLOGY OF AROMATIC CROPS

Production technology, Post- harvest handling- Drying, Processing, Grading, Packing and Storage. Processing of value addition - Major chemical constituents of spice essential oils- oleoresins and essential oils - Method of manufacture - Chemistry of volatiles- Enzymatic synthesis of flavor identicals - Cryogenic grinding- advantages- refrigerant used- construction and working. Phytochemical extraction techniques- production technology- Distillation methods, advanced methods- Solvent extraction process of aromatic spices and herbs

UNIT V **9 Hours**

QUALITY INDICES OF AROMATIC SPICES

Introduction- Defining Quality- Major international quality specifications- Quality standard in aromatic spice products. GAP and GMP certification of organic products. Quality analysis- AGMARK and ASTA standards

Total: 45 Hours

Reference(s)

1. Spices: Morphology, History, Chemistry, J W Parry, Chemical Publishing Co., New York (1969)
2. Kumar, N., Abdul Khader, Rangaswami, P. and Irvadappan, 1993, Introduction to spices, plantation crops, Medicinal and Aromatic plants, Rajalakshmi Publication
3. Peter, Kuruppacharil V., ed. Handbook of herbs and spices: volume 3. Woodhead publishing, 2006.
4. Panda, H. Handbook on spices and condiments (cultivation, processing and extraction). ASIA PACIFIC BUSINESS PRESS Inc., 2010
5. Pruthi, J. S. "Spices and condiments National Bank Trust." New Delhi, India 226 (1976)

21FD021 PROCESSING OF CHOCOLATE AND ITS PRODUCTS

3 0 0 3

Course Objectives

- To gain knowledge in chocolate and its products
- To know about processing, storage and packaging of different types of chocolate and its products
- To characterize the production and manufacturing process of cocoa and chocolate

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand scope, processing and production of cocoa and chocolate
2. Apply the processing methods of chocolate and its products
3. Analyze different types of cocoa and chocolate
4. Find the chocolate base products and its manufacturing process
5. Analyze the various chocolate based confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO COCOA

Introduction of chocolate - History & Development - Sources - Cocoa beans, types of cocoa - Morphological and varietal characteristics of cocoa - Pests and diseases of cocoa - Cocoa crop protection - Post- Harvest Treatments - Cocoa bean quality. Flowering and pod development - Environmental aspects of cocoa cultivation.

UNIT II **9 Hours**

POST HARVEST TREATMENTS OF COCOA

Introduction and techniques for improving cocoa bean quality - Verities of cocoa - Harvesting - Fermenting and drying. Fermentation techniques - Changes during fermentation of cocoa beans - Biochemical changes - Microbial succession during fermentation - Changes in enzymatic activities. Quality assessment of cocoa - Contaminants and residues - Cocoa butter hardness. Cocoa bean quality and selection - Steps in cocoa processing - cocoa powder production.

UNIT III **9 Hours**

CHOCOLATE MANUFACTURING AND ITS TYPES

Introduction to chocolate manufacture - Chocolate manufacturing process - Mixing - Refining - Conching - Principle - Phases - Conching machines. Tempering and Lipid crystallization, polymorphism of cocoa butter, Measurement of temper, Tempering machines - Moulding and enrobing, Cooling - Demoulding - Wrapping/ Packaging. Chocolate quality and defects - Fat bloom - Sugar bloom

UNIT IV **9 Hours**

PROCESSING TECHNOLOGY OF CHOCOLATES

Particle size reduction - Principles, equipment, cocoa nib grinding. Particle size reduction and chocolate flow properties. Flavor development in cocoa and chocolate - Fermentation - Roasting - Drying - Conching. Chocolate flow properties - Non Newtonian flow - Sample preparation and measurement procedures. Chocolate panning - Methods - Process. Packaging in confectionery industry - Metal cans - Paper and associated materials - Types of paper - Metal foils - Transparent films - flow wrap machinery and sealing.

UNIT V **9 Hours**

CHOCOLATE AND ITS PRODUCTS

Types of chocolates and its manufacturing processes - Milk chocolate - White chocolate - Dark chocolate - Semisweet chocolate - Bittersweet chocolate - Unsweetened chocolate - Sweet Garman chocolate - Couverture chocolate - Ruby chocolate - Cocoa powder - Cocoa butter - Application, Advantages, disadvantages of different varieties of chocolate. Nutritional and health aspects of chocolate - Uses and applications of chocolate.

Total: 45 Hours

Reference(s)

1. Flavour Development in Cocoa and Chocolate (Pages: 169-191) by Dr., Dr.-Ing. G. Ziegleder
2. Beckett, Steve T., ed. Industrial chocolate manufacture and use. John Wiley & Sons, 2011
3. Afoakwa, Emmanuel Ohene. Cocoa production and processing technology. CRC Press, 2014
4. Production and Quality Standards of Cocoa Mass, Cocoa Butter and Cocoa Powder (Pages: 121-141) by H. J. Kamphuis M.Sc., Ph.D
5. Chocolate Science and Technology by Afoakwa, Emmanuel Ohene

21FD022 VALUE ADDED SPICE PRODUCT 3 0 0 3

Course Objectives

- To gain knowledge in different spice processing techniques
- To know about processing techniques, value added techniques, marketing and commercialization of different types of spice and value added spice products
- To characterize quality control, appearance and industrial trends of value added spice products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

i.Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

j.Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand scope, processing and production of spices and plantation crops.
2. Know about processing methods for value addition of spices.
3. To understand value added techniques, marketing and commercialization of value added spice products.
4. Gain knowledge about different value added spice products.
5. Study about quality control, appearance and industrial trends of value added spice products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO THE SPICE INDUSTRY

Overview of the Spice Industry - Global and regional perspectives and Economic significance, Historical Overview of the Spice Trade - Exploration of the historical significance of spices, Impact

on cultural and economic development, Spice Cultivation and Harvesting - Basics of cultivation practices and Harvesting techniques, Post-Harvest Handling and Processing - Cleaning, sorting, and grading, Techniques to maintain spice quality. Global and Regional Spice Varieties - Examination of key spice varieties from around the world, Understanding regional preferences and uses.

UNIT II **9 Hours**

SPICE PROCESSING TECHNIQUES

Drying and Dehydration - Methods and equipment and Impact on spice properties, Grinding and Milling Processes - Techniques and different machinery - Particle size considerations, Extraction Methods - Essential oils extraction - Oleoresins and solvent extraction.

UNIT III **9 Hours**

VALUE ADDED TECHNIQUES, MARKETING AND COMMERCIALIZATION

Enhancing Flavor and Aroma - Techniques for intensifying sensory properties, Blending and mixing approaches, Product Development with Spices - Formulation principles, Incorporating spices into various products, Market Analysis and Consumer Trends - Identifying target markets, Understanding consumer preferences - Branding and Packaging - Strategies for effective branding, Packaging considerations for spice products - Marketing Strategies - Traditional and digital marketing approaches, Creating a marketing plan for spice products.

UNIT IV **9 Hours**

VALUE ADDED SPICE PRODUCTS

Introduction to spices - Cinnamon, black pepper, turmeric, cumin, cardamom, clove, chili powder, paprika, salt, coriander, oregano, bay leaves. Introduction to value added spice products - Spice blends and seasonings - Spice infused chocolates - Infused olive oils - Ready to use curry sauces - Spiced nut mixes - Spice infused beverages - Spiced honey and syrups - Herb and spice infused sea salts.

UNIT V **9 Hours**

QUALITY CONTROL, APPEARANCE AND INDUSTRY TRENDS

Importance of Quality in Spice Products - Factors affecting spice quality, Regulatory standards - Testing Methods and Standards, Quality control procedures - Laboratory testing techniques - Industry Trends and Case Studies, Analyzing successful value-added spice products - Emerging trends in the spice industry.

Total: 45 Hours

Reference(s)

1. Spices: Morphology, History, Chemistry, J W Parry, Chemical Publishing Co., New York (1969)
2. D. K. Salunkhe and S. S. Kadam, "Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing", 1st edition, CRC Press, 1995.
3. N. K. Jain, "Global Advances in Tea Science", 1st edition, Aravali Books International, 1999
4. M. N. Clifford and K. C. Willson, "Coffee: Botany, Biochemistry and Production of Beans and Beverage", 1st edition, AVI publishing Co.,1985

21FD023 PROCESSING OF COCONUTS AND ITS PRODUCTS

3 0 0 3

Course Objectives

- To gain knowledge in coconut and its products
- To know about harvesting, processing and development of coconut and its products
- To characterize quality control and marketing of coconut and its products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
i.Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
j.Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand characteristics, processing and production of coconut..
2. Know about the harvesting and post harvesting management of coconut..
3. Study about different coconut processing techniques.
4. Gain knowledge about value added coconut products.
5. To know about the quality control and marketing of coconut products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO COCONUT AND ITS IMPORTANCE

Definition and Botanical Characteristics - Classification and types of coconut palms, Anatomy of a coconut fruit, Overview of coconut cultivation - Cultivation Practices, Soil and climate requirements,

Propagation methods, Pest and disease management in coconut plantations - Economic and cultural significance of coconuts - Historical and cultural uses of coconuts, Economic impact on local and global economies, Global Coconut Production and Trade - Major coconut-producing regions, Trade dynamics and market trends.

UNIT II **9 Hours**

HARVESTING AND POST HARVEST MANAGEMENT

Techniques for harvesting coconuts - Timing of harvesting, Manual and mechanized harvesting methods, Tools and equipment used in harvesting, Handling and transportation of coconuts - Best practices for handling coconuts post-harvest, Transportation logistics and considerations, Post-harvest losses and mitigation strategies - Causes of post-harvest losses, Storage conditions to minimize losses, Technologies for reducing post-harvest losses, Storage and preservation methods - Storage facilities and conditions, Techniques for preserving coconuts and coconut products, Shelf-life considerations.

UNIT III **9 Hours**

COCONUT PROCESSING TECHNIQUES

Coconut husking and dehusking methods - Traditional vs. modern husking methods, Dehusking machines and equipment - Coconut water extraction and processing - Extraction methods, Processing technologies for coconut water, Coconut Oil Extraction Processes - Traditional methods - cold-pressing, expeller pressing, Modern methods - solvent extraction, cold extraction, Refining and fractionation processes - Coconut Milk and Cream Production - Grating and extracting coconut milk, Concentration and formulation of coconut cream, Copra Production and Drying Techniques - Traditional sun drying vs. mechanical drying, Copra quality standards.

UNIT IV **9 Hours**

VALUE ADDED COCONUT PRODUCTS

Introduction to value addition in coconut processing - Definition and importance of value-added products, Market demand for value-added coconut products, Desiccated Coconut Production - Grading and processing of desiccated coconut, Quality standards and packaging, Coconut Flour and Coconut Sugar Processing - Milling and production processes, Nutritional aspects and health benefits, Coconut-Based Snacks and Confectioneries - Recipe development and production techniques, Marketing strategies for coconut snacks.

UNIT V **9 Hours**

QUALITY CONTROL AND MARKETING OF COCONUT PRODUCTS

Quality standards for coconut and coconut products - International and national quality certifications, Adherence to food safety standards, Quality Control Measures in Processing Units - Process monitoring and control, Testing methods for coconut products, Packaging and Labeling - Sustainable packaging options, Importance of clear and informative labeling, Market Trends and Opportunities - Emerging trends in the coconut industry, Identifying and capitalizing on market opportunities, Export/Import Regulations and Certifications - Compliance with international trade regulations, Certification processes for exporting coconut products.

Total: 45 Hours

Reference(s)

1. "Coconut Handbook" by Asian and Pacific Coconut Community (APCC).
2. "Coconut Production and Marketing" by R. Sreedharan.
3. "Coconut: The Complete Guide to the World"s Most Versatile Superfood" by Bruce Fife.
4. "Coconut Processing for Value Addition" by N. G. Ravishankar and P. K. Gopalakrishna

21FD024 AROMATIC HERBS PROCESSING 3 0 0 3

Course Objectives

- To gain knowledge in different aromatic herbs processing techniques
- To know about processing techniques, quality control and safety, different types of aromatic herbs products
- To characterize advanced processing techniques and innovations of aromatic herbs

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. i.Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

j.Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand scope, processing and production of aromatic herbs.
2. Know about processing methods for aromatic herbs.
3. To understand quality control and safety of aromatic herbs.
4. Gain knowledge about different aromatic herbs products.
5. Study about advanced processing techniques and innovations of aromatic herbs.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO AROMATIC HERBS

Overview of Aromatic Herbs - Definition and classification of aromatic herbs, Historical and cultural significance, Importance in various industries - culinary, medicinal, Common Aromatic Herbs - Identification and characteristics of popular aromatic herbs, Growing conditions and cultivation practices, Harvesting and post-harvest handling.

UNIT II **9 Hours**

PROCESSING TECHNIQUES

Drying and Preservation Methods - Sun drying, air drying, and commercial drying techniques, Preservation methods: freeze-drying, dehydration, and extraction, Factors affecting the quality of dried herbs, Distillation and Extraction - Essential oil extraction methods, Distillation processes for aromatic herbs, Applications and uses of essential oils.

UNIT III **9 Hours**

QUALITY CONTROL AND SAFETY

Quality Assessment - Factors affecting herb quality, Sensory evaluation and grading, Quality control standards, Safety Measures in Processing - Hygiene and sanitation practices, Pesticide and contaminant control, Regulatory standards and certifications.

UNIT IV **9 Hours**

AROMATIC HERBS PRODUCTS

Culinary Applications - Using aromatic herbs in cooking, Herb blends and flavor profiles, Culinary product development, Medicinal Products - Herbal remedies and formulations, Aromatic herbs in different medicinal products, Marketing and branding considerations.

UNIT V **9 Hours**

ADVANCED PROCESSING TECHNIQUES AND INNOVATIONS

Sustainable Processing Practices - Sustainable agriculture and processing, Green processing techniques, Environmental impact assessment, Research and Development in Herb Processing - Current research in aromatic herbs, Innovations in herb cultivation and processing, Case studies of successful R&D projects, Emerging Trends and Future Prospects - Market trends and forecasting, Future prospects in the herb processing industry. Adapting to consumer preferences.

Total: 45 Hours

Reference(s)

1. "The Complete Book of Herbs: A Practical Guide to Growing and Using Herbs" by Lesley Bremness.
2. "The Essential Oils Handbook: All the Oils You Will Ever Need for Health, Vitality, and Well-Being" by Jennie Harding.
3. Standards from regulatory bodies such as the FDA, USDA, and EU regulations on herbs and herbal products.

"The Complete Guide to Growing Healing and Medicinal Herbs: A Complete Step-by-Step Guide" by Wendy Vincent

3 0 0 3

21FD025 NATIONAL AND INTERNATIONAL FOOD LAWS

Course Objectives

- To gain knowledge in food safety laws and regulations.
- To be aware of the regulatory and statutory bodies in national and international level.
- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the importance of the food laws and regulations in India and aboard.
2. Analyze the regulations followed by the food safety and standards act followed in India.
3. Predict the role of food authority and rules of FDA in USA.
4. Understand the federal systems followed in Europe.
5. Analyze the legislative process opted by China.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	2	2	2	2		2		2	2	2		
2	3		2	2	2	2		2		2				
3	2		2	2	2	1		1		2	1			
4	1		2	2	2	1		3		2				

5	1		2	2				2		1				

UNIT I **9 Hours**

FOOD SAFETY AND INTERNATIONAL FOOD STANDARDS

Food-borne hazards and risks; Codex Alimentarius Commission and application of risk analysis in food standard setting; Codex Standards in international food trade and national food legislation.

UNIT II **9 Hours**

FOOD AUTHORITY IN INDIA

Food safety and Standards Act-organizational chart-role of individual authority-Licensing and registration of food business -Food safety officer and their powers- Offences and penalties- Laws relating to Food Processing Industries in India-FPO,MMPO, PFA, AGMARK, Essential Commodities Act, BIS.

UNIT III **9 Hours**

FOOD LAW AND REGULATION IN USA

Major food legislation in USA: Food, Drug and Cosmetic Act (FD&C)-Food Safety Modernization Act (FSMA)and relevant sections of the Code of Federal Regulations (CFR)-Roles of Food and Drug Administration (FDA)-The United States Department of Agriculture (USDA) and other government agencies in food safety control.

UNIT IV **9 Hours**

EUROPEAN FOOD LAWS AND REGULATIONS

European treaties-Member states of the EU, EU regulatory institutions-European Commission, Food legislation in the European Union (EU) and other countries; the roles of European Food Safety Authority (EFSA) and government agencies of EU member countries in food safety control.

UNIT V **9 Hours**

FOOD LAWS AND REGULATIONS IN CHINA

Major principle food legislation: Food Safety Law and related Laws; Subsidiary legislation including rules and regulations, National standards on labelling, food additives, food quality, food hygiene etc.; Roles of various government agencies in the food safety control system.

Total: 45 Hours

Reference(s)

1. Mehta R. and George J. "Food Safety Regulation Concerns And Trade- The Developing Country Perspective", Macmillan India Ltd., New Delhi. 2005.
2. Mehta, R and George, J. "Food Safety Regulations Concerns and Trade". The Developing Country Perspective", Macmillan, 2005
3. Vetter, J.L. 1993. "Food Labeling- Requirements for FDA Regulated Products" American Institute of Baking, Manhattan, Kansas.
4. Goodburn K. (Ed) 2005. EU Food Law: A Practical Guide, CRC Press Boca Raton, Boston, New York, Washington DC., Woodhead Publishing Limited, Cambridge, England.

21FD026 RISK ANALYSIS 3 0 0 3

Course Objectives

- To gain knowledge in hazard identification.
- To be aware of the regulatory aspect of risk analysis.
- To characterize different aspects of riak analysis, risk management, risk assessment and risk communication.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the importance of the risk analysis in relation with food safety hazards.
2. Analyze the principles of risk analysis in decision making.
3. Predict the role of risk management in managing food safety.
4. Understand the concept of risk assessment.
5. Analyze the priority of risk communication and its principle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2	2	2		2		2	2	2		
2	2		2	2	2	2		2		2				
3	2		2	2	2	2		2		2	2			
4	2		3	2	2	2		1		2				
5	1		2	2				1		2				

UNIT I **9 Hours**

INTRODUCTION TO RISK ANALYSIS

Definitions, Risk assessment (Hazard identification, Hazard characterization, Exposure assessment (deterministic and probabilistic approach), Risk characterization, Chemical risk assessment in foods (including aggregated and cumulative assessment), Microbial risk assessment in foods.

UNIT II **9 Hours**

REGULATORY PROCESS OF RISK ANALYSIS

Introduction to risk analysis, Principles of risk management decision-making, General principles of food law, Risk analysis and WTO, How risk analysis fits into food safety law systems.

UNIT III **9 Hours**

RISK MANAGEMENT

Risk manager"s role and how we think about things, Risk management frameworks and models, Principles of decision-making and the constraints, Dealing with uncertainty of risk assessment, Risk management options and decision, Interactions between risk manager and risk assessor.

UNIT IV **9 Hours**

RISK ASSESSMENT

Context of food safety risk assessment, Risk assessor"s toolbox, Application to food-borne and related hazards, Components of risk assessment.

UNIT V **9 Hours**

RISK COMMUNICATION

Principles of risk communication, Establishing your goal, Risk perception and understanding your audience, Creating your message, Communication in action

Total: 45 Hours

Reference(s)

1. Hoboken, N.J. (2011) Risk assessment : theory, methods, and applications
2. Hoboken, N.J. (2011) Risk and crisis communications methods and messages

21FD027 FOOD ADULTERATION AND ITS CONTROL

3 0 0 3

Course Objectives

- To gain knowledge about adulteration in food.
- To be aware of adulterants and its impact on health.
- To ensure the safety, quality and authenticity of food products.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the types of adulterants in food.
2. Analyze the detection methods of adulterant in different food products.
3. Predict the food laws and procedures on adulteration.
4. Understand the strategies to control food adulteration.
5. Educate the consumer by providing appropriate education and public awareness.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2	2	2		2		2	1	2		
2	2		2	2	2	2		2		2				
3	2		2	2	2	1		2		1	2			
4	2		2	2	2	2		2		2				
5	3		1	1				3		1				

UNIT I **9 Hours**

INTRODUCTION TO ADULTERATION

Common Foods subjected to Adulteration-Adulteration-Definition-Types; Poisonous substances, Foreign matter, cheap substitutes, Spoiled parts. Adulteration through Food Additives-Intentional and incidental. General Impact on Human Health.

UNIT II **9 Hours**

METHODS OF DETECTION OF ADULTERATION

Means of Adulteration Methods of Detection Adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices and Condiments, Processed Food, Fruits and Vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).

UNIT III **9 Hours**

PRESENT LAWS AND PROCEDURES ON ADULTERATION

Highlights of Food Safety and Standards Act 2006 (FSSA)-Food Safety and Standards Authority of India-Rules and Procedures of Local Authorities. Role of Voluntary Agencies such as, Agmark, ISI.

UNIT IV **9 Hours**

QUALITY CONTROL ROLE ON FOOD ADULTERANT

Quality control laboratories of Companies, Private testing laboratories, Quality control laboratories of Consumer co-operatives.

UNIT V **9 Hours**

CONSUMER EDUCATION

Consumer Education, Consumer"s problems, rights and responsibilities, COPRA 2019- Offenses and Penalties- Procedures to Complain- Compensation to victims.

Total: 45 Hours

Reference(s)

1. A first course in Food Analysis -A.Y. Sathe, New Age International (p) Ltd, 1999
2. Food Safety, case studies-Ramesh.V.Bhat,NIN,1992.
3. Rapid Detection of Food Adulterants and Contaminants-Theory and Practice, Shyam Narayan Jha and Pranay, 2016.

21FD029 FOOD SUPPLY CHAIN MANAGEMENT AND LOGISTICS

3 0 0 3

Course Objectives

- To define food supply chain management and logistics.
- To identify the key components of a food supply chain.
- To Explain the role of logistics in food supply chain management.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply food supply chain management principles to real-world scenarios.
2. Develop strategies for improving food supply chain efficiency and effectiveness.
3. Analyze the impact of logistics on food safety and quality.
4. Evaluate the sustainability of food supply chain practices.
5. Understand the food supply chain and its components

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION

Logistics and supply chain management - Scope, Significance and Drivers; Basic Model - Primary and Secondary Activities; Role and Challenges of Logistics and supply chain management in food industry.

UNIT II **9 Hours**

DEMAND FORECASTING AND WAREHOUSING

Demand and supply management, Forecasting techniques, Strategic planning for material sourcing, Outsourcing strategies, Warehouse strategies, Inventory models and control techniques.

UNIT III **9 Hours**

DISTRIBUTION AND TRANSPORTATION

Various sources of distribution channels, Distribution models, 3PL and 4PL, Distribution network planning, Modes of transportation, Design of transshipment, Containerization.

UNIT IV **9 Hours**

PACKAGING AND INFORMATION TECHNOLOGY

Applications of Packaging in logistics, Types of packaging and packaging materials, Export & import packaging and labeling details, Reverse Supply Chain, Information Technology and the Supply Chain (ERP, Bar-coding, RFID, GPS, E-Procurement).

UNIT V **9 Hours**

GLOBAL LSCM AND PERFORMANCE ANALYSIS

Export and import procedure and Documentation, Customer relationship management in LSCM, Performance metrics in Supply Chain, Challenges in SCM.

Total: 45 Hours

Reference(s)

1. D K Agarwal, Logistics and supply chain management, Macmillan Publishers India Ltd. (2003), Eighth Impressions, 2010.
2. Sunil Chopra and Peter Meindi, Supply chain management Pearson Education publishers, 2010.
3. David Taylor and David Brunt, Manufacturing Operations and Supply chain Management, Vikas Thomson Learning publishers, 2009.
4. Amit Sinha and Herbert Kotzab, Supply Chain Management, Tata McGraw Hill, 2011.
5. David Blanchard, Supply Chain Management Best Practices, Wiley Publications, 2010.

21FD030 QUALITY ASSURANCE AND QUALITY CONTROL IN FOOD INDUSTRIES

3 0 0 3

Course Objectives

- To Identify the different types of QA/QC systems used in food processing operations
- To implement QA/QC procedures to ensure the safety and quality of food products
- To troubleshoot and resolve QA/QC problems in food processing operations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Define quality management systems (QMS) and their importance in food industries
2. Identify the different types of QMS and their applications
3. Explain the principles of ISO 22000, HACCP, and SQF
4. Implement and maintain a QMS in a food processing facility
5. Develop statistical models and to study the several characteristics of data structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

CONCEPT OF QUALITY CONTROL AND QUALITY ASSURANCE

Definition and scope of quality control and quality assurance in food processing; Importance of quality control and quality assurance in the food industry; Relationship between quality control, quality assurance, and food safety.

UNIT II **9 Hours**

QUALITY CONTROL TECHNIQUES IN FOOD PROCESSING

Physical, chemical, and microbiological methods for food quality control; Sensory evaluation methods for food quality control; Sampling techniques for food quality control; Statistical process control for food quality control.

UNIT III **9 Hours**

QUALITY ASSURANCE FOR MEAT INDUSTRY

acteristics of meat-Microorganisms associated with meat - spoilage of animal food - control of microbial food borne pathogens in meat chain - meat safety at pre-harvest, harvest and post-harvest level - nutritive value of meat-Structure of muscle, methods of slaughtering, Ante mortem and post mortem inspection of meat, Biochemical changes in meat-Rigor mortis-Aging of meat, meat cut and grade, MPL for Meat and Meat products. Maximum Permissible Limit of additives for meat and meat products

UNIT IV **9 Hours**

QUALITY ASSURANCE FOR BAKERY AND CONFECTIONARY INDUSTRIES

Quality of raw materials, quality checks on flours, building inspection and routine cleaning programs, process control- microbial and fungal contaminants. Ingredients, equipment, bakery quality assurance, ingredient inspection, process control, assessing products for quality.

UNIT V **9 Hours**

ADVANCED INSTRUMENTATION FOR FOOD SAFETY AND QUALITY ASSURANCE

Basic chromatographic technique; spectrophotometric techniques; high pressure liquid chromatography and gas chromatography; advanced analytical techniques; advanced analytical instrumentation in trace analysis.

Total: 45 Hours

Reference(s)

1. International Food Standards Organization (IFS). (2022). IFS Food Standard.
2. Codex Alimentarius Commission. (2023). Food Hygiene Basic Principles.
3. World Health Organization. (2016). Five keys to safer food manual.
4. British Standards Institution. (2018). BS EN ISO 22000:2018 Food safety management systems - Requirements for organizations involved in the food chain.
5. American Society for Quality (ASQ). (2023). Body of knowledge (BoK) for Certified Quality Auditor (CQA).

21FD031 MICROBIAL PRESERVATION AND PROCESSING

3 0 0 3

Course Objectives

- Understand and identify the important pathogens and spoilage microorganisms in Foods and the conditions under which they grow (covered in detail)
- Impart knowledge on role and significance of microrganisms in development of fermented food products
- Learn about the general characteristics of Bacteria, Fungi, Virus, Protozoa and algae also morphological characteristics important in Food Bacteriology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the functions of food microbes for manufacturing fermented foods
2. Analyze the importance of as food safety to act as a mode of transmission of various infectious agents.
3. Find the importance of microbes in producing pro and prebiotic food products
4. Apply the new innovation in developing new preservative techniques
5. Analyze the response to the changes in processing foods by modern preservation techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							-	
4	2	2	2		2	1								
5	1	2	1		-	-								

UNIT I **9 Hours**

INTRODUCTION AND SCOPE OF FOOD MICROBIOLOGY

Introduction of microbiology-General characteristics of Bacteria, Fungi, Virus, Protozoa and algae- Importance of microorganisms in Food- Food as a substrate for micro organism- Classification of

Nomenculture of Micro organism- Factor affecting the growth of micro organisms in Food, Feed and Fodder- Normal microflora of some common foods

UNIT II **9 Hours**

MICROBIAL GROWTH RESPONSE IN THE FOOD ENVIRONMENT

Microbial Growth Characteristics - Factors infuencing Microbial Growth in Food- Microbial Metabolism of Food components- Microbial Sporulation and Germination- Microbila stress response in Food Environment

UNIT III **9 Hours**

BENEFICIAL USES OF MICROORGANISMS IN FOOD

Microorganisms used in Food Fermentation- Microbiology of Feremented Food Production- Intestinal Beneficial Bacteria- Food Bio preservatives of Microbial origin- Food Ingredients and Enzymes of Microbial Origin

UNIT IV **9 Hours**

MICROBIAL FOODBORNE DISEASES

Important Factors in Microbial Food spoilage- Food Spoilage by Microbial Enzymes- Indicators of Microbial Food spoilage- Microbial Foodborne diseases- Foodborne Intoxications- Foodborne infections- Foodborne Toxicoinfections-Opportunistic pathogens, Parasites, and Algal Toxins- Indicators of Bacterial Pathogens

UNIT V **9 Hours**

CONTROL OF MICROORGANISMS IN FOODS

Control of Access(cleaning and sanitation)- Physical removal- heat- Low temperature- reduced Aw- Low pH and organic acids- Modified Atmosphere (or Reducing O-R Potenetial)- Antimicrobial Preervatives- Novel Processing Technologies- Hurdle concept- Detection of Microorganisms in Food and Food environment

Total: 45 Hours

Reference(s)

1. Adams, M. R. and M. O. Moss. 2008. Food Microbiology, 3rd Edition. Cambridge: The Royal Society of Chemistry (RSC Publishing).
2. Benwart, G. J. 1987. Basic Food Microbiology. New Delhi: CBS Publishers & Distributors.
3. Blackburn, Clive de W. 2006. Food Spoilage Microorganisms. Cambridge: Woodhead Publishing.
4. Deak, T. and L. R. Beuchat. 1996. Handbook of Food Spoilage Yeasts. US: CRC Press.
5. Frazier, William C. and Dennis C. Westhoff. 1988. Food Microbiology. New York: McGraw-Hill.

21FD032 BIOPROCESS TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the fundamentals of bioreactor design for efficient production of biomolecules and monitoring of bioprocesses in industry.
- To plan a research career or to work in the biotechnology industry with a strong foundation about bioreactor design and scale-up
- To apply modelling and simulation of bioprocesses to reduce costs and to enhance the quality of products and systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the bioprocess and sterilization kinetics.
2. Apply stoichiometric calculations to predict bioprocess efficacy.
3. Analyze the productivity in a bioreactor for the given metabolite
4. Evaluate the structured models and metabolic pathways in product formation.
5. Evaluate simulated bioprocesses for automatic control with reduced costs and enhanced product quality.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3									1		
2	2	1	3									2		
3	2	2	3									1		
4	1	2	3	-								2		
5	1				-							1		

UNIT I **9 Hours**

MEDIA DESIGN AND STERILIZATION

Basic configuration of bioreactor and ancillaries, Medium requirements for bioprocesses, Medium formulation of optimal growth and product formation, Medium optimization methods, Thermal death kinetics of microorganisms, Heat and filter sterilization of liquid media, Air sterilization,Design of sterilization equipment.

UNIT II **9 Hours**

METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass, Available electron balances, Yield coefficients of biomass and product formation, Energetic analysis of microbial growth and product formation, Thermodynamic efficiency of growth.

UNIT III **9 Hours**

BIOREACTOR DESIGN AND SCALE UP

Batch, Fed batch and continuous cultivation.Feeding Strategies and Microbial Kinetics, Rheology of fermentation fluids, Transport phenomena in bioprocess systems, Oxygen mass transfer rate determination methods, Stirred tank reactor, Plug flow reactor, Fluidized bed reactor, Bubblecolumn, Air lift reactor, Photo bioreactor, Bioreactors on a chip, Scale up criteria for bioreactors.

UNIT IV **9 Hours**

MODELLING OF BIOPROCESSES

Monod model, Multiple substrate models, Models of growth associated product formation kinetics, Compartmental models, Models of cellular energetics and metabolism, Single cell models,Modelsof gene expression and regulation, Models of plasmid expression and replication.

UNIT V **9 Hours**

BIOPROCESS SIMULATION

Major subsystems of a process simulator, General architecture of on-line simulation system,Dynamic simulation of batch, fed batch, steady and transient culture metabolism,Model simulation usingMATLAB-SIMULINK and ISIM software packages..

Total: 45 Hours

Reference(s)

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering - Basic Concepts, Pearson New International Edition, 2014.
2. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press Limited, 2013.
3. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of Fermentation Technology, Butterworth Heinemann publications, 1995.
4. Harvey W. Blanch, S. Douglas and Clark, Biochemical Engineering, New York: Marcel Dekker Inc., 1997.
5. Shijie Liu, Bioprocess Engineering - Kinetics, Sustainability, and Reactor Design, Elsevier Science, 2013.

21FD033 FOOD ALLERGENS AND TOXICOLOGY 3 0 0 3

Course Objectives

- Familiarize with hazards, and toxicity associated with food and their implications for health.
- Know the various kinds of allergens and basis of allergic reactions
- The objective of the course is to introduce food related toxicological compounds in different foods
- To understand the protocols of sampling techniques in food toxicology measurements
- To gain the knowledge on level of processing of food to destroy allergens / toxins
- Creates an awareness to choose food with highly safe

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Awareness about the different types of allergens and Natural toxins associated with food
2. Understand about food toxicology and its hazards
3. Understand about food sensitivity and allergy
4. Analyze food toxin in food samples
5. Adapting toxin formed during processing and controlling

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1	-	3	2							1	
4	2	2	2		2	1								
5		2	1			-								

UNIT I **9 Hours**

INTRODUCTION OF FOOD TOXICOLOGY AND ALLERGENS

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 **9 Hours**

FOOD ALLERGY AND SENSITIVITY.

Natural toxins in food: natural toxins of importance in food-toxins of plant and animal origin;microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence,toxicity and significance, determination of toxicants in foods and their management.

UNIT III **9 Hours**

PRINCIPLES OF TOXICOLOGY

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

UNIT IV **9 Hours**

DETERMINATION OF TOXICANTS IN FOOD SAMPLING

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 behavioral effect, immunotoxicity.

UNIT V **9 Hours**

TOXICANTS FORMED DURING FOOD PROCESSING

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavor enhancers, food colors, 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: 45 Hours

Reference(s)

1. Helferich,W.,and Winter,C.K " Food Toxicology",.CRC Press,LLC.Boca Raton,F.L.2007.
2. Shimbamoto,T., and Bjeldanes, L. " Introduction to Food Toxicology", 2009, 2nd Edition.Elsevier Inc.,Burlington,M.A.
3. Watson, D.H. "Natural Toxicants in Food",CRC Press,LLC,Boca Raton,FL1998

21FD034 ENZYME TECHNOLOGY 3 0 0 3

Course Objectives

- To provide students with a basic understanding of classification, nomenclature, mechanism and purification and characterization of enzymes
- To understand enzyme immobilization methods, kinetics of free, immobilized and allosteric enzymes
- To learn the Kinetics, inhibition study of enzyme and also its application in Food Industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply and gain knowledge on enzyme, coenzyme and their classification
2. Apply the different methods of Production and Purification of enzymes from various sources
3. Apply the theoretical and practical aspects of enzyme kinetics to promote research
4. Analyze the different methods of enzyme inhibition and kinetics
5. Evaluate the role of enzymes in Food Processing and Preservation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3												2
2	1	2	3	2										1
3	3	3	1											2
4	2	3	1	1							2			1
5	2	3	3								2			1

UNIT I **9 Hours**

INTRODUCTION TO ENZYMES

Nomenclature and Classification of enzymes. Mechanism and specificity of enzyme action - Units for enzyme activity - Coenzymes-Classification, Coenzymes in metabolic pathways, metal-activated enzyme and metalloenzyme

UNIT II **9 Hours**

ENZYMES: EXTRACTION, PURIFICATION AND IMMOBILIZATION

Production and purification of crude enzyme extracts from plant, animal, and microbial sources; methods of characterization of enzymes; development of enzymatic assays. Physical and chemical techniques for enzyme immobilization adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding

UNIT III **9 Hours**

ENZYME INHIBITION

Reversible Inhibition- Competitive, Non Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition- Suicide inhibition. Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF.

UNIT IV **9 Hours**

ENZYME KINETICS

Factors affecting the enzyme activity- Concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes

UNIT V **9 Hours**

APPLICATION OF ENZYME IN FOOD INDUSTRY

Application of Enzymes in food processing and production- Enzymes in baking, brewing, dairy and meat industries. Enzymes used in various fermentation processes, cellulose degrading enzymes, Applications of enzymes in flavor enhancement and modification,

Total: 45 Hours

Reference(s)

1. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995
2. Chaplin and Bucke, Enzyme Technology, Cambridge University Press, 1990
3. Price and Stevens, Fundamentals of Enzymology, Oxford University Press
4. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
5. Branden C. and Tooze J., Introduction to Protein Structured Garland Publishing, 1999
6. Creighton T.E. Proteins, 2ndEdition. W.H. Freeman, 1993.

21FD035 FOOD FERMENTATION TECHNOLOGY 3 0 0 3

Course Objectives

- Explore how fermentation can be used as a method of food preservation, extending the shelf life of perishable foods
- Gain insights into developing fermented food products with desirable sensory attributes, nutritional value, and safety
- Understand how fermentation can enhance the nutritional profile of foods by synthesizing vitamins, increasing bioavailability of nutrients, and reducing anti-nutritional factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the different methods of Fermentation Technique for the Food product formation
2. Analyze the history and properties of the fermented foods
3. Asses the production of different types of fermented dairy, Fruit and Vegetable Products
4. Evaluate the process of wine processing and preservation by Fermentation
5. Understand the concept of producing Fermented Fish and meat Products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							1	
4	2	2	2		2	1								
5	1	2	1											

UNIT I **9 Hours**

INTRODUCTION TO FERMENTATION

History of food fermentations; types of fermented foods and substrates/raw materials used, traditional fermented foods, major biotransformation of raw materials during fermentation, Modern fermented foods industry, Properties of fermented foods, Fermented foods in the twenty-first century, Health benefits of fermented foods and beverages

UNIT II **9 Hours**

FERMENTED DIARY PRODUCTS

Fermented Dairy products Introduction, Consumption of cultured dairy products, Cultured dairy products- Yogurt, Cultured buttermilk, Sour cream, Kefir, Other cultured dairy products. Cheese Introduction, Manufacturing principles, General steps in cheese making, Types of cheese, Cheese ripening, Microbial defects, Recent technological advances in cultured dairy products technology.

UNIT III **9 Hours**

FERMENTED FRUITS AND VEGETABLE PRODUCTS

Fermented Vegetable products- Introduction, Production principles, Manufacture of Sauerkraut, Principles of pickle production, fermented olives, Kimchi. Fermented Fruit products-Manufacture of Canned fruits- Fruit vinegar production- Fermented Fruit juices

UNIT IV **9 Hours**

ENOLOGY (STUDY OF WINE)

Wine manufacture principles-Harvesting and preparation of grapes, Crushing and maceration, Sulphur dioxide treatment, Separation and pressing, Fermentation, Yeast metabolism, Factors affecting yeast metabolism, Sulphur and nitrogen metabolism, stuck fermentations, Adjustments, blending, and clarification, Aging, Malolactic fermentation, Types of wine, Wine spoilage and defects-

UNIT V **9 Hours**

FERMENTED MEAT AND FISH PRODUCTS

Fermented Meat product Sausages- History and evolution of the fermented meats industry, Meat composition, Fermentation principles, Meat starter cultures, Principles of fermented sausage manufacture, Manufacture of fermented sausage-. Fermented fish products Fish sauces, Fish paste-Manufacturing steps, Biochemical changes, Storage and Shelf-life of products

Total: 45 Hours

Reference(s)

1. Joshi, V. K. Biotechnology Food Fermentation Volume 1. Educational Publishers Distributors, 2004.
2. Robert W. Hutkins. Microbiology and Technology of Fermented Foods, 2nd Edition, Blackwell, 2006
3. Hui Y. H Handbook of Food and Beverage Fermentation Technology. Marcel Dekker, 2004.
4. Farnworth, Edward R. Handbook of Fermented Functional Foods II Edition. CRC Press, 2008.
5. Ramesh C. Ray and Didier Montet, Fermented Foods, Part- II Technological Interventions,CRC Press, 2017

21FD036 CELLULAR AGRICULTURE 3 0 0 3

Course Objectives

- Familiarize with cellular agriculture and its applications.
- Know the various kinds of cellular development in food products
- The objective of the course is to introduce food related cellular developing products in different foods sector
- To understand the protocols of sampling techniques in cellular agricultural measurements
- To gain the knowledge on level of tissue culturing
- Creates an awareness to choose food with highly natural

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the Fundamentals of Cellular Agriculture
2. Understand Fermentation in Cellular Agriculture
3. Evaluate Plant-Based Alternatives and Dairy Substitutes
4. Analyze Technological Platforms and Automation
5. Apply Knowledge Through Projects and Presentations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							1	
4	2	2	2		2	1								
5	1	2	1											

UNIT I **9 Hours**

INTRODUCTION TO CELLULAR AGRICULTURE

Overview of Cellular Agriculture,Historical perspective and development,Definition and scope of cellular agriculture,Basics of cell biology and its relevance to cellular agriculture,Comparison with

traditional agriculture,Ethical considerations and sustainability,Evolution of traditional agriculture practices,Challenges and opportunities in developing regulatory frameworks

UNIT II **9 Hours**

TISSUE ENGINEERING AND BIOPROCESSING

Definition and goals of tissue engineering, Basic principles of tissue engineering design and methodology, Cellular Components in Tissue Engineering-Cell sources and selection for tissue engineering, Role of stem cells in tissue regeneration, Bioprocessing Techniques in Cellular Agriculture-Overview of bioprocessing in cellular agriculture, Scale-up challenges and solutions, Bioreactor design and function, Challenges and innovations in large-scale cultivation

UNIT III **9 Hours**

CELLULAR AGRICULTURE PRODUCTS

Cultured Meat Productions-In-depth exploration of cultured meat production, Different cell sources and their impact on product characteristics. Plant-Based Alternatives-plant-based cellular agriculture products, Types of plant-based alternatives (e.g., burgers, sausages, dairy substitutes),Formulation and production methods, Fermentation-Based Products-Products produced through fermentation (e.g., cheese, yogurt, protein alternatives),Innovations and challenges in fermentation processes. Consumer acceptance and market trends, Nutritional considerations and comparisons with traditional products

UNIT IV **9 Hours**

TECHNOLOGICAL PLATFORMS IN CELLULAR AGRICULTURE

Automation and Robotics-Role of automation in cellular agriculture, Robotics applications in bioprocessing and cultivation, Advantages and challenges of automated systems, Cellular Agriculture Startups and Industry Landscape-Exploration of emerging startups in the cellular agriculture sector

UNIT V **9 Hours**

INDUSTRY PERSPECTIVES AND FUTURE TRENDS IN CELLULAR AGRICULTURE

Introduction to the current state of the cellular agriculture industry, Challenges faced by companies in the cellular agriculture sector, Opportunities for innovation and growth, Global Perspectives on Cellular Agriculture, Sustainability and Environmental Impact

Total: 45 Hours

Reference(s)

1. "Cellular Agriculture: Developing Sustainable Foods" edited by Lauri Reuter and Marianne Ellis.
2. "Cultured Meat and Animal Welfare: The New Food Revolution" by Walter Veit
3. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
4. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press, 2003
5. Jaiwal P K & Singh R P (eds) Plant Genetic Engineering Vol-1 to Vol. 9. Studium Press, USA
6. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.

21FD037 FRUIT SCIENCE 3 0 0 3

Course Objectives

- Understand and analyze the fundamentals of horticulture in fruit production.
- Impart knowledge on role and significance of breeding in development of fruits.
- Learn about the general characteristics of tropical, subtropical and temperate fruits and also its post-harvest practices.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals of horticulture.
2. Analyze the techniques of breeding fruit crops and its importance.
3. Identify and analyze the tropical and subtropical fruits and its cropping system
4. Assess the temperate fruits production and varieties
5. Evaluate the post-harvest practices of fruits and packaging systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1		2			3						
2	3	3												
3	3	3	3	3	2									
4			2	3	3			1			2	2		3
5		3		3	2									

UNIT I **9 Hours**

FUNDAMENTALS OF HORTICULTURE

Classification of horticulture crops and nutritive value, area and production, exports and imports, fruit and vegetable zone of India - soil and climate, planning and layout, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops. Types and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management - irrigation methods, weed management, fertility management, cropping systems, Rejuvenation, Principles of organic farming

UNIT II **9 Hours**

BREEDING OF FRUIT CROPS

Origin and distribution, Taxonomical status - species and cultivars, cytogenetic, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions.

UNIT III **9 Hours**

TROPICAL AND SUBTROPICAL FRUITS

Commercial varieties of regional, national and international importance, recent trends in propagation, rootstock influence, planting systems, cropping systems, nutrient management, water management, fertigation, bioregulation, physiology of flowering, maturity indices, harvesting and ripening techniques; Crops: Apple, pear, quince, grapes, Plums, peach, apricot, cherries, Litchi, loquat, persimmon, kiwifruit, strawberry, Nuts- walnut, almond, pistachio, pecan, hazelnut, Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan, pomegranate.

UNIT IV **9 Hours**

TEMPERATE FRUITS

Classification of temperate fruits - detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, nutrient and weed management - harvesting, post-harvest handling and storage of apple, pear, peach, apricot, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecan nut, hazel nut and chest nut.

UNIT V **9 Hours**

POST HARVEST TECHNOLOGY

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, transpiration; Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling; Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage- ventilated, refrigerated, MAS, CA storage, physical injuries and disorders; Packing methods and transport, principles and methods of preservation, food processing methods, processing waste management, food safety standards.

Total: 45 Hours

Reference(s)

1. Prasad and Kumar, 2014. Principles of Horticulture 2nd Edn. Agrobios (India).
2. Neeraj Pratap Singh, 2005. Basic concepts of Fruit Science 1st Edn. IBDC Publishers.
3. Gardner/Bardford/Hooker. J.R., 1957. Fundamentals of Fruit Production. Mac Graw Hill Book Co., New York.
4. Mukhergee,S.K. and Majumdar,P.K.1973.Propagation of fruit crops. ICAR, New Delhi.
5. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

21FD038 POST-HARVEST MANAGEMENT OFFRUITS AND VEGETABLE 3 0 0 3

Course Objectives

- To provide basic knowledge of postharvest processing methods and processes involved in post- harvest loss reduction.
- To introduce postharvest management practices which are eco-friendly and sustainable by integrating them with existing modern technologies.
- To encourage students in product development, conversion of fresh produce to processed form for value addition (nutritive and economic value).s

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Application of postharvest technologies in their career through practical knowledge
2. Identifying and providing inputs to mitigate postharvest losses during cool chain management.
3. Providing skill on postharvest loss reduction through processing of fruits and vegetables.
4. Facilitating the students with knowledge and activities of food processing industries and also drive towards entrepreneurship.
5. Applying novel packaging techniques and improve the shelf-life of the horticulture produce.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1							1	1
2	1		2	2	2	1								
3	1		1	2	3	2							1	
4	2		2	2	2	1								
5	1		1	2										

UNIT I **9 Hours**

PRINCIPLES OF POST-HARVEST TECHNOLOGY

Introduction, History and role of post-harvest technology; principles and methods of food preservation.

Post-harvest handling (harvesting, precooling, sorting, grading and packaging) of perishables. Food

storage systems; ripening and senescence of horticultural crops; Post harvest treatment for quality retention of horticultural crops; spoilage of fruits & vegetables, methods to reduce decay. Processing of
fruit and vegetables.

UNIT II **9 Hours**

PRE-HARVEST PHYSIOLOGICAL ASPECTS RELATED TO POST-HARVEST MANAGEMENT OF HORTICULTURAL PRODUCE

Introduction, Growth and development - definition, parameters of growth and development. Role of environmental factors and physiological processes on post-harvest life and quality. Physiological changes associated with ripening and seed development, preharvest factors affecting ripening and spoilage. Influence of plant growth regulators as pre harvest application on post-harvest storage life and
quality. Growth and developmental processes during stress manipulation of developing crop.

UNIT III **9 Hours**

POST-HARVEST PHYSIOLOGY AND BIOCHEMISTRY OF FRUITS AND VEGETABLES

Introduction, Structure and composition of fruits and vegetables, postharvest factors affecting physiology and biochemical constituents. Maturity and ripening processes and factors affecting them. Presence of constituents and their changes during development; maturation and ripening of fruits and vegetables; Biosynthesis of ethylene and its regulation, Ethylene action and ripening processes.
Regulation of ripening and senescence of fruits and vegetables.

UNIT IV **9 Hours**

POST-HARVEST TECHNOLOGY OF VEGETABLE CROPS

Scope and importance of post-harvest management of vegetables; Nature and causes of postharvest losses; Harvesting methods, tools, harvesting practices for specific market requirements; pre cooling methods; grading, washing, pack house operations, pre-treatments, chemicals, wax coating, edible coating, pre-packaging and irradiation; packaging of vegetables, packaging materials; Storage methods
and Storage disorders, post-harvest diseases and pests - prevention from infestation.

UNIT V **9 Hours**

POST-HARVEST TECHNOLOGY OF FRUIT CROPS

Scope and importance of post-harvest management of fruits; Factors leading to post-harvest losses; Harvesting methods, tools, harvesting practices for specific market requirements; Pre cooling methods;
grading, washing, pack house operations, pre-treatments prior to shipment; Pre-packaging and irradiation, packaging of fruits, packaging materials; Storage methods and storage disorders; quality evaluation, principles and methods of processing and preservation.

Total: 45 Hours

Reference(s)

1. Sudheer, K.P. and V.Indira. 2007. Post-harvest technology of horticultural crops. New India Publishing Agency, New Delhi.
2. Verma, L.R. and V.K. Joshi. 2000. Post-harvest technology of fruits and vegetables, Handling, Processing, Waste Management. Indus Publishing Company. New Delhi.
3. Chadha K.L. 2009. Handbook of Horticulture. IARI Publications, New Delhi.
4. Thompson, A.K. 1996. Post harvest Technology of Fruits and Vegetable. Blackwell science ltd. London

21FD039 FRUIT AND VEGETABLE PROCESSING 3 0 0 3

Course Objectives

- Implement speccific Post harvest handling Technique for storage and transport of fruits and Vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the Industrial scale Processing and Preservation methods to extend the shelflife of fruit and Vegetable commodities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				2								1
2	2	-			2									-
3	2	1		2										1
4	2		2	1										1
5	2	-		2	2									2

UNIT I **9 Hours**

INTRODUCTION TO FRUIT AND VEGETABLE TECHNOLOGY

Introduction to Fruit and Vegetable Technology-Overview of the fruit and vegetable industry Importance of fruit and vegetable processing-Historical perspective and technological advancements-Harvesting and Post-Harvest Handling- Harvesting techniques and considerations

UNIT II **9 Hours**

POST-HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Post-harvest physiological changes and factors affecting shelf life handling, sorting, and grading of fruits and vegetables- Preservation and Storage

UNIT III **9 Hours**

PROCESSING AND PRESERVATION OF FRUITS AND VEGETABLES

Principles of preservation: refrigeration, controlled atmosphere storage- Cold storage technology and its applications- Packaging materials and methods for fruits and vegetables- Processing Techniques-Drying and dehydration processes Canning and bottling-Freezing and refrigeration
Juicing and extraction techniques

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UNIT IV **9 Hours**

QUALITY AND SAFETY STANDARDS IN FRUIT AND VEGETABLE PROCESSING

Quality Control and Food Safety-Quality assessment parameters and techniques principles in fruit and vegetable processing- Food safety regulations and standards

UNIT V **9 Hours**

EMERGING TRENDS IN FRUIT AND VEGETABLE TECHNOLOGY

Emerging Trends and Future Directions-Innovations in fruit and vegetable processing technologies-Sustainable practices in fruit and vegetable technology

Total: 45 Hours

Reference(s)

1. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
2. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
4. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
5. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

21FD042 FRUIT AND VEGETABLE WASTEMANAGEMENT

3 0 0 3

Course Objectives

- To define fruit and vegetable waste (FVW) and describe its sources and characteristics
- To Describe various FVW valorization techniques
- To Develop strategies for sustainable FVW management

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the significance of fruit and vegetable waste management in the context of sustainability
2. Analyze the environmental, economic, and social impacts of fruit and vegetable waste.
3. Identify effective practices for reducing food waste in households and foodservice establishments.
4. Identify potential applications for valorized and upcycled fruit and vegetable waste.
5. Evaluate the effectiveness of existing policies and suggest improvements for better waste management practices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				

5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO FRUIT AND VEGETABLE WASTE MANAGEMENT

Definition and scope of fruit and vegetable waste management; Sources and types of fruit and vegetable waste; Environmental and economic impact of fruit and vegetable waste; Importance of fruit and vegetable waste management.

UNIT II **9 Hours**

ON-FARM FRUIT AND VEGETABLE WASTE MANAGEMENT

Pre-harvest and post-harvest waste reduction strategies; Segregation and collection of fruit and vegetable waste at the farm level; On-farm composting and vermicomposting techniques; Biogas production from fruit and vegetable waste

UNIT III **9 Hours**

POST-HARVEST FRUIT AND VEGETABLE WASTE MANAGEMENT

Handling and storage practices to minimize post-harvest waste; Segregation and collection of fruit and vegetable waste at the market and processing level; Anaerobic digestion of fruit and vegetable waste for energy production; Recycling and reuse of fruit and vegetable waste

UNIT IV **9 Hours**

FRUIT AND VEGETABLE WASTE VALORIZATION

Production of value-added products from fruit and vegetable waste; Extraction of bioactive compounds from fruit and vegetable waste; Utilization of fruit and vegetable waste for animal feed; Development of innovative products from fruit and vegetable waste

UNIT V **9 Hours**

SUSTAINABLE FRUIT AND VEGETABLE WASTE MANAGEMENT POLICIES AND PRACTICES

Role of government policies and regulations in promoting sustainable fruit and vegetable waste management; Public awareness and education programs for reducing fruit and vegetable waste; Implementation of sustainable waste management practices in the food processing industry; Case studies of successful fruit and vegetable waste management initiatives

Total: 45 Hours

Reference(s)

1. Food and Agriculture Organization of the United Nations (FAO). (2011). Global food losses and food waste--Extent, causes and prevention. Rome: Food and Agriculture Organization of the United Nations.
2. Parfitt, E., Bartley, J., & Food Waste & Resources Action Programme (WRAP). (2016). Food waste reduction in the UK: A study by WRAP. Banbury, UK: Waste & Resources Action Programme.
3. Kaur, I. (Ed.). (2014). Fruit and vegetable waste management: Concepts, technologies, and policy. Dordrecht: Springer.
4. Singh, A., Kumar, A., & Gupta, S. K. (Eds.). (2020). Fruit and vegetable waste valorization: Challenges, opportunities, and solutions. Cham: Springer.
5. Lee, J. Y., & Choi, H. J. (Eds.). (2021). Sustainable waste management and resource recovery. Cham: Springer.