DEPARTMENT OF FOOD TECHNOLOGY

B.Tech FOOD TECHNOLOGY

CURRICULUM AND SYLLABUS 2018R

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
(Deemed to be University)
Anand Nagar, Krishnankoil - 626 126

Institute Vision	Institute Mission
To be a University of Excellence of International Repute in Education and Research.	1. To provide a scholarly teaching-learning ambience which results in creating graduates equipped with skills and acumen to solve real-life problems. 2. To promote research and create knowledge for human welfare, rural and societal development. 3. To nurture entrepreneurial ambition, industrial and societal connect by creating an environment through which innovators and leaders emerge.
Department Vision	**Department Mission**
To be a center of repute in the frontier areas of Food Technology through quality research and education.	1. To impart knowledge in the realm of food technology through research and education. 2. To nurture professional leaders in the field of food technology with entrepreneurship skills. 3. To cultivate strong ethical values for sustainable growth in food processing to fulfill the needs of the society

Program Educational Objectives (B.Tech – Food Technology)

PEO 1	The graduates will exhibit competence as professionals in academic and research in food processing industry or related disciplines through professional development.
PEO 2	The graduates will have acumen to be a successful entrepreneur in areas related to food and allied technologies.
PEO 3	The graduates will promote ethics, sustainability and environmental responsibility in their practice.

Programme Specific Outcomes (B.Tech – Food Technology)

A graduate of the Food Technology program will demonstrate:

PSO1	Professional Skills: The ability to understand, evaluate and prepare ways to process, preserve, package, or store food, according to industrial requirements.
PSO2	Problem Solving Skills: The ability to apply standard practices and regulation in developing the food and allied products.
PSO3	Career and Entrepreneurship: The ability to employ modern technologies to produce new or value added products in the area of Food Technology.

Program outcomes:

PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**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.
PO 3	**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.
PO 4	**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.
PO 5	**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.
PO 6	**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.
PO 7	**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.
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**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.
PO 11	**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.
PO 12	**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.

CURRICULUM STRUCTURE

S.No	Category		Credits
I	**Basic Sciences and Mathematics**		**25**
II	**Humanities and Social Sciences**		**12**
	Soft Skills	3	
	Humanities Elective	9	
III	**Basic Engineering**		**24**
IV	**Program Core**		
	a) Core Courses	48	
	b) Community Service Project	3	**61**
	c) Project work	10	
V	**Professional Elective Courses**		
	a) Professional Elective	18	**36**
	b) Open Elective Engineering	12	
	c) Open Elective Basic Science and Mathematics	6	
VI	**Internship/Industrial Training**		**2**
Total			**160**

I BASIC SCIENCES AND MATHEMATICS

Course Code	Course Title	Course Type	L	T	P	Credit
PHY18R175	Optics, Electromagnetism and Quantum Mechanics	IC	3	1	2	5
CHY18R171	Chemistry	IC	3	1	2	5
MAT18R101	Calculus and Linear Algebra	T	3	1	0	4
MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	T	3	1	0	4
MAT18R201	Bio Statistics	T	3	1	0	4
BIT18R101	Biology for Engineers	T	3	0	0	3
Total						**25**

II HUMANITIES AND SOCIAL SCIENCE

Course Code	Course Title	Course Type	L	T	P	Credit
HSS18R151	English for Technical Communication	TP	2	0	2	3
HSS18RXX	Humanities Elective I	T	3	0	0	3
HSS18RXX	Humanities Elective II	T	3	0	0	3
Total						**9**

Soft Skill

Course Code	Course Title	Course Type	L	T	P	Credit
HSS18R101	Soft Skill-I	T	3	0	0	1
HSS18R102	Soft Skill-II	T	3	0	0	1
HSS18R201	Soft Skill-III	T	3	0	0	1
				Total		**3**

III BASIC ENGINEERING

S. NO	Course Code	Course Title	Course Type	L	T	P	Credit
1	MEC18R211	Engineering Mechanics	T	3	1	0	4
2	EEE18R171	Basic Electrical and Electronics Engineering	IC	3	1	2	5
3	MEC18R151	Engineering Graphics & Design	T	3	0	2	3
4	CSE18R171	Programming for Problem solving	IC	3	1	2	5
5	MEC18R152	Engineering Practice	TP	3	0	2	3
6	FT18R101	Principles of Chemical Engineering	T	3	1	0	4
			Total				**24**

PROGRAM CORE

a) Core Courses

S. No	Course code	Course Title	Course Type	Pre-requisite	Co-requisite	L	T	P	Credit
1	FT18R201	Food Additives	T			3	0	0	3
2	FT18R251	Principles of Food Processing and Preservation	TP			3	0	1	3.5
3	FT18R271	Food Microbiology	IC			3	0	2	4
4	FT18R272	Food Biochemistry	IC			3	0	2	4
5	FT18R202	Instrumental Methods of Analysis of Foods	T			3	0	0	3
6	FT18R203	Technology of Dairy Products	T			3	0	0	3
7	FT18R281	Bakery and Confectionary Laboratory	L		FT18R251	0	0	3	2

8	FT18R273	Unit Operations in Food Processing	IC	FT18R101		3	1	2	5
9	FT18R301	Food Packaging Technology	T	FT18R251		3	0	0	3
10	FT18R381	Food Engineering Laboratory	L		FT18R251	0	0	2	1
11	FT18R371	Food Safety Regulations and Quality Control	IC	FT18R201		3	0	2	4
12	FT18R351	Instrumentation and Process Control	TP			3	0	1	3.5
13	FT18R372	Heat and Mass Transfer	IC	FT18R101		3	1	2	5
14	FT18R382	Instrumental Methods of Analysis Laboratory	L		FT18R202	0	0	2	1
15	FT18R401	Emerging Technologies in Food Process Engineering	T	FT18R251		3	0	0	3
				Total					**48**

b) COMMUNITY SERVICE PROJECT

Code	Subject Name	Credit
FT18R399	Community Service Project	3
Total		**3**

c) PROJECT WORK

Code	Subject Name	Credit
FT18R499	Project Work	10
Total		**10**

V ELECTIVE COURSES

a) Professional Elective

S.No	Code	Course Name	Course Type	Pre-requisite	L	T	P	Credit
PROCESS ENGINEERING & FOOD SAFETY								
1	FT18R302	Sugarcane and Beverage Technology	T		3	0	0	3
2	FT18R303	Technology of Animal Foods	T		3	0	0	3
3	FT18R304	Oils and Fats Processing Technology	T		3	0	0	3
4	FT18R305	Fruits and Vegetables Processing Technology	T	FT18R251	3	0	0	3

5	FT18R306	Technology of Flavors and Colorants	T	FT18R201	3	0	0	3
6	FT18R310	Food Plant Safety and Hazards in Food Industry	T	FT18R271	3	0	0	3
7	FT18R402	Spices and Plantation products	T		3	0	0	3
8	FT18R403	Milling Technology for Food Materials	T	FT18R273	3	0	0	3
9	FT18R404	Processing Commodities of Food	T	FT18R251	3	0	0	3
10	FT18R409	Food Industry Waste Management	T	FT18R251	3	0	0	3
DESIGN & DEVELOPMENT								
11	FT18R204	Sensory Evaluation of Foods	T		3	0	0	3
12	FT18R205	Engineering Properties of Food Materials	T		3	0	0	3
13	FT18R307	Food Process Equipment Design	T	MEC18R151	3	0	0	3
14	FT18R405	Food Product Development	T	FT18R204	3	0	0	3
15	FT18R406	Food Plant Layout and Design	T	FT18R310	3	0	0	3
FOOD NUTRITION								
16	FT18R308	Protein Chemistry and Technology	T	FT18R272	3	0	0	3
17	FT18R309	Nutritional Biochemistry	T		3	0	0	3
18	FT18R407	Traditional and Fermented Foods	T		3	0	0	3
19	FT18R408	Radiation Preservation and Processing of Food Products	T		3	0	0	3
					Total			**18**

b) OPEN ELECTIVES

COURSES OFFERED TO OTHER DEPARTMENTS								
S. NO	**Code**	**Course Title**	**Course Type**	**Pre-requisite**	**L**	**T**	**P**	**Credit**
1	FT18R206	Food Biotechnology	T	-	3	0	0	3
2	FT18R207	Technology of Convenience Foods	T	-	3	0	0	3
3	FT18R208	Foundation of Food and Nutrition	T	-	3	0	0	3
4	FT18R209	Food Processing Technology	T	-	3	0	0	3
5	FT18R210	Composition, Quality & Safety of Foods	T	-	3	0	0	3
6	FT18R211	Bakery and Confectionary Technology	T	-				
8	FT18R311	Beverage Technology	T	FT18R 209	3	0	0	3
9	FT18R312	Fermented Food Products	T	-	3	0	0	3
10	FT18R313	Food Laws and Standards	T	FT18R210	3	0	0	3
11	FT18R314	Packaging Technology of	T	-	3	0	0	3

		Foods						
12	FT18R315	Nutraceuticals and Functional Foods	T	FT18R208	3	0	0	3
13	FT18R410	Processing of Marine Products	T	FT18R209	3	0	0	3
14	FT18R411	Nanotechnology in Food Processing	T	FT18R 210	3	0	0	3
15	FT18R412	Environmental Pollution Control	T	FT18R313	3	0	0	3
Total								18

HUMANITIES ELECTIVES

Course Code	Course Name	Course Type	L	T	P	Credit
HSS18R001	Management Concepts and Techniques	T	3	0	0	3
HSS18R002	Marketing Management	T	3	0	0	3
HSS18R003	Organizational Psychology	T	3	0	0	3
HSS18R004	Project Management	T	3	0	0	3
HSS18R005	Stress Management and Coping Strategies	T	3	0	0	3
HSS18R006	Economics for Engineers	T	3	0	0	3
HSS18R007	Human Resource Management and Labour Law	T	3	0	0	3
HSS18R008	Entrepreneurship Development	T	3	0	0	3
HSS18R009	Cost Analysis and Control	T	3	0	0	3
HSS18R010	Product Design and Development	T	3	0	0	3
HSS18R011	Business Process Reengineering	T	3	0	0	3
HSS18R012	Political Economy	T	3	0	0	3
HSS18R013	Professional Ethics	T	3	0	0	3
HSS18R014	Operations Research	T	3	0	0	3
HSS18R015	Total Quality Management	T	3	0	0	3
HSS18R016	Advanced soft Skills	T	3	0	0	3
Total						**6**

INTERNSHIP/INDUSTRIAL TRAINING

S.NO	Code	Name of the Training	Credit
1	FT18R397	Industrial Training	1
2	FT18R398	Internship Training	1
		Total	**2**

HONOURS COURSES

S.NO	Code	Subject Name	Course Type	Pre-requisite	L	T	P	Credit
1	FT18R413	Technology of Food Emulsion, Foams and Gels	T	FT18R272	3	0	0	3
2	FT18R414	Nanotechnology In Food Processing	T	FT18R251	3	0	0	3
3	FT18R415	Drying Technology	T	FT18R372	3	0	0	3
4	FT18R416	Food Toxicology	T	FT18R371	3	0	0	3
5	FT18R417	Extrusion Technology	T	FT18R381	3	0	0	3
6	FT18R418	Refrigeration & Cold storage	T	FT18R372	3	0	0	3
7	FT18R419	Post-harvest Pest Management in food safety	T	FT18R371	3	0	0	3
8	FT18R420	Food Material Science	T	FT18R272	3	0	0	3

BASIC SCIENCES AND MATHEMATICS

PHY18R175	OPTICS, ELECTROMAGNETISM AND QUANTUM MECHANICS				L	T	P	C
					3	1	2	5
Pre-Requisite	:	Basic Knowledge in Physics	**Course Category**	:	Basic sciences and mathematics			
			Course Type	:	Integrated Course			

Course objective(s):

- To understand the basic concepts of optics, quantum physics and its applications.
- To provide the students a firm understanding of the basics of Electricity, Magnetism and its applications.

Course Outcomes:

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

CO1: Understand the concepts of diffraction and polarization.

CO2: Apply the concepts of optics in laser and fiber optics.

CO3: Explore the knowledge on electrostatistics.

CO4: Understand the fundamentals of magnetism.

CO5: Apply the knowledge on solving the wave equations

UNIT 1: DIFFRACTION AND POLARISATION 9 Hours

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications. Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity

UNIT 2: LASER AND FIBER OPTICS 9 Hours

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers (Neodymium), applications of lasers in science, engineering and medicine. Numerical aperture and Acceptance angle of fibre – Types of optical fibre - Active and passive fibre sensors- Endoscope.

UNIT 3: ELECTROMAGNETISM AND DIELECTRICS 9 Hours

Laws of electrostatics, electric current and the continuity equation, laws of magnetism. Ampere's Faraday's laws. Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics, Dielectric Breakdown – Types and Remedies

UNIT 4: MAGNETOSTATICS AND MAGNETIC MATERIALS 9 Hours

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's

circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

UNIT V: QUANTUM MECHANICS 9 Hours

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in a box (1D) .

List of Experiments 15 Hours

1. To determine the dispersive power of prism using spectrometer and mercury source
2. To determine the wavelength of sodium light by Newton's Ring
3. To determine the wavelength of sodium light using diffraction grating
4. To determine the numeral aperture (NA) of a Optical Fibre.
5. To find the wavelength of He-Ne Laser using transmission diffraction grating.
6. To determine the refractive index of a prism/ liquid using spectrometer.
7. Deflection magnetometer – M and BH – TAN C position
8. To determine the thickness of a material using air wedge method
9. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
10. Determination of dielectric constant of liquids / Solids
11. Determination of Magnetic Susceptibility

Text Book(s):

1. Ghatak, "Optics" Fith edition, Tata McGraw-Hill Inc, 2012.
2. N. Subrahmanyam and Brij Lal, "A Text Book of Optics", S. Chand Limited, 2015.
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009 .
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011

Reference Books:

1. Kailash K. Sharma Optics: Principles and Applications Elsevier, 2006
2. William T. Silfvast, Laser Fundamentals, Cambridge University Press, New York, 2nd Edition, 2004
3. Gaur R. K, and Gupta S. L, Engineering Physics, Dhanpat Rai & Sons, New Delhi, 7th Edition, 1993
4. Halliday D, Resnick R and Waler J, Fundamentals of Physics, Wiley and Sons, New York, 6th Edition, 2001
5. Rajput B.S, Pragati Prakashan, Advanced Quantum Mechanics, Pragati publications, New Market, Begum Bridge, Meerut, 2009.
6. Practical Physics – S.L. Gupta & V. Kumar (Pragati Prakashan).
7. Advanced Practical Physics – B.L. Workshop and H.T. Flint (KPH)
8. Advanced Practical Physics Vol. I & II – Chauhan & Singh (Pragati Prakashan)
9. Physics Laboratory Manual, prepared by Department of Physics, Kalasalingam University.

CHY18R171	CHEMISTRY				L	T	P	C
					3	1	2	5
Pre-Requisite	:	Nil	Course Category	:	Basic Sciences and Mathematics			
			Course Type	:	Integrated Course			

Unit -1: Atomic and Molecular Structure **9 Hours**

Schrodinger wave equation: Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory: MOT concept, MO diagrams of homo- nuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory: CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe^{2+}& $Fe^{3+)}$ in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

Unit-2: Periodic Properties **9 Hours**

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shieldingof orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle (Building-up principle): Application of Aufbau principle in writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

Unit-3: Free Energy and Chemical Equilibria **9 Hours**

Thermodynamic functions: Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation: Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis: Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion.

Unit-IV: Organic Reactions **9 Hours**

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of SN1, SN2, SNi and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons: Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones): Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and NaHSO3 addition. Electrophilic addition reactions (case alkenes): General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff & Anti- Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene).

Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl halides - E1 and E2 mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

Unit-V: Stereochemistry & Spectroscopic Technique 9 Hours

Stereochemistry - Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy: Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (1H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound C_3H_6O from ^{1}H-NMR data). X-ray diffraction: Principle, instrumentation and applications X-ray diffraction.

List of Experiments (Any 10): 15 Hours

1. Determination of Viscosity by Ostwald Viscometer.
2. Determination of surface tension by stalagmometer.
3. Adsorption of acetic acid by charcoal.
4. Determination of chloride content of water.
5. Estimation of hardness of water by EDTA method.
6. Determination of the rate constant of a reaction
7. Thin layer chromatography.
8. Determination of the partition coefficient of a substance between two immiscible liquids
9. Determination of Saponification /acid value of oil.
10. Preparation of Aspirin
11. Potentiometric titration of strong acid vs strong base.
12. Potentiometric titration of weak acid vs strong base.
13. Determination of cell constant and conductance of solutions.

Text Books

1. Engineering Chemistry, 2nd Edition, Wiley India (P) Ltd., 2018.
2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2017.
3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11th Edition, Noida, 2017.
4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018.

Reference Books

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4th Edition, New Delhi, 2008.
2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10th Edition, 2014.
3. Modern Inorganic Chemistry, R. D. Madan, 4th Edition S. Chand & Company Ltd., 2009.
4. Organic Chemistry, Paula Y. Bruice, 7th Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47th Edition, Vishal Publishing Co., 2017.
6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8th Edition, Wiley India (P) Ltd., 2010.
7. Inorganic Chemistry, Peter Atkins, Mark Weller, Fraser Armstrong, Jonathan Rourke, Tina Overton, Michael Hangerman 5th Edition, Oxford press, 2015.
8. Organic Chemistry, Volume 1, I. L. Finar, 6th Edition, Pearson (Thomson press India (P) Ltd.) 2014.

MAT18R101	CALCULUS AND LINEAR ALGEBRA (Common to all Branches of B.Tech) (For those who have joined in June 2018 and later)					L	T	P	C
						3	1	0	4
Pre-Requisite	:		Course Category	:	Basic sciences and mathematics				
			Course Type	:	Theory with tutorial				

Course objective(s):

To enable the students to acquire knowledge and skills in basic components of calculus, to handle the situations involving multivariable calculus, and to diagonalize a symmetric matrix using eigenvalues and eigenvectors.

Course Outcomes:

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

CO1 Know the fundamental theorems such as Rolle's theorem, Mean value theorem, Taylor's theorem and its applications.

CO2 Understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.

CO3 Solve the real world problems using differentiation and integration.

CO4 Understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.

CO5 Find the solution of simultaneous linear equations using matrices and to find the eigen values and eigen vectors of a matrix, Cayley-Hamilon theorem and orthogonal transformations.

Unit 1: Calculus: 12 Hours

Rolle's Theorem- Mean value theorems - Taylor's and Maclaurin theorems with remainders indeterminate forms and L'Hospital's rule - Maxima and minima.

Unit 2: Multivariable Calculus (Differentiation): 12Hours

Limit, continuity and partial derivatives - directional derivatives - total derivative - Maxima, minima and saddle points - Method of Lagrange multipliers.

Unit 3: Calculus (Applications): 12 Hours

Curvature (Cartesian coordinates) - Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 4: Sequences and series 12 Hours

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions;

Unit 5: Matrices: 12 Hours

System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem - Diagonalization of matrices - Orthogonal transformation- Reduction of Quadratic form to Canonical form.

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers New Delhi 3rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publishing company Limited, 2008.

MAT18R102	MULTIPLE INTEGRATION, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE (Common to all Branches of B.Tech except for CSE, EEE and E (For those who have joined in June 2018 and later)				L	T	P	C
					3	1	0	4
Pre-Requisite	**:**	**NIL**	**Course Category**	**:**	Basic sciences and mathematics			
			Course Type	**:**	Theory with tutorial			

Course objective(s):

To enable the students to understand the concepts of multiple integrations, their applications, and to handle analytic functions on complex plane and perform complex integration.

Course Outcomes:

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

CO1 Understand the concepts of double and triple integral and its applications.

CO2 Know about the applications of double and triple integral in vector calculus.

CO3 Know the methods of solving differential equations of first and second orders.

CO4 Understand the concepts of analytic functions, conformal mappings and bilinear transformations.

CO5 Understand the concepts of singularity, residues and evaluation of certain improper integrals.

Unit 1: Multivariable Calculus (integration) 12 Hours

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volume; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds;

Unit 2: Integral theorems: 12 Hours

Gradient, curl and divergence. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 3: Ordinary differential equations 12 Hours

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy- Euler equations.

Unit 4: Complex Variable – Differentiation 12 Hours

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Unit 5: Complex Variable – Integration **12 Hours**

Contour integrals, Cauchy Integral formula (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (Integration around small semicircles and rectangular contours).

TEXT BOOKS:

1. Grewal, B.S., Grewal, J.S., *Higher Engineering Mathematics*, Khanna Publishers, New Delhi, 43rd Edition, 2015.

REFERENCE BOOKS:

1. Kreyszig, E, *Advanced Engineering Mathematics*, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Ramana B. V., *Engineering Mathematics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., *Engineering Mathematics (For First Year)*, Tata McGraw-Hill publishing company Limited, 2008.

MAT18R201	Bio-Statistics (for BioTech, BioMedical and Foodtech) (For those who have joined in June 2018 and later)				L	T	P	C
					3	1	0	4
Pre-Requisite	:	Mathematics	**Course Category**	:	Basic sciences and mathematics			
			Course Type	:	Theory with tutorial			

Course objective(s):
To enable the students to understand the concepts of probability and statistics and to solve real world problems using statistical tools.

Course Outcomes:
Upon successful completion of this course, students will be able to
CO1 Know the methods of finding averages, deviations, moments and skewness and kurtosis.
CO2 Understand the concepts of probability and to know about the discrete and continuous distributions.
CO3 Understand the concepts of correlation and regression and its applications.
CO4 Fit the curve of first- and second-degree equations by least square method and know the method of analys of variance.
CO5 Study about the testing of hypothesis of small and large samples.

Unit 1: Statistical Average **12 Hours**
Introduction – Diagrammatic representation of data – Graphic representation of data – Measures of central tendency: Arithmetic mean, Geometric mean, Harmonic mean,Median and Mode – Measures of dispersion: Range, Mean deviation and Standard deviation – Moments, Skewness and Kurtosis.

Unit 2: Probability **12 Hours**
Introduction – Probability – Theorems on probability - Addition Rule – Multiplication rule – Probability distributions: Binomial, Poisson and Normal distributions.

Unit 3: Correlation and Regression **12 Hours**
Introduction – Types of correlation – coefficient of correlation – Rank correlation – Regression – Difference between correlation and regression – Regression equations – Applications of regression

Unit 4: Fitting of Curves and Analysis of Variance **12 Hours**
Principles of least square techniques – Fitting a straight line – Fitting a second degree parabola – Fitting a curve of the types ybxa , yaebx kabx - Analysis of variance (ANOVA) – one criterion and two criterion of classification

Unit 5: Testing of Hypotheses **12 Hours**
Test for single mean- mean difference – proportion – difference of proportions- small sample tests: based on t and F distributions – chi-square test for population variance – Chi-square test to goodness of fit.

TEXT BOOKS:
1. Khan and Khanum, Fundamentals of Biostatistics, Ukaaz Publications, Reprint 2004.
2. Arumugam and Issac, Statistics, New Gamma Publishers, July 2013.

REFERENCE BOOKS:

1. Eason, G., Coles, C.W., Gittinby, G., Mathematics and Statistics for the Biosciences, Pearson Higher education, New York, 3rd Edition, 1992
2. Kreyszig, E., Advanced Engineering Mathematics, John Wiley, Brisbane, 9th Edition, 2006

BIT18R101	BIOLOGY FOR ENGINEERS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Basic sciences and mathematics			
			Course Type	:	Theory			

Course Outcomes:

CO1: Describe the fundamentals of cell structure and cell cycle

CO2: Understand the classification and functions of biomolecules

CO3: Elaborate the basic cellular mechanisms such as replication, transcription and translation

CO4: Describe the underlying concepts of infection and immunity.

CO5: Explain various applications of biology

Mapping of course outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M		M		H							L	L	
CO2	H	M		H		M							L	M	M
CO3	H			H		M							M		
CO4	H	M		H		H							L		
CO5	H	M		M									L	M	L

Unit I: INTRODUCTION **9 Hours**

Fundamental difference between science and engineering- comparison between eye and camera, Bird flying and aircraft; major discoveries in biology; Classification based on: Cellularity- Unicellular and Multicellular; Ultra structure - prokaryotes and eukaryotes; three major kingdoms of life; Cell structure, intracellular organelles and their functions, comparison of plant and animal cells- Overview of Cell cycle and cell division

Unit II: BIOMOLECULES **9 Hours**

Chemistry of biomolecules: Carbohydrates, Lipids, Proteins; classification of amino acids; classification of proteins based on structure and functions; Nucleic acids -types, structure and function of DNA and RNA

Unit III: GENES TO PROTEINS **9 Hours**

Gene, Genome and chromosome; Central dogma of molecular biology; Classical experiments of DNA: Griffith and, Avery, McCarty and MacLeod, Meselson and Stahl - DNA replication, Transcription and Translation

Unit IV: MICROBIOLOGY **9 Hours**

Microscopy; Microbes as infectious agents - malaria, tuberculosis, typhoid, polio, dengue, AIDS; cultivation of bacteria. Immunity - innate and acquired immunity - organs and cells of the immune system - classification of antibodies - types of T cells - transplantation, autoimmunity overview

Unit V: APPLICATIONS OF BIOLOGY **9 Hours**

Healthcare-antibiotics, vaccines, monoclonal antibodies, insulin and interferons; Beneficial bacteria - probiotic bacteria, nitrogen fixing bacteria, fermentation and fermented foods and products Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for medical and environmental applications; Biosensors;

TEXT BOOKS:

1. De Robertis, E.D.P. and De Robertis, E.M.F. - Cell and Molecular Biology Lippincott Williams & Wilkins- Philadelphia- USA- 8th Edition- 2010.
2. Voet, D., Voet, G., - Biochemistry - John Wiley and Sons, Singapore - 3rd Edition- 2001.
3. Pelczar MJ, Chan ECS and Krieg NR - Microbiology - Tata McGraw Hill, India- 7th Edition- 2010

REFERENCES:

1. Friefelder. D. -Molecular Biology- McGraw-Hill Companies- New York, USA- 5th Edition- 2013.

MEC18R211	ENGINEERING MECHANICS				L	T	P	C
					3	1	0	4
Pre-Requisite	:		Course Category	:	Basic sciences and mathematics			
			Course Type	:	Theory			

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the vectorial and scalar representation of forces and moments of particles and rigid bodies both in two dimensions and in three dimensions.

CO2: Apply the knowledge of trusses in frames, beams and machine components.

CO3: Contrast the effect of friction on equilibrium.

CO4: Illustrate the importance of properties of surfaces and solids.

CO5: Demonstrate the dynamic equilibrium equation.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	L											
CO2	H	M	M	L											
CO3	H	H	M	L											
CO4	H	M	M	L											
CO5	H	L	L	L											

3-StrongCorrelation-2-MediumCorrelation-1–Low Correlation

Unit 1. Statics of Particles and Rigid bodies (9+3) **12 Hours**

Six Fundamental principles and concepts - vector algebra - Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D - System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant - Equations of Equilibrium of Coplanar Systems and Spatial Systems. Rigid Body equilibrium in 2-D & 3-D - Moment of Forces and its Application - Couples and Resultant of Force System - Equilibrium of System of Forces, Free body diagrams - Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Unit 2. Analysis of Trusses (9+3) **12 Hours**

Basic Structural Analysis- Equilibrium in three dimensions - Method of Sections- Method of Joints- How to determine if a member is in tension or compression- Simple Trusses- Zero force members- Beams & types of beams- Frames & Machines.

Unit 3. Friction (9+3) **12 Hours**

Types of friction, limiting friction, Laws of Friction, Static and Dynamic Friction - Motion of Bodies, simple contact friction, sliding block, wedge friction, screw jack & differential screw jack, rolling resistance.

Unit 4. Properties of Surface sand Solids (9+3) 12 Hours

Centroid of simple figures from first principle, centroid of composite sections - Centre of Gravity and its implications - Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections (T section and I section) - Mass moment inertia of circular plate, Cylinder, Cone, Sphere- Principal moment of inertia.

Unit 5. Dynamics (9+3) 12 Hours

Review of particle dynamics - Displacements, velocity and acceleration, their relationship - Equations of motions - Rectilinear motion- Plane curvilinear motion - Newton's 2nd law- Impulse, momentum, impact - D'Alembert's principle and its applications in plane motion and connected bodies - Work energy principle and its application in plane motion of connected bodies - Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies.

Text Book(s):

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units

Reference(s):

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.
2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition

EEE18R171	BASIC ELECTRICAL AND ELECTRONICS ENGINEER (Common to EEE, Food, Biomedical, Biotech & Chemical)				L	T	P	C
					3	1	2	5
Pre-Requisite	:	Basic Knowledge in Physics	**Course Category**	:	Basic Engineering			
			Course Type	:	Integrated Course			

Course Objective(s):

To focus the fundamental ideas of the Electrical and Electronics Engineering by providing wide exposure to the basic concepts of Electrical and Electronics Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments, electrical installation, Basic Electronic Devices and various electronic circuits such as rectifiers, amplifiers, oscillators, etc.

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Apply the basic laws of electricity in DC and AC circuits

CO2: Describe the construction and operation of static and rotating electrical machines

CO3: Explain the functioning of measuring instruments and Low Voltage Electrical Installations

CO4: Describe the constructional features and operation of fundamental electronic devices

CO5: Explain the characteristics of electronic circuits

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M		M	M	L		L	M	L			M		
CO2	M	M		M	M	L		M	L	M			M		
CO3	M			M	M	L		L	M	L			S		
CO4	S	M											M		
CO5	S	S	L	M	M	L	M	M	L	M			M		

Course Topics:

Unit 1: DC Circuits and AC Circuits **9Hours**

Electrical quantities - resistors - inductors - capacitors - Ohm's Law - Kirchhoff's Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems- Sinusoidal functions - phasor representation - RMS and Average values - form and peak factors - RLC series circuits - power andpower factor-concept of three phase system.

Unit 2: Electrical Machines **9Hours**

Construction and principle of operation of DC machines – DC generator – EMF equation – Types – DC motor – Types - single phase transformer – Construction and operation – EMF equation - Alternator - three phase induction motor – Construction – Types - single phase induction motor – Construction – Working - types.

Unit 3: Measuring Instruments and Electrical Installation 9Hours

Measuring Instruments*:* Moving coil and moving iron instruments -dynamometer type wattmeter - Induction type energy meter

Electrical Installation: Components of LT Switchgear - Switch Fuse Unit (SFU) – MCB – ELCB – MCCB- Domestic wiring - accessories - types - staircase wiring - fluorescent tube circuits – Earthing

Unit 4: Electronic Devices 9Hours

Basic concepts of PN junction diodes - Zener diode - bipolar junction transistor - Unipolar devices - FET, MOSFET, UJT - Thyristor–SCR and Triac, Photoelectric Devices-Photo diode and Photo transistor

Unit 5: Electronic Circuits 9Hours

Half wave and full wave rectifier –Transistor as an amplifier –RC- phase shift oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - Schmitt trigger

Text Book(s):

1. V.K. Mehta, “Principles of Electrical Engineering and Electronics”, S. Chand & Company Ltd, 2012
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

Reference(s):

1. T. Thyagarajan, “Fundamentals of Electrical and Electronics Engineering”, SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill,2006.
3. Shantha kumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999.
4. Rajput R. K., Basic Mechanical Engineering, Fourth edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

LIST OF EXPERIEMENTS: 15 Hours

1. Verification of Kirchoff’s Laws.
2. Verification of Mesh and Nodal analysis
3. Measurement of electrical quantities-voltage current, power & power factor in RLC circuit
4. Open circuit characteristics of Separately excited DC Generator
5. Draw the characteristic between output power versus efficiency of DC shunt motor
6. Verification of turns ratio on single phase transformer
7. Study of basic electrical installation components for LT switchgear
8. Residential house wiring using fuse, two way switches and lamp

9. Wiring layout for Fluorescent lamp
10. VI characteristics of PN junction diode
11. VI Characteristics of Zener diode
12. Construct and demonstrate the Light sensor using Photo Transistor
13. Design a diode based Half wave and Full wave rectifier
14. Study of Zener diode as voltage regulator
15. Study of Clipping & Clamping circuit

MEC18R151	ENGINEERING GRAPHICS & DESIGN				L	T	P	C
					3	0	2	3
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory With Practical			

Course Objective(s)

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

Course Outcome(s):

After completing this course, the student will be able to:

CO1: Create the projection of points in all quadrants and straight lines

CO2: Construct the projections of planes and solid objects with refer to reference planes

CO3: Illustrate the true shape of truncated solids in both the manual and computerized manner

CO4: Develop surfaces of truncated solids in both the manual and computerized man

CO5: Apply orthographic and isometric projections in both the manual and computerized man

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		M												
CO2		H										L			
CO3	M		H		H		H					M			
CO4	L	M			H		H					H			
CO5	H		H		H		H					H			

3-Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

Unit1: Projection of Point and Straight Lines 9 Hours

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

Unit 2: Projection of Planes and Solids 9 Hours

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference Planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

Unit 3: Section of Solids **9 Hours**

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

Unit 4: Development of Surfaces **9 Hours**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

Unit 5: Orthographic and Isometric Projection **9 Hours**

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones. Introduction to CAD software – menus and tools – drafting platform demonstration

Practical Modules

1. Construction of conic sections using CAD software
2. Construction of simple planes using exclusive commands like extend, trim etc.,
3. Construction of 3D model – solids and sectional views
4. Generating 2D orthographic blue prints from 3D part models
5. Vectorization of simple building plan and elevation

Text Book(s):

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2013.
2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.
3. K. Venugopal, Engineering Drawing + AutoCAD, New Age; Fifth edition, 2011.

Reference(s):

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Paul Richard, Jim Fitzgerald., Introduction to AutoCAD 2017: A Modern Perspective, Pearson, 2016.
4. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2014.
5. Luzadder and Duff, “Fundamentals of Engineering Drawing”, Prentice Hall of India Pvt. Ltd., 2009.
6. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009.

CSE18R171	PROGRAMMING FOR PROBLEM SOLVING				L	T	P	C
					3	1	2	5
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Integrated Course			

Course Objective(s)

To make the students to understand the basic concepts of programming using C language, syntax and rules to be followed while writing a C program and how to compile and execute C programs.

Course Outcome(s):

CO1 Understand the basic programming concepts and syntax of C language
CO2 Solve simple problems using C using arrays and strings.
CO3 Apply modular programming concept of C to solve given problem.
CO4 Develop efficient code using memory allocation techniques.
CO5 Create user defined data types and files to solve real world problems

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		M													
CO2	M														
CO3	M														
CO4									M						
CO5															

Unit 1: BASICS OF C **9 Hours**

Structure of C program - concept of a variable-Data type in C - Program Statement – Declaration – Tokens - Operators and expressions - Type Conversion - Input and output - Control statements Selection – Iteration-Goto statement - Special control statement—Nested loops

Unit 2: ARRAYS AND STRINGS **9 Hours**

Introduction - One dimensional and two dimensional arrays – Declaration of arrays - Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization-String Manipulation - Multidimensional Arrays - Arrays of String

Unit 3: FUNCTIONS **9 Hours**

Introduction - Concept of function - Using Functions - Call by Value Mechanisms -Working with Functions -Passing Arrays to Functions - Scope and Extend - Storage Classes - Inline Functions – Sorting Using Functions : Bubble sort - Searching : Linear and Binary Search – Recursive Functions.

Unit 4: POINTERS **9 Hours**

Introduction - Address of operands – Pointer: Declaration and Initialization - Arrays and Pointers - Pointers and Strings - Pointer Arithmetic - Pointers to Pointers - Array of Pointers - Pointer to Array - Dynamic Memory Allocation (DMA)

Unit 5: USER DEFINED DATA TYPES AND FILES **9 Hours**

Introduction – Structures - Declaration and Initialization of Structures - Arrays within Structure - Structure and Pointers - Structures and Functions – Union - Enumeration types - Using Files in C - Working with Text Files - Working with binary files

LIST OF EXPERIMENTS **15 Hours**

1. Programs using control and looping statements.
2. Programs using 1-D and 2-D arrays.
3. Programs using string handling functions.
4. Programs using functions with various parameter passing mechanisms.
5. Programs using recursive functions.
6. Programs using pointers and dynamic memory allocation functions for 1-D and 2-D arrays.
7. Programs to create user defined data like structures and unions to represent real world problems Programs for creating text files to store and manipulate data.

Text Book(s):

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, Oxford University Press, 2nd Edition, 2013.
2. Byron S. Gottfried, “Programming with C”, Second Edition, Tata McGraw Hill, 2006

Reference(s):

1. Brian W. Kerninghan and Dennis M.Richie, “The C Programming language”, Pearson Education,2005.
2. Johnsonbaugh R. and Kalin M, “Applications Programming in ANSI C”, Third Edition, Pearson Education, 2003.
3. .E. Balagurusamy, “Programming in ANSI C”, Fourth Edition, Tata McGraw Hill 2008.

MEC18R152 ENGINEERING PRACTICE	Credits			
	L	T	P	Credit
	3	0	2	3
Pre-requisite: Nil	**Course Category:** Basic Engineering **Course Type:** Theory with Practical			

Lectures & videos:

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Carpentry **(1 lecture)**
5. Plastic moulding, glass cutting **(1 lecture)**
6. Metal casting **(1 lecture)**
7. Welding (arc welding & gas welding), brazing **(1 lecture) Suggested**

Text/ Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Workshop Practice:

1. Machine shop **(10 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(6 hours)**
4. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**
5. Casting **(8 hours)**

6. Smithy **(6 hours)**
7. Plastic moulding & Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

FT18R101	PRINCIPLES OF CHEMICAL ENGINEERING	L	T	P	Credit
		3	1	0	4
Prerequisite: NIL		**Course Categories:** Program Core **Course Type :**Theory with tutorial			

Objective(s)

To acquaint them with the fundamentals of the application of material and energy balances in chemical engineering

Course Outcome(s)

CO1 Attain basic knowledge about Process calculation
CO2 Understand material balance calculation for process
CO3 Apply Energy balance calculation for process
CO4 Understand the fluid flow behavior and transportation.
CO5 Apply thermal processing of foods and its equipment

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		M								M	L	M	L
CO2	M	M	L	M		M	L					M	M	L	L
CO3	H	M	M	M	M	M		M	M			M	M	M	M
CO4	H	M	M	M	H	M						M	L	L	M
CO5	H	M	L		H	M	M					H	M	H	H

Course Topic(s)

UNIT – I UNITS AND DIMENSIONS, FUNDAMENTAL CALCULATIONS 12hours

Units and dimensions, Concept of mole and Molecule, Composition of mixtures of Solids,liquids and gases- Composition of mixtures and solutions- Percentage by weight, mole andVolume; normality, molarity, molality, ppm, pH and pKa Buffer Calculations

UNIT – II MATERIAL BALANCE WITH AND WITHOUT CHEMICAL REACTIONS 12hours

Material balances in distillation, absorption, extraction, crystallization, drying, mixing and evaporation operations, Material balances involving bypass, recycle and purge.

Principles of stoichiometry, definitions of limiting and excess reactants, fractions and percentage conversion, yield and percentage yield, Selectivity and related problems.

UNIT III ENERGY BALANCE 12 hours

General energy balance equation for steady and unsteady state processes, Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Heat of combustion.

UNIT IV FLUID FLOW THEOR **12 hours**

Properties of fluids: Fluid statics& Dynamics,Newtonian and non-Newtonian liquids, Reynolds number: Laminar flow and turbulent flow,stress in fluid flow, Pressure drop calculation and friction factor –Fluid flow measurements: variable head meter, variable area meter, Paddle flow meter, pitot tube.Forces on submerged bodies -Equation of continuity and motion - Bernoulli•s equation and its applications, influence of temperature on viscosity. Pumps & Its classification, Pipe fittings & valves.

UNIT V THERMAL PROCESSING **12 hours**

Decimal Reduction time (D), Thermal resistance constant, thermal death time (F), Relationship between chemical Kinetics and Thermal processing Parameters: Decimal reduction time, rate constants k and Q10 Thermal resistance constant z, Activation energy Ea and their inter-relationship. Plate heat exchanger, Tubular heat exchanger ,

TEXT BOOKS

1. McCabe, W.L., Smith, J.C., Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill, New York, 7th ed, 2005.
2. Brennan, J. G., Butters, J. R., Cowell, N. D. and Lilly, A. E. Food Engineering Operations, Applied Science, London, 3rd Edition, 1990.

REFERENCE BOOKS

1. S K Ghosal, S K Sanyal, S Datta. “Introduction to Chemical Engineering” . Tata Mc Graw-Hill Publishing Company Limited. 2011.
2. Narayanan, K.V. and Lakshmi Kutty. “Stoichiometry and Process Calculations”,PHI, 2006.
3. “Chemical Engineering” by Coulson & Richardson. Vol.1 & 2

FT18R201	FOODADDITIVES	L	T	P	C
		3	0	0	3
Prerequisite: NIL		**Course Categories:** Program Core **Course Type:** Theory			

Objective(s) To enable the students to understand types and chemical properties of preservative, emulsifiers and antioxidants

Course Outcome(s)

CO1 Interpret the applications of food additives in Food Industry
CO2 Identify adulterants in food additives
CO3 Classify preservative and its limitation in food processing industries
CO4 Categorize colorant and flavor of food additives
CO5 Relate Laws and quality standards related to food additives

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1			L									L	H	M	H
CO2	M	M	H	L		M	L	M				M	H	M	M
CO3	H	M	H		`	M	L	M				M	H	H	L
CO4	H	M	H	L		H	L	M	L	L		M	H	M	L
CO5	M	H	H			H	H	H	L	L		M	H	L	H

Course Topic(s)

Unit 1: FOOD ADDITIVES 9 Hours

Food additives definition – Determination of the limit for addition, functions of Acid, Base, Buffer systems, Salts and chelating /sequestering a g e n t s , Low calorie and non-n utritive sweeteners, Polyols.

Unit 2: TYPES OF FOOD ADDITIVES 9 Hours

Types, chemical properties, levels of additions in individual products, toxicity data of Acidulates – Preservatives – Emulsifiers and gums – Antioxidants- Anti-caking agents, thickeners,

Unit 3: PROPERTIESE AND ENZYMES 9 Hours

Types, chemical properties, levels of additions in individual products, toxicity data of Dough conditioners - flour improvers – Humectants –Enzymes, Starches-

Unit 4: COLOURANTS AND FLAVORANTS 9 Hours

Types, chemical properties, levels of additions in individual products, toxicity data of Colourants – Natural and artificial, Flavourants, Flavour enhancers, Fat substitutes and Replacers

Unit 5: NATURAL, SYNTHETIC AGENTS AND LAW 9 Hours

Types, chemical properties, levels of additions in individual products, toxicity data Sweeteners – Natural and synthetic, Chelating agents, anti-browning agents, SWMA, MPO(1977), VCO(1978), AGMARK, BIS, US, Canadian, EU, ISO and Codex Food Standards, Export Quality Control and Inspection act (1963)

Text Book(s):

1. Food additives by Brannen A.L., Davidson P.M., Salminen S. and Thorngate J.H. Second Edition, Revised and Expanded. Marcel dekker Inc. USA, 2002.

Reference Book(s):

1. Jim Smith, Lily Hong – Shum. "Food Additives Data Book". John Wiley & Sons. 2nd Edition.2011.
2. Richard J.Lewis, Sr."Food Additives Handbook" .International Thomsan Publication. 1989

FT18R251	PRINCIPLES OF FOOD PROCESSING & PRESERVATION	L	T	P	Credit
		3	0	1	3.5

Prerequisite: NIL **Course Categories:** Program Core

Course Type: Theory with Practical

Objective(s)

To Introduce students about the methods of processing and preserving food to prevent wastage and losses

Course Outcome(s)

CO1 Understand the needs for preservation and mechanisms of preservation

CO2 Understand the importance of the processing and formulation bottleneck organisms

CO3 Apply preservation principles in product design

CO4 Calculate the efficacy of a heat process and interpret its key parameters (i.e. D-, z, and F0 - values)

CO5 Enhance the effectiveness of preservation methods and the efficiency of production

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M												H	L	M
CO2	H		M	M	M	M	M	M				M	L	M	L
CO3	H	H	H	H	H	H	H	H	L			H	H	M	H
CO4	H	M	H	M	H	M	M	M	L	L		M	M	M	H
CO5	H	M	M			H	H	M	M	M		H	L	L	H

Course Topic(s)

Unit 1: INTRODUCTION: 9 Hours

Sources of food- plant, animal and microbial origin; Different groups of food; properties of food- physical, mechanical, thermal and sensory; Biochemical changes during processing of foods. Scope and importance of food processing.

Unit 2: LOW TEMPERATURE PROCESSING 9 Hours

Chilling and freezing: Freezing - Phase diagram, ice crystal formation, comparison of freezing and thawing. Freezing methods: air freezing, plate freezing, liquid immersion freezing and cryogenic freezing. Freeze concentration of liquid foods.

Unit 3: HIGH TEMPERATURE PROCESSING 9 Hours

Methods of applying heat to foods-sterilization, Blanching, Pasteurization. Basic concepts in thermal destruction of microorganisms -D, Z, F values. Sterilization- methods and equipments, UHT, Aseptic processing and packaging.

Unit 4: DRYING AND DEHYDRATIONS 9 Hours

Theory and mechanism of drying-water activity and its effect on the keeping quality, sorption isotherms and their use, factors affecting rate of drying, methods of drying of various food products- batch and continuous drying, spray dryer, fluidized bed dryer, Freeze drying and

vacuum drying

Unit 5: PRESERVATION **9 Hours**

Introduction to food spoilage; Preservation of foods by use of sugar, salt, chemicals, smoking, pickling, curing, fermentation, baking, extrusion and canning, and Packaging-CAP, MAP. Hurdle technology.

Text Book(s):

1. B. Sivasankar. "Food Processing and Preservation". PHI Learning Private Limited. 2015.
2. Fellows, P.J. "Food Processing Technology : Principles and Practice". Wood head Pub. Ltd, 2nd Edition, 2002.

Reference(s):

1. M. Shafeiur Rahman (1999). Handbook of Food Preservation, Marcel Dekker, Inc.
2. Khetarpaul N. "Food Processing and Preservation". Dya Publishing House, New Delhi. 2005

FT18R271	FOOD MICROBIOLOGY	L	T	P	Credit
		3	0	2	4

Pre requisite: NIL **Course Categories:** Program Core
Course Type: Integrated Courses

Course Objective(s)

Recognize and describe the characteristics of important pathogens and spoilage microorganism s in food

Course Outcome(s)

CO1 Acquire knowledge on historical developments in microbiology & classify the structure of microorganisms.
CO2 Interpret significance of microbial spoilage in different foods
CO3 Apply the knowledge of microorganisms in fermentation process.
CO4 Categorize food borne diseases and intoxication caused by microorganisms
CO5 Formulate microbiological quality control programmes for growth control.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M											L	L	L	
CO2	M	L	M			M	M		M	H	M	M	M	M	L
CO3	H	M	H	L		M	M		H	H	L	M	H	M	M
CO4	H	M	M	M		M		M	M	M	H	H	M	M	L
CO5	H	H	M	M	H	H	H	M	M	M	L	M	M	M	H

Course Topic(s)

Unit 1: INTRODUCTION 9Hours

Introduction, historical developments in the food microbiology and its Significance, Microscope and its types, Microbial growth pattern, Study of microorganisms- Morphology, structure, classifications - bacteria, virus, fungi, yeast and mold, Microbiological Methods of enumeration and isolation of bacteria and fungi.

Unit 2: CONTAMINANTS& SPOILAGE 9Hours

Sources of contamination, Spoilage of foods-Factors affecting Spoilage, Biochemical changes caused by microorganisms, Contamination and spoilage of foods- Fruits &vegetables, cereals & pulses, milk, sea foods and meat during Handling and processing.

Unit 3: MICROBES IN FOOD FERMENTATION 9Hours

Importance of microbes in food fermentation, batch, fed batch and continuous fermentation, Homo and hetro-fermentative bacteria, yeast & fungi; Biochemistry of fermentation-pathway involved, Types of fermentation - lactic acid fermentation, alcoholic fermentations, Fermented foods – Sauerkraut, Cheese, Beer, Vinegar, yoghurt, soy products

Unit 4: FOOD BORNE DISEASES 9Hours

Factors affecting growth of microorganism in food - intrinsic and extrinsic factors, foodborne Pathogens- Bacterial food borne diseases, Food Borne Viral Pathogens, Food Borne Animal Parasites, Food poisoning, food infection and intoxication.

Unit 5: FOOD SPOILAGE CONTRO 9 Hours

Control of microorganisms- physical and chemical agents, Anti-microbial agents- their mechanism of action, HACCP & food safety, Hurdle Technology and its applications.

List of Experiments 15 hours

1. Microscope its parts and utility in identification and differentiation of bacteria, yeast and mold.
2. Micrometry and determination of size of deferent different microbes
3. Direct total, viable, and non-viable count of microorganisms in milk.
4. Preparation and sterilization of culture media for microbial counts
5. Simple and differential staining of microorganisms and their examination.
6. Determination of Standard Plate Count (SPC) in natural and processed foods
7. Preparation of different types of plating techniques
8. Isolation of bacteria in food
9. Determination of Standard Plate Count (SPC) in milk
10. Enumeration of yeast and mold in food
11. Microbiological examination of potable water: Total and coliform count.
12. Preparation of yoghurt

Text Book(s):

1. Frazier, W.C. and Westh off. “Modern Food Microbiology”. Tata McGrawHill Publishing Co. Ltd., New Delhi,4 Edition,2008.

Reference(s):

1. Adams M.R. and Moss M.O. “Food Microbiology”. New Age International Ltd Publication. 2007.
2. Bibek Ray. “Fundamental food microbiology”. CRC Press. 3rd Edition. 2005.

FT18R272	FOOD BIOCHEMISTRY	L	T	P	Credit
		3	0	2	4

Prerequisite: NIL **Course Categories:** Program Core
Course Type: Integrated Course

Objective(s)

1. To understand the chemistry of foods - composition of food, role of each component and their interactions.
2. To study the properties of various food components which affect the quality of food.

Course Outcome(s)

CO1 Indicate the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications
CO2 Interpret the structure and properties of carbohydrates
CO3 Enumerate the structure and properties of lipids
CO4 Elaborate the minerals and vitamins and their immobilization
CO5 Elucidate the structure of pigments and illustrate the basics of energy metabolism

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M					M	H					H	H	M	M
CO2	H	L				M	L		M	M		M	M	M	L
CO3	H		L	M	H	L		L	M	H	M	M	H	L	L
CO4	H	M	L	M	L	M		M	M	H	M	L	M	L	L
CO5	H	H	M	M	M	M	M	M	M	H	M	M	H	M	L

Course Topics

Unit 1: INTRODUCTION 9 Hours

Importance of food, Scope of food chemistry - Introduction to different food groups: their classification and importance -Water -Structure of water molecule, types and properties of water, water activity and its importance

Unit 2: CARBOHYDRATES 9Hours

Carbohydrates -Definition, classification, sources, chemical make-up, properties, nutritional and industrial importance- Proteins - Sources, chemical make-up, properties, nutritional aspects– amino acids, amino essential acids, biological value, PER (Protein Efficiency Ratio), and industrial importance

Unit-3 FATS 9 Hours

Fats -Sources, chemical make-up, properties, nutritional aspects – essential fatty acids, PUFA (Polyunsaturated Fatty Acids) hydrogenation, rancidity and industrial-importance - Deficiency disorders and requirement of differentnutrients

Unit 4: MINERALS & VITAMINS 9 Hours

Minerals and Vitamins – Importance and sources of minerals and vitamins with special emphasis on calcium, iodine, zinc, iron, floride, fat, and minerals soluble and water-soluble vitamins, effect of processing and storage on vitamins- Deficiency disorders and requirement of different vitamins

Unit 5: FOOD PIGMENTS AND ENZYMES 9 Hours

Food Pigments-Importance, types and sources of pigments - their changes during processing and storage- Enzymes -Definition, importance, sources, nomenclature, classification –discuss their application in food processing in brief

List Of Experiments 15 Hours

1. Estimation of reducing, non- reducing, total sugars.
2. Estimation of protein by Lowry's method/ Biuret method
3. Estimation of fat using soxhlet apparatus.
4. Estimation of moisture content in different foods.
5. Estimation of carotenoids in spices.
6. Estimation of Starch in cereals.
7. Determination of pH and Titratable acidity of foods
8. Estimation of Ascorbic acid in fruits
9. Determination of ash in foods
10. Determination of Fiber in foods
11. Estimation of enzymatic browning in food
12. Estimation of antioxidant(s) / polyphenol(s) in food sample

Textbook(s):

1. Belitz, H.D., Grosch .W., Schieberle .P. " Food Chemistry". Springer Publication, 4th Edition, 2009.
2. Dulsy Fatima. "Biochemistry". Saras Publication, 2015.

Reference(s):

1. John M. deMan. "Principles of Food Chemistry". An Aspen Publication. 1999.
2. Owen R.Fennama. "Food Chemistry". Marcel Dekker. 3rd Edition. 1996.

FT18R202	INSTRUMENTAL METHODS OF ANALYSIS FOR FOOD	L	T	P	C
		3	0	0	3

Prerequisite: NIL **Course Categories:** Program Core

Course Type: Theory

Course Objective(s)

Provides students with an opportunity to identify different types of analytical instruments in their respective laboratories

Course Outcome(s)

CO1 Illustrate the usage of conductance and potential measurements for analysis of components

CO2 Interpret the application of UV-Visible and IR spectroscopy in food analysis

CO3 Apply X- ray diffraction, flame photometers and Polarimetry in food analysis

CO4 Explain the thermal methods to analyze different food materials

CO5 Infer the chromatographic principles to separate and analyze materials

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M	L	L	H		L					M	H	H	L
CO2	M	H	M	M	M	M	L					M	H	H	L
CO3	H	H	H	L	H	M	M					L	H	H	L
CO4	H	M	M	H	M		L	M				L	M	M	M
CO5	H	H	H	H	H	M	L	L	M	L		L	M	M	M

Course Topic(s)

Unit 1: COMPONENTS AND CLASSIFICATIONS OF INSTRUMENTS 9 Hours

Classification- Types of optical instruments- Fourier transform measurements, Calibration of instrumental Methods- precision, validity. Electrical components and Circuits, Signal to noise ratio- Signal-Noise enhancement -General Design-Sources of Radiation-Wavelength selectors- Sample containers-Radiation transducers.

Unit 2: TRANSMITTANCE AND ABSORBANCE 9Hours

Spectrometry: Electromagnetic radiation – electromagnetic spectrum, Interaction of electromagnetic radiation with matter. Spectrophotometer analysis- Measurement of transmittance and Absorbance- Beer's law- Qualitative and quantitative absorption Measurements-Types of spectrophotometers–UV- Visible-IR-Raman Spectroscopy-Principle, instrumentation and applications. Visible spectrometry and Calorimetry – Theory, Instrumentation (Line diagram alone) and applications. Ultra violet spectroscopy – Theory, instrumentation - Single and Double beam, applications. Infra-red spectroscopy – Theory, Fundamental Vibrations, Instrumentation, Applications.Turbidimetry & Nephlometry

Unit3: ATOMIC ABSORPTION& PHOTOIONIZATION MEASUREMENTS 9 Hours

Atomic Absorption and NMR Spectroscopy: AAS - Principle, Instrumentation and applications. NMR spectroscopy – Principle, Instrumentation, Chemical shift and applications. X-ray diffraction - Principle, instrumentation, detectors and applications. X- ray-photo electron spectroscopy(XPS)-Ultravioletphotoelectronspectroscopy(UPS)- Electron impact spectroscopy and auger electron Spectroscopy-Instrumentation Radiation Sources-Energy Analysis-Detectors and auxiliary systems. Flame photometer - Theory, Instrumentation and applications. Polarimetry- specific rotation, optical activity, Principle and instrumentation. Saccharimetery- Analysis of Sugar.

Unit 4: THERMO GRAVIMETRIC AND CONDUCTOMETRY 9 Hours

Thermal methods: thermos balance, derivative thermos gravimetric analysis-Thermogravimetry, Differential thermal analysis, Differential Scanning Calorimetry – Principle, Instrumentation, Applications and difference. Conductance and Potential Measurements: Definitions, conductance measurements, applications, Types, advantages and disadvantages of Conductometric titrations. Potential measurements, pH determination, Potentiometric Titrations. Basic principles of electrophoresis, theory and application of paper and gel.

Unit 5: SIZE EXCLUSION AND IONEXCHANGE CHROMATOGRAPHY 9 Hours

Introduction to chromatography- principle, types, applications, models, ideal separation, retention parameters, Van Deemter Equation-Gas chromatography, stationary phases, detectors- Kovats indices- HPLC-reverse phase and normal phase, pumps, columns, detectors- Ion Exchange Chromatography-Size Exclusion Chromatography-Supercritical chromatography- Capillary electrophoresis

Text Book(s):

1. Chatwal, Gurdeep R., and Anand, Sham K., ―Instrumentation Methods of Chemical Analysis‖, 2nd Edition, Himalaya Publications, Bombay, 2003.
2. Willard, H., Merrit, L.,Instrumental Methods and Analysis, CBS Publishers and Distributors, NewDelhi,7th Edition,2004
3. Skoog, Holler and Nieman., Principles of Instrumental Analysis, Thomson Asia Pvt Ltd., Singapore,5th edition, (Reprint)2003

Reference(s):

1. Chatwal, R.G.,Anand, K.S.,Instrumental Method of Chemical Analysis, Himalaya PublishingHouse,Mumbai,5thEdition(Reprint),2006
2. Ewing,G.W.,InstrumentalMethodsofChemicalAnalysis,McGrawHillCompany, NewDelhi,5thEdition,1989.
3. Skoog Douglas A., West Donald M., Holler F James, and Crouch Stanley R., ―Analytical Chemistry: An Introduction‖, 7 th Edition, South-Western, Australia, 2000.

FT18R203	TECHNOLOGY OF DAIRY PRODUCTS	L	T	P	Credit
		3		0	3
Prerequisite: NIL					**Course Categories:** Program Core
					Course Type: Theory

Objective(s)

1. To enable the students to understand the need and importance of dairy
2. To know the compositional and technological aspects of milk

Course Outcome(s)

CO1 Identify the physico-chemical properties of milk
CO2 Relate the acquired knowledge on raw milk collection, transportation and reception
CO3 Correlate the technical aspects of fluid milk processing and production of milk Products
CO4 Select and design appropriate dairy processing equipments
CO5 Choose suitable cleaning operations in dairy industry

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M										M	H	M	M
CO2	H	M	M	M	M	H	M	M				M	H	M	H
CO3	H	M	L		M	M	M	M				M	M	H	M
CO4	H	M	H			M	M	M	M	M		M	M	M	H
CO5	M	L	H		M	M	M	H	M	M		H	M	M	H

Course Topic(s)

Unit 1: INTRODUCTION 9 Hours

Introduction, Milk – Types, composition, nutritive value, factors affecting composition, physico- chemical properties- Color, Flavour, Specific Gravity, Boiling point, Freezing point, Refractive Index, Acidity and pH, Viscosity, Surface Tension, System of pricing of milk.

Unit 2: PRIMARY PROCESSES OF MILK 9 Hours

Raw milk collection – cooling and transportation – milk reception –Platform tests- Quality and Quantity tests at reception- contaminants, Smell, Appearance, Temperature, Sediment, Acidity, Lactometer Reading, Fat, Solids-Not-Fat, Dye Reduction Test: MBRT test, Resazurin tests, Mastitis test -Processing of milk, filtration, clarification, Bactofugation of milk, Cooling and storage of raw milk, Bulk transportation technologies – carbon dioxide impregnation. Milk Standardization, cream separation, Homogenization, Milk Pasteurization & heat treatment of milk-Milk Sterilization.

Unit 3: MANUFACTURE OF DAIRY PRODUCTS 9Hours

Fluid Milk Processing, Milk product Processing – cream, Butter, Khoa, Paneer, Ice- cream, condensed milk & evaporated milk.Judging & grading of milk & its products.Dried milk prod ucts -Buttermilk powder, Whey Powder, IceCream mixPowder, Infant milk food, WMP& SMP. Manufacturing of Fermented productYoghurt, Curd, acidophilus milk, buttermilk, and Cheddar cheese,Introduction, Manufacturing process, packaging, storage, defects and their prevention

Unit 4: BYPRODUCTS UTILIZATION 9Hours

Introduction, Classification & composition of byproducts, Principles & methods of Utilization –whey utilization, Applications of enzymes in dairy industry

Unit 5: CLEANING AND SANITATION OF DAIRY EQUIPMENTS 9 Hours

Dairy plant sanitization – Basic principles, Cleaning in place-types and design of CIP System, agents and methods – bottle and can washing- Rotary type and Straight through type, cleaning of tankers and silos – Energy use in Dairy plant - sources and cost of energy, Control of energy losses and Energy conservation.

Text book(s):

1. SukumarDe, Outlines of Dairy Technology, OxfordUniversity Press, 2nd edition,1994.
2. JamesN.Warner, Principles of Dairy Processing, Wiley Eastern Ltd,3rdedition1998.
3. Tufail Ahmed, ―Dairy Plant Engineering and Management‖, Kitab Mahal, New Delhi, 2012.

REFERENCS

1. Y.H.Hui. "Dairy Science and Technology Handbook-". Wiley Publication. 2005.
2. Jane Selia dos Reis Coimbra, Jose A. Teixeira, ―Engineering Aspects of Milk and Dairy Products‖, CRC Press, New York, 2010.
3. Robinson R.K., ―Modern Dairy Technology: Advances in Milk Products‖, Volume 2, Springer London Ltd., 2012

FT18R281	BAKERY AND CONFECTIONARY LABORATORY	L	T	P	Credit
		0	0	3	2
Co requisite: NIL		**Course Categories:** Program Core **Course Type:** Laboratory Course			

Course Objective(s)

To learn the formulation and processing of bakery and confectionary products

Course Outcome(s)

CO1 Relate the production of white bread, whole wheat bread, bun, and pizza
CO2 Show the preparation of different types of biscuits
CO3 Regonize the sponge and butter cake manufacturing process
CO4 Develop the confectionary products
CO5 Observe the chocolate manufacturing process

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	M	M	M		L	L	M	M		M	M	L	H
CO2	H	M	M		M		M		M	L	M	M	H	M	M
CO3	H	M	H				L	L	H	M	M	M	M	H	H
CO4	M		M				M		H	L	M	H	M	M	M
CO5	L	M	L	L	M		L		M	L		M	L	M	L

Experiments **45 Hours**

1. Preparation of whole wheat bread& multigrain bread
2. Preparation of bun
3. Preparation of puffs and pizza
4. Preparation of doughnuts
5. Preparation of Hard dough biscuits&soft dough biscuits
6. Preparation of multigrain biscuits&high fiber biscuits
7. Preparation of multigrain cookies, Butter Cookies and Plain cookies
8. Preparation of Sponge cake, Chocolate and Fudge Cake
9. Preparation of cake [Eggless]
10. Preparation of Muffins
11. Preparation of hard boiled candies
12. Preparation of chocolates

Text Book(s):

1. Beckette, Industrial Chocolate Manufacture, Wiley-blackwellpublisher,3rdedition,2009
2. FaridiFaubion, Dough rheology and baked product texture,CBSpublications,1997

Reference Book(s):

1. Pyler, Baking science and Technology,SoslandPubCo,2009

FT18R273	UNIT OPERATIONS IN FOOD PROCESSING			L	T	P	C
				3	1	2	5
Pre-Requisite	:	FT18R101	Course Category	:	Program core		
			Course Type	:	Integrated Course		

Course Objective(s):

This course aims at making the students understand the fundamental principles and concepts of heat transfer and mechanical operation in biochemical processes.

Course Outcome(s)

CO1: Characterize particles and perform size reduction and size analysis of particles
CO2: Explain the principles of agitation & mixing and its applications
CO3: Derive the concepts of Filtration & Sedimentation and its applications
CO4: Elucidate the principles of Evaporators and its industrial application
CO5: Enumerate the performance of material and energy balance in Distillation

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	H	L		L						M	H	M	L
CO2	H	H	M	H	M	L	M		M	L		M	M	H	M
CO3	M	M	H	M	M	L	L		M	M		M	M	M	M
CO4	M	M	H	M	L	M		L	M	M	L	M	M	M	H
CO5	H	H	M	M		L	L	M	L	L	L	M	H	H	H

Course Topic(s)

UNIT-I SIZE REDUCTION AND SEPARATION 9Hours

Size reduction principles, Need for size reduction and Laws: Kicks law, rittingers law and Bonds law, Size reduction operation: Compression & Attrition, Impact, Cutting & Grinding - various grinding equipments–Sieving Principles and equipments.

UNIT-II AGITATION AND MIXING 9Hours

Types of impellers and blades, Power for agitation, Agitation of liquids - Gas-liquid systems – Gas- solid, and liquid-solid**,** emulsification suspensions, Agitator scale up,

UNIT-IIIFILTRATION&SEDIMENTATION 9Hours

Constant pressure and constant volume filtration, batch filtration, continuous filtration – Industrial filtration equipments: Plate & frame, centrifugal, rotary drum filter, vacuum leaf filter, pressure filter, gravity filter- batch sedimentation test – Centrifugation, Flocculation.

UNIT-IV EVAPORATORS 9Hours

Steam economy, capacity, and boiling point elevation. Types of evaporators - Open pan evaporator, horizontal tube evaporator, vertical tube evaporator, long tube evaporator, forced circulation evaporator, Film type evaporators – working principle and applications. Multiple effect evaporators: Feed forward and feed backward operations.

UNIT-V DISTILLATION 9Hours

Vapour-liquid equilibria, Raoult's law and deviations from ideality. Methods of distillation: Simple distillation- calculations using Rayleigh equation, Flash vaporization, steam distillation. Design of multistage tray towers for binary systems using McCabe-Thiele method

List Of Experiments 15 Hours

1. Experiments on size reduction of fibrous food
2. Experiments on pulse milling
3. Experiments on grinding machine to determine the new surface created.
4. Experiments on pneumatic separation
5. Experiment on sieve analysis
6. Experiment on drying
7. Experiment on mixing index
8. Experiment on simple distillation
9. Determination of Work Index in Size reduction operation.
10. Experiment on batch sedimentation
11. Experiment on filtration
12. Experiment on Open pan evaporator

Text Book(s):

1. McCabe, W. L., Smith, J.C., Harriott, P., Unit Operations of Chemical Engineering, McGraw- Hill, NewYork,7th edition., 2005.
2. Brennan ,J. G., Butters, J.R., Cowell, N.D. and Lilly, A.E., Food Engineering Operations, AppliedScience ,London, 3rdEdition,1990.

Reference(s):

1. Coulson, J.M., Richardson, J.F, Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Volume-I, Butterworth Heinemann, Oxford, NewYork,5th Edition,2002.
2. David, M.Himmel blau, Basic Principles and Calculations in Chemical Engineering, Prentice- Hall of India, New Delhi, 7thEdition, 2004

FT18R301	FOOD PACKAGING TECHNOLOGY	L	T	P	Credit
		3	0	0	3

Prerequisite: FT18R251 **Course Categories:** Program Core

Course Type: Theory

Course Objective (s)

To study about the functions of packaging along with the influence of various factors on food

Course Outcome(s)

CO1 Infer basic concepts in food packaging and its importance in food Industry.

CO2 Classify plastics and elaborate their properties

CO3 Choose appropriate metal and glass containers for food packaging

CO4 Use recent trends in food packaging for right application in Food Industry

CO5 Explain the laws, regulations and environmental standards pertaining to food Packaging

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	L	L				M						L		M
CO2	H	H	M	L	H		H	L				L	H	H	M
CO3	H	M	M	L	M	L	L		L			L	H	M	M
CO4	H	H	H	H	M	H	L	L	M	L		L	H	M	L
CO5		M				H	M	H				M	M	L	H

Course Topic(s)

Unit 1: INTRODUCTION TO FOOD PACKAGING 9 Hours

Packaging terminology –definition. Functions of Food Package, Packaging environment. Food marketing and role of packaging. Characteristics of food stuff that influences packaging selection - Packaged product quality and shelf life. Current status in food packaging in India.

Unit 2: PLASTIC AND PAPER PACKAGING 9 Hours

Types of plastics used in packaging – PE, PP, PET, PVC, EVOH, PVA. Secondary conversion techniques – film, extrusion and thermal lamination. Printing of plastic films and rigid plastic containers. Food contact and barrier properties. Sealability and closure. Application of plastics for food packaging.Paper and Paperboard Packaging: Properties of paper and paperboard. Paper and paperboard manufacture - SBB, SUB, FBB, and WLC. Package types – paper, pouches, sachets, cartons, boxes, tubes, tubs, containers, drums, tapes, cushion, cap liners and diaphragm. Application of paper and paperboards for food packaging.

Unit 3: GLAS & METAL PACKAGING 9 Hours

Glass - Composition, Glass bottle design and specification, Glass container manufacture– melting, forming, surface treatments, Closure selection. Application of glass containers in food industries. Metal cans: Raw materials for can making – steel, aluminium. Can making processes - three piece welded cans, DWI, DRD cans – end making processes – coating. Film laminates and inks, metal packages – corrosion and sulphur staining. Latest developments in can making, Application of metal containers in food industries

Unit-4 TRENTS IN PACKAGING OF FRESH AND PROCESSED FOODS 9 hours

Special packaging methods- TETRA Packs, modified atmosphere packaging, Inner gas & vacuum packaging, Carbonation, Edible Packaging, Biodegradable packages, shrink wrapping, retort pouches, nano packaging, antimicrobial packaging, self-heating and cooling cans. Convenient packages-blister pack, stand up and zip lock pouch. filling machines – Aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines. Packaging of Horticulture products, Carbonated beverages and dairy products – UHT milk and Cheese.

Unit-5 LAWS, REGULATIONS AND ENVIRONMENTAL ISSUES IN PACKAGING 9 Hours

Packaging Laws and Regulations, Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials; Packaging material residues in food products; Environmental & Economic issues, recycling and water disposal.

Text Book(s):

1. Richard Coles and Mark J. Kirwan, ―Food and Beverage Packaging Technology‖, 2nd Edition, Blackwell Publishing Asia Pty Ltd, CRC press, USA, 2011.
2. Robertson Gordon L., ―Food Packaging: Principles and Practice, 3rd Edition, Marcel Dekker Inc, USA, 2012.

Reference(s):

1. Han Jung H., ―Innovations in Food Packaging, 2 nd Edition, Academic Press, USA 2013.
2. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, ―Food Packaging Science and Technology, CRC press, USA, 2008.
3. Otto G . Piringer and A.L. Baner, ―Plastic Packaging Materials for Food‖, 1st Edition, Wiley VCH, Germany, 2008.
4. Ahvenainen,R. " Novel Food Packaging Techniques". CRC Press. 2003.
5. Coles, R., McDowell, D. and Kirwan, M.J. "Food Packaging Technology". CRC Press.2003.

FT18R381	FOOD ENGINEERING LABORATORY	L	T	P	Credit
		0	0	2	1
Prerequisite: NIL		**Course Categories:** Program Core **Course Type:** Laboratory Course			

Objective(s) To understand the principle and working of various food engineering operation and machinery

Course Outcome(s)

CO1 Explain the construction and operating principles of food and beverage processing systems using engineering terminology
CO2 Infer the effects of drying rate in foods and its impact
CO3 Construct freezers and preservation of food by refrigeration
CO4 Outline the physical and rheological properties of food and its changes during processing
CO5 Identify the heat and Mass transfer in food processing

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		M			L			M	M			H	M	L
CO2	M	M	H	M	M				H	M	M		M	L	`
CO3	H	M	H	M	M				M	H	M	M	H	M	H
CO4	H	M		H		L		M	H	H	M	M	L	H	L
CO5	H	L	M			L		M	L	L	L	M	M	L	L

Experiments **45 Hours**

1. Determination of drying rate of given food materials
1. Experiments on extrusion cooking
2. Experiments on microwave cooking
3. Experiments on freezing of foods – freeze thaw stability
4. Experiments on determination of physical properties of foods
5. Experiments on rheological properties of foods
6. Experiments on thermal conductivity of materials
7. Experiments on determination of firmness of foods
8. Experiments on determination of hardness of food
9. Experiments on tear strength of packaging materials

Text Book(s):

1. Nuri N. Mohsenin: Physical Properties of Plant and Animal Materials Gordon and Reach Science Publishers (1970)
2. Nuri N. Mohsenin: Thermal Properties of Food & Agricultural materials Gordon and Reach Science Publishers (1970)

Reference Book(s):

1. M.A.Rao and S.S.H.Rizvi: Engineering Properties of Foods Mercel Dekker inc. New York (1998)

2. M.J.Lewis: Physical Properties of Foods and Food Processing Systems Woodhead Publishing Cambridge, UK (1990)
3. Shafiur Rehman: Food Properties Hand Book CRC Press Inc. New York (1995)

FT18R371	REGULATIONS AND QUALITY CONTROL	L	T	P	Credit
		3	0	2	4
Pre requisite: FT18R201		**Course Categories:** Program Core **Course Type:** Integrated Course			

Course Objective(s): To learn about quality management in food production chain.

Course Outcome(s)

CO1: Classify different type of food hazards, physical, chemical and biological in the industry
CO2: Enumerate the food safety management system
CO3: Interpret the international food laws and standards
CO4: Explain the national food laws and standards
CO5: Identify the food labeling regulations

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	M	H	L						L	H	M	L
CO2	H	M	L	H	H	M	M		H	H	M	H	H	H	M
CO3	M	H	H	M	M	L	M		M	M	M		M	M	H
CO4						L	L	M			H	M	M	M	H
CO5		M	M			L		M			H	M	M	M	H

Course Topic(s)

Unit 1: INTRODUCTION TO QUALITY CONTROL 9 Hours

Principles of food safety and quality, food safety system, Introduction, Sources of Contamination, Control methods . quality attributes of food- Nutritional , Microbial, Sensory, total quality management, GHP, GMP

Unit 2: FOOD SAFETY MANAGEMENT 9 Hours

Food Quality Management system, Quality Management Principles, Food laws – HACCP, AOQL, ISO/22000: Food Safety managements system

Unit 3: INTERNATIONAL FOOD LAWS AND REGUALTIONS 9 Hours

Structure, organization and practical operation of WTO, WHO, FAO, CAC (Codex Alimantarious Commission), ICGFI.

Unit 4: NATIONAL FOOD LAWS AND REGUALTIONS 9 Hours

Structure, organization and practical operation of BIS, AGMARK, PFA, FSSAI.

Unit 5: LABELLING REGULATIONS 9Hours

Need for labelling, limitations of labelling- safety issues, labelling for irradiated foods, genetically modified foods, nutritional labelling, health claims.

List of Experiments **15 Hours**

1. Qualitative tests for hydrogenated fats, butter, and ghee.
2. Quality inspection of various food stuffs- cereals, pulses, spices and condiments etc.
3. Estimation of sulphur dioxide in foods
4. Estimation of chromatographic estimation of colour.
5. Analysis of edible common salt for moisture content, MIW and total chlorides.
6. Determination of peroxide value, saponification value, acid value in oils
7. Estimation of benzoic acid/ sorbic acid in foods.
8. Detection of adulteration in food products
9. Detection of microorganism in food processing equipments using swab test
10. Sensitivity tests (Threshold/Dilution) to measure individual ability for sensory analysis
11. Assessment of quality of wheat flour – sedimentation value, water absorption, alcohol acidity, gluten content.
12. Assessment of analysis of water used in food industry – Alkalinity, acidity, PH, hardness.

TextBook(s):

1. S.Ranganna. “HandBook of Anlysis and Quality Control for Fruit and Vegetables Products”. Tata McGraw –Hill. 2nd Edition.1986.
2. Manoranjan Kalia. “Food Quality Management”. Agrotech Publishing Academy. 2nd Edition. 2014.

Reference Book(s):

1. Taxmann’s. “Guide to the Food Safety and Standards Act 2006”. Allied Services Pvt. Lt. 2006.

2. Rajesh Mehta and J. George - Food Safety Regulation Concerns and Trade. Published by Macmillan India Ltd., New Delhi. 2005

FT18R351	INSTRUMENTATION AND PROCESS CONTROL	L	T	P	Credit
		3	0	1	3.5
Prerequisite: NIL			**Course Categories:** Program Core		
			Course Type: Theory with Practical Component		

Course Objective(s)

1. To study about the basic knowledge of instruments
2. To enable hands-on environment that is crucial for developing students understanding of theoretical concept

Course Outcome(s)

CO1: Explain the principle, Construction and operation of instruments

CO2: Infer the concepts of feedback controller, its dynamic response and automation

CO3: Apply Laplace transformation for second order control systems and determine its dynamic response

CO4: Extend Laplace transformation for first order control systems

CO5: Interpret the stability criteria for various controllers

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	L								M	M	L	L
CO2	H	M	M	L	H	H			M	H		M	M	M	M
CO3	H	H	M	L		M	L	M	M	H		L	M	M	H
CO4	M	H	M	L	H	H	L	M	H	M		L	H	M	L
CO5	H	M	M	L	H	M	L		M	H	L	M	H	M	M

Course Topic(s)

Unit 1: INTRODUCTION 9 Hours

Introduction of process variables, static and dynamic characteristic of instruments and their General classification. Elements of measuring system and their function, principles, construction and operation of instruments for the measurements, transmission, control/ indication/recording of process variables like pressure, flow, level, humidity and composition. Principles of transducers: electro pneumatic, pneumatic, electrical and multi pressure.

Practical: Flow measurement, Level Measurement

Unit 2: CONSTRUCTION AND CHARACTERISTICS OF FINAL CONTROL ELEMENTS 9 Hours

Proportional, integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

Practical: PID controller, Control Valve Characteristics

Unit 3: PROCESS INSTRUMENT AT ION DIAGRAMS AND SYMBOLS 9 Hours

Process instrumentation for process equipments such as distillation column, heat exchangers, fluid storage vessel. Dynamic behavior of first order, second order and two or more first order systems in series.

Practical: MAT Lab Exercise for I& II order system

Unit 4: LAPLACE TRANSFORM 9Hours

Laplace Transform- Linear open loop system, first and second order system and their Transient response. Interacting and non-interacting system. Transportation lag, linear closed loop system, block diagram of closed loop transfer function, controllers, transient response of closed loop systems.

Practical: Interacting system level control, Non interacting system level control

Unit 5: STABILITY CONCEPT AND INTRODUCTION TO FREQUENCY RESPONSE 9Hours

Stability concept Routh stability criterion, relative stability, huwitz Stability criterion, Nyquist's criterion. Root locus technique, introduction to frequency response, Bode diagrams, Bode stability criterion, gain and phase margins.

Practical: Stability analysis using MAT Lab – Root Locus – Bode diagram

Text Book(s):

1. 1.Coughnowr, D.R., Process Systems Analysis and Control, McGraw Hill, New York,3rd Edition, 2013
2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., NewDelhi,1990

Reference(s):

1. Doeblin Ernest, Measurement Systems, Mc GrawHill, New York, 6th edition 2017
2. C.A. Smith and A.B. Corripio, Principles and Practice of Automatic Process Control, John Wiley and Sons, New York, 3rd Edition, 2005.
3. Luyben, M.L., Luyben, W. L., Essentials of Process Control, McGraw Hill, New York, 1997.

FT18R372	HEAT AND MASS TRANSFER	L	T	P	Credit
		3	1	2	5
Prerequisite: FT18R101		**Course Categories:** Program Core **Course Type:** Integrated Course			

Objective(s)

To introduce a basic study of the phenomenon of heat and mass transfer

To develop methodologies for solving a wide variety of practical engineering problems.

Course Outcome(s)

CO1: Infer the fundamental concept of heat conduction and radiation
CO2: Interpret of dimensional analysis for solving convective heat transfer coefficient
CO3: Design a heat exchanger for food process operations
CO4: Assess the drying rate of different foods and select the suitable dying techniques
CO5: Classify and quantify the diffusion in gas, liquid and solid

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M	H										M	M	M
CO2	H	H	H	H			H		H			M	M	H	
CO3	H	H	H	H	H	M	M	M	H	H	M	M	H	H	H
CO4	H	H	H	H	H	H	M	M	H	H	M	M	H	H	H
CO5	M	H	M		M	M	M	M	M	M		M	M	H	M

UNIT 1: INTRODUCTION 9 Hours

Introduction to various modes of heat transfer, Fourier's law of heat conduction, effect of temperature on thermal conductivity, convection-free & forced, Laws of Radiation. Introduction to mass transfer operation & its application in food industries.

UNIT 2: CONDUCTION AND CONVECTION 9 Hours

Steady-state conduction, compound resistances in series, heat flow through a cylinder, and critical radius of insulation in pipes. Heat flux, average temperature of fluid stream, overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients. Application of dimensional analysis for convection, heat transfer to fluids without phase change: heat transfer coefficient calculation for natural and forced convection, heat transfer to fluids with phase change: heat transfer from condensing vapours, drop-wise and film-type condensation, heat transfer coefficients calculation for film-type condensation

UNIT 3: HEAT EXCHANGING EQUIPMENTS 9 Hours

Typical heat exchange equipment, counter current and parallel-current flows, enthalpy balances in: heat exchanges, total condensers. Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel-counter flow exchanger, 2-4 exchanger, heat transfer coefficients in shell-and-tube exchanger, coefficients for cross flow, correction of LMTD foe cross flow. Condensers: shell-and-tube condensers, kettle-type boilers, Calculation of number of tubes & Heat transfer area in heat exchangers.

UNIT 4: DRYING **9 Hours**

Drying–Equilibrium; classification of dryers; batch drying –Mechanism and time of cross through circulation drying, continuous dryers – material & energy balance, determination of length of rotary dryer using rate concept- tray dryer-spray drying

UNIT 5: DIFFUSION **9 Hours**

Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through non-diffusing B, equimolal counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through non- diffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity.

Experiments **15 Hours**

1. Separation factors of the experiments with distillation.
2. Separation factors of the experiments with vapour liquid equilibrium.
3. Separation factors of the experiments with liquid–liquid extraction.
4. Separation factors of the experiments with solid–liquid extraction.
5. Experiment on Shell & tube heat exchanger for Surface area & Heat transfer coefficient determination
6. Studies on Bubble cap/tray/fractional column.
7. Studies on Humidification/Dehumidification columns.
8. Studies on crystallization
9. Experiment on adsorption
10. Experiment on
11. Diffusivity measurement
12. Experiment on Atmospheric batch drying.

TEXT BOOKS

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "Unit Operations of Chemical Engineering", 7th Edition., McGraw Hill International Edition, New York 2014.
2. Donald Q. Kern, "Process Heat Transfer", Tata McGraw Hill Book Co., New Delhi, 1997
3. Robert E. Treybal, "Mass-Transfer Operations", 3rd Edition., McGraw Hill International Edition, Singapore, 1980

REFERENCE BOOKS

1. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "Coulson & Richardson's Chemical Engineering", Vol. I, 6th Edition., Butter worth Heinemann, Oxford,1999.

FT18R382	INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1
Prerequisite: Nil		**Course Categories:** Program Core			
Course Type: Laboratory					

Objective(s) Provides students with an opportunity to identify different types of analytical instruments in their respective laboratories

Course Outcome(s)

CO1 Develop the professional sampling and sample treatment prior to analysis
CO2 Explain treatment and evaluation of the results of analysis
CO3 Identify basic chemical processes in an analytical laboratory
CO4 Utilize complex Instruments to identify adulterants in Food
CO5 Infer Trace elements in food using chromatography techniques

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	H	M					M	L			M	M	L
CO2	M	L	M	M	H		L	M	H	H	M	M	H	M	M
CO3	H	M	L	H	H		L	M	H	H	M	M	H	L	H
CO4	H	M	M	H	H		M	M	H	H	M	M	H	H	H
CO5	M	L	L				L		M	M		L	M	M	M

Course Topic(s)

List of Experiments 45 Hours

1. Precision and validity in an experiment using absorptionspectroscopy
2. Validating Lambert-Beer's law using KMnO4
3. Finding the molar absorbtivity and stoichiometry of the Fe (1, 10 phenanthroline) 3 using absorption spectrometry
4. Estimation of suspended particles using nephlometry/turbidimetry
5. Limits of detection using aluminium alizarin complex
6. Chromatography analysis using TLC
7. Chromatography analysis using columnchromatography
8. Estimation of suspended solids and dissolvedoxygen
9. Estimation of BOD
10. Estimation of COD
11. Gas chromatography analysis
12. Estimating color of food using spectrophotometer
13. Use of electrophoresis in determination of protein
14. Use of flame photometer in estimation of trace metals like sodium and potassium

Text Book(s):

1. Chatwal, Gurdeep R., and Anand, Sham K., ―Instrumentation Methods of Chemical Analysis‖, 2nd Edition, Himalaya Publications, Bombay, 2003
2. Willard, H., Merrit, L.,Instrumental Methods and Analysis, CBS Publishers and Distributors,NewDelhi,7th Edition,2004
3. Skoog, Holler and Nieman., Principles of Instrumental Analysis, Thomson Asia Pvt Ltd., Singapore,5th edition, (Reprint)2003

Reference(s):

1. Chatwal,R.G.,Anand,K.S.,InstrumentalMethodofChemicalAnalysis,Hima laya PublishingHouse,Mumbai,5thEdition(Reprint), 2006.

FT18R401	EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT17R251	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s)

To enable the student to understand:

Emerging / alternative technologies applied to food processing Relative advantages / disadvantages over existing technologies Economics and commercialization of newer technologies

Course Outcome(s)

CO1 Explain the concepts and effects of high-pressure processing
CO2 Organize non thermal processing of food and its application in food processing
CO3 Choose novel non thermal methods for sterilization of food
CO4 Show basic hurdle technology, mechanism and its action in food
CO5 Experiment with freeze concentration and its effect on food

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		M									M	L	M
CO2	H	M	H										M	M	M
CO3	H	M	M		L								M	M	H
CO4	H	M	H	H									H	M	H
CO5	H	M	L										M	M	L

Unit 1: HIGH PRESSURE PROCESSING [HPP] OF FOODS 9 Hours

Introduction, principles, use of high pressure to improve food safety and stability. Effects of high pressure on food quality, Applications of high pressure. HPP of Salads/Ready Meals – effects on microorganisms, enzyme activity, texture and nutrients.

Unit 2: NON THERMAL PROCESS 9 Hours

Non thermal methods- its applications - in sterilization of foods and packaging materials – effects on food quality- effects on microorganisms, enzyme activity, texture and nutrients. Insight on technologies like osmotic dehydration, ohmic heating. Application of Radiofrequency, microwave, Infrared, Pulsed electric field, Ultrasonic waves, Pulsed light, Pulsed X rays and Oscillating magnetic field.

Unit 3: NOVEL METHOD 9 Hours

Food irradiation - advantages and applications. – Super critical fluid extraction and separation – Aseptic processing in foods - extrusion cooking – equipment.

Unit 4: HURDLE TECHNOLOGY **9 Hours**

Basics of hurdle technology – Mechanism, Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived antimicrobials – Antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle).

Unit 5: LOW THERMAL PROCESSING **9 Hours**

Freeze drying (lyophilisation) **–** Frozen Foods- Freeze concentration -Cryogenic Grinding – Principle **–**-Equipment - Effect on foods.

Textbook(s):

1. Da-Wen Sun,"Emerging Technologies for Food Processing", Academic press/ Elsiever, London, UK,2005.
2. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food Stability safety and quality, Kluwer Academics / Plenum Publishers, New York (2002)

Reference Book(s):

1. Da –Wen Sun, "Thermal Food Processing: New Technologies and Quality Issues, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, Florida,USA, 2012.
2. Gustavo V.Barbosa-Canovas, Maria S.Tapia and M.Pilar Cano, "Novel Food Processing Technologies". CRC Press, 2004

PROFESSIONAL ELECTIVES PROCESS ENGINEERING

FT18R302	SUGARCANE AND BEVERAGE TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To gain knowledge on machinery and process involved in sugarcane technology and fermentation process involved in making beverage process

Course Outcome(s)

CO1 Identify sugar cane constituents and apply pre processing operations
CO2 Choose appropriate clarification methods for sugarcane juice
CO3 Adapt filtration and evaporative techniques for quality output
CO4 Setup process flow line with quality standards in sugar manufacturing unit
CO5 Apply the acquired knowledge on quality control for beverage industry

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M				L						L		L		
CO2	M				L	M					L		L		
CO3	M				L	M					L		L		
CO4		M			L		M			M	L		L		
CO5			M		L					M		L	L		M

Course Topic(s)

Unit 1: PRE PROCESSINGOPERATIONS AND JUICE EXTRACTION 9 Hours

Sugarcane-Constituents-Harvesting indices –Cane cutting-Manual, Mechanical-Transportation-loading-Unloading-Caneconveyor-Washing-Shredders-Types. Crushing-Crushers- Types, Crushing efficiency-Extractionofjuice-methods,Accumulators-types-Maceration- Theoryofcanediffusivity-differentdiffuser-ring diffuser-weighing of juice.

Unit 2: CLARIFICATION 9 Hours

Clarification-methods-clarifying agent-bleaching agent-Role of pH, non-sugars, colloids and gums in cane juice clarification. Limingofcanejuice-$CO_2P_2O_5$and its importance. Filtration of mud.

Unit 3: FILTERATION AND EVAPORATION 9 Hours

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

Unit 4: SUGAR PRODUCTION 9 Hours

Entrainment separator-methods-Boiling in Vacuum pan-Footing magma-Massecuite. A,B,C-Mother liquor, Molasses A,B,C Molasses exhaustibility.Crystallization-Supersaturation-Crystallizerstype-batch and continuous. Centrifuge-types. Drying of sugar –conveyors for sugar- by- product from sugar mills -utilization.

Unit 5: TECHNOLOGY OF BEVERAGES MANUFACTURE (ALCOHOLIC AND NON ALCOHOLIC) 9 Hours

Manufacture of beer, wine and champagne - Quality characteristics, Manufacture of distilled beverages including whisky, brandy, rum and gin – Quality aspects Manufacture of carbonated beverages – quality aspects – Manufacture of sugar-free, sugarless, carbonated beverages.

Text Book(s):

1. RamBehari Lal and Mathur.1972., Hand book of cane sugar technology. Oxford and IBH Publishing company NewDelhi
2. W.V.Cruees, Technology of wine making food science, Agrobios Publishers, 2009

Reference(s):

1. Baikow,V.E.1967.Manufacturing and refining of raw cane sugar. Elsevier Publishing Company,NewYork
2. Girdhilal and Siddappa, Preservation of Fruits and Vegetables, Kalyani Publishers 2001.

FT18R303	TECHNOLOGY OF ANIMAL FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To understand need and importance of live stock and poultry industry
To study structure, composition and nutritional quality of animal products

Course Outcome(s)

CO1: Evaluate the structure and composition of meat, meat microbiology and safety requirements
CO2: Gain knowledge on meat animals, slaughtering and stunning methods, abattoir practices.
CO3: Apply the scientific knowledge on processing of meat
CO4: Select suitable processing techniques for poultry products
CO5: Illustrate fish processing and preservation techniques

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	M			H						L	M		
CO2	H	M	H		H	H	M	H				M	H	M	H
CO3	M		H		M	M	M	M				M	H	H	H
CO4	H	M	H		M	M	M	H				M	M	M	M
CO5	H	M	M			M	M	H				H	H	H	H

Course Topic(s)

Unit1: INTRODUCTION **9 Hours**

Meat composition from different sources; muscle structure and compositions; post-mortem muscle chemistry; Factors influencing the quality of meat. Meat Microbiology and safety

Unit 2: SLAUGHTERING AND STUNNING METHODS **9 Hours**

Ante mortem inspection and handling , Stunning types, Slaughtering types. Steps in slaughtering (Pig, Cattle, Sheep/ Goat) and dressing .Slaughter house operations-Hoisting rail and traveling pulley system; .Modern abattoirs, typical layout and features, Offal handling and inspection. Grading of meat- retail and whole sale cuts. Operational factors affecting meat quality. Byproduct utilization. Meat plant hygiene – GMP and HACCP.

Unit 3: PROCESSING OF MEAT **9 Hours**

Processing and preservation of meat: Chilling and freezing of meat, Canning, cooking, drying, pickling, curing and smoking; prepared meat products like sausages, kebabs, etc.. Intermediate moisture and dried meat products, Packaging of meat products.

Unit 4: POULTRY PRODUCT **9 Hours**

Poultry: methods of slaughtering, Slaughtering equipment and operations, dressing, handling, storage and preservation of poultry meat . Spoilage and its control. Freezing and chilling of poultry. Whole sale and retail cuts.

Eggs: Composition , handling , candeling, washing, coating, packaging and storage. Egg processing (Egg powder manufacturing, pasteurization, etc., Spoilage and its control.

Unit 5: FISH PRODUCTS **9 Hours**

Commercially important marine products from India, Proximate composition, Post mortem changes in fish muscle . Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish , Freezing of fish and shell fish.

Text Book(s):

1. Legarreta,I.G. " Handbook of Poultry Science and Technology" (Volume I and Volume II), John Wiley & Sons, Inc., Hoboken, 2010 .

Reference Book(s):

1. Mead M. "Poultry Meat Processing and Quality". Woodhead Publ. 2004.
2. Pearson, A.M. & Gillett, T.A. "Processed Meat". 3rd Ed. Chapman & Hall, 2006.

FT18R304	OILS AND FATS PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To enable the students to understand

1. Physical and chemical properties of fats and oils
2. Extraction and refining processes
3. Packaging, quality standards of fats and oils.

Course Outcome(s)

CO1: Assess the physical and chemical properties of fats and oils
CO2: Infer different methods of oil extraction for edible purpose
CO3: Elucidate solvent extraction and refining of oils
CO4: Interprete edible oil, fat products and modified oil
CO5: Demonstrate an appropriate package and storage for oils

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	M	L		L	L			L		L	M	L	L
CO2	H	M	M	L	L	M	L		M	L	L	M	M	H	M
CO3	H	M	M	L	L	M	L		M	L	L		H	M	M
CO4	H		M	L	L	M	L		M	L	L		L	H	M
CO5	M	L	H	L	M	L					L		M	M	L

Unit 1: PHYSICAL AND CHEMICAL PROPERTIES OF OIL 9 Hours

Sources; chemical composition; physical and chemical characteristics; functional and Nutritional importance of dietary oils and fats. Post-harvest and ling storage and processing of oilseeds for directs use and consumption, importance of oil seeds processing in India.

Unit 2: EXTRACTION METHODS 9 Hours

Extractionofoilbymechanicalexpellingandsolventextractionandobtainingdeoiledcakes Suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ,etc.

Unit 3: REFINING OF OILS 9 Hours

Degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining),bleaching, deodorization techniques/processes. Blending of oils. Chemical adjuncts- lecithins, monoglycerides and derivatives, propylene glycolesters, polyglycoesters, Hydrogenation, fractionation, winterzation,inter-esterification etc.for obtaining tailor-made fats and oils.

Unit 4: FAT AND OIL PRODUCTS 9 Hours

Production of butteroil lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low Fat spreads, peanut butter etc. Speciality fats and designer lipids for nutrition and dietetics, especially by biotechnology. Mayonnaise and salad dressings.Confectionery coatings. Immitation dairy products- peanut butter and vegetable ghee.

Unit 5: PACKAGING OF EDIBLE OILS 9 Hours

Packing and storage of fats and oils,cocoa butter, fat substitutes. Changes during storage of oil – rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing

Text Book(s):

1. Bailey, Industrial Oil and Fat Products, John Wiley and Sons.6thedition2005

Reference(s):

1. M.M. Chakrabarty, Chemistry and Technology of Oils & Fats, Applied Publisher, 2003.
2. Wolf Hamm, Richard J. Hamilton, Gijs Calliauw, Edible Oil Processing, 2nd Edition Wiley-Blackwell, 2013

FT18R305	FRUITS AND VEGETABLES PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s)

1. To understand the processing techniques involved fruit and vegetable technology.
2. To have small scale commercial practices as well as to illustrate the fundamental scientific principles involved in processing.

Course Outcome(s)

CO1 Understand the harvesting, post-harvest handling, packaging and storage of fruits and vegetables

CO2 Apply the freezing preservation method to extend the shelf life of fruits and vegetables

CO3 Apply different dehydration techniques to preserve fruits and vegetables

CO4 Evaluate the different preservation methods to extend the shelf life of fruit juices and concentrates

CO5 Understand the standards and regulations for the production of value-added products from fruits and vegetables

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1													M	L	
CO2	H	M	M	M	M		M		M				H	L	H
CO3	M	M	M						M				M	L	H
CO4	M		L		M				M				M	L	H
CO5	M		L			M		M	M				H	L	H

Course Topic(s)

Unit 1: INTRODUCTION **9 Hours**

Indian and global scenario on production and processing of fruits and Vegetable. Pre-processing: Fresh fruits and vegetables – Handling, grading, cleaning, pretreatments, transportation, pre cooling, chilling, modified atmosphere packaging, Controlled atmosphere storage, packaging, transportation, quality assurance.

Unit 2: FREEZING OF FRUITS AND VEGETABLES **9 Hours**

Freezing of Fruits and Vegetables - Different freezing methods and equipments, problems associated with specific fruits and vegetables

Unit 3: DEHYDRATION OF FRUITS AND VEGETABLES 9 Hours

Dehydration – different methods of drying including sun, tray, cabinet, drum, spray, vacuum, tunnel, spray, low temperature drying process, process calculations ,osmotic dehydration and other modern methods, choice of suitable methods, preserving the colour, flavour and nutrient content of the products.

Unit 4: CANNING, JUICES & CONCENTRATES 9 Hours

Different unit operations involved in fruit and vegetable Pulp/juice extraction, concentration, Bulk aseptic packaging of fruit and vegetable pulps, juices and concentrates; aseptic packaging of fruit drinks, juices and other products. Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic.

Unit 5: FRUIT AND VEGETABLE PRODUCTS & STANDARDS 12 Hours

Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres - specific processing, different packing including aseptic, Product specifications and standards; food regulations with respect to fruit and vegetable products.

Text Book(s):

1. Wim Jongen. “Fruit and Vegetable Processing”. Woodhead Publishing. 2002.

Reference(s):

1. RonB.H. Wills., John Golding. “Advances in Postharvest Fruit and Vegetable Technology”.CRC Press.2015.
2. Sueli Rodrigues, Fabiano Andre NArciso Ferandes. “Advances in Fruit Processing Technologies”. CRC Press, 2012.

FT18R306	TECHNOLOGY OF FLAVORS AND COLORANTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To enable the student to understand basic chemistry & technology of flavours and pigments

Course Outcome(s)

CO1 Explain basics food flavors and colours
CO2 Infer the flavor compound used in food industry
CO3 Demonstrate the chemical sensors and receptors
CO4 Describe the methods for stabilization of natural colorants
CO5 Infer the flavor compound used in food industry

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M						H				M			
CO2			M				L						M		
CO3	M					L				L				M	
CO4		M				L					M	M			
CO5	M	L			L	L						M			

Course Topic(s)

Unit 1: INTRODUCTION 9 Hours

Problems in flavour research – classification of food flavours; chemical compounds responsible forflavour. Recent trends in flavors and colorants.

Unit 2: FLAVOUR COMPOUNDS 9 Hours

Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

Unit 3: TASTE & FLAVOR PERCEPTION 9 Hours

Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating, Taste maskers-Taste modifiers, flavor Enhancers

Unit 4: COLOR AND FLAVOUR ANALYSIS 9 Hours

Subjective versus Objective methods of analysis; psychophysics and sensory evaluation; Instrumental analysis; sample handling and artifacts; data handling

Unit 5: COLORANTS 9 Hours

Natural and chemical colors, Natural color synthesis, extraction and preservation methods, factors affecting color stability. Chemical synthesis of food colors and health aspects

Text Book(s):

1. Fisher, Carolyn "Food Flavours : Biology and Chemistry". Royal Society of Chemistry, 1997
2. Ashurst, Philip R. "Food Flavorings". 3rd Edition. Aspen Publication, 1999.

Reference(s):

1. Reineccius, Gary "Flavor Chemistry and Technology". 2nd Edition. Taylor & Francis, 2006.
2. Hofman, Thomas, Chi-Tang-Ho and Wilhelm Pickenhagen "Challenges in Taste Chemistry and Biology ". ACS Publications, 2003.

FT18R310	FOOD PLANT SAFETY AND HAZARDS IN FOOD INDUSTRY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R271	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Objective(s)

To study about waste management in food industry.

To Study about the safety regulations undertaken in food industry.

Course Outcome(s)

CO1 Identify suitable food quality standards

CO2 Use quality tools for effective quality assurance

CO3 Implement and maintain HACCP principles for quality assurance

CO4 Identify food safety issues due to additives, toxic substances and preservatives

CO5 Identify food allergy, food intolerance and contaminants in processed food

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		H				L		M			M			M	
CO2	L	M	M			M		H		M				M	
CO3		H	M		L	H		H	M	L	M	M		H	
CO4		M	M		L	H	M	M						M	
CO5		L	H		L	H	M	H						M	

Course Topic(s)

Unit 1: FOODSAFETY 9 Hours

Principles of food safety-Historical developments-indicators of risk-risk analysis-risk management- causes of major failure- clothing and personal hygiene-source of contamination-test for food safety.

Unit 2: QUALITY CONTROL ANDFOOD LABELING 9 Hours

Introduction to quality control-definition. Aspects of quality-Quality control tools. Quality control chart-Quality factors in food-Nutritional labeling-Specification-Rules and. Regulations- need for food plant sanitation—cleaning and cleaners-Water supply-Good Manufacturing Practice.

Unit 3: HAZARDANALYSIS-HACCP 9 Hours

HACCP-History definition-preliminary task -principles-hazard analysis-record keeping -HACCP implementation and maintenance. General principle of microbial risk- assessment -hazard determination-HACCP work sheet. Critical Control Point- identification of critical points in the process- Methods by which obstacles can be overcome.

Unit 4: METAL CONTAMINANTS AND ADDITIVES **9 Hours**

Metal contaminants-Sources of health hazard of metallic contaminants-Assessment of food safety-Generalandacutetoxicity-Mutagenicityandcarcinogenicity.Additives(Intention - direct)-Preservatives-antioxidants, sweeteners, flavours, colours, vitamins, stabilizers- indirect additives-organic resides- inorganic residues and contaminants.

Unit 5: FOOD ALLERGY **9 Hours**

Food allergy, food intolerance, contaminants of processed foods, solvent residue, Contaminants of smoked foods. Cleaner food industry-fruit and vegetable processing, seafood processing, brewing and wine processing

TextBook(s):

1. Michael M Cramer., *Food plant sanitation*. CRC Press, 2016
2. Tatiana Koutchma., Food Plant safety: *UV Applications for food and nonfood surfaces*. Elsevier, 2014

Reference(s):

1. Y.H.Hui. *Plant sanitation for food processing and food service*.,CRC Press, 2014
2. Sanjay Banerjee., *Industrial hazards and plant safety*., CRC Press, 2002

FT18R402	SPICES AND PLANTATION PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To enable the student to understand

1. The importance and different basic unit operations in processing of spices
2. Processing methods of plantation crops.
3. Identifying the quality aspects of plantation crops and spices

Course Outcome(s)

CO1 Illustrate the steps involved in processing of coffee and its products
CO2 List the appropriate techniques for processing of tea and its products
CO3 Identify the quality aspects of cocoa processing and chocolate manufacturing technology
CO4 Explain the food processing operations in processing of major spices
CO5 Select appropriate techniques for processing of minor spices

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	L	H	H	H	M	H		L	H	L	M	M	H	H	H
CO2	M	H	H	H	M	H		M	H	M	H	M	M	M	H
CO3	L	M	H	H	M	H		H	H	M	M	M	H	H	H
CO4	L	M	H	H	L				M	H	H	L	M	M	H
CO5	L	H	L	H	L		L		H	H	M	L	H	H	H

Course Topic(s)

Unit1: CHEMISTRY AND TECHNOLOGY OF COFFEE 9 Hours

Coffee – Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the manufacture of coffee powder – Instant coffee, technology – Chicory chemistry - Quality grading of coffee

Unit 2: TEA – CHEMISTRY AND TECHNOLOGY 9 Hours

Occurrence – chemistry of 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 3: CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS 9 Hours

Occurrence – Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture C hocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates

Unit 4: CHEMISTRY AND TECHNOLOGY OF MAJOR SPICES 9 Hours

Pepper, Cardamom, ginger and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identicals - Quality control

Unit 5: CHEMISTRY AND TECHNOLOGY OF MINOR SPICES 9 Hours

Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Quality control Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

Text Book(s):

1. Minor spices and condiments : crop management and post harvest technology., J.S.Purthi, ICAR Publication, Ist edition 2001
2. J.S.Purthi, Ist edition., Major spices of india crop management and post harvest technology. ICAR Publication.2003

Reference Book(s):

1. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004.
2. Kenji hirasa and mitsuo takemasam., Spice science and technology, CRC Press, 1998
3. Minifie Bernard W.,Chocolate, Cocoa and Confectionery Technology, III Edition, Aspen Publication, 1999

FT18R403	MILLING TECHNOLOGY FOR FOOD MATERIALS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R273	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) On successful completion of the subject, students will get exposure about Processing of cereals, pulses and storage of cereals

Course Outcome(s)

CO1 Understand the post harvest practices and losses of food grains
CO2 Adapt the suitable post harvest practice for wheat
CO3 Adapt suitable parboiling and milling methods for paddy
CO4 Elaborate the process involved in corn and millets milling
CO5 Development the process involved products from pulses

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L			L	H			L			M		
CO2		M	M		L	L	H			L	M		M		
CO3	M		M		L		H			L	M		M		
CO4	M		M		L		H			L	M		M		
CO5			M		L		H			L	M		M		

Course Topic(s)

Unit 1: INTRODUCTION AND POSTHARVEST LOSSES 9 Hours

Importance of cereals and legumes, Post-harvest quality and quantity losses. Recommended pre-processing practices for handling of cereals and pulses for their safe storage, including control of infestation, National and International quality and grading standards.

Unit 2: MILLING OF WHEAT 9 Hours

Structure, types, composition, quality characteristics and physicochemical properties of wheat. Cleaning, tempering and conditioning, and milling processes for different wheat's. Turbo griding & Air Classification. Blending of flours. Milling equipments and milling products (Dalia, Atta, Semolina and flour). Flour grades and their suitability for baked goods. Quality characteristics and rheological properties of wheat milling products and its assessment. Byproduct utilization.

Unit 3: RICE MILLING 9 Hours

Structure, types, composition, quality characteristics and physicochemical properties of rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice). By-product (husk and rice bran) utilization.

Unit 4: MILLING AND PROCESSING OF MAIZE AND MILLETS 9 Hours

Structure, types and composition of corn. Dry and wet milling of corn. Starch and its conversion products. Processed corn products (popped corn, corn flakes etc.) Structure and composition of barley, bajra, jowar and other cereal grains and millets. Malting of barley. Pearling of millets. Parched and snack products.

Unit 5: MILLING OF PULSES 9 Hours

Structure, composition and properties of legumes. Cleaning, grading, pretreatments for difficult-to-mill (urad, arhar, moong, moth) and easy-to-mill (chana, masoor and pea) legumes, milling practices and actual milling of different legumes. Sweet and savory products from legumes in India

Text Book(s):

1. N.L.Kent, Technologyof Cereals, Wood Head Publishing, 4th edition 2004.
2. Shankuntala N.Mannay, Food Facts and Principles , New age International (p) Ltd, 2008

Reference(s):

1. Norman N.Potter , Food science, Springer publication, 1995
2. DAV Dendy and B.J.Dobraszerk, Cereals and cereals Products- Chemistry and Technology, Aspen Publication 2001

FT18R404	PROCESSING COMMODITIES OF FOOD				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R251	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Objective(s) To Introduce students about the methods of processing food to prevent wastage and losses

Course Outcome(s)

CO1 Elaborate handling and processing of fruit and vegetables
CO2 Select appropriate techniques for milk processing
CO3 Summarize the techniques for bakery products and preservation techniques
CO4 Outline hygiene and sanitation procedures in meat, fish and poultry industries
CO5 Interpret milling processing of cereals and pulses and learn the grain storage practices

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		L		L		L			L	M		M		
CO2	M		M		L		L			L	M		M		
CO3		M	M		L		L			L	M		M		
CO4		M	M		L		L			L	M		M		
CO5		M	M		L		L			L	M		M		

Course Topic(s)

Unit 1: FRUITS AND VEGETABLE PROCESSING 9 Hours

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Canning of Fruits and Vegetables, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic and other methods of processing.

Unit 2: DAIRY PROCESSING 9 Hours

Basic dairy terminology, composition, Quality and Quantity tests at reception, dairy Processing Equipments, various dairy Products, Packaging of milk in bottles and sachets.

Unit 3: MILLING AND BAKERY TECHNOLOGY 9 Hours

Fundamentals of Market Analysis for Wheat and Wheat Products, Laboratory testing of Wheat grain Quality, Moisture tests, Outline of the Wheat Milling Process, equipments

Unit 4: MEAT, FISH AND POULTRY PROCESSING 9 Hours

Meat composition from different sources, Definitions and measurements, Slaughtering and Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing

Unit 5: CEREAL TECHNOLOGY **9 Hours**

Paddy Processing - Varieties**,** their Composition and Quality characteristics, Curing of Paddy, Parboiling Processes, By Products. Rice milling and equipments, Milling of Pulses, Grain Storage and Handling.

Text Book(s):

1. Srivastava, R.P. and Kumar, S.: Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow (2nd Edition 1998).
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press, USA (2001)

Reference Book(s):

1. W. James Harper and Carl W. Hall: Dairy Technology and Engineering AVI Publishing, Westport, USA (1976)
2. Karel Kulp and Joseph P Pante:Hand Book Of Cereal Science and Technology Mercel Dekkar USA (2000)

FT18R409	FOOD INDUSTRY WASTE MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R251	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Outcome(s)

CO1 Understand the characterization and chemical properties of food waste

CO2 Handle industrial waste with necessary precautions to avoid infection and cross contamination

CO3 Identify the method for treatment of liquid and solid waste

CO4 Monitor the sludge and effluents discharged from food industries meet the limitation by law

CO5 Control environmental pollution by proper treatment of food waste

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	H				L	H	M			H	M	L		
CO2		M	M			H	H	M				M	M		
CO3		H	M			H	H	M		M	H	M			L
CO4		M	M			H	H	M		M	H	M			L
CO5			M				H	M				M			M

Course Topic(s)

Unit 1: CHARACTERIZATION OF FOOD WASTE 9 Hours

Characterization of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from aforesaid food industries. Treatments of solid waste. Standards BOD/COD Waste from various industries.

Unit 2: STANDARDS FOR EMISSION/ DISCHARGE 9 Hours

Standards for emission or discharge of environmental pollutants from food processing industriescoveredunderEPAAct.Characterizationoffoodindustrieseffluentsin terms of parameters of importance

Unit 3: TREATMENT OF FOOD INDUSTRY EFFLUENTS 9Hours

Unit concept of treatment of food industry effluents: Screening, sedimentation, floatation as per and primary treatments, biological oxidations:– objectives, organisms, reactions, oxygen requirements, aeration devices. Improved biocatalysts and innovative bioreactors for enhanced bioprocessing of liquid food wastes. Effect on characteristic parameters of effluents in treatments using lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biololgical contractors and their variations and advanced modifications. Occupational health and safety

Unit 4: ADVANCED WASTE WATER TREATMENT SYSTEMS 9 Hours

Advanced wastewater treatment systems: physical, physicochemical and chemical treatments. Genobiotics- Bio remediation, Coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents conforming to EPA provisions.

Unit 5: BY PRODUCT UTILIZATION 9 Hours

Extraction of Pectin, color, collagen, Pharmaceutical and functional ingredients, Bio fertilizers, Food ingredients.

Textbook(s):

1. Lawrence K.Wang, Yung-TseHung., Waste water treatment in the food processing industry, CRC press, 2nd edition, 2006.
2. N.F.Gray.,Watertechnology:an introduction for environmental scientists and engineers, Elsevier Butter worth-Heinemann, 2nd Edition, 2002

Reference(s):

1. Patwardhan.,Industrial Waste Water Treatment, Prentice-Hallof India Pvt Ltd, 1stedition, 2008
2. K.C.Agrawal., Environmental pollution and law, Agro Botanical Publishers, 1995.

FT18R204	SENSORY EVALUATION OF FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) The objective of the course is for evaluating processed foods

Course Outcome(s)

CO1 Infer the fundamental concept of taste and its impact in sensory
CO2 Explain the mechanism of odor perception and its effect on sensory
CO3 Classify different methods of evaluating colors
CO4 Assess the textural responses using subjective and objective methods
CO5 Select the appropriate sensory methods to analyze the food samples

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L										M		L
CO2	H	M	L				L						M	L	
CO3	H	M	L	L	M		L	L	L	L		M	H	M	M
CO4	H	H	M	L	M		M	L	L	L		M	H	H	H
CO5	H	H	M	M	H	M	M	H	H	H	M	M	H	M	H

Course Topic(s)

TASTE **9 Hours**

Introduction and importance of taste-Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands - Mechanism of taste perception - Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami - Factors affecting taste quality, reaction time, taste modification, absolute and recognition - threshold Taste abnormalities - Taste measurement

ODOUR **9 Hours**

Introduction, definition and importance of odour and flavor - Anatomy of nose, physiology of odour perception - Mechanism of odour perception - Odour classification, chemical specificity of odour. - Odour measurement using different techniques – primitive to recent techniques. Merits and demerits of each method. Olfactory abnormalities

COLOUR **9 Hours**

Introduction and importance of colour. - Dimensions of colour and attributes of colour, appearance factors, gloss etc. - Perception of colour. Colour abnormalities - Measurement of colour; Munsell colour system, CIE colour system, Hunter colour - system, spectrophotometry and colorimetry etc.

TEXTURE **9 Hours**

Introduction, definition and importance of texture - Phases of oral processing - Texture perception, receptors involved in texture perception - Texture classification - Texture measurement – basic rheological models, forces involved in texture measurement

SENSORY EVALUVATION **9 Hours**

Sensory evaluation-introduction, panel screening, Sensory and instrumental analysis in quality control, IPR and patents

TEXTBOOK

1. Rao E. S. (2013). Food Quality Evaluation, Variety Books.
2. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999

REFERENCE BOOK

1. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer. 62
2. Brannen and et al.,(1990) Food Additives, Marcel Dekker,New York,1990

FT18R205	ENGINEERING PROPERTIES OF FOOD MATERIALS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To enable the students understand the effect of various methods of processing on the structure and texture of food materials

Course Outcome(s)

CO1 Interpret the physical characters of foods to design the formulation, processing equipments, and quality parameters
CO2 Elaborate the texture and rheological properties of food to design processing methods
CO3 Adapt the Thermal properties of food to design pack material, processing methods, and equipments
CO4 Illustrate the Aerodynamic properties of food to design processing methods, equipments
CO5 Infer the Electrical properties of food to design formulation, processing methods, and equipments

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	M	M				L				M	M	M	M
CO2	H	M	M	L		M						L	H	L	M
CO3	H	M	M	M	L	M						L	L	H	M
CO4	H	M	M	L	L								M	H	H
CO5	M	L			M	L		L				M	H	L	M

Course Topic(s)

Unit 1: PHYSICAL PROPERTIES OF FOODS 9 Hours

Methods of estimation of - Shape, size, volume, density, porosity, texture, viscosity, surface area, Structures of materials - gel structure, amorphous and crystalline, drag coefficient, glass transition

Unit 2: RHEOLOGICAL PROPERTIES OF FOODS 9 Hours

Rheological Classification and models, Static tests for solid foods, Creep, relaxation, Dynamic testing of solid foods, stress and strain in solid foods, stress-strain diagram, visco-elastic fluids, measurement methods, Viscometers and Rheometers of different design and their applications, texture measuring instruments, Hardness and brittleness of food materials.

Unit 3: THERMAL PROPERTIES OF FOODS 9Hours

Definitions - specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Absorptivity, transmissivity.Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity;

Unit 4: AERODYNAMIC AND HYDRODYNAMIC PROPERTIES OF FOODS 9Hours

Drag coefficient, terminal velocity and their application in the handling and seperation of food materials.

Unit 5: ELECTRICAL PROPERTIES OF FOODS 9 Hours

Dielectric properties, electric energy transmission properties, Electro-magnetic field effects, Dielectric measurements, Polar solvents, Ionic solutions. Reaction to electromagnetic radiation. Definition- Optical properties-method and light aborsorptance, light transmittance, color, intensity, light reflectance.

Text Book(s):

1. Nuri N. Mohsenin: Physical Properties of Plant and Animal Materials Gordon and Reach Science Publishers (1970)
2. Nuri N. Mohsenin: Thermal Properties of Food & Agricultural materials Gordon and Reach Science Publishers (1970)

Reference Book(s):

1. M.A.Rao and S.S.H.Rizvi: Engineering Properties of Foods Mercel Dekker inc. New York (1998)
2. M.J.Lewis: Physical Properties of Foods and Food Processing Systems Woodhead Publishing Cambridge, UK (1990)
3. Shafiur Rehman: Food Properties Hand Book CRC Press Inc. New York (1995)

FT18R307	FOOD PROCESS EQUIPMENT DESIGN				L	T	P	C
					3	0	0	3
Pre-Requisite	:	MEC18R151	**Course Category**	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To design and develop equipments used in food processing operations

Course Outcome(s)

CO1: Illustrate details of Material composition for effective construction of machines depending on food product

CO2: Illustrate the design equipments based on material handling capacity and quality of materials

CO3: Enumerate food transportation within processing unit with Conveyor belts and Elevators

CO4: Indicate Food quality and its standard level in food industry

CO5: Identify Computer applications and Instrument calibration for perfection and automation.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	M			M	M						H	L	M
CO2	H	M	H		M	M		L					H	M	M
CO3	H	H	H	H		M		L	M	M		M	M	H	H
CO4	H	H	H	H	H	M	M	L	M	M		M	M	H	H
CO5	H	H	H	H	H	M	M	L	H	H	M	M	M	H	M

Course Topic(s)

INTRODUCTION **9 Hours**

Introduction to various mechanical properties of materials to be used as material of construction, resistance of metals to corrosion under varying conditions of temperature and pressure etc. Application and use of various codes and standards in design.

DESIGNING OF HANDLING EQUIPMENT **9 Hours**

Design of material handling equipment: Belt conveyor, bucket elevator, screw conveyor, Cyclone conveyor, chain conveyor, pneumatic conveyor. Design of seed processing equipments: Air screen cleaner, rotary cleaner, graders based on size shape and surface produce and led, seed treater.

DESIGNING OF STORAGE VESSELS **9 Hours**

Design of non-pressure storage vessel, tall vertical vessels, unfired pressure vessels with Internal pressure: storage vessels and process vessels.

DESIGNING OF PRESSURE EQUIPMENTS **9 Hours**

Design of unfired pressure vessels with external pressures, end closures, flat plates, domed ends, tori spherical, ellipsoidal, hemispherical and conical ends. Design of nozzles, openings and re inforcements, Bolts, flanges, gaskets.

DESIGING OF DRYERS AND HEAT EXCHANGERS **9 Hours**

Bolted flanges, pipelinedesignandMechanicaldesignofselectedprocessequipmentssuch As heat exchangers, Evaporators, Distillation columns, Absorbers, Reactors and Dryers and Crystallizers; Use of soft wares for design of equipments.

TEXTBOOKS

1. PetersMax.S., Timmerhaus Klaus D. and Ronald EWest., Plant Design and Economics for Chemical Engineers, VEdition McGrawHill. 2003
2. Coulson,J.M. and Richardson J.F., ChemicalEngineering, Pargamon Press, vol.6 1989.

REFERENCES

1. Evans, F. L., "Equipment Design Hand book", Gulf Publishing Company, 2nd Edition1979.
2. Perry, R. Hand Chitton, Perry's Chemical Engineers Hand book, McGrawHill, NewYork, 7th Edition, 1997

FT18R405	FOOD PRODUCT DEVELOPMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Objective(s) To provide the opportunity for students to integrate their training in food science and technology courses and related disciplines and to gain experience with the theory and practice of developing food products.

Course Outcome(s)

CO1 Explain about the food company organization and marketing.
CO2 Analyze the technical aspects of new product development in dairy and meat industry.
CO3 Illustrate the technical aspects of new product development in beverages industry.
CO4 Summarize the technical aspects of new product development in flavor industry.
CO5 Adapt the concepts of quality control aspects.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	M				M		M		M	M		M		
CO2			H			M		H		M	H		M		H
CO3		L	H			M		H		M	H		M		H
CO4		L	H			M		H		M	H		M		H
CO5		M	M			H		H		M	H		M	M	H

Course Topic(s)

Unit 1: INTRODUCTION **9 Hours**

Corporate Organization of Food Companies, Overview of Food Product Development(FPD), Product Development Process, Ideation and Screening Process, FP Marketing and Market Research, Legal and Fiscal, – Test Markets and Launches, Successes and Failure.

Unit 2: PRODUCT DEVELOPMENT **9 Hours**

Technical Aspects of New Product Development–Dairy, Meat, Poultry, Egg Products, Fish and Shellfish Products.

Unit 3: PRODUCT DEVELOPMENT **9 Hours**

Technical Aspects of New Product Development–Juices and Non-alcoholic Beverages, Cereals and Grains, Fats and Oils.

Unit 4: PRODUCT DEVELOPMENT **9 Hours**

Technical Aspects of New Product Development –Flavors and Flavor Companies, Sugar, Candy and Chocolate.

Unit 5: QUALITY ASPECTS **9 Hours**

QC/QA Aspects of Food Product Development, Microbial Aspects of New Product Development, Package Development , Shelf Life of Packaged Foods , Nutrients and Fortification, Labeling and Pertinent Regulations

Text Book(s):

1. Brody, A.L. and Lord, J. 2008. Developing New Food Products for a Changing Marketplace, 2nd Edition. CRC Press, Boca Raton, FL.
2. Campbell-Platt, G. 2009. Food Science and Technology. Blackwell Publishing Ltd., Oxford, UK.

Reference Book(s):

1. Fuller, G.W. 2011. New Food Product Development, 3rd Edition. CRC Press, Boca Raton, FL.
2. Moskowitz,H., Saguy, I. S., and Straus, T. 2009. An Integrated Approach to New Food Product Development. CRC Press, Boca Raton, FL.

FT18R406	FOOD PLANT LAYOUT AND DESIGN				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R310	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Objective(s) Design a layout for food processing plant and estimation of cost

Course Outcome(s)

CO1 Design and setting up of new food processing plant as Entrepreneur and/or consultant
CO2 Identify the importance HACCP and food safety laws governing food industries
CO3 Implement the food safety standards in food industries
CO4 Prepare cost estimate and economic analysis of food industry
CO5 Apply the acquired knowledge to minimize the food industry losses

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		H	M				M			M	H	M	M		
CO2		H	H				M			L	H	M	M		
CO3		M	H					H		L	M	M	L	M	
CO4		M	M							M	H	M	L		
CO5	L	H	M							M	H	M	L		

Course Topic(s)

Unit 1: SITE SELECTION 9 Hours

Site selection - Factors - Case Study: Site Selection - Product Capacity and quality – Storage of Raw materials and Product - Waste Disposal, Utilities – Requirements for water, electricity, labor, transportation facilities, refrigeration, boiler- laboratory - Plans for Future Expansion- Hours of Operation- Completion Date- Safety

Unit 2: PLANT DESIGN 9 Hours

Manufacturing Plant Design – Building design – Legal aspects – Building bylaws, Expansion – Plant Location – The structure – Facilities Lay-out Office, toilet, laboratory- classification of dairy a nd food plants, farm level collection and chilling Centre, space requirements

Unit 3: OCCUPATIOAL SAFETY AND HYGIENIC DESIGN 9 Hours

Impact of technological developments on working conditions, Occupational health problems-dermatitis, asthma, hearing damage, stress& policies, OSHA regulations for safe working environments, Hygienic design principles and benefits- factory, utilities & equipment, process and machineries, material of construction, Hygienic welding, Best practices of hygienic design as per GFSI - Cleaning and decontamination, personal hygiene, drainages, hazard management

Unit 4: LAYOUT AND COST ESTIMATION 9 Hours

New Plant Layout- Product and process layout - Expansion and Improvements of Existing/ Facilities- Case Study: Layout and Warehouse Requirements – Inventory control - Cost Indexes - Capacity vis-a-vis Costs - Factored Cost Estimate – Break – even point - Improvements– Module Cost Estimation - Unit Operations Estimate- Detailed Cost Estimate- Accuracy of Estimates- Case Study: Capital Cost Estimation.

Unit 5: ECONOMIC ANALYSIS 9 Hours

Cost of Producing a Product- Capital - Elementary Profitability Measures- Time Value of Money- Compound Interest- Net Present Value- Rate of Return- Comparison of Net Present Value and Rate of Return Methods- Proper Interest Rates - Expected Return on the Investment- Economic Evaluation – Depreciation – Amortization- Depletion Allowance- Investment Credit- Special Tax Rules - Problems.

Text Book(s):

1. Dennis R. Heldman and Daryl B. Lund. “Hand Book of Food Engineering”, Second edition, CRC Press, Taylor and Francis Group, 2007.
2. William D. Baasel.“Preliminary chemical engineering plant design”, Second edition Van Nostrand Reinhold, 1990.

Reference Book(s):

1. R.K. Sinnot. “Coulson and Richardsons Chemical Engineering” Vo. 6., 4th Edition, Elsevier Publication. 2005.
2. Max S. Peters and Klaus D. Timmerhaus and Ronald West. “Plant Design And Economics For Chemical Engineers”, 5th Edition, Tata Mc-Graw Hill Education. 2003.

FT18R308	PROTEIN CHEMISTRY AND TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R272	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) Understand basic chemistry and structures of protein found in food and develop new technologies and sources of proteins

Course Outcome(s)

CO1 Analyze protein quality and identify protein structure and application in food sector

CO2 Identify the protein architecture and their classification and functions

CO3 Understand the importance of protein engineering in improving the nutritional and functional properties of food

CO4 Isolate protein from source like fish, legume, oilseeds and microbes

CO5 Adapt the structural and functional properties of protein

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H					L					L		L		
CO2	M					L					L		L		
CO3		M				L					M				H
CO4		M	M			L	M				M		L		
CO5	M					L	M				M		L		

Course Topic(s)

Unit 1: BASICS OF AMINO ACIDS AND PROTEIN CHEMISTRY 9 Hours

Amino acids (the students should be thorough withthree and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis. Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X- ray) and elucidation of protein structure.

Unit 2: PROTEIN ARCHITECTURE 9 Hours

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setu Secondary structure: Alpha, beta and loop structures and methods to determine (Basics only) Basics of Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha- beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

Unit 3: PROTEIN ENGINEERING 9 Hours

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, de novoprotein design.

Unit 4: BASICS OF THE PROPERTIES OF FOOD PROTEINS – ANIMAL AND MARINE SOURCES CASEINS AND WHEY PROTEINS 9 Hours

Caseins – Heterogeneity and Molecular properties – caseins micelles – Mechanism of stabilization – Structure models – Structure of whey proteins and improvement of functionality Muscle proteins– Structure and functionality – Application of muscle proteins in foods Sea weed proteins – Protein content and functionality, digestibility of algal proteins – applications to food systems

Unit 5: BASIC PROPERTIES OF FOOD PROTEINS – PLANT SOURCES 9 Hours

Composition, functional properties of soya, rapeseed, peanut. Leaf as a protein source – Basic and Food applications of rubisco

Text Book(s):

1. Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2. Zidzisław E. Sikorski, Chemical and Functional Properties of Food Proteins, CRC Press, 2001.

Reference Book(s):

1. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993
2. Moody P.C.E. and Wilkinson A.J. "Protein Engineering", IRL Press, Oxford, UK, 1999

FT18R309	NUTRITIONAL BIOCHEMISTRY			L	T	P	C
				3	0	0	3
Pre-Requisite	: Nil	Course Category	:	Professional Elective			
		Course Type	:	Theory			

Objective(s) To enable students understand the basics of food biochemistry and nutrition and importance of nutrition and enable them to develop new products of high nutritive value

Course Outcome(s)

CO1 Explain the carbohydrate digestion and its metabolism
CO2 Elaborate the protein and fat metabolism
CO3 Explain the energy expenditure and caloric value of foods
CO4 Interpret the antinutritional factors and its effect on nutrition
CO5 Develop a nutritional foods for infant, sports person and aged people

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	L											M	L	
CO2	M	L											M	L	
CO3	H	M	L	M	L	M		M	M	L			H	M	M
CO4	H	M	L			M							H	M	
CO5	H	M	L			L	M	M	M	L		L	M	M	H

Course Topic(s)

Unit 1: CARBOHYDRATE METABOLISM 9 Hours

Electron transport chain - glycolysis, TCA cycle, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof Pathway (EMP), urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

Unit 2: AMINOACID AND LIPID METABOLISM 9 Hours

Biosyntheses and degradation of fatty acids, and cholesterol - Biosyntheses and degradation of amino acids (one example each for sulphur containing, aliphatic, aromatic, heterocyclic, basic and acidic amino acids), peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids.

Unit 3: BASIC CONCEPTS OF NUTRITION 9 Hours

Basic concept of nutrition – Importance of nutrition and dietetics - Assessment of nutritional status – energy value of carbohydrates, proteins and fats – determination of energy value – balanced diet – Recommended dietary intake – Acceptable dietary intake – Protein efficiency ratio – Net protein utilisation and their determinations – Malnutrition and its problems – Nutrient supplementation – fortification - Nutritional labeling and its importance - Effect of processing on protein quality, essential amino acids - Digestibility, carbohydrates in food and dietary fibre

Unit4: INBORN ERRORS OF CARBOHYDRATE, PROTEIN AND FAT METABOLISM 9 Hours

Inborn errors of carbohydrate, protein and fat metabolisms - Nutrition and disorders associated with organs such as liver and kidney - Naturally occurring anti-nutritional factors – Cyanogens, lectins, enzyme inhibitors, phytoallexins, phytates

Unit 5: NUTRITION FOR SPECIALIZED PURPOSES 9 Hours

Nutrition for specialized purposes – Paediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods Ageing –Theories of ageing – Nutrition and ageing – Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, Alzheimer's disease

Text Book(s):

1. Voet D, Voet G, Principles of Biochemistry, Third Edition, John Wiley and Sons, 2008.
2. Martin Eastwood. Principles of Human nutrition – Second Edition, Ed. Wiley - Blackwell Publishing, 2003.

Reference Book(s):

1. Ronald Ross Watson, Functional foods and Nutraceuticals in Cancer Prevention, Ed. Wiley – Blackwell, 2003.
2. Lehninger A.L, Nelson D.L. and Cox M.M., Principles of Biochemistry, W.H. Freeman and Company
3. Publications, 2008.

FT18R407	TRADITIONAL & FERMENTED FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Objective(s) To understand various concepts, principles and procedures involved in the area of fermented food production

Course Outcome(s)

CO1 Understand the basics of fermentation process and their benefits.

CO2 Interpret about the microorganisms associated with food and the probiotic microbial activity in the food fermentation

CO3 Explain the manufacturing processes of various fermented products

CO4 Utilize knowledge about manufacturing of fermented beverages and the quality control of the product

CO5 Compare the various methods for producing industrially relevant enzymes

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	L													M	M
CO2	M	L	L	L		M	L						H	M	L
CO3	H	L	M	L		M	M						M	L	M
CO4	H		H	L		M	M						M		H
CO5	H	L	L	M		H	M						H	L	H

Course Topic(s):

TRADITIONAL FERMENTED FOODS

Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, Papads Idli and Dosa.

CULTURE MAINTENANCE

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Probiotics - Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

FERMENTED PRODUCTS

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products, Oriental fermented foods

FERMENTED DRINKS

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin,whisky), Fermented Vegetables (Pickles).

MICROBIAL PROTEINS

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases,protease, lipases, pectinases, rennin), HFCS(High Fructose Corn Syrup)

TEXT BOOKS

1. K.H. Steinkrus, Handbook of Indigenous Fermented Foods, Marcel Dekker publisher,1983.
2. Sukumar De, Outlines of Dairy Technology , Oxford University Press N Delhi , 1991.
3. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009

REFERENCES:

1. L.E.Casida, Industrial Microbiology, New Age International(p) Ltd N Delhi, 2007
2. W.C.frazier and D.C.Westhoff, Food Microbiology, Tata Mcgraw Hill publisher, 3rd edition , 2008

FT18R408	RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Professional Elective			
			Course Type	:	Theory			

Course Objective(s) On completion of the subject, the students will gain knowledge about irradiation and safety measures to be followed and its application in food industries.

Course Outcome(s)

CO1 Identify importance of non-thermal methods like irradiation as an alternative to the conventional methods.

CO2 Infer the importance and safety issues of the irradiated foods

CO3 Analyze the effect of microwave radiation as a processing and preservation method

CO4 Understand the interaction of IR radiation with food materials- its merits and demerits

CO5 Illustrate the impact of radio and UV radiation on microorganism of food

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H			M									L		
CO2		H	M	M				M					L	M	
CO3		M	M		H			L					L	M	
CO4		M			H						L				L
CO5		M	M		H						M				M

Course Topic(s)

Unit 1: BASICS OF RADIATION CHEMISTRY 9 Hours

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics –primarychemical 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 2: RADIATION CHEMISTRY OF FOOD COMPONENTS 9 Hours

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 3: MICROWAVES IN FOOD PROCESSING 9 Hours

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 4: INFRA RED RADIATION 9 Hours

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 5: RADIO FREQUENCY HEATING PRINCIPLES 9 Hours

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.

Text Book(s):

1. J.F.Diehl: Safety of Radiated FoodsMarcel Dekker Inc. NY (1995)
2. Gould G.W. New Methods of Food Preservation, Aspen Publisheres Inc. Maryland. 1999.

Reference Book(s):

1. Ohlsson and Bengtson: Microwave Processing Technologies Wood head Publishing, Cambridge, UK (2002)
2. Philip Richardson: Thermal Technologies for Food ProcessingWoodhead Publishing Limited, CRC Press. (2001)

FT18R206	FOOD BIOTECHNOLOGY					L	T	P	C
						3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective				
			Course Type	:	Theory				

Course Objective(s) The objective of the course is to create general understanding about new techniques used in food biotechnology

Course Outcome(s)

CO1 Understand about the Prospectus of Bio-Technology
CO2 Explain the fermentation process and its application
CO3 Relate the enzyme technology and its application in food industry
CO4 Describe the plant tissue culture techniques
CO5 Classify the functions of vaccine and bioremediation

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H					L					L	L	L		L
CO2		M	H			L		L			M		M		M
CO3	M					L					H		M		M
CO4			M		H						L	L	M		M
CO5		M	M			H	H				M		M		M

Course Topic(s)

Unit 1: BIOTECHNOLOGY 9 Hours

Definition, Scope, Application. Gene cloning - Definition, Basic concepts, Characteristics of ideal cloning vector, Plasmid, Bacteriophages, Cosmid and Phasmid Eg. PBR 322.

Unit 2: FERMENTATION TECHNOLOGY 9 Hours

Definition, Steps in fermentation, Design of bio reactors, Medium & Microorganism. Microbial products - Primary, secondary metabolites, Vit B12, Citric Acid, Penicillin & alcohol.

Unit 3: ENZYME TECHNOLOGY 9 Hours

Production of enzymes - Amylase, Protease, Lipase, Lactase and pectinase, Use of enzymes in food & beverage industry (eg Cheese, fruit, juice, Wine, Meat tenderizing & dairy)

Unit 4: PLANT TISSUE CULTURE 9 Hours

Basic requirement for tissue culture Lab, Media & Techniques (Basics only)Animal cell culture - Primary culture cell line, media requirement & application (only outline)

Unit 5: BIOTECHNOLOGY & HEALTH CARE VACCINES 9 Hours

Types, Biogas & Bio ethanol production, Concept of Bio - remediation, Hazards of genetic engineering.

Text Book(s):

1. Biotechnology, Kumar's V. Saris Publications, Kanyakumari.
2. Biotechnology, Singh B.D. Kalyani Publications, New Delhi.
3. A text book of Biotechnology, Dubey , R.C. S Chand & Co, New Delhi.

Reference Book(s):

1. Gene Technology, Davson, M.T., Powel, R,. and Gannon F. Bios scientific publishers Ltd U.K.
2. Basic Biotechnology, Rev, Fr, Dr. Ignasimuthu, S.J. Tata Mc Graw Hill Publication Co Ltd., New Delhi.

FT18R207	TECHNOLOGY OF CONVENIENCE FOOD				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) To enable the student to understand traditional patterns of food

Course Outcome(s)

CO1 Understand about cultural perspectives and basic ingredient for food preparation
CO2 Describe the traditional method of food preservation
CO3 Explain the production of traditional food
CO4 Choose the commercial methods for the production of traditional foods
CO5 Infer the health aspect of Traditional foods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M					H		L		L			L		
CO2			M		L	L					M		M		
CO3		M	M			H					M		M		
CO4			M			M					M		M		
CO5	M		M			H	M				H			H	

Course Topic(s)

Unit 1: HISTORICAL AND CULTURAL PERSPECTIVES 9 Hours

Importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, festive occasions, specific religious festivals, mourning; Kosher, Halal foods.

Unit 2: TRADITIONAL METHODS OF FOOD PROCESSING 9 Hours

Dairy Products- paneer, butter and ghee manufacture; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi.

Unit 3: TRADITIONAL FOOD PATTERNS 9 Hours

Typical breakfast, meal and snack foods of different regions of India, Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

Unit 4: COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 9 Hours

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods, Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

Unit 5: HEALTH ASPECTS OF TRADITIONAL FOODS 9 Hours

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.

Text Book(s):

1. Sen, 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.

FT18R208	FOUNDATION OF FOOD AND NUTRITION				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) Students will be able to apply their knowledge in nutrition in designing new range of products with improved nutritional characteristics

Course Outcome(s)

CO1 Acquire knowledge about the importance of food and nutrition
CO2 Interpret the importance of nutrition and classification of nutrition
CO3 Select appropriate balanced diet based on their health effects
CO4 Recommend the different method of cooking and its functions
CO5 Develop new products of high nutritive value by adopting new methods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M			M							L		
CO2	M		M			M	L						L		
CO3	M		L			M		L			L		M	M	
CO4	M		L	L		L							M		
CO5	M	L	M	L		H		L			M		M	M	

Course Topic(s)

Unit 1: INTRODUCTION TO FOOD AND NUTRITION 9 Hours

Basic terms used in study of food and nutrition , Understanding relationship between food, nutrition and health

Unit 2: BALANCED DIET 9 Hours

Functions of food-physiological, psychological and social.,Concept of Balanced Diet, Food Groups, Food Pyramid, Food Exchange List, Principles of Meal Planning

Unit 3: NUTRIENTS 9 Hours

Classification, digestion, absorption, functions, dietary sources, RDA, clinical manifestations of deficiency and excess of the following in brief: Energy, Carbohydrates, lipids and proteins,Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate,vitamin B12 and vitamin C Minerals – calcium, iron, iodine, fluorine and zinc

Unit 4: METHODS OF COOKING 9 Hours

Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods

Unit 5: NUTRITION IMPROVEMENT OF FOODS 9 Hours

Nutrient losses in cooking and enhancing the nutritional quality of foods, Fortification of foods, Probiotic and Prebiotic foods.

Text Book(s):

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.

Reference book(s):

1. Sizer, F & Whitney, E. (2008). Nutrition: concepts and controversies. (11th ed.). Belmont, CA: Wadsworth/Thompson.
2. Millsaps, E.M. (Ed.). (2009). Writing at Carson-Newman college. (5th ed.). Jefferson City, TN: Carson-Newman

FT18R209	FOOD PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) To introduce students about the methods of processing and preservation to prevent food wastage and losses

Course Outcome(s)

CO1 Outline the current scenario of food demand in India & world.
CO2 Enumerate the factors affecting food quality and preservation method
CO3 Describe the different preservation techniques for food processing.
CO4 Explain the various packaging technologies for different food products
CO5 Explain the manufacturing process of food products and pollution control in food industry.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		L		L		M				L	M	M	
CO2	M		L	M						L	L		M	L	
CO3	M		L		M	L					M		L		L
CO4	M		M		L	L					M		L		L
CO5	M	L	M		L	L	H	M			L		M		

Course Topic(s)

Unit 1: INTRODUCTION 9 Hours

General aspects of food industry; World food need and Indian situation; Constituents of food; Quality and nutrition aspects; Food additive and standards

Unit 2: DETERIORATIVE FACTORS 9 Hours

D eteriorative factor and their control; Preliminary processing methods; Conservation and Preservation Operations

Unit 3: PRESERVATION METHODS 9 Hours

Preservation by heat and cold; Dehydration; Concentration; Frying; Drying; Irradiation; Microwave heating.

Unit 4: PACKING METHODS 9 Hours

Sterilization and pasteurization; Fermentation; Pickling; Packing methods. Cereal, grains; pulses; Vegetables; Fruits; Spices; Fats and Oils.

Unit 5: PRODUCTION AND UTILIZATION OF FOOD PRODUCTS 9 Hours

Bakery, confectionery and chocolate products; Soft and alcoholic beverages; Dairy products; Meat; poultry and fish products: - Factory Hygiene -Wastewater disposal and pollution control in food industry.

Text Book(s):

1. P.J. Fellows. " Food Processing Technology –Principles and Practice". Woodhead Publication. 3rd edition.2009.

Reference Book(s):

1. Toledo, R. T., Fundamentals of Food Process Engineering, Aspen Publishers, 2nd Edition, 2002.
2. Stephanie Clark, Stephaine Jung, Buddhi Lamsal. " Food Processing: Principles and Applications". Wiley Blackwell. 2nd Edition.2014.

FT18R210	COMPOSITION, QUALITY & SAFETY OF FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) To enable the student to understand interaction between constituents and its effects on food quality

Course Outcome(s)

CO1 Asses nutritional quality of food and composition
CO2 Evaluate sensory quality test with instruments
CO3 Setup quality management system in food industry
CO4 Inspect from raw material to final product in processing line
CO5 Analysis of undesirable constituents in food during processing

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		L			L							M		
CO2		H	M	M	M						M				
CO3		M	H		L	M		M		M	H	M			
CO4		M	H		L	L			L	M	H		M		
CO5	L	M	H			M		M		L	M				

Course Topic(s)

Unit 1: INTRODUCTION **9 Hours**

Ways of describing food quality: Composition, appearance, kinesthetic and flavor attributes. Nutritional quality of foods and its assessment (content and quality of nutrients). Microbiological quality of foods.

Unit 2: SENSORY **9 Hours**

Sensory quality and its evaluation, instrumental measurement of sensory attributes such as color, viscosity, texture etc.

Unit 3: QUALITYCONTROL **9 Hours**

Quality control, quality assurance and total quality management in food industry.

Unit 4: DEFECTS IN FOOD QUALITY **9 Hours**

Defects in food quality, its sources, classification, prevention and control. Statistical quality control. Quality costs.

Unit 5: ANTI NUTRITIONAL FACTORS 9 Hours

Anti nutritional factors in food. Undesirable constituents developing in Process and storage of food. Microbial contamination, pesticide residues, concept of HACCP, physical, chemical and microbiological safety of food.

Text Book(s):

1. Mark Clute, Quality Control for the food industry, CRC press, Nov 2008.
2. V K Joshi, Sensory Science: Principles And Application In Food Evaluation, Agrotech Books, 2nd edition, 2006

Reference Book(s):

1. Elena Castell perez, Ljubica Dokic, Petar Dokic ,P.W.Vowsy, Rheology Applications To Food Quality And Product Development, Black well Pub Professional, 2010
2. Fenemaowen, Food Chemistry. Marcel Dekker publication, 3rd edition, 2005.

FT18R211	BAKERY AND CONFECTIONARY TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) On successful completion of the subject, students will get exposure about how to process bakery and confectionary products

Course Outcome(s)

CO1 Adapt the standards and regulations followed in bakery and confectionary Industry
CO2 Identify the basic food ingredients which will help to prepare bakery products
CO3 Utilize bakery unit processing machinery effectively
CO4 Handle confectionary products and check quality in process line
CO5 Adapt various process flow line in confectionary and bakery products.

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M			L		M			L		M		
CO2		M	M			L				M	L		M		
CO3	L	M	M			L				M	L		M		
CO4		H	M			L				M	L		M		
CO5		M	M			L				M	L		M		

Course Topic(s)

Unit 1: BAKERY INDUSTRY 9 Hours

Current status, growth rate, and economic importance of Bakery Industry in India. Product types, nutritional quality and safety of products, pertinent standards & regulations.

Unit 2: BREAD, BUNS AND PIZZA BASE 9 Hours

Ingredients & processes for breads, buns, pizza base, Equipments used, product quality characteristics, faults and corrective measures

Unit 3: CAKES, BISCUITS, COOKIES & CRACKERS 9 Hours

Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and Corrective measures. Different types of icings.

Unit 4: CONFECTIONARY PRODUCTS 9 Hours

Hard-boiled candies, toffees fruit drops, chocolates and other confectionaries: ingredients, equipment's & processes, product quality parameters, faults and corrective measures.

Unit 5: BREAKFAST CEREALS, MACARONI PRODUCTS AND MALT 9 Hours

Production and quality of breakfast cereals, macaroni products and malt, Production &quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products,sprouted grains.

Text Book(s):

1. Beckette, Industrial Chocolate Manufacture, Wiley- Blackwell publisher, 3rd edition, 2009
2. Faridi Faubion, Dough rheology and baked product texture, CBS publications,1997

Refernce Book(s):

1. Pyler, Baking science and Technology, Sosland PubCo, 2009

FT18R311	BEVERAGE TECHNOLOGY					L	T	P	C
						3	0	0	3
Pre-Requisite	:	FT18R209	Course Category	:	Open Elective				
			Course Type	:	Theory				

Course Objective(s) The students acquire knowledge of various processing and preservation techniques for beverages.

Course Outcome(s)

CO1 Explain the ingredients for production of beverages

CO2 Selection of suitable techniques for production of fruit juices and concentrates with process equipments

CO3 Explain the production process of tea and coffee

CO4 Classify the different production techniques for wine

CO5 Explain the brewing process for different beverages

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		M			L		M					H	L	
CO2	M		M		L	L					L		H		
CO3	M		M		L	L					L		H		
CO4	M		M				L				L		M		
CO5	M										L		H		

Course Topic(s)

Unit1: INTRODUCTION 9 Hours

Classification, production and consumption of beverages- Alcoholic beverages & non- alcoholic beverages- carbonated and non carbonated.- Concept of fermentation for production of beverages, legislation of beverage products.

Unit 2: FRUIT JUICES 9 Hours

Fruit Juices Squashes &Cordials: Equipment for fruit juices, double operations process- Pulping equipment, flash pasteurization, fruit beverage-preparation &preservation- Straining, filtration& clarification- Preservation of fruit juices preservation by addition of sugar, freezing, by carbonation &by filtration.

Unit 3: COFFEE AND TEAPROCESSING 9 Hours

Coffee-Production practice, processing of coffee beans into powder, instant coffee, decaffeination- Tea-Leaf processing, various classes of tea, changes during processing of tea leaves, instant tea.

Unit 4: CHEMISTRYOFFERMENTATION 9 Hours

compositionofwine-mold&yeastofgrape&wine-Productionofred&whitetablewine, production of sherry sparkling wine, desert win ever mouth wine, flavored wine, fruit wine etc-Nonbacterial &bacterial spoilage of wine-winery byproducts.

Unit 5: BREWING 9 Hours

Fermented Beverages: Beer– Brewing, raw material & manufacture, storage finishing & packaging- Brandy &whisky production - Definition, compounds &methods for manufacturing

Text Book(s):

1. Varman Alan, and Sakesland, Technology, Chemistry and Microbiology of food beverages, Springer(sie) Publisher, 2nd edition, 2009

Reference(s):

1. Girdharilal and Siddappa, Preservation of Fruits and Vegetables, Kalyani Publishers, 2001.
2. W.V.Cruees,Commercial fruits and Vegetable products, Agrobios Publishers,2009.

FT18R312	FERMENTED FOOD PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective			
			Course Type	:	Theory			

Objective(s) To provide students with the skill to produce some foods and drinks resulting from alcoholic or acidic fermentation process.

Course Outcome(s)

CO1 Understand the basics of fermentation process and their benefits.
CO2 Interpret about the microorganisms associated with food and the probiotic microbial activity in the food fermentation.
CO3 Evaluate the manufacturing processes of various fermented products.
CO4 Acquire knowledge about manufacturing of fermented beverages and the quality control of the product.
CO5 Assess the various methods for producing industrially relevant enzymes, microbes etc

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M					L							L		
CO2	L	M						L					L		
CO3	M		M			L					M		M		
CO4			M			M					M		M		
CO5			M			M					M		M		

Course Topic(s)

Unit 1: INTRODUCTION TO FERMENTATION 9 Hours

Definition- benefit of fermentation-nutritive value of fermented foods-microbial changes in fermented foods-microorganism-proteolytic, liploytic and fermentative bacteria.

Unit 2: CULTUREMAINTENANCE 9 Hours

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Probiotics - Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

Unit 3: FERMENTEDPRODUCTS 9 Hours

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Buttermilk and the fermented milks. Spoilages and effects of fermented dairy products and their control. Fermented meat and fish products, Oriental fermented foods

Unit 4: FERMENTEDDRINKS 9 Hours

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg.Rum, gin, whisky), Fermented Vegetables (Pickles).

Unit 5: MICROBIALPROTEINS 9 Hours

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin), HFCS (High Fructose Corn Syrup)

Text Book(s):

1. Sukumar De, Outlines of Dairy Technology, Oxford University Press NDelhi,1991.
2. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher,2009

Reference Book(s):

1. L.E. Casida, Industrial Microbiology, New Age International (p)Ltd New Delhi, 2007
2. W.C.frazier and D.C.Westhoff, Food Microbiology, Tata Mcgraw Hill publisher, 3rd Edition, 2008

FT18R313	FOOD LAWS AND STANDARDS					L	T	P	C
						3	0	0	3
Pre-Requisite	:	FT18R210	Course Category	:	Open Elective				
			Course Type	:	Theory				

Course Objective(s) To enable the students to understand the basics of food safety and regulations governing the same, the world over.

Course Outcome(s)

CO1 Characterize different type of safety management system and its functions
CO2 Analyze the HACCP system and its applications in food industry
CO3 Adapt the international food laws and standards
CO4 Adapt the national food laws and standards
CO5 Apply the food labeling regulations

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M			L		H	M	M	L	M	M	H	
CO2		H						H	M	M	L	M		H	
CO3		M	H					H	M	M	L	M		H	
CO4		M	M					H	M	M	L	M		H	
CO5		M	H				H	H	M	M	L	M		H	

Course Topic(s)

Unit 1: GENERAL PRINCIPLES FOR FOOD SAFETY AND HYGIENE 9 Hours

Principles of food safety and quality - Food Safety System - Quality attributes - Total Quality Management. Good Hygienic Practices, Good Manufacturing Practices

Unit 2: HACCP 9 Hours

HACCP –Introduction, Seven Principles, – AOQL (Average Outgoing Quality Limit) – HACCP plan chart.

Unit 3: INTERNATIONAL BODIES 9 Hours

Structure, organization and practical operation of International Standardization Organization (ISO), Codex Alimentarius, World Trade order, World Health Organization

Unit 4 :NATIONAL STANDARDS 9 Hours

Food standards and Specifications: FSSAI- Structure, Organization and Functions, PFA, AGMARK, and BIS Standards.

Unit 5: FOOD LABELLING STANDARDS 9 Hours

Food labelling –Standards for processed food, irradiated foods, Safety aspects of drinking water and Indian regulations for bottled water.

Textbook(s):

1. Neal D. Fortin. 2009. Food regulation, Wiley Publishers.
2. Naomi Rees. David Watson. 2000. International standards for food safety, An Aspen Publications.

Reference Book

1. O'Rourke. 2005. European Food law, 3rd Edition, Thomson, Sweet and Maxwell.

FT18R314	PACKAGING TECHNOLOGY OF FOODS					L	T	P	C
						3	0	0	3
Pre-Requisite	:	Nil	Course Category	:	Open Elective				
			Course Type	:	Theory				

Objective(s) To study about the functions of packaging along with the influence of various factors on food

Course Outcome(s)

CO1 Infer basic concepts in food packaging and its importance in food Industry
CO2 Adapt the packaging technique for right application in Food Industry
CO3 Choose appropriate metal and glass containers for food packaging.
CO4 Standardize testing methods for packaging material to assure quality
CO5 Confirm packaging laws and regulations meeting standards

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M				L							L		
CO2		M	H		M		M						M		
CO3		M	M	L			L						M		
CO4	H		M			L					M		M		
CO5	M		H			H	H	L		L	L			H	

Course Topic(s)

Unit 1: INTRODUCTION TO FOOD PACKAGING 9 Hours

Packaging terminology –definition.Functions of Food Package, Packaging environment. Characteristics of food stuff that influences packaging selection, Shelf Life Estimation.

Unit 2 :PACKAGING METHODS 9 Hours

Active packaging, CAP & MAP. Special packaging methods-vacuum and gas packaging, shrink package, retort pouches, Biodegradable packages.

Unit 3: PACKAGING MATERIAL AND THEIR PROPERTIES 9 Hours

Manufacturing of Metal cans, glass containers, plastic containers and pouches, paper and paper board. Properties of plastics, Filling and sealing of Flexible plastic containers

Unit 4 : PACAKGING OF FRESH AND PROCESSED FOODS 9 Hours

Packaging of Fruits and vegetables, Fats and Oils, Spices, meat, Poultry and sea foods, Dairy Products, Bakery, beverages, Dehydrated and frozen foods. Liquid and powder filling machines –bottling machines, Form Fill Seal (FFS) and multilayer aseptic packaging machines.

Unit 5: ENVIRONMENTAL ISSUES IN PACKAGING 9 Hours

Packaging Laws and Regulations, Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials, Environmental & Economic issues, recycling and water disposal.

Text Book(s):

1. Robertson,G.L. "Food Packaging: Principles and Practice (2nd Edn). Taylor & Francis.2006.

Reference Book(s):

1. Han,J.H. " Innovations in Food Packaging". Elsevier Academic Press,2005.
2. Ahvenainen,R. " Novel Food Packaging Techniques". CRC Press. 2003.
3. Coles,R., McDowell,D. and Kirwan,M.J. " Food Packaging Technology". CRC Press.2003

FT18R315	NUTRACEUTICALS AND FUNCTIONAL FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R208	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) Describe the research on the health benefits of functional foods and nutraceuticals identifying strengths ,limitations and future directions

Course Outcome(s)

CO1 Classify the functional foods and its properties
CO2 Infer regarding Metabolic disorders and its relation with functional foods
CO3 Adapt the methods to formulate fortification in Food supplements
CO4 Utilize food waste for nutrition enrichment and its functions
CO5 Identify the importance of herbal medicine and nutraceuticals foods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		L		L							L		
CO2		M	H			M		H		M		L	L	L	
CO3	M	M				M		M			M	L		L	
CO4	L		M			M	L	L			L	L	L		
CO5	L		M			M	H	M			M	M	M		

Course Topic(s)

Unit 1: NUTRACEUTICALS: HISTORICAL, TELEOLOGICAL ASPECTS AND CLASSIFICATION 9 Hours

Introduction – Historical Reviews - Teleology of nutraceuticals - Organization models for nutraceuticals – Classification of Nutraceuticals based on the sources– Animal, Plant and Microbial – Nutraceuticals in specific foods.

Unit 2: FOOD RECOMMENDED FOR METABOLIC DISORDER 9 Hours

Food recommended and restricted in metabolic disorders and disturbances, gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculo skeletal diseases; allergies.

Unit 3: NUTRITIONAL DEFICIENCIES 9 Hours

Nutritional deficiencies and its correction trough fortification and supplementation of foods. Beneficial effect of spices, honey, spirulina etc.

Unit 4 :HEALTH BENEFITS OF MICRO NUTRIENTS 9 Hours

Health benefits/mode of action of PUFA/gamma linolenic acids, antioxidants, dietary fiber, oligo saccharides, sugar alcohols, peptides and proteins, glycosides, alcohols, iso-prenoides and vitamins, choline, LAB, phenolics, flavonols, minerals

Unit 5: HERBS AS FUNCTIONAL FOODS 9 Hours

Herbal medicine – Herbs as ingredients in functional foods – actions of herbal and evidence of efficacy, Cruciferous vegetables and cancer prevention, Evolution of marketing environment for Functional foods and Nutraceuticals, Potential product positioning.

Text Book(s):

Robert E.C Wildman. Handbook of Nutraceuticals and Functional Foods, Ed., Robert E.C. Wildman, CRC Press LLC. ISBN – 0849387345, 2001.

FT18R410	PROCESSING OF MARINE PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R209	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) To understand about the composition, nutritive value and processing technology of marine products

Course Outcome(s)

CO1 Understand the composition of marine products
CO2 Select appropriate techniques for processing of sea by-products
CO3 Examine the quality of marine products and quality issues in post production and factors affecting the quality
CO4 Elaborate the handling, processing and preservation of sea foods
CO5 Adapt hygiene and sanitation procedures for canning of sea foods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	M					L	H						M		L
CO3	M	M		L	L						L		L	L	
CO4	L		M								M		M		
CO5	L	M	M	L	L						L		M		

Course Topic(s)

Unit 1: INTRODUCTION **9 Hours**

Chemistry of sea food components- Proteins, Lipids. Protein hydrolysis in sea foods, oxidation of lipids in sea foods. Flavor of fish- Taste active component

UNIT 2: PROCESSING OF BY-PRODUCTS **9 Hours**

Fish By-products: Protein, Peptides, Collagen and Gelatin, Fish oil. Crustaceans By-products: Chitin and Chitosan, Seaweed by-products and their applications.

Unit 3: QUALITY OF SEA FOODS **9 Hours**

Freshness quality of sea foods- Appearance, Color, Texture, Odor and Flavor, Destructive slow analyses, Alternative methods. Factors affecting the loss of quality in sea foods.

Unit 4: PRESERVATION OF SEA FOOD **9 Hours**

Chilling of fresh fish, Freezing and frozen storage, Drying of sea foods, Smoking and other methods of preservation

Unit 5: CANNING OF SEA FOODS **9 Hours**

Introduction, Unit operations in the canning process- primary processing, heat treatment, packing and sealing, cooling. Production of canned sea foods – Mackerel, Salmon, Tuna, Shrimp and clams.

Text Book(s):

1. Shahidi and J.R. Botta, “Sea foods: Chemistry, Processing, Technology and Quality”, Springer Science Business media, 1996.
2. Zdzislaw E. Sikorshi, “ Sea foods: Resources, Nutritional Composition, and Preservation”, CRC Press, 2004

FT18R411	NANOTECHNOLOGY IN FOOD PROCESSING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R210	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) The student will be able to work in nanotechnology principles and industry applications

Course Outcome(s)

CO1 Understand about basic of nanotechnology in food sector
CO2 Adapt the technology of nanosensors in food applications.
CO3 Apply key concepts of nanotechnology in food packaging
CO4 Improve the Ethical behaviours to be followed in nanotechnology
CO5 Apply the regulations of nanotechnology in foods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M	L	H	L							M		L
CO2	H		M	L	H	L					M	M			H
CO3		M	H	L	H	L					M	M			H
CO4	L		M	L	H	L		H				M		M	
CO5			H	L	H	L		M		L	M			M	

Course Topic(s)

Unit 1: BASICS OF NANOTECHNOLOGY AND NANOSTRUCTURES IN FOOD 9 Hours

Background-Evolution of new technologies in the food sector, Public perception of nanotechnology food products, Nanomaterials for food applications-Nano-sized food ingredients and additives, Naturally occurring food nano substances and nanostructure

Unit 2: NANOSENSORS 9 Hours

Introduction-Sensors- Biosensors-Enzyme biosensors and diagnostics-DNA-based biosensors and diagnostics-RFID- Integrated nano sensor networks, detection and response-Nano sensors for food quality- Transduction principles.

Unit 3: NANOTECHNOLOGY IN FOOD PACKAGING 9 Hours

Introduction-Reasons to package food products-Physical properties of packaging materials-Antimicrobial functionality-Visual indicators-Improvement of mechanical properties through nanocomposites, nano-structured coatings, Active packaging materials-Intelligent packaging concepts.

Unit 4: NANO-ETHICS 9 Hours

Nano-ethics-Historical background-Identifying and avoiding unethical nano technological products- Ensuring ethical nanotechnological research, innovation and production-Nano-ethics as the question of the good nano technological society

Unit 5: APPLICATIONS **9 Hours**

Current and projected applications of nanotechnology for the food sector-Potential health risks and governance of risks - Regulations pertaining to nano foods the world over

Text Book(s):

1. Qasim Chaudhry, Lawrence Castle and Richard Watkins, "Nanotechnologies in Food" published by Royal Society of Chemistry, 2010.

Reference Book(s):

1. Lynn J. Frewer, Willem, Norde, Arnout Fischer, and Frans Kampers, "Nanotechnology in Agri- Food Sector" Published by Wiley-VCH Verlag GmbH & co. KGaA Hoschstr, 2011.

FT18R412	ENVIRONMENTAL POLLUTION CONTROL				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R313	Course Category	:	Open Elective			
			Course Type	:	Theory			

Course Objective(s) To enable the student to understand environmental pollution control in food industries

Course Outcome(s)

CO1 Utilize byproducts from cereals, pulses, oilseeds, fruits and vegetables
CO2 Manage industrial waste from food industries
CO3 Use of biological oxidation system
CO4 Use advanced waste water system by using physic chemical methods
CO5 Analyze environmental issues that lead to global warming, acid rain and green house effects

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M				H						M		
CO2		M	M			L	H	M		L				M	
CO3		M	M				H				M		L		
CO4	M		M	M			H	M			M		L		
CO5			M			L	H	H						M	

Course Topic(s)

Unit 1: FOOD WASTE FROM INDUSTRIES 9 Hours

Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits, Vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from aforesaid food industries.

Unit 2: POLLUTION AND ITS ABATEMENT 9 Hours

Standards for emission or discharge of environmental pollutants from food processing Industries covered under EPA. Characterization of food industries effluents, in terms of parameters of importance.

Unit 3: PRIMARY TREATMENTS OF EFFLUENT 9 Hours

Screening, sedimentation, floatation as per and primary treatments, biological oxidations:– objectives, organisms, reactions, oxygen requirements, aeration devices.

Unit 4: ADVANCED WASTE WATER SYSTEMS 9 Hours

Effect on characteristic parameters of effluents in treatments using lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biological contracters and theirs variations and advanced modifications. Coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents Conforming to EPA provisions

Unit 5: ENVIRONEMENTAL ETHICS FOR SUSTAINABLE DEVELOPMENT 9 Hours

Environmental ethics-issues and possible solutions-population explosion, climatic change, ozone layer depletion, global warming, acid rain and greenhouse effect. Sustainable development: definition, objectives and environmental dimensions of sustainable development- environmental audit for sustainable development.

Text Book(s):

1. Green J H, Kramer A, Food processing waste management AVI Publishers, West port, CT, 1979.
2. Vasso Oreopoulou, Winfried Russ,(Eds.), Utilization of by-products and treatment of waste in the food industry, Springer, 2007.

Reference(s):

1. N F Gray, Water Technology: An introduction for Scientists, Elsevier, 2005.
2. K C Agarwal, Environmental pollution, Vedams Books, 2001

FT18R413	TECHNOLOGY OF FOOD EMULSIONS, FOAMS AND GELS			L	T	P	C
				3	0	0	3
Pre-Requisite	:	FT18R272	Course Category : Honours				
			Course Type : Theory				

Objective(s) To impart basic knowledge regarding food dispersion systems, their formation, behavior and factors affecting their stability.

Course Outcome(s)

CO1 Explain the importance of food dispersions
CO2 Elaborate the interaction of food constituents in maintaining food emulsion
CO3 Interpret the functions and properties of foam and its stability
CO4 Classify the structure of gel and its applications
CO5 Develop new products which are nutritional with the help of gel theory

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H												M		
CO2	H												M		
CO3	H										L		M		L
CO4	H										M		M		L
CO5	H										M		M		

Course Topic(s)

Unit 1: FOOD DISPERSIONS **9 Hours**

Food dispersions, their characteristics and factors affecting food dispersions.

Unit 2: FOOD EMULSIONS **9 Hours**

Food emulsions; emulsifiers and their functions in foods; the HLB concept in food emulsifiers; emulsion formation and stability; polymers and surfactants.

Unit 3: FOAM AND STRUCTURES **9 Hours**

Milk foams and their applications, structure of foams, egg foams and uses, foam formation and stability.

Unit 4: STRUCTURE OF GELS **9 Hours**

Structure of dairy foods representing emulsions, foams and gels; physical structure of fat rich, concentrated, fermented, coagulated and dried products.

Unit 5: THEORY OF GEL FORMATION **9 Hours**

Theory of gel formation; pectic substances and jellies; fruit pectin gels; milk jellies.

Text Book(s):

1. Stig E.Friberg., Kare Larsson and Johan Sjoblom. “Food Emulsions”. CRC Press .2003.
2. David Julian Mc Clements. “ Food Emulsions”. CRC Press. 1998.

Reference Book(s):

1. Blanshard JMV & Lillford P. “ Food Structure and Behaviour”.Academic Press.1987.

FT18R414	NANOTECHNOLOGY IN FOOD PROCESSING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R251	Course Category	:	Honours			
			Course Type	:	Theory			

Course Objective(s) The student will be able to work in nanotechnology principles and industry applications

Course Outcome(s)

CO1 Describe the basic of nanotechnology in food sector
CO2 Explain the technology of nanosensors in food applications.
CO3 Relate the concepts of nanotechnology in food packaging
CO4 Describe the ethics to be followed in nanotechnology
CO5 Explain the regulations of nanotechnology in foods

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		M	L	H	L							M		L
CO2	H		M	L	H	L					M	M			H
CO3		M	H	L	H	L					M	M			H
CO4	L		M	L	H	L		H				M		M	
CO5			H	L	H	L		M		L	M			M	

Course Topic(s)

Unit 1: BASICS OF NANOTECHNOLOGY AND NANOSTRUCTURES IN FOOD 9 Hours

Background-Evolution of new technologies in the food sector, Public perception of nanotechnology food products, Nanomaterials for food applications-Nano-sized food ingredients and additives, Naturally occurring food nano substances and nanostructure

Unit 2: NANOSENSORS 9 Hours

Introduction-Sensors- Biosensors-Enzyme biosensors and diagnostics-DNA-based biosensors and diagnostics-RFID- Integrated nanosensor networks, detection and response-Nanosensors for food quality- Transduction principles.

Unit 3: NANOTECHNOLOGY IN FOOD PACKAGING 9 Hours

Introduction-Reasons to package food products-Physical properties of packaging materials-Antimicrobial functionality-Visual indicators-Improvement of mechanical properties through nanocomposites, nano-structured coatings, Active packaging materials-Intelligent packaging concepts.

Unit 4: NANO-ETHICS 9 Hours

Nano-ethics-Historical background-Identifying and avoiding unethical nanotechnological products- Ensuring ethical nanotechnological research, innovation and production-Nano-ethics as the question of the good nanotechnological society

Unit 5: APPLICATIONS **9 Hours**

Current and projected applications of nanotechnology for the food sector-Potential health risks and governance of risks - Regulations pertaining to nano foods the world over

Text Book(s):

1. Qasim Chaudhry, Lawrence Castle and Richard Watkins, "Nanotechnologies in Food" published by Royal Society of Chemistry, 2010.

Reference Book(s):

2. Lynn J. Frewer, Willem, Norde, Arnout Fischer, and Frans Kampers, "Nanotechnology in Agri- Food Sector" Published by Wiley-VCH Verlag GmbH & co. KGaA Hoschstr, 2011.

FT18R415	DRYING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R372	Course Category	:	Honours			
			Course Type	:	Theory			

Course Objective(s) To enable the student to understand basic theory of drying and its significance in food systems

Course Outcome(s)
CO1 Infer the mechanism and quality changes during drying
CO2 Select suitable dryers for food products based on requirement
CO3 Identify the applications of spray drying and mechanism
CO4 Choose suitable dryers for solid food materials
CO5 Recommend appropriate dryers for liquid food materials

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	M	H									M		L
CO2	M		H		M						M		M		L
CO3	M		M		M						M		M		L
CO4	M		M		M						M		M		L
CO5	M		M		M						M		M		L

Course Topic(s)

Unit 1: BASICS OF DEHYDRATION 9 Hours

Principles of drying– Fundamentals of air-water mixtures – psychrometric chart – Heat and mass transfer in ideal dryers – with and without recirculation. Theories of drying – constant and falling rate period - diffusion theory, capillary theory, evaporation – condensation theory, Luikov, Philip and De Vries theory Water content in foods and its determination – Theoretical and empirical models for determining water activity

Unit 2: CABINET, VACUUM AND DRUM DRYING OF FOODS 9 Hours

Fundamentals of cabinet drying – Mass and Heat balances in dryers (batch and continuous) (simple problems only) – description of batch and continuous dryers – Application in Food industry – Vacuum and Drum driers

Unit 3: SPRAY DRYING OF FOOD 9 Hours

Fundamentals –Nozzles, Rotary atomizers and two fluid feeds- Interaction of droplets with air- Drying of droplets with soluble and insoluble solids – Microstructure of spray dried products – Reconstitution – Foam spray drying – Applications in the Food industry

Unit 4: FREEZE DRYING OF FOODS 9 Hours

Fundamentals of freeze drying – Freezing and drying steps – Combined heat and mass transfer (only theory) – Structural changes and volatile retention during freeze drying – Freeze dehydration related processes : prefreezing, preconcentration, condensation, defrosting – Industrial freeze driers – Atmospheric freeze drying - Applications in food industry

Unit 5: FLUIDISED BED DRYING, MICROWAVE DRYING AND EXTRUSION OF FOODS 9 Hours

Fluidised bed drying – Batch and Continuous dryers – Pneumatic dryer. Extrusion cooking – Single and Twin-screw extruders Packaging of dehydrated products

Text Book(s):

1. Y. H. Hui :Food Drying Science and Technology, Microbiology, Chemistry, Application, CHIPS (2008)

Reference Book(s):

1. Arun S. Mujumdar: Handbook of Industrial Drying, 3rd Edition, CHIPS (2006)

FT18R416	FOOD TOXICOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R371	Course Category	:	Honours			
			Course Type	:	Theory			

Course Objective(s)

The objective of the course is to introduce food related toxicological compounds

Course Outcome(s)

CO1 Classify the different types of hazards and their characteristics
CO2 Infer the metabolic activity for food sensitivity and allergy
CO3 Recommend the principle of toxicology and its biological action
CO4 Adapt the methodology for biological determination of toxicants.
CO5 Identify the toxin formed during processing and controlling

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		M			L	H						L	M	
CO2	M		M			L	M	L						M	
CO3		M	M	L			M							H	
CO4		M		M		L	H			L				H	
CO5			H	M			H	L		L		M		H	

Course Topic(s)

Unit 1: INTRODUCTION 9 Hours

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

Unit 2: FOOD ALLERGY AND SENSITIVITY 9 Hours

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

Unit 3: PRINCIPLES OF TOXICOLOGY 9 Hours

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

Unit 4: DETERMINATION OF TOXICANTS IN FOOD SAMPLING 9 Hours

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

Unit 5: TOXICANTS FORMED DURING FOOD PROCESSING 9 Hours

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

Textbook(s):

1. Shibamoto, Taka yuki and Leonard F.Bjeldanzes "Introduction to Food Toxicology" 2nd Edition. Academic Press, 2009.
2. Alluwalia, Vikas "Food Hygiene and Toxicology" Paragon International Publishers, 2007

Reference Book(s):

1. Helferich, William and Carl K.Winter "Food Toxicology" CRC Press, 2001.

FT17R417	EXTRUSION TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R381	Course Category	:	Honours			
			Course Type	:	Theory			

Objective(s)To enable to students to develop extruded products with different food ingredients

Course Outcome(s)

CO1 Classify the different types of extrusion methods with their principle

CO2 Adapt the concept of modeling to design the extruders

CO3 Analyze the impact of physio-chemical characters of food ingredients and process parameters on quality of extruded products

CO4 Adapt the impact of process parameters on Nutritional aspect extruded product

CO5 Infer the Applications and Advantages of Extruders

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		H	M	H								M		
CO2		M	M	M	H								M		
CO3	M		M	M	H								M		
CO4	H			M	H								M		
CO5	H		M	M	H		M				M	M	M		M

Course Topic(s):

Unit 1: Introduction 9 Hours

Definition of extrusion, Principle of extrusion, functions and advantages of extruders, Componenets of extruder, classification of extruders: single screw, twin screw, cold extruder, extruder cooker, pressure classification

Unit 2: Basics of Extruder design 9 Hours

Rheology of feeds, modeling of feed flow in extruder, Isothermal Newtonian flow, Corrected flow equation, Leakage flow, Isothermal Non Newtonian, Modelling of input power, Design of Die: die characteristics and effects

Unit 3: Composition and physical requirements of extruder feeds 9 Hours

Preconditioning of extruder feeds, benefits, types of pre conditioners (atmospheric and pressurized, single/double shaft, DDDS, Effects of extruder parameters and feed composition on characteristics of extruded products: gelatinization of starch feeds, denaturation of protein feeds

Unit 4: Changes caused by extrusion 9 Hours

Structural changes – expansion, texturization etc. and nutritional changes in carbohydrates, protein, lipid, vitamins, minerals, antinutritional factors

Unit 5: Application of extrusion technology 9 Hours

Food – Protein based, sugar based and cereal based (Ex. RTE Breakfast cereals, meat substitutes, textured plant and milk proteins, specialty foods, toffee, surimi, snacks etc.,) Precooked/thermally modified starch, flours and grain. Animal feed- pet foods, aquatic feed, cattle feed. Quality improvement – Texture alteration, Enzymes inactivation, partial dehydration, Homogenization, Protein denaturing, Gelatinization, destruction of microbes and toxic compounds.

Text Book(s):

1. Medeni Maskan, Aylin Altan - Advances in Food Extrusion Technology - CRC Press (2016)
2. N.D. Frame - The Technology of Extrusion Cooking - Springer science business media (2012)

Reference(s)

1. Jean-Marie Bouvier and Osvaldo H. Campanella -Extrusion Processing Technology: Food and Non-Food Biomaterials – Wiley – (2014).

FT18R418	REFRIGERATION AND COLD STORAGE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R372	Course Category	:	Honours			
			Course Type	:	Theory			

Objective(s)

1. To enable the students to understand the various concepts behind refrigeration and cold storage construction.
2. On completion of the subject, the students will be able to apply their knowledge on cold storage of perishable products.

Course Outcome(s)

CO1 Recommend the various concepts behind refrigeration and storage construction.
CO2 Design the refrigeration and cold storage systems
CO3 Adapt chilling technology to control microbial activity and maintain freshness of the products.
CO4 Apply knowledge on freezing to maintain perishable products
CO5 Analyze the shelf life enhancement under refrigerated condition

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M			L		L							M		
CO2	M			M		L	M				M	M	M		
CO3	M			L		L		L			H		M		
CO4	M			L		L							M		
CO5			M			L		M			M	M	M		

Course Topic(s)

Unit 1: REFRIGERATOR **9 Hours**

Thermodynamic principles of refrigeration, Refrigeration cycles, Refrigerants and Equipments- COP -Atmospheric air and its properties, Psychometrics

Unit 2: COLD STORAGE **9 Hours**

Cold Storage- construction, design, prefabricated systems. Freezer storage, pre-cooling and pre freezing. Cold storage practice, stacking and handling of materials, optimum temperatures for foods. Storages- operation and maintenance

Unit 3: CHILLING **9 Hours**

C hilled foods- equipment, Secondary refrigerants, direct expansion, transport and display cabinets - microbiology, packaging - Hygienic design considerations for chillers and chilled Storages- Evaporative cooling and its applications.

Unit 4: FREEZING **9 Hours**

Freezing equipment, Freezing rates, ice crystals, quick freezing, cryogenic Freezing, freezing of different foods.

Unit 5: PRESERVATION **9 Hours**

Preservation of different products - dairy plant refrigeration system, meat and poultry refrigeration system, seafood refrigeration system

Text Book(s):

1. Da-Wen Sun, Hand book of Frozen Food Processing and Packaging, Second Edition, CRC Press, Taylor and Francis Group, 2012.
2. C.P. Mallet, Frozen Food Technology, Springer London, Limited, 2012.

Reference Book(s):

1. William C. Whitman, William M. Johnson, John A. Tomczyk, and Eugene Silberstein Refrigeration and Air Conditioning Technology, Sixth Edition, Delmar, Cengage Learning, 2009
2. Judith A. Evans, Frozen Food Science and Technology, Blackwell Publishing Ltd, 2008

FT18R419	POST HARVEST PEST MANAGEMENT IN FOOD SAFETY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R371	Course Category	:	Honours			
			Course Type	:	Theory			

Course outcomes:
On Successful completion, students can be able to
CO1: describe the pests that damage agricultural produces.
CO2: analyze methods to control pests of cereals and pulses
CO3: analyze methods to control pests of vegetables, oil crops and spices
CO4: analyze methods to control pests of tropical and sup tropical fruits
CO5: describe integrated and innovative pest management concepts

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M		L		M	M	L			M	M	L	L	
CO2		M	M	L		M	M			L			L	L	
CO3		M	H	L		M	M			L			L	L	
CO4		M	H	L		M	M			L			L	L	
CO5		M	M	L		M	M			L	M		L	L	

Unit I

Definition of pests, classification of insects, diagnostic characters of arachinda and diploma. Some knowledge of phytophagous, mites, slugs and snails, crows, parrots, rats, mice and ungulates. Pathway of pest entry, risk analysis, prevention of entry, pest free areas, An introduction of acaricides, rodenticides, weedicides, fumigants etc. insect growth regulators like repellents, attractants, inhibitors etc.

Unit II

Insect pests of cereals and pulses including nature of damage life history of important pests and physical, mechanical & biological control.

Unit III

Insects pests of vegetables, oil crops and spices with nature of damage, physical, mechanical & biological control and life history of at least two important pests from each category

Unit IV

Insects pests of tropical and sub-tropical fruits including nature of damage. physical, mechanical & biological control and life history of at least two important pests from each category

Unit V

Components of Integrated pest management (IPM) -implementation of IPM, legal approach-sanitary and phytosanitory measures (SPS) measures and quarantine concepts, health approach-

pesticide residual effects, pest management informatics, Innovative pest management concepts – biotechnological approaches, pesticide resistance management,

TEXT BOOKS

1. L.R. Verma and V.K. Joshi, (Eds).,Post Harvest Technology of Fruits and vegetables, Indus Publishing company, New Delhi, 2000.
2. Mircea Enachescu Dauthy, "Fruit and Vegetable Processing" FAO Agricultural Services Bulletin No.119, 1995
3. Pantastico, E.C.B. , Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVi Pub. Co, 1975.
4. Birch, G. and Campbell-Platt, G. (Eds.)., Food Safety - the Challenge Ahead. Intercept Ltd., Andover, England., 1993

REFERENCES

1. 1.Hand book of Food dehydration and drying, NIIR board, 2000.
2. 2.P H Pandey, Post Harvest Technology of Fruits and Vegetables (Principles and practices), Kalyani Publishers, New Delhi, 1998

FT18R420	FOOD MATERIAL SCIENCE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	FT18R372	Course Category	:	Honours			
			Course Type	:	Theory			

Course Objective(s)
Enable the students to understand foods with modified textural properties

Course Outcome(s)
CO1 Describe the structural properties of foods materials
CO2 Analyze the structural relationship of emulsion
CO3 Infer the composite properties of foods
CO4 Develop new products which are nutritional and cost effective
CO5 Recommend the kinetics of maillard reaction and its applications

Mapping of COs and POs:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M		M	M									M		
CO2		M	M	M							L		M		
CO3	L		M	L									M		
CO4	L		M	L							L		M		
CO5	M			L						M	L		M		

Course Topic(s)

Unit 1: Composite structure of biological tissue used for food, food polymers-fringed micelle structural model, state diagram of food materials, concept of glass transition, crystallization kinetics, dynamic maps, interfacial properties

Unit 2: Structure property relationship in food, structure in water by gelation, bubble containing food, emulsions, fat crystal network, processing of food powder

Unit 3: Food structuring-composite materials, factors affecting composite materials, types of composite-particulate, fibrous, laminate. Solid, foam and sponges.

Unit 4: Structuring food products-dairy products, cereal, dairy, meat, chocolate.

Unit 5: Maillard reaction, strecker degradation, flavor formation via maillard reaction, role of kinetic modelling in maillard reaction

Text Book(s):
1. Aguilera, José Miguel, Lillford, Peter J. (Eds.), Food Materials Science Principles and Practice, (2008)
2. Pieter Walstra , Physical Chemistry of Foods (2002)

Reference Book(s):
1. Hans-Dieter Belitz, Werner Grosch, Peter Schieberle and published, Springer, Food Chemistry (4th revised and extended edition) 2009