

B.Tech – FOOD TECHNOLOGY



CURRICULUM REGULATION 2018

**KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
Anand Nagar, Krishnankoil - 626 126**

<u>Institute Vision</u> <i>To be a Center of Excellence of International Repute in Education and Research</i>	<u>Institute Mission</u> <i>To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research</i>
<u>Department Vision</u> To be a center of repute in research and education in the frontier areas of Food Technology	<u>Department Mission</u> To impart knowledge through research and education and to groom them as professional leaders with entrepreneurship skills in the field of food technology for ensuring sustainable growth in food processing and preservation to meet the ever increasing demand of the society.

Program Educational Objectives (B.Tech – Food Technology)

PEO 1	Pursue higher studies or to be employed in food technology or related disciplines.
PEO 2	Be a successful entrepreneur in creating jobs related to applied science and technology
PEO 3	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 Outcome(s):**Graduates will be able to**

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		6
III	Basic Engineering	24	
IV	Program Core	61	
	a) Core Courses		48
	b) Community Service Project		3
	c) Project work		10
V	Elective Courses	36	
	a) Professional Elective		18
	b) Open Elective		18
VI	Internship/Industrial Training	2	
VII	Mandatory courses	--	
Total		160	

Basic Sciences and Mathematics

Course Code	Course Name	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

Humanities and Social Science

Course Code	Course Name	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 Name	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

I BASIC ENGINEERING

S. NO	Course Code	Course Name	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

II PROGRAM CORE**a) Core Courses**

S. No	Code	Subject Name	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

8V 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
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 Name	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 Foods	T	-	3	0	0	3
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

Total number of Credits = 160

Subject Code	Optics, Electromagnetism and Quantum mechanics	L	T	P	C
PHY18R175		3	1	2	5
Pre-requisite: Basic Knowledge in Physics		Course Category: Basic Sciences and Mathematics			
Course Type: Integrated Course					
Course Objectives:					
<ul style="list-style-type: none"> 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 electrostatics.					
CO4: Understand the fundamentals of magnetism.					
CO5: Apply the knowledge on solving the wave equations					
Unit I: 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 II: 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 III: 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 IV: 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" Fifth 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 Mathematics		Course Category: Basic Sciences and Course Type: Integrated Course			

Unit -I: 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-II: Periodic Properties

9 Hours

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of 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-III: 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 Argentometric 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 nucleophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of $\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$, $\text{S}_{\text{N}}i$ 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 $\text{C}=\text{O}$ bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN , HOH , ROH and NaHSO_3 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 C₃H₆O from ¹H-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	L	T	P	C
	(Common to all Branches of B.Tech) (For those who have joined in June 2018 and later)	3	1	0	4
Pre-requisite: Nil <i>Mathematics</i>		Course Category: <i>Basic Sciences and</i> <i>Course Type:</i> <i>Theory with tutorial</i>			

Course Objective:

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

1. know the fundamental theorems such as Rolle's theorem, Mean value theorem, Taylor's theorem and its applications.
2. understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.
3. solve the real world problems using differentiation and integration.
4. understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.
5. find the solution of simultaneous linear equations using matrices and to find the eigen values and eigen vectors of a matrix, Cayley-Hamilton 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):	12 Hours
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 Delh 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.

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 <i>Mathematics</i>		Course Category: <i>Basic Sciences and</i> Course Type: <i>Theory with tutorial</i>			

Course Objective:

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

1. understand the concepts of double and triple integral and its applications.
2. know about the applications of double and triple integral in vectorcalculus.
3. know the methods of solving differential equations of first and secondorders.
4. understand the concepts of analytic functions, conformal mappings and bilinear transformations.
5. 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:

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

REFERENCE BOOKS:

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

MAT18R201	Bio-Statistics	L	T	P	C
	(for BioTech, BioMedical and Foodtech)				
	(For those who have joined in June 2018 and later)	3	1	0	4
Pre-requisite: Nil <i>Mathematics</i>		Course Category: Basic Sciences and			
		Course Type: Theory with tutorial			

Course Objective:

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

1. know the methods of finding averages, deviations, moments and skewness and kurtosis.
2. understand the concepts of probability and to know about the discrete and continuous distributions.
3. understand the concepts of correlation and regression and its applications.
4. fit the curve of first and second degree equations by least square method and know the method of analysis of variance.
5. study about the testing of hypothesis of small and large samples.

Unit 1: Statistical Averages

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 $y \propto bx^a$, $y \propto ae^{bx}$, $y \propto ka^{bx}$ - 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

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:

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

BASIC ENGINEERING

MEC18R211	ENGINEERING MECHANICS	L	T	P	Credit
		3	1	0	4
Pre-requisite: Nil		Course Category: Basic Engineering Course Type: Theory			

Course Outcome(s):

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 Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	1											
CO2	3	2	2	1											
CO3	3	3	2	1											
CO4	3	2	2	1											
CO5	3	1	1	1											

3-StrongCorrelation-2-MediumCorrelation-1-LowCorrelation

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 Surfaces and 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 Engineering (Common to EEE, Food, Biomedical, Biotech & Chemical)	<i>Credits</i>			
	<i>L</i>	<i>T</i>	<i>P</i>	<i>Credit</i>
	3	1	2	5
Pre-requisite: --NIL	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 Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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 and power 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, Muthusbramanian 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

MEC18R151 ENGINEERING GRAPHICS & DESIGN	Credits			
	L	T	P	Credit
	3	0	2	3
Pre-requisite: Nil		Course Category: Basic Engineering Course Type: Theory with Practical		

15. Study of Clipping & Clamping circuit

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 Course Outcome(s):

CO/ PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2		2													
CO2		3										1				
CO3	2		3		3		3					2				
CO4	1	2			3		3					3				
CO5	3		3		3		3					3				

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

Course Topics:

Unit 1: Projection of Points 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

CO4									M			
CO5												
Course Topic(s)												
<p>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</p>												
<p>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 Strings</p>												
<p>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.</p>												
<p>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)</p>												
<p>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</p>												
<p>LIST OF EXPERIMENTS 15 Hours</p> <ol style="list-style-type: none"> 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 <p>Programs for creating text files to store and manipulate data.</p>												
<p>Text Book(s):</p> <ol style="list-style-type: none"> 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 												
<p>Reference(s):</p> <ol style="list-style-type: none"> 1. Brian W. Kernighan 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:

- (i) 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.
- (ii) Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- (iii) Gowri P. Hariharan and A. Suresh Babu, ”Manufacturing Technology – I” Pearson Education, 2008.
- (iv) Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
- (v) 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.

(ii) 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	To attain basic knowledge about Process calculation											
CO2	To understand material balance calculation for process											
CO3	To understand Energy balance calculation for process											
CO4	To understand the fluid flow behavior and transportation.											
CO5	understand thermal processing of foods and its equipment											
Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2												
CO3												
CO4						H						
CO5												M
Course Topic(s)												
UNIT – I UNITS AND DIMENSIONS, FUNDAMENTAL CALCULATIONS											12 hours	
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 and Volume; normality, molarity, molality, ppm, pH and pKa Buffer Calculations												
UNIT – II MATERIAL BALANCE WITH AND WITHOUT CHEMICAL REACTIONS:											12 hours	
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 THEORY											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	Applications of food additives in Food Industry														
CO2	Identify adulterants in food additives														
CO3	Preservative class and its limitation in food processing industries														
CO4	Study on colorant and flavor of food additives														
CO5	Laws and quality standards related to food additives														
Mapping of COs and POs															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M														
CO2			M												
CO3										M					
CO4			M							M					
CO5			M							M				M	
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 agents , 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. 2 nd Edition.2011.															

2. Richard J. Lewis, Sr. "Food Additives Handbook". International Thomson 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 Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M			L							H		H
CO2			H			M	M						L		
CO3	M	M			M	M	M						L		M
CO4		L	M		L	M		L	M	M			H		
CO5		H	L			H	H	L		M	M			H	
Course Topic(s)															
<p>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.</p> <p>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.</p> <p>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.</p> <p>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</p> <p>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.</p> <p>Text Book(s): 1. B. Sivasankar. "Food Processing and Preservation". PHI Learning Private Limited. 2015.</p>															

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 microorganisms in food														
Course Outcome(s)															
CO1	Explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival														
CO2	Explain the significance and activities of microorganisms in food.														
CO3	Describe the characteristics of food-borne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification														
CO4	Explain the effects of fermentation in food production and how it influences the Microbiological quality and status of the food product.														
CO5	Explain why microbiological quality control programmes are necessary in food Production.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M			L							H		H
CO2			H			M	M						L		
CO3	M	M			M	M	M						L		M
CO4		L	M		L	M		L	M	M			H		
CO5		H	L			H	H	L		M	M			H	
Course Topic(s)															
Unit 1: INTRODUCTION							9 Hours								
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							9 Hours								
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							9 Hours								
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**9 Hours**

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.

Unit5: FOOD SPOILAGE CONTROL**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 McGraw Hill Publishing Co. Ltd., New Delhi, 4th 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	Understand and control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications				
CO2	Understand how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems, and to understand the principle that underlies the biochemical/enzymatic techniques used in food analysis.				
CO3	Explain the chemistry underlying the properties and reactions of various food components.				
CO4	Understand the need of biochemistry and efficiency of carbohydrates and protein in the industry.				
CO5	To delivers food pigment and their application in food processing				

--	--

Mapping of Course Outcome(s)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H												L		
CO2	M	L				M							L		
CO3	M	L				M							L		
CO4	M	L				M							L		
CO5	M	L				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

9 Hours

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 different nutrients

Unit 4: MINERALS & VITAMINS

9 Hours

Minerals and Vitamins -Importance and sources of minerals and vitamins with special emphasis on calcium, iodine, zinc, iron, fluoride, 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. Dulys 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	Cred it	
											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	Take professional sampling and sample treatment prior to analysis														
CO2	Calibration of Instrumental methods and troubleshoot														
CO3	Understand and capable of performing basic chemical processes in an analytical laboratory														
CO4	perform measurements on basic analytical instruments (photometers, spectrometers, chromatographs, ion-selective electrodes)														
CO5	Evaluate the result of analysis and identify the compounds present in it.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			M												
CO2					M										
CO3			M												
CO4					M										
CO5					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										9 Hours					

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 & Nephelometry.

Unit 3: ATOMIC ABSORPTION & PHOTO IONIZATION 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. Saccharimetry- 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, t ypes, 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, New Delhi, 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 Publishing House, Mumbai, 5th Edition (Reprint), 2006
2. Ewing, G.W., Instrumental Methods of Chemical Analysis, McGraw Hill Company, New Delhi, 5th Edition, 1989
3. Skoog Douglas A., West Donald M., Holler F James, and Crouch Stanley R., —Analytical Chemistry: An Introduction, 7th Edition, South-Western, Australia, 2000.
4. Rouessac F., —Chemical Analysis: Modern International Method and Techniques, 3rd Edition, Wiley, New Delhi, 1999.
5. Banwell G.C., —Fundamentals of Molecular Spectroscopy, 2nd Edition, Tata McGraw-Hill, New Delhi, 1992.

FT18R203	TECHNOLOGY OF DAIRY PRODUCTS	L	T	P	Credit										
		3	0	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	The students learn the technology of milk and its processing methods														
CO2	The students gain knowledge about the various milk processing equipments														
CO3	Hands-on skills in manufacturing selected dairy products in a pilot plant setting														
CO4	An appreciation of the safety and quality factors that determine the acceptability of the dairy products by consumers														
CO5	Ability to adapt new technology and develop quality products														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M			L							H		H
CO2			H			M	M						L		
CO3	M	M			M	M	M						L		M
CO4		L	M		L	M		L	M	M			H		
CO5		H	L			H	H	L		M	M			H	
Course Topic(s)															
<p>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.</p> <p>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</p> <p>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 products -Buttermilk powder, Whey Powder, Ice Cream mix Powder, Infant milk food, WMP& SMP. Manufacturing of Fermented products – Yoghurt, Curd, acidophilus milk, buttermilk, and Cheddar cheese, Introduction, Manufacturing process, packaging, storage, defects and their prevention</p> <p>Unit 4: BYPRODUCTS UTILIZATION 9Hours Introduction, Classification & composition of byproducts, Principles & methods of Utilization – whey utilization, Applications of enzymes in dairy industry</p>															

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,3rd edition1998.
3. Tufail Ahmed, —Dairy Plant Engineering and Managementl, Kitab Mahal, New Delhi, 2012.

REFERENCES

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 Productsl, CRC Press, New York, 2010.
3. Robinson R.K., —Modern Dairy Technology: Advances in Milk Productsl, 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	Adapt the standards and regulations followed in bakery and confectionary industry														
CO2	Grasp basic knowledge about food ingredients and its used in 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 Course outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			M											M	
CO2		M												M	
CO3										M					
CO4										M				M	
CO5														M	
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	Credit									
			3	1	2	5									
Pre requisite: FT18R101			Course Categories: 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	Principles and mechanism of heat transfer														
CO2	Fundamentals of conventional heat transfers														
CO3	Basic principles of heat exchanger design														
CO4	Concepts of drying and thermal processing of biological materials														
Mapping of Course(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M			L							H		H
CO2			H			M	M						L		
CO3	M	M			M	M	M						L		M
CO4		L	M		L	M		L	M	M			H		
Course Topic(s)															
UNIT OPERATIONS															
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-III FILTRATION & 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, New York, 7th edition., 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(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, New York, 5th Edition, 2002
2. David, M.Himmel blau, Basic Principles and Calculations in Chemical Engineering, Prentice-Hall of India, New Delhi, 7th Edition, 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	Describe the functions of packaging materials and its importance in food Industry														
CO2	Explain the properties, types and applications of plastics and papers in packaging														
CO3	Explain the properties, types and applications of glass and metals in packaging														
CO4	Adapt and utilize packaging materials for right application in Food Industry														
CO5	Explain the laws, regulations and environmental standards pertaining to food Packaging														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M			L							H		
CO2			H			M	M						L		
CO3	M	M			M	M	M						L		
CO4		L	M		L	M		L	M	M			H		
CO5		H	L			H	H	L		M	M			H	
Course Topic(s)															
<p>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.</p> <p>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.</p> <p>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</p> <p>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.</p>															

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.
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	Ability to describe the construction and operating principles of food and beverage processing, handling and packaging systems using engineering terminology											
CO2	Effects of drying rate in foods and its impact											
CO3	Designing of freezers and preservation of food by refrigeration											
CO4	Physical and rheological properties of food and its changes during processing											
CO5	Heat and Mass transfer in food processing											
Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2						M						
CO3						M						
CO4		M										
CO5		M										
Experiments										45 Hours		
<ol style="list-style-type: none"> 1. Determination of drying rate of given food materials 3. Experiments on extrusion cooking 4. Experiments on microwave cooking 5. Experiments on freezing of foods – freeze thaw stability 6. Experiments on determination of physical properties of foods 7. Experiments on rheological properties of foods 8. Experiments on thermal conductivity of materials 9. Experiments on determination of firmness of foods 10. Experiments on determination of hardness of foods 11. 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	FOOD SAFETY 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	Describe about physical, chemical contaminants in foods														
CO2	Describe about food safety system														
CO3	Describe international food laws and standards														
CO4	Describe national food laws and standards														
CO5	Describe food labelling regulations														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L			H		L					L	L	
CO2			M		M	M		M		M	H			H	
CO3						M		H		M					
CO4		L				H		H		M				M	
CO5		M	M			H		M		H				M	
Course Topic(s)															
<p>Unit 1: INTRODUCTION TO QUALITY CONTROL</p> <p>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</p> <p>Unit 2: FOOD SAFETY MANAGEMENT 9 Hours</p> <p>Food Quality Management system, Quality Management Principles, Food laws – HACCP, AOQL, ISO/22000: Food Safety managements system</p> <p>Unit 3: INTERNATIONAL FOOD LAWS AND REGUALTIONS 9 Hours</p> <p>Structure, organization and practical operation of WTO, WHO, FAO, CAC (Codex Alimentarius Commission), ICGFI.</p> <p>Unit 4: NATIONAL FOOD LAWS AND REGUALTIONS 9 Hours</p> <p>Structure, organization and practical operation of BIS, AGMARK, PFA, FSSAI.</p> <p>Unit 5: LABELLING REGULATIONS 9 Hours.</p> <p>Need for labelling, limitations of labelling- safety issues, labelling for irradiated foods, genetically modified foods, nutritional labelling, health claims</p>															

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	Understand the principle, Construction and operation of instruments				
CO2	Control instruments and its function to give accurate outputs				
CO3	Control processing instruments in food industry				
CO4	Give Logical reasoning and interpret results with standard values				
CO5	Troubleshoot instruments to maintain accuracy				

Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M							
CO2					M							
CO3					M							
CO4								M				
CO5												
Course Topic(s)												
<p>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.</p> <p>Practical: Flow measurement, Level Measurement</p> <p>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.</p> <p>Practical: PID controller, Control Valve Characteristics</p> <p>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.</p> <p>Practical: MAT Lab Exercise for I& II order system</p> <p>Unit 4: LAPLACE TRANSFORM 9 Hours 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.</p> <p>Practical: Interacting system level control, Non interacting system level control</p> <p>Unit 5: STABILITY CONCEPT AND INTRODUCTION TO FREQUENCY RESPONSE 9 Hours 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.</p> <p>Practical: Stability analysis using MAT Lab – Root Locus – Bode diagram</p> <p>Text Book(s): 1. Coughnowr, D.R., Process Systems Analysis and Control, McGraw Hill, New York,</p>												

- 3rd Edition, 2013
 2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., NewDelhi,1990

Reference(s):

1. Doebelin 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	Basic Heat & mass Transfer mechanism											
CO2	Heat Transfer by conduction in solid for steady state condition and convection											
CO3	Heat Transfer in closed, conduit, and on external surface											
CO4	To understand the basics of drying											
CO5	Diffusive mass transfer											
Mapping of Course Outcome(s):												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2												
CO3												
CO4						H						
CO5										M		M
Course Topic(s)												
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 exchangers, 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 for 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, equimolar counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through non-diffusing B, equimolar 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,

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	Proficiency in professional sampling and sample treatment prior to analysis											
CO2	Capability of treatment and evaluation of the results of analysis											
CO3	Understanding and capability of performing basic chemical processes in an analytical laboratory											
CO4	Ability to handle complex Instruments to identify adulterants in Food											
CO5	Ability to identify Trace elements in food using chromatography techniques.											
Mapping of COs and POs												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M									
CO2					M							
CO3			M									
CO4					M							
CO5					M							
Course Topic(s)												
List of Experiments										45 Hours		
<ol style="list-style-type: none"> Precision and validity in an experiment using absorptionspectroscopy Validating Lambert-Beer's law using KMnO₄ Finding the molar absorbtivity and stoichiometry of the Fe (1, 10 phenanthroline) 3 using absorption spectrometry Estimation of suspended particles using nephelometry/turbidimetry Limits of detection using aluminium alizarin complex Chromatography analysis using TLC Chromatography analysis using columnchromatography Estimation of suspended solids and dissolvedoxygen Estimation of BOD Estimation of COD Gas chromatography analysis Estimating color of food using spectrophotometer Use of electrophoresis in determination of protein 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 AnalysisI, 2nd Edition, Himalaya Publications, Bombay, 2003.												

2. Willard, H., Merrit, L., Instrumental Methods and Analysis, CBS Publishers and Distributors, New Delhi, 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 Publishing House, Mumbai, 5th Edition (Reprint), 2006

FT18R401	EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING			L	T	P	Credit								
				3	0	0	3								
Prerequisite: FT17R251				Course Categories: 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	High pressure processing of foods and impact on nutrition and microbes														
CO2	Different non thermal processing of food and its application in food processing														
CO3	Novel non thermal methods for sterilization of food														
CO4	To understand the basic hurdle technology, mechanism and its action in food														
CO5	Freeze concentration and its effect on food														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		M	M		H	L					L	M			H
CO2		M	M		H	L					L	M			H
CO3			M		H	L					L	M			H
CO4			M		H	L					L	M			H
CO5			M		H	L					L	M			H
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.

9 Hours

Unit 3: NOVEL METHOD

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/ Elsevier, 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	Credit									
			3	0	0	3									
Prerequisite: NIL			Course Categories: 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	Preprocessing sugarcane for best result														
CO2	Utilize clarifiers and preservatives to maintain pH and color of juice														
CO3	Adapt filtration and evaporative techniques for quality output														
CO4	Setup process flow line with quality standards in sugar manufacturing unit														
CO5	Process fermented beverages with alcohol and without alcohol														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>Unit 1: PRE PROCESSING OPERATIONS AND JUICE EXTRACTION 9 Hours Sugarcane-Constituents-Harvesting indices –Cane cutting-Manual, Mechanical-Transportation-loading-Unloading-Cane conveyor-Washing-Shredders-Types. Crushing-Crushers-Types, Crushing efficiency-Extraction of juice-methods, Accumulators-types-Maceration-Theory of cane diffusivity-different diffuser-ring diffuser-weighing of juice.</p> <p>Unit 2: CLARIFICATION 9 Hours Clarification-methods-clarifying agent-bleaching agent-Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice-CO₂P₂O₅ and its importance. Filtration of mud.</p> <p>Unit 3: FILTRATION 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</p> <p>Unit 4: SUGAR PRODUCTION 9 Hours Entrainment separator-methods-Boiling in Vacuum pan-Footing magma-Massecurite. A,B,C-Mother liquor, Molasses A,B,C Molasses exhaustibility. Crystallization-Supersaturation-Crystallizer type-batch and continuous. Centrifuge-types. Drying of sugar –conveyors for sugar-by-product from sugar mills -utilization.</p>															

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.Cruces, 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	Credit
												3	0	0	3
Prerequisite: NIL												Course Categories: 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	Good knowledge about physio-chemical properties of milk and its by products														
CO2	Knowledge regarding processing methods and its importance in milk based products														
CO3	Ability to Optimize Technology for processing of milk and its byproducts														
CO4	Knowledge regarding handling and transportation of meat and Fish														
CO5	Ability to adopt preservation techniques and Packaging for poultry products														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					L	L								
CO2	M	M	L		L	M	M	M					L		
CO3	M		M			M					M		M	M	
CO4		L	M			M	L	M					M	M	M
CO5	L					M	L	M			M		M	M	M
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 PRODUCTS

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 Categories: 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	Check the physical and chemical property of oils and fats
CO2	Utilize different methods of oil extraction for edible purpose
CO3	Setup process flow line for oil extraction
CO4	Different types of fat and oil products
CO5	Storage and packaging materials used in oil

Mapping of Course Outcome(s):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L				L							L		
CO2			M		L						L		M		
CO3	L				L	L					L		M		
CO4	L					L					L				H
CO5	L		M			L					L		M		

Course Topic(s)

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 long storage and processing of oilseeds for direct use and consumption, importance of oil seeds processing in India.

Unit 2: EXTRACTION METHODS **9 Hours**

Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maize germ, etc.

Unit 3: REFINING OF OILS **9 Hours**

Degumming, refining, bleaching, hydrogenation, fractional crystallization, 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 glycol esters, polyglycoesters, Hydrogenation, fractionation, winterization, inter-esterification etc. for obtaining tailor-made fats and oils.

Unit 4: FAT AND OIL PRODUCTS **9 Hours**

Production of butter, oil, 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. Imitation 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. 6th edition 2005

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: FT18R251					Course Categories: Professional Elective										
					Course Type: Theory										
Objective(s)	<ol style="list-style-type: none"> 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	Analyze the nutritional aspects in fruit and vegetables														
CO2	provide solution for spoilage of fruit and vegetables while handling and storage.														
CO3	Set up new processing flow line for new products with quality standards														
CO4	set quality assurance policy in process flow meeting the standards for effective output														
CO5	set up processing flow line with quality standards for chocolate and spices														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M				L	M						M		
CO2		L	M		L	L				M					H
CO3		M	H							M			M		M
CO4		M	M		L					M	M		M		
CO5		M				M		M		M	M			M	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	Credit							
					3	0	0	3							
Prerequisite: FT18R201					Course Categories: Professional Elective Course Type: Theory										
Objective(s)	To enable the student to understand basic chemistry & technology of flavours and pigments														
Course Outcome(s)															
CO1	Understand basics food flavors and colours														
CO2	To understand flavor compound used in food industry														
CO3	To develop chemical sensors and receptors														
CO4	To develop methods for stabilization of natural colorants														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 for flavour. 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	Credit
		3	0	0	3
Pre requisite: FT18R271		Course Categories: 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 the source of contamination in process line				
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 Course Outcome(s):					

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 controlchart-Qualityfactorsinfood-Nutritionallabeling-Specification-Rulesand 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-recordkeeping -HACCPimplementationandmaintenance.Generalprincipleofmicrobialrisk- assessment -hazarddetermination-HACCPworksheet.CriticalControlPoint-identificationofcritical points in the process- Methods by which obstacles can be overcome.

9 Hours

Unit 4: METAL CONTAMINANTS AND ADDITIVES

Metal contaminants-Sources of health hazard of metallic contaminants-Assessment of food safety-Generalandacutetotoxicity-Mutagenicityandcarcinogenicity.Additives(Intention - direct)- Preservatives-antioxidants, sweeteners, flavours, colours, vitamins, stabilizers- indirectadditives-organicresides-inorganicresiduesandcontaminants.

Unit 5: FOOD ALLERGY

9 Hours

Food allergy, food intolerance, contaminants of processed foods, solvent residue, Contaminants of smokedfoods. 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	Credit									
			3	0	0	3									
Pre requisite: Nil			Course Categories: Professional Elective												
			Course Type: Theory with Practical Component												
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	To understand about Coffee, its processing techniques and coffee products.														
CO2	To learn the different types of tea, its manufacturing techniques and quality parameters														
CO3	To learn Cocoa, its processing and chocolate manufacturing technology														
CO4	To know the processing and chemistry of major and minor spices.														
CO5															
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L				L	M						L		
CO2		L	M			L	M								L
CO3	L		M			L	M				L		L		L
CO4	H	M	L			L	M				L				M
CO5	H	M	L			L	M				L				
Course Topic(s)															
<p>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</p> <p>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</p> <p>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</p>															

Chocolates – 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	Credit			
										3	0	0	3			
Pre requisite: FT18R273										Course Categories: 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 right post harvest practice for wheat														
CO3		Understand physicochemical properties of rice and byproducts from it														
CO4		Development of snacks from millets														
CO5		Development of sweets and savory based products from pulses														
Mapping of Course Outcome(s):																
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P01	P02	PS01	PS02	PS03
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. Turbogriding & 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.

9 Hours

Unit 5: MILLING OF PULSES

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, Technology of 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.

FT17R404	PROCESSING COMMODITIES OF FOOD										L	T	P	Credit	
											3	0	0	3	
Pre requisite: FT18R251						Course Categories: 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	To learn about different processing techniques of fruits and vegetables														
CO2	To learn about processing of dairy products														
CO3	To study about bakery technology and learning quality aspects of bakery products														
CO4	To learn about slaughtering and processing methods of meat and marine processing technology														
CO5	To study about milling processing of cereals and pulses and learn the grain storage practices														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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	Credit						
						3	0	0	3						
Pre requisite: FT18R251					Course Categories: Professional Elective Course Type: Theory										
Course Objective(s)	Effective utilization of food waste														
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	To enable the student to understand the methods of treatment														
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 Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 industries covered under EPA Act. Characterization of food industry effluents in terms of parameters of importance

Unit 3: TREATMENT OF FOOD INDUSTRY EFFLUENTS 9 Hours

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 biological contractors and their variations and advanced modifications. Occupational health and safety.

Unit 4: ADVANCED WASTEWATER 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-Tse Hung., Wastewater treatment in the food processing industry, CRC press, 2nd edition, 2006
2. N.F. Gray., Water technology: an introduction for environmental scientists and engineers, Elsevier Butterworth-Heinemann, 2nd Edition, 2002

Reference(s):

1. Patwardhan., Industrial Waste Water Treatment, Prentice-Hall of India Pvt Ltd, 1st edition, 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 Categories: Professional elective Course Type: Theory			
Objective(s)	The objective of the course is for evaluating processed foods				
Course Outcome(s)					
CO1	Understand and apply importance of taste				
CO2	Understand and analyze the odor perception				
CO3	Learn about detection of color in food substances				
CO4	Learn about texture and rheological properties				
CO5	Learn the method of panel screening and instrumental analysis				
Mapping of COs and Pos					

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				M	M					M		L		
CO2		H	M		M	M				M	M		L		L
CO3	H	L			M	M				M	M		L		
CO4					M	M				M	M		L		
CO5	M				M	M				M	M		L		

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 EVALUATION

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	Credit						
						3	0	0	3						
Pre requisite: Nil					Course Categories: Professional Elective Course Type: Theory with Practical										
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	Understand the physical characters of foods to design the formulation, processing equipments, quality parameters														
CO2	Understand the texture and rheological properties of food to design processing methods and equipments														
CO3	Understand the Thermal properties of food to design pack material, processing methods and equipments														
CO4	Understand the Aerodynamic properties of food to design processing methods, equipments														
CO5	Understand the Electrical properties of food to design formulation, processing methods and equipments														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				M	M					M		L		
CO2		H	M		M	M				M	M		L		L
CO3	H	L			M	M				M	M		L		
CO4					M	M				M	M		L		
CO5	M				M	M				M	M		L		
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 separation 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 absorptance, 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 Categories: Professional elective											
				Course Type: Theory											
Objective(s)	To design and develop equipments used in food processing operations														
Course Outcome(s)															
CO1	Use details of Material composition for effective construction of machines depending on food product														
CO2	Design equipments based on material handling capacity and quality of materials														
CO3	Set up food transportation within processing unit with Conveyor belts and Elevators														
CO4	Check Food quality and its standard level in food industry														
CO5	Importance of Computer applications and Instrument calibration for perfection and automation.														
Mapping of COs and POs															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	H	L		M	H				M		L		L
CO2		M	H		L	L					H		L		L
CO3	M	M	H								H		L		

CO4	M	M	H								H		L		
CO5	M	M	H	H	H						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.

DESIGNING 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., TimmerhausKlausD. andRonaldEWest., PlantDesignandEconomics forChemicalEngineers, VEditionMcGrawHill.2003
2. Coulson,J.M. andRichardsonJ.F., ChemicalEngineering, PargamonPress, vol.6 1989.

REFERENCES

1. Evans,F. L., "EquipmentDesignHandbook", GulfPublishingCompany, 2nd Edition1979.
2. Perry,R. HandChitton, Perry'sChemicalEngineersHandbook, McGrawHill, NewYork, 7th Edition, 1997

FT18R405	FOOD PRODUCT DEVELOPMENT					L	T	P	Credit						
						3	0	0	3						
Pre requisite: Nil					Course Categories: 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	Understand about the food company organization and marketing.														
CO2	To analyze the technical aspects of new product development in dairy and meat industry.														
CO3	To analyze the technical aspects of new product development in beverages industry.														
CO4	To analyze the technical aspects of new product development in flavor industry.														
CO5	Understand the concepts of quality control aspects.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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, PackageDevelopment , 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	Credit
															3	0	0	3
Pre requisite: FT18R310															Course Categories: 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	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	Help to minimize the food industry losses and maximize the processed food production																	
Mapping of Course Outcome(s)																		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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																		

and food plants, farm level collection and chilling Centre, space requirements

Unit 3: OCCUPATIONAL SAFETY AND HYGIENIC DESIGN

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. Sinnott. “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	Credit
		3	0	0	3
Pre requisite: FT18R272		Course Categories: 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					
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	Structural and Functional properties of protein				
Mapping of Course Outcome(s):					

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 with three 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 setup

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 novo protein 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. Zidzislaw 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	Credit									
			3	0	0	3									
Pre requisite: Nil			Course Categories: 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	Understand chemical process involved in carbohydrates metabolism														
CO2	Group amino acids and lipid metabolism														
CO3	Understand basic concepts of nutrition														
CO4	Understand anti nutritional factors and its affects in health														
CO5	Designing new range of products with improved nutritional characteristics														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M				L							L		
CO2	H					L							L		
CO3	H	M				L		L			L		L	M	
CO4	M	M				L		L					L		
CO5	M					H		L						M	
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															

Unit 4: 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, phytoalexins, 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 Publications, 2008.

FT18R407	TRADITIONAL & FERMENTED FOODS					L	T	P	C						
						3	0	0	3						
Prerequisite: Nil					Course Categories: 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 importance of food and its relationship with culture in India													
CO2		Grasp good knowledge of Fermented foods and its revolution in Indian food culture													
CO3		Use benefits of traditional foods and its existence at present to explore													
CO4		Adapt the Impact of fermented products and its benefits													
CO5		Preserve Traditional Foods by adapting technology to meet demands.													
Mapping of COs and POs															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			H			H							M		
CO2	L		M			H		L					L		
CO3			M			H					L		H		
CO4	L		M			H					L		H		
CO5	L		M			H					M				
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	Credit
		3	0	0	3

Pre requisite: Nil **Course Categories:** 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	To study the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
CO2	To study the importance and safety issues of the irradiated foods
CO3	To study 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	Understand the impact of radio and UV radiation on microorganism of food														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>Unit 1: BASICS OF RADIATION CHEMISTRY 9 Hou 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.</p> <p>Unit 2: RADIATION CHEMISTRY OF FOOD COMPONENTS 9 Hou 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.</p> <p>Unit 3: MICROWAVES IN FOOD PROCESSING 9 Hou 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.</p> <p>Unit 4: INFRA RED RADIATION 9 Hou 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.</p> <p>Unit 5: RADIO FREQUENCY HEATING PRINCIPLES 9 Hou 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.</p> <p>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.</p> <p>Reference Book(s): 1.Ohlsson and Bengtson: Microwave Processing TechnologiesWoodhead Publishing, Cambridge, UK (2002) 2. Philip Richardson: Thermal Technologies for Food ProcessingWoodhead Publishing Limited, CRC Press. (2001)</p>															

FT18R206	FOOD BIOTECHNOLOGY					L	T	P	Credit						
						3	0	0	3						
Pre requisite: NIL						Course Categories: 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 Prospectus of Bio-Technology														
CO2	Understand about different microbial products														
CO3	Adapt enzyme technology														
CO4	Adapt biotechnological aspects in plant tissue culture														
CO5															
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 & Micro organism. 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)															
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 CONVENIENT FOOD					L	T	P	Credit						
						3	0	0	3						
Pre requisite: NIL						Course Categories: 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	To understand traditional method of food preservation														
CO3	To understand commercial production of traditional food and health aspects of traditional food														
CO4	Understand the commercial method of production of traditional foods														
CO5	Understand the health aspect of Traditional foods														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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	Credit
		3	0	0	3
Pre requisite: NIL		Course Categories: 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	Understand students about the importance of food and nutrition				
CO2	Understand students about the importance of nutrition and classification of nutrition				
CO3	The student will be able to understand about balanced diet				
CO4	Enable them to develop different method of cooking				
CO5	Enable them to develop new products of high nutritive value				

Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>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</p> <p>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</p> <p>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</p> <p>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</p> <p>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.</p> <p>Text Book(s):</p> <ol style="list-style-type: none"> Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. 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 Categories: 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	Explain the current scenario of food demand in India & world.														
CO2	Understand the unit operations to control the factors affecting foods.														
CO3	Apply Unit Operations and Unit Processes in food process industries.														
CO4	Explain about the packaging technologies for various kinds of foods														
CO5	Apply the manufacturing techniques in the production of value added food products under aseptic conditions in food process industries.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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					

Deteriorative 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	Credit						
						3	0	0	3						
Pre requisite: NIL					Course Categories: 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 Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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.

9 Hours

Unit 4 :DEFECTS IN FOOD QUALITY

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.

TextBook(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

ReferenceBook(s):

1. Elena Castell-perez, Ljubica Dokic, Petar Dokic, P.W. Vowsy, Rheology Applications To Food Quality and Product Development, Blackwell Pub Professional, 2010
2. Fenema Owen, Food chemistry. Marcel Dekker publication, 3rd edition, 2005

				L	T	P	Credit
--	--	--	--	----------	----------	----------	---------------

FT18R211	BAKERY AND CONFECTIONARY TECHNOLOGY					3	0	0	3						
Pre requisite: NIL					Course Categories: 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	Utilize bakery unit processing machinery effectively														
CO3	adapt various process flow line in confectionary and bakery products														
CO4	Handle confectionary products														
CO5	Knowledge about preparation method and quality aspect of cereal based products														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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.															
										9 Hours					
Unit 2: BREAD, BUNS AND PIZZA BASE															
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, equipments & 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. Beckett, Industrial Chocolate Manufacture, Wiley-blackwell publisher, 3rd edition, 2009
2. Faridi Faubion, Dough rheology and baked product texture, CBS publications, 1997

Reference Book(s):

1. Pyle, Baking science and Technology, Sosland Pub Co, 2009

FT18R311	BEVERAGE TECHNOLOGY			L	T	P	Credit								
				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	Process fermented beverages with and without alcohol														
CO2	Process fruit juices and concentrates with process equipments														
CO3	Process instant coffee powder adapting new technologies														
CO4	Adapt new technology to process tea														
CO5	Adapt brewing and fermentation for effective production of beverages														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 noncarbonated.- 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 TEA PROCESSING**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: CHEMISTRY OF FERMENTATION**9 Hours**

composition of wine- mold & yeast of grape & wine- Production of red & white table wine, production of sherry sparkling wine, desert wine, vermouth 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 (sic) Publisher, 2nd edition, 2009

Reference(s):

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

FT18R312	FERMENTED FOOD PRODUCTS	L	T	P	Credit
		3	0	0	3
Pre requisite: NIL		Course Categories: 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	Adapt the Impact of fermented products and its benefits				

CO3	Preserve fermented Foods by adapting technology to meet demands.														
Mapping of Course Objective(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>Unit 1: INTRODUCTION TO FERMENTATION 9 Hours Definition-benefitoffermentation-nutritivevalueoffermentedfoods-microbialchanges infermentedfoods-microorganism-proteolytic,lipolytic and fermentativebacteria.</p> <p>Unit 2: CULTURE MAINTENANCE 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.</p> <p>Unit 3: FERMENTED PRODUCTS 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</p> <p>Unit 4: FERMENTED DRINKS 9 Hours Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin, whisky), Fermented Vegetables (Pickles).</p> <p>Unit 5: MICROBIAL PROTEINS 9 Hours Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin), HFCS (High Fructose Corn Syrup)</p>															
Text Book(s):															
<ol style="list-style-type: none"> 1. Sukumar De, Outlines of Dairy Technology, Oxford University Press N Delhi, 1991. 2. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009 															
Reference Book(s):															
<ol style="list-style-type: none"> 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.

FT18R313	FOOD LAWS AND STANDARDS					L	T	P	Credit						
						3	0	0	3						
Pre requisite: FT18R210					Course Categories: 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	Students will be able to develop Protocols based on GMP for Food Processing Industries														
CO2	Develop new innovative norms and Ensure implementation of adequate safety regulations and control.														
CO3	Students will be able to run risk analysis based upon data and statistics obtained from production lines.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>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</p> <p>Unit 2: HACCP 9 Hours HACCP –Introduction, Seven Principles, – AOQL (Average Outgoing Quality Limit) – HACCP plan chart.</p> <p>Unit 3: INTERNATIONAL BODIES 9 Hours Structure, organization and practical operation of International Standardization Organization (ISO),</p>															

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	Credit									
			3	0	0	3									
Pre requisite: NIL			Course Categories: 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	Understand packaging materials and its importance in food Industry														
CO2	Adapt and utilize packaging materials for right application in Food Industry														
CO3	Check Barrier properties of Packaging materials to avoid cross contamination with air,water and printing ink														
CO4	Standardize testing methods for packaging material to assure quality														
CO5	Confirm packaging laws and regulations meeting standards														
Mapping of COs and Pos															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 paperboard. 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.

TextBook(s):

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

ReferenceBook(s):

1. Han,J.H. “ Innovations in Food Packaging”. Elsevier Academic Press,2005.
2. Ahvenainen,R. “ Novel Food Packaging Techniques”. CRC Press. 2003.
- . 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 Categories: 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	Understand about functional foods and its properties														
CO2	Understand regarding Metabolic disorders and its relation with functional foods														
CO3	Learn the benefits of fortification in Food supplements														
CO4	Utilize food waste for nutrition enrichment														
CO5	Understand the importance of Prebiotic and probiotic foods														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>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.</p> <p>Unit 2: FOODRECOMMENDED 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.</p> <p>Unit 3: NUTRITIONAL DEFICIENCIES 9 Hours Nutritional deficiencies and its correction trough fortification and supplementation of foods. Beneficial effect of spices, honey, spirulina etc.</p> <p>Unit 4 :HEALTH BENEFITS OF MICRO NUTRIENTS 9 Hours Health benefits/mode of action of PUFA/gamma linolenic acids, antioxidants, dietary fiber,oligo saccharides,sugaralcohols,peptidesandproteins,glycosides,alcohols,iso-prenoides andvitamins, choline,LAB,phenolics,flavonols,minerals</p> <p>Unit 5: HERBS AS FUNCTIONAL FOODS 9 Hours</p>															

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 Categories: 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	The student will be able to understand about the composition of marine products														
CO2	The student will have knowledge on the processing of marine and their by products														
CO3	Examine the quality of marine products and quality issues in post production and factors affecting the quality														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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															
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	Credit							
					3	0	0	3							
Pre requisite: FT18R210				Course Categories: Honours											
				Course Type: Theory											
Course Objective(s)	The student will be able to work in nanotechnology principles and industry applications														
Course Outcome(s)															
CO1	Understanding about basic of nanotechnology														
CO2	Understand about nano particles structures														
CO3	Apply key concepts of nanotechnology in food packaging														
CO4	Understand the Ethical behaviors to be followed in nanotechnology														
CO5	Understand the regulations of nanotechnology in foods														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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):

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

Reference Book(s):

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

FT18R412	ENVIRONMENTAL POLLUTION CONTROL	L	T	P	Credit
		3	0	0	3

Pre requisite: FT18R313

Course Categories: 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 Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 their variations and advanced modifications. Coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents Conforming to EPA provisions.															

Unit 5: ENVIRONMENTAL 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.

TextBook(s):

1. Green JH, Kramer A, Food processing waste management AVI Publishers, Westport, 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. NF Gray, Water technology: An introduction for Scientists, Elsevier, 2005.
2. KC Agarwal, Environmental pollution, Vedams Books, 2001.

FT18R413	TECHNOLOGY OF FOOD EMULSIONS, FOAMS AND GELS		L	T	P	Credit									
			3	0	0	3									
Pre requisite: FT18R272			Course Categories: 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	To understand about food dispersions														
CO2	To understand about food emulsions														
CO3	To understand about foam and structure														
CO4	To understand about structure of gel														
CO5	To understand about theory of gel formation														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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	Credit									
			3	0	0	3									
Pre requisite: FT18R251			Course Categories: Honours												
			Course Type: Theory												
Course Objective(s)	The student will be able to work in nanotechnology principles and industry applications														
Course Outcome(s)															
CO1	Understanding about basic of nanotechnology														
CO2	Understand about nano particles structures														
CO3	Apply key concepts of nanotechnology in food packaging														
CO4	Understand the Ethical behaviors to be followed in nanotechnology														
CO5	Understand the regulations of nanotechnology in foods														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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)															
<p>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</p> <p>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.</p> <p>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.</p>															

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):

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

Reference Book(s):

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

FT18R415	DRYING TECHNOLOGY					L	T	P	Credit						
						3	0	0	3						
Pre-requisite: FT18R372					Course Categories: 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	Understand the importance of drying as a method of food processing														
CO2	Understand the principle and working of various types of dryers.														
CO3	Apply the knowledge on drying technology in various food industries.														
CO4	Understand and apply the principle of freeze drying in the industry														
CO5	Understand and apply the fluidized bed drying technology in the industry														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 O 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	Credit
		3	0	0	3
Pre-requisite: FT18R371		Course Categories: Honours Course Type: Theory			

Course Objective(s)	The objective of the course is to introduce food related toxicological compounds														
Course Outcome(s)															
CO1	Understand about food toxicology and its hazards														
CO2	Understand about food sensitivity and allergy														
CO3	Analyze food toxin in food samples														
CO4	Adapting toxin formed during processing and controlling														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 mechanism of 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, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.															
Unit 5: TOXICANTS FORMED DURING FOOD PROCESSING														9 Hours	

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, Componentes 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)

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	Credit									
			3	0	0	3									
Prerequisite: FT17R372			Course Categories: 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	To enable the students to understand the various concepts behind refrigeration and air conditioning.														
CO2	The students will be able to design refrigeration and cold storage systems														
CO3	To study the various refrigeration systems														
CO4	The students will be able to understand freezing and different types of freezer used														
CO5	To enable the students to understand the various concepts behind cold storage construction, design, maintenance, and applications in food industry.														
Mapping of Course Outcome(s):															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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									

Chilled 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.

Refernce 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
Prerequisite: FT18R371		Course Categories: Honours Course Type: Theory			

Course outcomes:

On Successful completion, students can be able to
CO1: describe and analyze 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

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 arachnida 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 phytosanitary 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.Hand book of Food dehydration and drying, NIIR board, 2000.
- 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	Credit
		3	0	0	3
Pre requisite: FT18R272		Course Categories: 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 and describe the structural relationship and emulsion				

CO3	Describe the composite properties of foods
CO4	Describe the structural properties of different foods
CO5	Describe and Analyze the kinetics of maillard reaction

Mapping of Course Outcome(s):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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):

Hans-Dieter Belitz, Werner Grosch, Peter Schieberle and published, Springer, Food Chemistry (4th revised and extended edition) 2009.

