

2019 REGULATIONS
(APPLICABLE TO 2019-2020 BATCHES)

CURRICULUM

SEMESTER I									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
1.	19HE1101	Technical English	3	0	0	3	25	75	HS
2.	19MA1102	Calculus and Linear Algebra	3	1	0	4	25	75	BS
3.	19ME1101	Basics of Civil and Mechanical Engineering	3	0	0	3	25	75	ES
THEORY WITH LAB COMPONENT									
3.	19PH1151	Applied Physics	2	0	2	3	50	50	BS
4.	19CY1151	Chemistry for Engineers	2	0	2	3	50	50	BS
5.	19CS1151	Python Programming and Practices	2	0	2	3	50	50	ES
VALUE ADDED COURSE									
6.	19HE107/ 19HE1071R	Language Competency Enhancement Course – I	1	0	0	1	-	100	HS
MANDATORY COURSE									
7.	19AC119	Induction Program	0	0	0	0	-	-	MC
TOTAL			16	1	6	20			

SEMESTER II									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
THEORY									
1.	19HE2101	Business English for Engineers	3	0	0	3	25	75	HS
2.	19MA2101	Differential Equation and Complex Variables	3	1	0	4	25	75	BS
3.	19FT2201	Principles of Microbiology	3	0	0	3	25	75	PC
THEORY WITH LAB COMPONENT									
4.	19PH2151	Material Science	2	0	2	3	50	50	BS
5.	19CY2151	Environmental Studies	2	0	2	3	50	50	BS
6.	19IT2151	Programming in C	2	0	2	3	50	50	ES
LABORATORY COURSES									
7.	19ME2001	Engineering Practices Laboratory	0	0	4	2	50	50	ES
VALUE ADDED COURSE									
8.	19HE2071/ 19HE2071R	Language Competency Enhancement Course – II	1	0	0	1	-	100	HS
TOTAL			16	1	10	22			

SEMESTER III									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
THEORY									
1.	19MA3102	Fourier Analysis and Transforms	3	1	0	4	25	75	BS
2.	19FT3201	Fluid Mechanics	3	1	0	4	25	75	PC
3.	19FT3101	Principles of Thermodynamics	3	0	0	3	25	75	ES
4.	19FT3202	Food Microbiology	3	0	0	3	25	75	PC
THEORY WITH LAB COMPONENT									
5.	19FT3251	Bio Chemistry	2	0	2	3	50	50	PC
LABORATORY COURSES									
6.	19FT3001	Food Microbiology Laboratory	0	0	3	1.5	50	50	PC
7.	19FT3002	Food Production Analysis Laboratory	0	0	3	1.5	50	50	PC
MANDATORY COURSE									
8.	19AC3191	Indian Constitution	2	0	0	0	100	-	MC
TOTAL			16	2	8	20			

SEMESTER IV									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
THEORY									
1.	19FT4201	Fundamentals of Heat and Mass Transfer	3	1	0	4	25	75	PC
2.	19FT4202	Food Process Calculations	3	1	0	4	25	75	PC
3.	19FT4203	Engineering properties of food materials	3	0	0	3	25	75	PC
THEORY WITH LAB COMPONENT									
4.	19MA4152	Statistics and Numerical Methods	3	0	2	4	50	50	BS
5.	19FT4251	Food Chemistry	2	0	2	3	50	50	PC
LABORATORY COURSES									
6.	19FT4001	Unit Operations Laboratory	0	0	3	1.5	50	50	PC
7.	19FT4002	Food Process Equipment Design Laboratory	0	0	3	1.5	50	50	PC
MANDATORY COURSE									
8.	19AC4191	Essence of Indian Traditional Knowledge/Value Education	2	0	0	0	100	-	MC
TOTAL			16	2	10	21			

SEMESTER V									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
THEORY									
1.	19FT5201	Food Process Engineering – I	3	1	0	4	25	75	PC
2.	19FT5202	Food Analysis and	3	0	0	3	25	75	PC

Chairman, Board of Studies

Principal/Dean

		Quality Control							
3.	19FT5203	Milling Technology for Food Materials	3	0	0	3	25	75	PC
4.	19FT53XX	Professional Elective-I	3	0	0	3	25	75	PE
THEORY WITH LAB COMPONENT									
5.	19FT5251	Baking and Confectionery Technology	2	0	2	3	50	50	PC
6.	19FT5252	Fruits and Vegetable Processing Technology	2	0	2	3	50	50	PC
LABORATORY COURSES									
7.	19FT5001	Food Analysis and Quality Control Laboratory	0	0	3	1.5	50	50	PC
8.	19FT5002	Food Process Engineering Laboratory I	0	0	3	1.5	50	50	PC
TOTAL			16	1	10	22			

LIST OF ELECTIVES	
COURSE CODE	COURSE TITLE
PROFESSIONAL ELECTIVE – I	
19FT5301	Technology of Fats and Oils
19FT5302	Food Storage and Infestation Control
19FT5303	Refrigeration and Cold Chain Management
19FT5304	Post-Harvest Technology
19FT5305	Cane sugar Technology

SEMESTER VI									
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY
THEORY									
1.	19FT6201	Food Process Engineering – II	3	1	0	4	25	75	PC
2.	19FT6202	Plantation crops and Spices Products Technology	3	0	0	3	25	75	PC
3.	19FT63XX	Professional Elective-II	3	0	0	3	25	75	PE
4.	19XX64XX	Open Elective – I	3	0	0	3	25	75	OE
5.	19FT6181	Professional ethics	3	0	0	3	25	75	HS
THEORY WITH LAB COMPONENT									
6.	19FT6251	Food packaging	2	0	3	3.5	50	50	PC
LABORATORY COURSES									
7.	19FT6001	Food Process Engineering Laboratory II	0	0	3	1.5	50	50	PC
8.	19FT6701	Industrial training	0	0	0	1*	0	100	EEC
TOTAL			17	0	6	22			

* At the end of VI Semester, students will make presentation about the training and submit a report for which 1 credit will be awarded

LIST OF ELECTIVES	
COURSE CODE	COURSE TITLE
PROFESSIONAL ELECTIVE – II	
19FT6301	Beverage Technology

Chairman, Board of Studies

Principal/Dean

19FT6302	Technology of Snack and Extruded Foods
19FT6303	Food Biotechnology
19FT6304	Bioprocess Engineering
19FT6305	Enzyme Technology
OPEN ELECTIVE – I	
19FT6401	Principles of Food Science

SEMESTER VII										
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY	
THEORY										
1.	19FT7201	Food Additives	3	0	0	3	25	75	PC	
2.	19FT7202	Dairy Engineering	3	0	0	3	25	75	PC	
3.	19FT73XX	Professional Elective-III	3	0	0	3	25	75	PE	
4.	19XX74XX	Open Elective – II	3	0	0	3	25	75	OE	
THEORY WITH LAB COMPONENT										
5.	19FT7251	Poultry, Meat and Fish Process Technology	2	0	2	3	50	50	PC	
LABORATORY COURSES										
6.	19FT7001	Dairy Engineering Laboratory	0	0	3	1.5	50	50	PC	
7.	19FT7002	Food Processing and Preservation Laboratory	0	0	3	1.5	50	50	PC	
PROJECT WORK										
8.	19FT7901	Project Phase I	0	0	4	2	50	50	EEC	
TOTAL			14	0	12	20				

LIST OF ELECTIVES	
COURSE CODE	COURSE TITLE
PROFESSIONAL ELECTIVE – III	
19FT7301	Functional foods and Nutraceuticals
19FT7302	Biology and Chemistry of Food Flavors
19FT7303	Food Toxicology and Allergy
19FT7304	Advanced Drying Technology
19FT7305	Cereal Technology
OPEN ELECTIVE – II	
19FT7401	Food Product Development

SEMESTER VIII										
S.N o.	Course Code	Course	L	T	P	C	CIA	ESE	CATRGORY	
THEORY										
1.	19FT83XX	Professional Elective – IV	3	0	0	3	25	75	PE	
2.	19FT83XX	Professional Elective – V	3	0	0	3	25	75	PE	
PROJECT WORK										
3.	19FT8901	Project Phase II	0	0	24	12	100	100	EEC	
TOTAL			6	0	24	18				

LIST OF ELECTIVES	
COURSE CODE	COURSE TITLE
PROFESSIONAL ELECTIVE – IV	
19FT8301	Food Process Economics and Industrial Management

Chairman, Board of Studies

Principal/Dean

19FT8302	Food Laws And Safety
19FT8303	Waste Management and By-Product Utilization in Food Industries
19FT8304	Instrumentation And Process Control
19FT8305	Economics and Management
PROFESSIONAL ELECTIVE – V	
19FT8306	Food process plant layout and safety
19FT8307	Energy Management in Process Industries
19FT8308	Emerging Technologies in Food Processing
19FT8309	Separation Techniques in Food Processing
19FT8310	Analytical Instruments in Food Industries

AUDIT COURSE FOR UG PROGRAMMES

SEMESTER - III

S.No	Course Code	Course Name	L	T	P	C
1	19AC3191	Constitution of India	2	0	0	0
2	19AC3192	Disaster Management	2	0	0	0
3	19AC3193	Sanskrit for Technical knowledge	2	0	0	0
4	19AC3194	Pedagogy Studies	2	0	0	0
5	19AC3195	English for Research Paper writing	2	0	0	0

SEMESTER - IV

S. No	Course Code	Course Name	L	T	P	C
1	19AC4191	Value Education- Essence of Indian Traditional Knowledge	2	0	0	0
2	19AC4192	Stress Management by Yoga	2	0	0	0
3	19AC4193	Personality Development Through Life Enlightenment Skills	2	0	0	0
4	19AC4194	Unnat Bharat Abhiyan	2	0	0	0

CAREER GUIDANCE/VALUE ADDED COURSES – UG PROGRAMMES

S.No	Course Code	Course Name	Semester	L	T	P	C
1	19HE1072	Career Guidance Level – I Personality, Aptitude and Career Development	I	2	0	0	1
2	19HE1073	Entrepreneurship & Innovation	I	2	0	0	1
3	19HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	II	2	0	0	1
4	19HE3071	Career Guidance Level – III Personality, Aptitude and Career Development	III	2	0	0	1
5	19HE4071	Career Guidance Level – IV Personality, Aptitude and Career Development	IV	2	0	0	1

CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	22	22	20	18	165

SYLLABUS

Programme	Course code	Name of the course	L	T	P	C
B.TECH	19HE1101	TECHNICAL ENGLISH	2	1	0	3

- COURSE OBJECTIVES**
- To facilitate students to communicate effectively with coherence.
 - To train the learners in descriptive communication.
 - To introduce professional communication.
 - To enhance knowledge and to provide the information on corporate environment.
 - To equip the trainers with the necessary skills on critical thinking.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Listening and Speaking – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) Reading –Reading articles from newspaper, Reading comprehension Writing Chart analysis, process description, Writing instructions Grammar and Vocabulary - Tenses, Regular and irregular verb, technical vocabulary.	9
II	Listening and Speaking - listening to product description, equipment & work place (purpose, appearance, function) Reading - Reading technical articles Writing - Letter phrases, writing personal letters, Grammar and Vocabulary -articles, Cause & effect, Prepositions.	9
III	Listening and Speaking - - listening to announcements Reading - Reading about technical inventions, research and development Writing - Letter inviting a candidate for interview, Job application and resume preparation Grammar and Vocabulary - Homophones and Homonyms.	9
IV	Listening and Speaking - - Practice telephone skills and telephone etiquette (listening and responding, asking questions). Reading - Reading short texts and memos Writing - invitation letters, accepting an invitation and declining an invitation Grammar and Vocabulary - Modal verbs, Collocation, Conditionals, Subject verb agreement and Pronoun-Antecedent agreement.	9
V	Listening and Speaking - listening to technical group discussions and participating in GDs Reading - reading biographical writing - Writing - Proposal writing, Writing definitions, Grammar and Vocabulary - Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs.	9
TOTAL INSTRUCTIONAL HOURS		45
COURSE OUTCOMES	CO1-Trained to maintain coherence and communicate effectively. CO2- Practiced to create and interpret descriptive communication. CO3- Introduced to gain information of the professional world. CO4- acquired various types of communication and etiquette. CO5- Taught to improve interpersonal and intrapersonal skills.	

TEXT BOOKS:

1. T1- Norman Whitby, “Business Benchmark-Pre-intermediate to Intermediate”, Cambridge University Press 2014
2. T2- Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, 2005.

REFERENCE BOOKS :

1. R1- Meenakshi Raman , Sangeetha Sharma. “Technical Communication- Principles and Practice”, Oxford University Press 2009.
2. R2- Raymond Murphy, “English Grammar in Use”- 4th edition Cambridge University Press, 2004
3. R3- Kamallesh Sadanan “A Foundation Course for the Speakers of Tamil-Part-I &II”, Orient Blackswan, 2010.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.Tech	19MA1102	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

COURSE OBJECTIVES

- To Understand the concept of differentiation.
- To Evaluate the functions of several variables which are needed in many branches of engineering.
- To Understand the concept of double integrals.
- To Understand the concept of triple integrals.
- To Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	DIFFERENTIAL CALCULUS Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
II	MULTIVARIATE CALCULUS (DIFFERENTIATION) Total derivatives - Jacobians – Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	DOUBLE INTEGRATION Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parallelepiped.	12
IV	TRIPLE INTEGRATION Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parallelepiped.	12
V	MATRICES Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
TOTAL INSTRUCTIONAL HOURS		60

COURSE OUTCOMES

- CO1: Apply the concept of differentiation in any curve.
 CO2: Identify the maximum and minimum values of surfaces.
 CO3: Apply double integrals to compute area of plane curves.
 CO4: Evaluation of triple integrals to compute volume of solids.
 CO5: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.
2. Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

1. Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition,, Narosa Publishing House, New Delhi.
2. Bali N.P & Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.
3. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.TECH	19ME1153	BASIC CIVIL AND MECHANICAL ENGINEERING	3	0	0	3

- COURSE OBJECTIVES**
- To learn about the working principles of IC engines and detailed explanation of components of power plant units.
 - To study Refrigeration and Air Conditioning system.
 - To impart basic knowledge on Civil and Mechanical Engineering.
 - To study materials used for the construction of civil structures.
 - To gain knowledge on the fundamentals of construction of structure.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	A – MECHANICAL ENGINEERING IC ENGINES Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines.	9
II	POWER PLANT ENGINEERING Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits –Prime movers and Power Transmission systems- Pumps– working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.	9
III	REFRIGERATION AND AIR CONDITIONING SYSTEM Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.	9
IV	B – CIVIL ENGINEERING SURVEYING AND CIVIL ENGINEERING MATERIALS Surveying: Objects – types – classification – principles – measurements of distances Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections-Woods-Plastics.	9
V	BUILDING COMPONENTS AND STRUCTURES Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Types of Bridges and Dams.	9
TOTAL INSTRUCTIONAL HOURS		45

- COURSE OUTCOMES**
- CO1: Apply the concept of differentiation in any curve.
CO2: Identify the maximum and minimum values of surfaces.
CO3: Apply double integrals to compute area of plane curves.
CO4: Evaluation of triple integrals to compute volume of solids.
CO5: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes.

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., —Basic Mechanical Engineering, Anuradha Publishers, Kumbakonam, 2000.
2. Shanmugam G and Palanichamy M S, —Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCES:

1. Ramamrutham S., — Basic Civil Engineering, Dhanpat Rai Publishing Co. (P) Ltd.1999.
2. Seetharaman S., — Basic Civil Engineering, Anuradha Agencies, 2005.
3. Shantha Kumar S R J., — Basic Mechanical Engineering, Hi-tech Publications, Mayiladuthurai.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE	19PH1151	Applied Physics	2	0	2	3

COURSE OBJECTIVES

- Enhance the fundamental knowledge in properties of matter
- Analysis the oscillatory motions of particles
- Extend the knowledge about wave optics
- Gain knowledge about laser and their applications
- Conversant with principles of optical fiber, types and applications of optical fiber

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PROPERTIES OF MATTER Elasticity – Hooke’s law – Stress-strain diagram - Poisson’s ratio – Bending moment – Depression of a cantilever – Derivation of Young’s modulus of the material of the beam by Uniform bending theory and experiment. Determination of Young’s modulus by uniform bending method.	6+3=9
II	OSCILLATIONS Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution – Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment. Determination of Rigidity modulus – Torsion pendulum.	6+3=9
III	WAVE OPTICS Conditions for sustained Interference – air wedge and it’s applications - Diffraction of light – Fresnel and Fraunhofer diffraction at single slit – Diffraction grating – Rayleigh’s criterion of resolution power - resolving power of grating. Determination of wavelength of mercury spectrum – spectrometer grating. Determination of thickness of a thin wire – Air wedge method.	6+6=12
IV	LASER AND APPLICATIONS Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein’s coefficients (A&B) – Type of lasers – Nd:YAG laser and CO ₂ laser- Laser Applications – Holography – Construction and reconstruction of images. Determination of Wavelength and particle size using Laser.	6+3=9
V	FIBER OPTICS AND APPLICATIONS Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors.	6
TOTAL INSTRUCTIONAL HOURS		45

COURSE OUTCOMES

- CO1: Illustrate the fundamental properties of matter
 CO2: Discuss the Oscillatory motions of particles
 CO3: Analyze the wavelength of different colors
 CO4: Understand the advanced technology of LASER in the field of Engineering
 CO5: Develop the technology of fiber optical communication in engineering field

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

- R1** - Arthur Beiser “Concepts of Modern Physics” Tata McGraw Hill, New Delhi – 2015
R2 - M.N Avadhanulu and PG Kshirsagar “A Text Book of Engineering physics” S. Chand and Company ltd., New Delhi 2016
R3 - Dr. G. Senthilkumar “Engineering Physics – I” VRB publishers Pvt Ltd., 2016

Programme	Course code	Name of the course	L	T	P	C
BE	19CY1151	ENGINEERING CHEMISTRY	2	0	2	3

- COURSE OBJECTIVES**
- The boiler feed water requirements, related problems and water treatment techniques.
 - The principles of polymer chemistry and engineering applications of polymers and composites.
 - The principles of electrochemistry and with the mechanism of corrosion and its control.
 - The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
 - The important concepts of spectroscopy and its applications.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	WATER TECHNOLOGY Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination. Estimation of total, permanent and temporary hardness of water by EDTA.	6 +3=9
II	POLYMER & COMPOSITES Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, Polymerization – types Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP	6
III	ELECTROCHEMISTRY AND CORROSION Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric titration (Mixture of strong acid and base). Conductometric precipitation titration using BaCl₂ and Na₂SO₄	6+9 =15
IV	ENERGY SOURCES AND STORAGE DEVICES Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H ₂ -O ₂ fuel cell applications.	6
V	ANALYTICAL TECHNIQUES Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).	6+3
TOTAL INSTRUCTIONAL HOURS		45

COURSE OUTCOMES	DESCRIPTION
	CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life
	CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.
	CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design.
	CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities.

TEXT BOOK

1. T1 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCES

1. R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi (2017).

Programme	Course code	Name of the course	L	T	P	C
BE	19CS1151	PROBLEM SOLVING AND PYTHON PROGRAMMING	2	0	0	3

- COURSE OBJECTIVES**
- To know the basics of algorithmic problem solving
 - To read and write simple Python programs
 - To develop Python programs with conditionals and loops and to define Python functions and call them
 - To use Python data structures — lists, tuples, dictionaries
 - To do input/output with files in Python

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	ALGORITHMIC PROBLEM SOLVING Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo code, flow chart, programming language), algorithmic problem solving, simple strategiesfor developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	DATA, EXPRESSIONS, STATEMENTS Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;variables, expressions, statements, tuple assignment, precedence of operators, comments;modules and functions, function definition and use, flow of execution, parameters and arguments. <i>Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.</i>	7+2(P)
III	CONTROL FLOW, FUNCTIONS Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: returnvalues, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. <i>Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.</i>	5+4(P)
IV	LISTS, TUPLES, DICTIONARIES Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension; <i>Illustrative programs: selection sort, insertion sort, merge sort, histogram.</i>	3+6(P)
V	FILES, MODULES, PACKAGES Files and exception: text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages. <i>Illustrative programs: word count, copying file contents.</i>	5+4(P)
TOTAL INSTRUCTIONAL HOURS		45

- COURSE OUTCOMES**
- CO1 - Develop algorithmic solutions to simple computational problems
 - CO2 - Read, write, execute by hand simple Python programs
 - CO3 - Structure simple Python programs for solving problems and Decompose a Python program into functions
 - CO4 - Represent compound data using Python lists, tuples, dictionaries
 - CO5 - Read and write data from/to files in Python Programs.

TEXT BOOKS:

- T1: Guido van Rossum and Fred L. Drake Jr, *An Introduction to Python – Revised and updated for Python 3.6.2*, Shroff Publishers, First edition (2017).
T2: S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, *Fundamentals of Python Programming*, Mc-Graw Hill Education (India) Private Ltd, 2019

REFERENCE BOOKS:

- R1: Charles Dierbach, —*Introduction to Computer Science using Python: A Computational Problem-Solving Focus*, Wiley India Edition, 2013.
R2: Timothy A. Budd, —*Exploring Python*, Mc-Graw Hill Education (India) Private Ltd., 2015
R3: Robert Sedgewick, Kevin Wayne, Robert Dondero, —*Introduction to Programming in Python: An Inter-disciplinary Approach*, Pearson India Education Services Pvt. Ltd., 2016

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

SEMESTER II

Programme	Course code	Name of the course	L	T	P	C
B.E/B.Tech	19HE2101	BUSINESS ENGLISH FOR ENGINEERS	2	1	0	3

- COURSE OBJECTIVES**
- To introduce to business communication.
 - To train the students to react to different professional situations.
 - To make the learner familiar with the managerial skills
 - To empower the trainee in business writing skills.
 - To learn to interpret and expertise different content.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Listening and Speaking – listening and discussing about programme and conference arrangement Reading –reading auto biographies of successful personalities Writing Formal & informal email writing, Recommendations Grammar and Vocabulary - Business vocabulary, Adjectives & adverbs	9
II	Listening and Speaking - listening to TED talks Reading - Making and interpretation of posters Writing - Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success” Grammar and Vocabulary - Active & passive voice, Spotting errors (Tenses, Preposition, Articles)	7+2(P)
III	Listening and Speaking -travel arrangements and experience Reading - travel reviews Writing - Business letters (Placing an order, making clarification & complaint letters). Grammar and Vocabulary - Direct and Indirect speech,	5+4(P)
IV	Listening and Speaking - Role play - Reading - Sequencing of sentence Writing - Business report writing (marketing, investigating) Grammar and Vocabulary - Connectors, Gerund & infinitive	3+6(P)
V	Listening and Speaking - Listen to Interviews & mock interview Reading - Reading short stories, reading profile of a company - Writing - Descriptive writing (describing one’s own experience) Grammar and Vocabulary - Editing a passage(punctuation, spelling & number rules)	5+4(P)

TOTAL INSTRUCTIONAL HOURS 45

- COURSE OUTCOMES**
- CO1 - Introduced to different modes and types of business communication.
 - CO2 - Practiced to face and react to various professional situations efficiently.
 - CO3 - learnt to practice managerial skills.
 - CO4 - Familiarized with proper guidance to business writing.
 - CO5 - Trained to analyze and respond to different types of communication.

TEXT BOOKS:

- T1 - Norman Whitby, “Business Benchmark-Pre-intermediate to Intermediate”, Cambridge University Press, 2014.
 T2- Ian Wood and Anne Willams. “Pass Cambridge BEC Preliminary”, Cengage Learning press 2013.

REFERENCE BOOKS :

- R1 - Michael Mc Carthy, “Grammar for Business”, Cambridge University Press, 2009
 R2- Bill Mascull, “Business Vocabulary in use: Advanced 2nd Edition”, Cambridge University Press, 2009.
 R3- Frederick T. Wood, “Remedial English Grammar For Foreign Students”, Macmillan publishers, 1986.

Programme	Course code	Name of the course	L	T	P	C
B.E/B.Tech	19MA2104	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	3	1	0	4

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
COURSE OBJECTIVES	<ul style="list-style-type: none"> Describe some methods to solve different types of first order differential equations. Solve ordinary differential equations of certain types using Wronskian technique. Use the effective mathematical tools for the solutions of partial differential equations. Describe the construction of analytic functions and conformal mapping. Illustrate Cauchy's integral theorem and calculus of residues 	
I	FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Bernoulli's equation .	12
II	ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER Second order linear differential equations with constant and variable coefficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of parameters.	12
III	PARTIAL DIFFERENTIAL EQUATIONS Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form $f(p,q)=0$, Clairaut's type : $z = px+qy +f(p,q)$ – Lagrange's linear equation.	12
IV	COMPLEX DIFFERENTIATION Functions of complex variables – Analytic functions – Cauchy's – Riemann's equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne – Thomson's method – Conformal mapping $w = A+z$, Az , $1/z$ and bilinear transformations.	12
V	COMPLEX INTEGRATION Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series (statement only) – Residues - Cauchy's Residue theorem.	12
TOTAL INSTRUCTIONAL HOURS		45+15 = 60

COURSE OUTCOMES	
	CO1: Apply few methods to solve different types of first order differential equations.
	CO2: Develop sound knowledge of techniques in solving ordinary differential equations.
	CO3: Solve Partial Differential Equations using various methods.
	CO4: Infer the knowledge of construction of analytic functions and conformal mapping.
	CO5: Evaluate real and complex integrals over suitable closed paths or contours.

TEXT BOOKS

1. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics", McGraw Hill education (India) Private Ltd., Chennai, 2017.
2. Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016

REFERENCE BOOKS

1. Bali N.P & Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.
2. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2012.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley and Sons, 2006.
5. Wylie & Barrett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme BE	Course code 19PH2151	Name of the course Physics of Materials	L 2	T 0	P 2	C 3
-----------------	-------------------------	--	--------	--------	--------	--------

- COURSE OBJECTIVES**
- Acquire fundamental knowledge of semiconducting materials which is related to the engineering program
 - Extend the knowledge about the magnetic materials
 - Explore the behavior of super conducting materials
 - Gain knowledge about Crystal systems
 - Understand the importance of ultrasonic waves

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	SEMICONDUCTING MATERIALS Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative). Determination of band gap of a semiconductor. Determination of acceptance angle and numerical aperature in an optical fiber	6+6=12
II	MAGNETIC MATERIALS Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications. B – H curve by Magnetic hysteresis experiment.	6+3=9
III	PERCONDUCTING MATERIALS Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation. CRYSTAL PHYSICS	6
IV	Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
V	ULTRASONICS Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echo system. Determination of velocity of sound and compressibility of liquid – Ultrasonic wave. Determination of Coefficient of viscosity of a liquid – Poiseuille’s method.	6+6=12
TOTAL INSTRUCTIONAL HOURS		45+15 = 60

- COURSE OUTCOMES**
- CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor
- CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday
- CO3: Discuss the behavior of super conducting materials
- CO4: Illustrate the types and importance of crystal systems
- CO5: Evaluate the production of ultrasonics and its applications in NDT

TEXT BOOKS:

- T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

- R1 - Arthur Beiser “Concepts of Modern Physics” Tata McGraw Hill, New Delhi – 2015
R2 - M.N Avadhanulu and PG Kshirsagar “A Text Book of Engineering physics” S. Chand and Company Ltd., New Delhi 2016
R3 - Dr. G. Senthilkumar “Engineering Physics – II” VRB publishers Pvt Ltd., 2016

Programme BE/B.Tech	Course code 19CY2151	Name of the course ENVIRONMENTAL SCIENCES	L 2	T 0	P 2	C 3
------------------------	-------------------------	---	--------	--------	--------	--------

COURSE OBJECTIVES

- The natural resources, exploitation and its conservation
- The importance of environmental education, ecosystem and biodiversity.
- The knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
- Scientific, technological, economic and political solutions to environmental problems.
- An awareness of the national and international concern for environment and its protection.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	NATURAL RESOURCES Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources – Solar energy and wind energy - role of an individual in conservation of natural resources.	6
II	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	6
III	ENVIRONMENTAL POLLUTION Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution. Determination of Dissolved Oxygen in sewage water by Winkler’s method. Estimation of alkalinity of water sample by indicator method. Determination of chloride content of water sample by argentometric method.	6+9=15
	SOCIAL ISSUES AND THE ENVIRONMENT From unsustainable to sustainable development – urban problems related to energy-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones. Determination of pH in beverages.	6+3=9
IV	HUMAN POPULATION AND THE ENVIRONMENT Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health. Estimation of heavy metal ion (copper) in effluents by EDTA.	6+3=9
TOTAL INSTRUCTIONAL HOURS		45

COURSE OUTCOMES

- CO1: Develop an understanding of different natural resources including renewable resources.
- CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.
- CO3: Understand the causes of environmental pollution and hazards due to manmade activities.
- CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
- CO5: Gain knowledge about the importance of women and child education and know about the existing technology to protect environment

TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

T2 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018

REFERENCES:

R1 – Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, 2015

R2 - G.Tyler Miller, Jr and Scott E. Spoolman "Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

R3 - Gilbert M. Masters and Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

CHAIRMAN/BOARD OF STUDIES**PRINCIPAL/Dean**

Programme	Course code	Name of the course	L	T	P	C
B.E/B.Tech	19IT2151	PROGRAMMING IN C	2	0	2	3

- COURSE OBJECTIVES**
- To develop C Programs using Basic programming constructs
 - To develop C programs using Arrays and Strings
 - To develop applications in C using Functions , Pointers and Structures
 - To do Input / Output and File handling in C
 - To develop C Programs using Basic programming constructs

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Basics of C Programming Structure of C program - C programming: Data Types –Keywords – Variables - Operators: Precedence and Associativity - Expressions – Input / Output statements Decision making statements - Looping statements – Pre-processor directives - Compilation process <i>Programs using decision - making and Looping Constructs.</i>	5+4(P)
II	Arrays And Strings Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – String operations and String functions <i>Programs Using Arrays and string functions.</i>	5+4(P)
III	Functions And Pointers Introduction to functions: Function prototype, function definition, function call - Parameter passing: Pass by value, Pass by reference – Recursion – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers — Pointer to pointers – pointer to strings <i>Programs Using Functions and Pointers</i>	5+4(P)
IV	Structures and Unions Structure - Nested structures – Pointer to Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Typedef-Unions – Union of Structures <i>Programs Using Structures and Unions.</i>	7+2(P)
V	File Processing Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file – Command line arguments <i>Programs Using File concepts</i>	7+2(P)
TOTAL INSTRUCTIONAL HOURS		45

- COURSE OUTCOMES**
- CO1 - Select appropriate data types and control structures for solving a given problem.
CO2 - Develop applications using arrays and strings
CO3 - Understand the importance of functions, pointers and dynamic memory allocation.
CO4 - Understand the Concepts of structures to develop applications in C using

TEXT BOOKS:

1. E. Balagurusamy – “Programming in ANSI C”, Tata McGraw Hill, 7th Edition,201. ISBN 13: 9789339219666
2. ReemaThareja, — “Programming in C”, Oxford University Press, Second Edition, 2016. ISBN 9780199456147

REFERENCES:

1. Ashok.N.Kamthane,RajKamal ,“ Computer Programming and IT”, Pearson Education (India),2012, ISBN -9788131799604
2. Paul Deitel and Harvey Deitel, —”C How to Program”, Eighth edition,2012, Pearson PublicationISBN–9780132990448
3. Kernighan, B.W and Ritchie,D.M, —The C Programming language, Second Edition, Pearson Education, 2012 ISBN 13: 9789332549449
4. Yashavnt P. Kane tkar. “ Let Us C”, BPB Publications, 15th Edition , July 201, ISBN-13:978-8183331630

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19FT2202	PRINCIPLES OF MICROBIOLOGY	3	0	0	3

COURSE OBJECTIVES

- Understand the history of microbiology.
- Understand the structure and classification of microorganisms.
- Understand the techniques to detect the microbes.
- Understand the conditions for the growth of microorganisms.
- Understand the isolation and control techniques.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Introduction: Development and Scope of Microbiology, History of Microbiology - Spontaneous generation theory, Biogenesis, Germ theory of diseases. Contributions by Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming and Waksman.	9
II	Classification and Structure of Microorganisms: Classification and Groups of microorganisms - Prokaryotes and Eukaryotes. Whittaker's five kingdom and three kingdom concept of living organisms. Microbial cell: Bacteria, Virus, Algae, Fungi- structure, reproduction and economic importance. Bacteriophage – structure, importance and life cycle (lytic and lysogenic cycle).	9
III	Microscopy and Staining Techniques- Principle, resolution, numerical aperture, magnification. Different types of microscopes – Light, UV, dark field, phase contrast and Electron microscope (Scanning and Transmission type). Stains – Auxochrome, chromophores, acidic and basic dyes. Staining techniques – Simple staining, Gram's staining, acid fast staining, endospore staining, capsule staining and flagella staining. Microbial Nutrition and Growth: Primary nutritional requirements and nutritional classification – Phototrophs, autotrophs, organotrophs, lithotrophs, chemotrophs. Culture Media – components of media, design and preparation of media using common ingredients. Types of media - natural, synthetic, complex, selective, differential, enriched, assay, enumeration, transport and enrichment media. Growth curve – batch culture, continuous culture, synchronous culture. Physical factors influencing the growth – Temperature, pH, osmotic pressure and salt concentration.	9
IV	Isolation and Control of Microbes: Pure culture technique – Serial dilution and plating methods; cultivation, maintenance and preservation of pure cultures. Control of microorganisms: Physical agents – heat, radiation and filtration; Chemical agents and their mode of action – Aldehydes, halogens, Quaternary ammonium compounds, phenol and phenolic compounds, heavy metals, alcohol, detergents and surfactants; Antibiotics and their mode of action – Pencillin, streptomycin, tetracycline and chloramphenicol.	9
TOTAL INSTRUCTIONAL HOURS		45

COURSE OUTCOMES

- CO1 - Acquire knowledge on historical developments in microbiology.
- CO2 - Classify and identify the structure of microorganisms
- CO3 – Interpret the different types of microscopes and staining techniques
- CO4 - Formulate media for microbial growth
- CO5 - Identify the technique used for isolation and control of microorganisms

TEXT BOOKS:

1. Pelczar M.J., Chan E.C.S. and Krieg N.R., —Microbiology, McGraw Hill, New York, 2004.
2. Powar C.B. and Dagainawala H.F., —General Microbiology, Volume I and II, Himalaya Publishing House, New Delhi, 2005.

REFERENCE BOOKS:

1. Wiley J., Sherwood L., and Woolverton C., —Prescott's Microbiology, McGraw Hill, New York, 2013.
2. Harvey R.A., Cornelissen C.N. and Fisher B.D., —Microbiology, 3rd Edition, Lippincott Williams & Wilkins, Philadelphia, 2013.
3. Black J.G., —Microbiology – Principles and Explorations, Wiley Publications, USA, 2008.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19ME2001 & 19EE2001	ENGINEERING PRACTICES LABORATORY	0	0	4	2
COURSE OBJECTIVES	<ul style="list-style-type: none"> To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical and Electrical Engineering. 					
UNIT	DESCRIPTION					
	GROUP A (CIVIL & MECHANICAL)					
I	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.					
II	Arrangement of bricks using English bond for 1brick thick wall and 1 1/2 brick thick wall for right angle corner junction.					
III	Arrangement of bricks using English bond for 1brick thick wall and 1 1/2 brick thick wall for T junction.					
IV	Preparation of arc welding of Butt joints, Lap joints and Tee joints.					
V	Practice on sheet metal Models– Trays and funnels					
VI	Hands-on-exercise in wood work, joints by sawing, planing and cutting.					
VII	Practice on simple step turning, taper turning and drilling.					
VIII	Demonstration on Smithy operation.					
IX	Demonstration on Foundry operation.					
X	Demonstration on Power tools.					
UNIT	DESCRIPTION					
	GROUP B (ELECTRICAL)					
I	Residential house wiring using switches, fuse, indicator, lamp and energy meter.					
II	Fluorescent lamp wiring.					
III	Stair case wiring.					
IV	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.					
V	Measurement of energy using single phase energy meter.					
VI	Soldering practice using general purpose PCB.					
VII	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.					
VIII	Study of Energy Efficient Equipment's and Measuring Instruments.					
	TOTAL WORKING HOURS : 45					
COURSE OUTCOMES	CO1 - Fabricate wooden components and pipe connections including plumbing works. CO2 - Fabricate simple weld joints. CO3- Fabricate different electrical wiring circuits and understand the AC Circuits.					

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

III SEMESTER

Programme/sem	Course Code	Name of the Course	L	T	P	C
B.TECH/III	19MA3109	FOURIER ANALYSIS AND TRANSFORMS	3	1	0	4

Course Objective

1. Analyze Fourier series which is central to many applications in engineering.
2. Apply the effective tools for the solutions of one dimensional boundary value problems.
3. Apply the effective tools for the solutions of two dimensional heat equations.
4. Apply Fourier transform techniques in various situations.
5. Analyze Z transform techniques for discrete time systems.

Unit	Description	Instructional Hours
I	FOURIER SERIES Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis.	12
II	BOUNDARY VALUE PROBLEMS Classification of PDE - Solutions of one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).	12
III	TWO DIMENSIONAL HEAT EQUATIONS Steady state solution of two dimensional equation of heat conduction in infinite plate and semi circular plate.	12
IV	FOURIER TRANSFORMS Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity(Statement only).	12
V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem(excluding proof)– Solution of difference equations using Z – transform.	12
Total Instructional Hours		60

Course Outcome

CO1: Understand the principles of Fourier series which helps them to solve physical problems of engineering.
 CO2: Employ Fourier series in solving the boundary value problems.
 CO3: Understand Fourier series in solving the two dimensional heat equations.
 CO4: Apply Fourier transform techniques which extend its applications.
 CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems.

TEXT BOOKS:

- T1 - Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.
 T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS :

- R1 - C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2003.
 R2 - Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 1996.
 R3 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2018.
 R4 - Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme B.Tech	Course code 19FT3201	Name of the course FLUID MECHANICS	L 3	T 1	P 0	C 4
---------------------	-------------------------	--	--------	--------	--------	--------

COURSE OBJECTIVES

- Understand the classification of fluids.
- Understand the statements regarding fluid flow.
- Understand the fluid flow through pores.
- Understand the performance of pumps.
- Understand the flow measuring devices and valves.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Fluid Statics and Dimensional Analysis: Nature of fluids – physical properties of fluids, Compressible and incompressible. Types of fluids – Newtonian and Non – Newtonian fluids. Fluid static: Hydrostatic equilibrium. Application of fluid statics: manometers, continuous gravity decanter. Basics of dimensional analysis: Rayleigh’s method and Buckingham’s method.	12
II	Basic Equations of Fluid Flow: Bernoulli equation. Correction of Bernoulli equation for fluid friction. Application of Bernoulli equation for pump work. Shear stress and skin friction in pipes. Laminar and turbulent flow of fluids through closed conduits. Velocity profiles and friction factor for smooth and rough pipes. Friction loss due to sudden enlargement, contraction. Friction loss in fittings valves and coils.	12
III	Flow Past Immersed Bodies: Pressure drop for flow of liquids through porous media. Motion of particles through fluids: Equation for one dimensional motion of spherical particle through fluid, terminal velocity, Hindered settling. Agitation of liquids: Types of impellers, Flow pattern in agitated vessel. Power consumption in agitated vessels, blending and mixing.	12
IV	Transportation of Fluids: Fluid moving machinery. Performance – selection and specification. Positive displacement, centrifugal pump - characteristics. Gear pump, diaphragm pumps, vacuum pump, metering pump, peristaltic pump –working principle and application. Fans, blowers and compressors – Selection, types and applications.	12
V	Metering of Fluids: Variable head meter: Orifice meter, Venturimeter, Pitot tube. Variable area meter: Rota meter. Calibration of flow meters. Principles and applications of Doppler Effect in flow measurement. Principle of Magnetic flow meters, V-Notch, Turbine flow meters, and Thermal flow meters. Valves – Types, applications.	12
TOTAL INSTRUCTIONAL HOURS		60

COURSE OUTCOMES

- CO1 - Classify fluids, apply hydrostatic equilibrium and dimensional analysis in fluid flow behaviour
- CO2 - Derive and apply basic equations of fluid flow
- CO3 - Analyze fluid flow through porous media and select suitable mixing equipment used in food industries
- CO4 - Select and evaluate the performance of pumps
- CO5 - Illustrate the principle and application of different flow measuring devices and valves

TEXT BOOKS:

1. McCabe W.L., Smith J.C. and Harriot P., —Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, New York, 2017.
2. Gavhane K.A., —Unit Operations – I, 8th Edition, Nirali Prakashan Publications, Pune, 2017.

REFERENCE BOOKS:

1. Coulson & Richardson's Chemical Engineering. 5th edition, vol. 2. Elsevier, 2006.
2. Mott, Robert L., and Joseph A. Untener. Applied fluid mechanics. Pearson, 2015.
3. Cengel, Yunus and Cimbala John M., —Fluid Mechanics Fundamentals and Applications, 4th Edition, Tata McGraw Hill Publishing Company, 2017.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.Tech	19FT3101	PRINCIPLES OF THERMODYNAMICS	3	1	0	4

COURSE OBJECTIVES

- Understand the basic concepts.
- Understand the principles of thermodynamics law.
- Understand the relationship of pure substance.
- Understand the properties of steam.
- Understand the mechanism of boiler.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Basic Concepts and First Law: Fundamental concepts of thermodynamics- microscopic and macroscopic approach – systems, properties, process, functions, units, energy, heat and work, zeroth law. First law - statement of first law for flow and non - flow process, internal energy, enthalpy, heat capacities (CV and CP) – steady state flow processes with reference to various thermal equipments - nozzle, throat, throttling process and compressors.	12
II	Second Law: Second Law of thermodynamics: Kelvin-Plank, Clausius statements and its equivalence, reversible cycle – Carnot cycle and theorem – thermodynamic temperature scale. Entropy, Clausius theorem, Clausius inequality, Entropy changes during processes – available and unavailable energies.	12
III	PVT Behavior of Pure Fluids: PVT surfaces: P-V, P-T, T-S and H-S Diagrams. Equation of state and the concept of ideal gas - Process involving ideal gases: constant volume, constant pressure, constant temperature, adiabatic and polytropic process. Equation of state for real gases – Vander Waals equation, Redlich Kwong equation, Virial equation of state. Principle of corresponding states – generalized compressibility charts. Steam Properties: Properties of steam, usage of steam tables. Determination of dryness fraction of steam. Calorimeters – Tank or barrel type, throttling, separating, separating and throttling. Steam distribution systems. Types of steam traps and their characteristics. Application of steam in food process industries.	12
IV	Boilers: Types and classification of boilers - Cochran Boiler, Lancashire boiler, Locomotive Boiler, Fluidized Bed Boiler. Boiler mountings and Accessories. Performance and energy efficiency of boilers.	12
V	Simple calculation of Boiler efficiency. Importance of boiler water treatment and blow down.	12
TOTAL INSTRUCTIONAL HOURS		60

COURSE OUTCOMES

- CO1 - Outline the basic concepts and apply the first law of thermodynamics in selected processes
CO2 - Understand the principle of second law of thermodynamics and concepts of Carnot cycle
CO3 - Interpret the second law of thermodynamics and relate the properties of pure substance
CO4 - Estimate the properties of steam and measurement of quality of steam using calorimeters
CO5 - Integrate the use of simple calculation in gaining the working knowledge of different boilers.

TEXT BOOKS

1. Narayanan K.V., —A Text Book of Chemical Engineering Thermodynamic, 2nd revised edition, Prentice Hall of India, New Delhi, 2013.
2. Reeve Sidney Armor., —”Thermodynamics of Heat Engines”, Wentworth press 2019.

REFERENCE BOOKS

1. Smith J.M., Van Ness H.C. and Abbott M.M., —Introduction to Chemical Engineering Thermodynamics, 7th Edition, McGraw Hill, New York, 2005.
2. Rao Y.V.C., —An Introduction to Thermodynamics, Universities Press, 2004.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.Tech	19FT3202	FOOD MICROBIOLOGY	3	0	0	3

- COURSE OBJECTIVES**
- Understand the basic concepts.
 - Understand the principles of thermodynamics law.
 - Understand the relationship of pure substance.
 - Understand the properties of steam.
 - Understand the mechanism of boiler.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Incidence of Microorganisms in Food: Importance of microorganisms in food, primary sources of microorganisms in food, Intrinsic and Extrinsic parameters of food affecting / influencing microbial growth. Types of microorganisms in foods like meats, poultry, seafood, vegetables, dairy products, fruits and vegetables.	9
II	Microbial Load Assessment: Sampling methods, SPC, MPN, spiral platter, DEFT, microcolony HGMF, DMC, Dye reduction, swab/swab-rinse method, impedance, microcalorimetry, flow cytometry, ATP measurement, PCR, Fluorescent antibody, RIA, ELISA.	9
III	Fermented Foods: Fermentation– Introduction, batch, fed batch and continuous fermentation. Fermented foods – Sauerkraut, Cheese, Beer, Vinegar and Tempeh. Single cell protein – Introduction, nutritive value, advantages over plant and animal proteins. Production process – BEL, SYMBA, PEKILO, BIOPROTEIN, QUORN and PRUTEEN process. Probiotics.	9
IV	Microbial Spoilage: principles and types of spoilage, microbial spoilage of different types of foods–fruits and vegetables, meat, poultry, sea foods, cereals products, bakery products, dairy products, fermented foods and canned foods.	9
V	Food Borne Diseases and Quality Control: Gastroenteritis, Listeriosis, Salmonellosis, Shigellosis, Vibriosis, Campylobacteriosis. Food toxins – Aflatoxin and Botulin. Food sanitation – indicators of food safety, Coliform bacteria. Food processing plant sanitation. Microbiological standards and guidelines –Microbiological criteria for foods, Enforcement and control agencies.	9
TOTAL INSTRUCTIONAL HOURS		45

COURSE OUTCOMES	CO1 - Recognize the sources and factors influencing the microbial growth CO2 - Identify the techniques used to assess the microbial load and CO3 - Apply the knowledge of microorganism in fermentation process CO4 - Interpret microbial spoilage of different foods CO5 - Distinguish food borne diseases and intoxication caused by microorganisms
------------------------	---

TEXT BOOKS

1. Frazier W.C., Westhoff D.C. and Vanitha N.M., —Food Microbiology, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Jay J.M., —Modern Food Microbiology, 6th Edition, Aspen Publications, Maryland, USA, 2000.

REFERENCE BOOKS

1. Adams M.R. and Moss M.O., —Food Microbiology, RSC Publishing, 2008.
2. Ray B. and Bhunia A., —Fundamental Food Microbiology, 5th Edition, CRC Press, 2013.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.TECH	19FT3251	BIOCHEMISTRY	2	0	2	3

COURSE OBJECTIVES

- To study the structure and properties of carbohydrates
- To understand the structure and properties of lipids
- To know the structural and functional role of proteins
- To have an idea about classification of the enzymes and interpret the enzyme action and their immobilization
- To learn the structure of nucleic acids and illustrate the basics of energy metabolism

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
------	-------------	---------------------

I	Carbohydrates: Classification; Simple Sugars: mono and disaccharides, Hygroscopicity and solubility, optical rotation, mutarotation; Sweetness: structure-activity relationship and sweetness index; Dextrose Equivalent, Degree of polymerisation; Sugar alcohols; Oligosaccharides: structure and occurrence. Polysaccharides: Starch-amylose and amylopectin- properties. Cellulose. Pectins, gums and seaweeds – structure & properties. Dietary fibres - Food sources, functional role and uses in foods. Qualitative tests for monosaccharide, disaccharides, polysaccharides. Estimation of reducing sugar by dinitrosalicylic acid method. Estimation of starch by anthrone method	9+6=15
II	Lipids: Structure, classification and composition of fats. Physical properties of fats and oils: crystal formation, polymorphism, melting point, plasticity, radiolysis. Shortening power of fats, emulsification, smoke point and polymerization. Chemical properties of fats – Hydrolysis, saponification, halogenation. Hydrolytic rancidity and oxidative rancidity. Extraction and estimation of oil content	9+2=11
III	Proteins: Amino acids - Definition, structure and classification. Protein - structure and conformation, Food sources and biological role. Properties of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation and stabilization, gel formation, emulsifying effect. Denaturation. Estimation of protein by biuret method, Lowry and Bradford.	9+5=14
IV	Enzymes as food processing aids: Introduction, Nature, classification and nomenclature of enzymes. Specificity. Enzyme kinetics – Michelis - Menten equation, Factors affecting enzyme action, mechanism of enzyme action; active site. Immobilization methods. Enzyme activity – phosphatase enzyme.	9+2=11
V	Nucleic Acids: Composition and structure of DNA and RNA. Metabolism: Metabolism - Glycolysis; TCA cycle; substrate level phosphorylation. Protein metabolism – urea cycle. Cellular respiration - electron transport chain. Lipid metabolism – lipases and phospholipases. Fatty acid metabolism – beta oxidation and fatty acid synthesis. Inter relationship of metabolic pathways.	9

TOTAL INSTRUCTIONAL HOURS 45+15=60

COURSE OUTCOMES	
	<ul style="list-style-type: none"> ➤ Interpret the structure and properties of carbohydrates ➤ Recall the structure and properties of lipids ➤ Recognize the structural and functional role of proteins ➤ Classify the enzymes and interpret the enzyme action and their immobilization ➤ Infer the structure of nucleic acids and illustrate the basics of energy metabolism

TEXT BOOKS

1. Belitz H. D., Grosch W., and Schieberle P., —Food Chemistry], 3rd Edition, Springer Verley, Berlin, 2008.
2. Jain J.L., Sunjay Jain and Nitin Jain, —Fundamentals of Biochemistry], S. Chand & Co., New Delhi, 2008.

REFERENCE BOOKS

1. Rastogi S.C., —Biochemistry], 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. Finley, John W., W. Jeffrey Hurst, and Chang Yong Lee. *Principles of food chemistry*. Springer, 2018.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19FT3001	FOOD MICROBIOLOGY LAB	0	0	4	2

UNIT LIST OF EXPERIMENTS

- I Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media-Types and Use; Preparation of Nutrient broth and agar
- II Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
- III Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram’s Staining
- IV Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC

- V Microbiological Quality of Water (MPN)
- VI Microbiological quality of milk
- VII Enumeration of Lactic acid bacteria from fermented foods
- VIII Yeast & Mould count from fruits
- IX Enumeration of spores from pepper
- X Inhibitory effect of spices on microbial load in fish & flesh foods
- XI Enumeration & Isolation of E. coli from processed meat/chicken
- XII Thermal destruction of microbes: TDT & TDP
- XIII Enumeration & Isolation of Staphylococci from ready to eat street foods
- XIV Effect of cleaning and disinfection on microbial load

TOTAL WORKING HOURS : 45

- COURSE OUTCOMES**
- CO1 - Complete understanding of isolation, characterization of various microbes associated with foods and food groups.
 - CO2 - Familiarize with microbiological techniques for the study of foods.
 - CO3 - Better understanding of methods to detect pathogens in foods.

REFERENCES

1. Yousef A.E. and Carlstrom C., —Food Microbiology: A Laboratory Manual, Wiley Interscience Publications, 2003.
2. McLandsborough L., —Food Microbiology Laboratory, CRC Press, 2004.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
Programme	Course code	Name of the course	L	T	P	C
B.Tech	19FT3002	FOOD PRODUCTION ANALYSIS LAB	0	0	4	2

UNIT LIST OF EXPERIMENTS

- I Studying the expansion characteristics of snack foods on frying.
- II Rancidity test for fried foods to assess primary and secondary oxidative products.
- III Determination of Vitamin C in fruit juices.
- IV Estimation of synthetic Food color in sweets, confectioneries and beverages.
- V Determination of Iron content in foods.
- VI Determination of Iodine content in iodized salt
- VII Detection of Annatto color in table butter.
- VIII Determination of Lead in spices powder.
- IX Detection of added MSG in foods.
- X Detection of sulphur-di-oxide in foods.
- XI Detection of anti oxidant in foods.
- XII Detection of certain emulsifiers and stabilizers in foods

COURSE OUTCOMES

- CO1 - Analyze the additives present in food
- CO2 - Familiarize with the nutrients after processing
- CO3 - Better understanding of processed foods with compliance to standards

REFERENCES

1. Oates, Semih. "Methods of Analysis of Food Components and Additives". CRC Press, 2005.
2. Nollert, Leo M.L. "Hand Book of Food Analysis" 2nd Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004.
3. Nollert, Leo M.L. " Food Analysis by HPLC". 2nd Rev. Edition, Marcel & Dekker, 2000
4. Oates, Semih. "Handbook of Food Analysis Instruments". CRC Press, 2009.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the course	L	T	P	C
B.E. / B.Tech	19MC3191	INDIAN CONSTITUTION	2	0	0	0

COURSE OBJECTIVES

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

UNIT	DESCRIPTIVE	INSTRUCTIONAL HOURS
------	-------------	---------------------

UNIT I : BASIC FEATURES AND FUNDAMENTALE PRINCIPLES		4
--	--	----------

Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.

UNIT II : FUNDAMENTAL RIGHTS		4
-------------------------------------	--	----------

Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.

UNIT III : PARLIAMENTARY FORM OF GOVERNMENT		4
--	--	----------

The constitution powers and the status of the president in India. – Amendement of the constitutional powers and procedures – The historical perspective of the constitutional amendement of India – Emergency provisions : National emergency, President rule, Financial emergency.

UNIT IV: LOCAL GOVERNANCE		4
----------------------------------	--	----------

Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article19 – scope of the right to life and personal liberty under article 21.

UNIT V : INDIAN SOCIETY		4
--------------------------------	--	----------

Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TOTAL INSTRUCTIONAL HOURS : 20

OUTCOMES:

Upon completion of the course, students will be able to:

- 1.Understand the functions of the Indian government
- 2.Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

- T1. Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.
- T2. R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.
- T3. Maciver and Page, “ Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.
- T4. K.L.Sharma, (1997) “Social Stratification in India: Issues and Themes”, Jawaharlal Nehru University, New Delhi.

REFERENCE BOOKS:

- R1. Sharma, Brij Kishore, “ Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
- R2. U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar.
- R3. R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

IV SEMESTER

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19FT4201	FUNDAMENTALS OF HEAT AND MASS TRANSFER	3	1	0	4

- COURSE OBJECTIVES**
- To understand and apply the principles in heat transfer phenomena
 - To understand and apply the principles in mass transfer phenomena
 - To design heat and mass transfer equipments.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Heat Transfer – Conduction : Basic transfer processes – heat, mass and momentum – heat transfer process - conductors and insulators - conduction – Fourier’s fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – extended surfaces (fins) — solving problems in heat transfer by conduction	12
II	Heat Transfer – Convection : Newton Rikhman’s law – film coefficient of heat transfer - convection – free and forced convection - dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in heat transfer by convection.	12
III	Heat Transfer – Heat Exchanger : Heat exchangers – parallel, counter and cross flow – evaporator and condensers – Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers – solving problems in heat exchangers..	12
IV	Heat Transfer: Radiation Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff’s law – Planck’s law - Stefan-Boltzman’s law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.	12
V	Mass Transfer: Mass transfer – introduction – Fick’s law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases – molecular diffusion in liquids, biological solutions and gels.	12
TOTAL INSTRUCTIONAL HOURS		60

COURSE OUTCOMES	CO1 - Understand and apply the principles in heat transfer phenomena CO2 - Understand and apply the principles in mass transfer phenomena CO3 - Design heat and mass transfer equipments.
------------------------	---

TEXT BOOKS:

1. Bellaney, P.L. “Thermal Engineering”. Khanna Publishers, New Delhi, 2001
2. Geankoplis C.J. “Transport Process and Unit Operations”. Prentice-Hall of India Private Limited, New Delhi, 1999

REFERENCES:

1. Jacob and Hawkins. “Elements of Heat Transfer”. John Willey and Sons Inc. New York, 1983
2. Eckert, E.R.G. “Heat and Mass Transfer”. McGraw Hill Book Co., New York, 1981
3. Holman, E.P. “Heat Transfer”. McGraw-Hill Publishing Co. New Delhi, 2001
4. Coulson, J.M. and etal. “Coulson & Richardson’s Chemical Engineering”, 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
5. McCabe, W.L., J.C. Smith and P.Harriot “Unit Operations of Chemical Engineering”, 6th Edition, McGraw Hill, 2003.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19FT4202	FOOD PROCESS CALCULATIONS	3	1	0	4

COURSE OBJECTIVES

- To have an idea about different systems of units and dimensions, estimation compositions of mixtures and solutions
- To understand the material balance for different unit operations
- To apply material balance for recycle operations and perform humidification calculations
- To perform energy balance calculations
- To determine the heat values and composition of fuels

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Units and Dimensions, Fundamental Calculations: Basic and derived units, unit conversions, use of model units in calculations, methods of expression, compositions of mixture and solutions. Ideal and real gas laws – gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.	12
II	Material Balance and Stoichiometry: Stoichiometric principles, Importance of material balance and energy balance in a process Industry, material balance with chemical reaction and without chemical reaction- application of material balance to unit operations like distillation, evaporation, crystallization, drying and extraction.	12
III	Recycle Operations: Recycle stream, block diagram, purging operations, purge ratio, recycle ratio and purge stream. Humidity and Saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, wet and dry bulb temperature, dew point - Humidity chart usage.	12
IV	Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction.	12
V	Combustion: Combustion of solids, liquid and gas, determination of NHV and GHV. Determination of composition by Orsat analysis - Calculation of excess air, theoretical oxygen requirement.	12
TOTAL INSTRUCTIONAL HOURS		60

COURSE OUTCOMES

- CO1 - Apply different systems of units and dimensions, estimate compositions of mixtures and solutions
- CO2 - Apply material balance for different unit operations
- CO3 - Calculate material balance for recycle operations and perform humidification problems
- CO4 - Examine energy balance calculations
- CO5 - Determine the calorific value and composition of fuels

TEXT BOOKS:

- 1.Gavhane K.A., —Introduction to Process Calculations (Stoichiometry)l, 22nd Edition, Nirali Prakashan Publications, Pune, 2009.
- 2.Venkataramani V. and Anantharaman N., —Process Calculationsl, Prentice Hall of India, New Delhi, 2003.

REFERENCE BOOKS:

- 1.Bhatt B.L. and Vora S.M., —Stoichiometryl, 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2004.
- 2.Himmelblau D.M., —Basic Principles and Calculations in Chemical Engineeringl, 6th Edition, Prentice Hall of India, New Delhi, 2003.
- 3.Narayanan K.V. and Lakshmikutty B., —Stoichiometry and Process Calculationsl, Prentice Hall of India, New Delhi, 2006.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
BE/B.Tech	19FT4203	ENGINEERING PROPERTIES OF FOOD MATERIALS	3	0	0	3

- COURSE OBJECTIVES**
- To interpret the physical properties of agricultural materials
 - To elaborate the thermal properties and its application
 - To outline the optical and electromagnetic properties
 - To recognize the rheological properties of food materials
 - To infer textural properties and color measurements of food materials

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Physical Properties: Physical properties of food materials- size, shape, density, porosity and surface area – definitions and measurements, moisture content and its determination, direct and indirect methods, units, Frictional properties –friction – types, coefficient of friction, angle of repose – types and its determination.	9
II	Thermal Properties: Thermal properties, Definition of specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity, thermal diffusivity. Cryogenics, Calorific value of food, Bomb calorimeter. Applications of thermal properties.	9
III	Optical Properties: Refractive index of food items, Abbe's refractometer, Sorting of food material using optical properties , Optical activity, Polarimeter, Spectrophotometer, Gloss, color, translucency – Definitions, measurement and applications. Electromagnetic Properties: Electrical properties, dielectric heating, electrical conductivity, dielectric measurements, microwave heating and other Applications.	9
IV	Rheological Properties: Stress Strain behavior of Newtonian and Non- Newtonian fluids- Bingham and Non Bingham. Stress-strain relationships in solids, liquids and viscoelastic behavior- stress relaxation test, creep test and dynamic test, stress-strain diagrams, Emulsions and Colloids. Viscosity – Principle, Types- Capillary, Orifice, Falling and Rotational viscometers	9
V	Textural Properties: Types of food textures, Texture measuring instruments- Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA, Properties of food powders. Colour: Interaction of object with light, Colorimeter- Color order systems- Munsel color system, CIE color system, Hunter lab color space, Lovibond system.	9
TOTAL INSTRUCTIONAL HOURS		45

- COURSE OUTCOMES**
- CO1 - Interpret the physical properties of agricultural materials
 - CO2 - Elaborate the thermal properties and its application
 - CO3 - Outline the optical and electromagnetic properties
 - CO4 - Recognize the rheological properties of food materials
 - CO5 - Infer textural properties and color measurements of food materials

TEXT BOOKS:

1. Rao M. A. and Rizvi S.S.H., —Engineering Properties of Foods, Merce Dekker Inc., New York, 1998.
2. Mohesnin N.N., —Physical Properties of Plant and Animal Materials, Volume I, Gordon and Breach Science Publishers, New York, 1970.

REFERENCE BOOKS:

1. Stroshine R., —Physical Properties of Agricultural Materials and Food Products, West Lafayette, IN., Purdue University, 2000.
2. Mathur D.S., —Properties of Matter, S. Chand & Co, New Delhi, 1997.
3. Singh R. Paul and Heldman Dennis R., —Introduction to Food Engineering, 3rd Edition, Gulf Publishing USA, 2001.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

BE/B.Tech	19MA4152	STATISTICS & NUMERICAL METHODS	3	0	2	4
-----------	----------	--------------------------------	---	---	---	---

COURSE OBJECTIVES

- To illustrate the relation between two random variables by using correlation concepts along with R studio
- To employ some basic concepts of statistical methods for testing the hypothesis together with R studio.
- To analyze the design of experiment techniques to solve various engineering problems accompanying with R studio
- To apply various methods to find the intermediate values for the given data
- To explain concepts of numerical differentiation and numerical integration of the unknown functions.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
------	-------------	---------------------

I	CORRELATION AND REGRESSION Correlation – Karl Pearson’s correlation coefficient – Spearman’s Rank Correlation – Regression lines(problems based on Raw data only). Introduction to R programming ,Applications of Correlation and Regression	9+3
---	---	-----

II	HYPOTHESIS TESTING Tests based on t (for single mean and difference of means) - F distribution – for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit Application of F test ,Application of Chi – square test	9+6
----	--	-----

III	ANALYSIS OF VARIANCE Introduction, analysis of variance, completely randomized design, randomized block design, Latin square design. ANOVA – completely randomized design ANOVA – randomized block design	9+3
-----	--	-----

IV	INTERPOLATION Interpolation: Newton’s forward and backward difference formulae Lagrangian interpolation for unequal intervals – Divided differences-Newton’s divided difference formula.	9
----	---	---

V	NUMERICAL DIFFERENTIATION AND INTEGRATION Differentiation using interpolation formula – Newton’s forward and backward interpolation formulae for equal intervals – Newton’s divided difference formula for unequal intervals - Numerical integration by Trapezoidal and Simpson’s 1/3 rules.	9
---	--	---

TOTAL INSTRUCTIONAL HOURS 45+15=60

COURSE OUTCOMES	CO1- Compute correlation and predict unknown values using regression together with R studio.
	CO2 - Understand the concepts of statistical methods for testing the hypothesis along with R studio.
	CO3 - Apply Design of Experiment techniques to solve various engineering problems in addition with R studio.
	CO4 - Understand the concept of interpolation in both cases of equal and unequal intervals.
	CO5 - Identify various methods to perform numerical differentiation and integration.

TEXT BOOKS:

1. T1 - Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, Wiley India Private Ltd.,New Delhi,2018.
2. T2 - Medhi J, “stochastic Processes”, New Age International Publishers,New Delhi,2014

REFERENCE BOOKS :

1. R1 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.
2. R2 - Grewal B.S. and Grewal J.S. “Numerical Methods in Engineering and Science “, 6thEdition , Khanna

Programme	Course code	Name of the course	L	T	P	C
BE/IV	19FT4251	FOOD CHEMISTRY	2	0	2	3

COURSE OBJECTIVES

- To interpret the nutritional importance of foods and water
- To summarize the nutritional importance of vitamins and minerals
- To recognize the changes in food components during cooking, processing and storage
- To modify the carbohydrates, proteins and fats based on its functional properties
- To apply the different methods of food preservation

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
------	-------------	---------------------

I	Food Groups - Definition. Major food groups (basic 4, 5, 7) and their characterization. Food as a source of energy, Energy value of foods, energy requirement of the body - estimation. Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; Concept of water activity –Water binding in foods. Nutrition: Definitions – Malnutrition, obesity, balanced diets, Recommended Dietary Allowances (RDA).	9
II	Minerals: Major minerals – Calcium, Potassium, Sodium, Phosphorus. Minor minerals – Iron, Zinc, Iodine, Copper, Selenium. Functional role and deficiency. Vitamins: Definition, water soluble and fatsoluble vitamins, sources, functions and deficiency symptoms. Extraction and estimation of polyphenols Extraction and estimation of flavonoids.	9
III	Changes during Cooking: Cooking – objectives, methods – moist heat, dry heat and combination. Loss of nutrients and prevention, biochemical changes in carbohydrates - Gelatinization and retrogradation of starch, proteins and lipids; parboiling of rice; enzymatic browning reactions; nonenzymatic browning reactions - caramelization, Maillard reaction. Estimation of non-enzymatic browning in foods. Isolation of protein from milk and egg.	9+5=14
IV	Modification of Biomolecules: Modified starches, resistant starch. Starch hydrolysates – Maltodextrins and dextrans. Modification of proteins – chemical and enzymatic methods. Modification of fats - Hydrogenation - cis and trans isomers, interesterification, winterization. Biochemical changes during processing of foods - pickling, malting, drying and baking. Determination of peroxide value of oil. Determination of TBA value of oil.	9+5=14
V	Food Preservation: principles of food preservation. Preservation by high temperature – sterilization, pasteurization, blanching. Preservation by low temperature – Refrigeration and freezing – factors affecting the process and characteristics of foods. Preservation by irradiation, drying and chemicals. Biochemical changes during preservation. Extraction and estimation of chlorophyll. Extraction and estimation of carotenoids and lycopene	9+5=14

TOTAL INSTRUCTIONAL HOURS 45+15=60

COURSE OUTCOMES

- CO1- Interpret the nutritional importance of foods and water
 CO2 - Summarize the nutritional importance of vitamins and minerals
 CO3 - Recognize the changes in food components during cooking, processing and storage
 CO4 - Modify the carbohydrates, proteins and fats based on its functional properties
 CO5 - Apply the different methods of food preservation

TEXT BOOKS

1. Belitz H.D., Grosch W. and Schieberle P., —Food Chemistry, 3rd Edition, Springer-Verley, Berlin, 2004.
2. Sivasankar B., —Food Processing and Preservation, Prentice Hall of India, New Delhi, 2005.

REFERENCE BOOKS

1. Fennema, Owen R., Srinivasan Damodaran, and Kirk L. Parkin. "Introduction to food chemistry." In Fennema's Food Chemistry, Fifth Edition, pp. 1-16. CRC Press, 2017.
2. Srilakshmi B., —Nutrition Science, 3rd Edition, New Age International Ltd., New Delhi, 2011.
3. Damodaran, Srinivasan, and Kirk L. Parkin. Fennema's food chemistry. CRC press, 2017.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.TECH	19FT4001	HEAT AND MASS TRANSFER LABORATORY	0	0	4	2

Experiments:

1. Flow measurement a) Orifice meter b) Venturimeter c) Coils
2. Flow through square duct, annular and circular pipes
3. Pressure drop studies in packed bed
4. Flow through fluidized bed, valves and pipe fittings
5. Calibration of V-notch
6. Solving problems on single and multiple effect evaporator
7. Determination the efficiency of heat transfer in agitated vessel.
8. Determination of efficiency of liquid solid separation by filtration.
9. Determination of absorption efficiency in a packing tower
10. Heat transfer in natural convection/ forced convection
11. Determination of the activity coefficients by vapor liquid equilibrium
12. Determination of vaporization efficiency (E_v) and thermal efficiency (E_t) of the given system using steam distillation setup. Also verify with Raleigh's equation
13. Studying the theoretical and actual recovery of solvent using leaching

CO1 Evaluate the process/performance parameters for mass transfer operations (distillation column, leaching)

CO2 Determine diffusivity and Stefan Boltzman constant using fundamental principles

COURSE OUTCOMES CO3 Calculate the individual and overall heat transfer coefficient of heat exchangers

CO4 Determine the discharge coefficient using variable area flow meters and variable head flow meters

CO5 Assess the flow of fluids through closed conduits, open channels, valves and pipe fitting

REFERENCES:

R1. McCabe W.L., Smith J.C. and Harriot P., —Unit Operations of Chemical Engineeringl, 7th Edition, McGraw Hill, New York, 2005.

R2. Perry Robert, —Perry's Chemical Engineers Hand Bookl, 8th Edition, McGraw Hill, New York, 2007.

Treybal R.E., —Mass Transfer Operationsl, 3rd Edition, McGraw Hill, New York, 1981.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.TECH	19FT4002	FOOD PROCESS EQUIPMENT DESIGN LABORATORY	0	0	4	2

LIST OF EXPERIMENTS:

1. Studies of symbols and materials used for design and drawing
2. Design and drawing of pipes and fittings
3. Design and drawing of storage tanks
4. Design and drawing of agitated vessel
5. Design and drawing of double pipe heat exchangers
6. Design and drawing of shell and tube heat exchangers
7. Design and drawing of plate heat exchanger
8. Design and drawing of single effect evaporator
9. Design and drawing of cyclone separators
10. Design and drawing of rotary drier
11. Design and drawing of spray drier
12. Design and drawing of vessel supports

COURSE OUTCOMES	CO1 Adapt symbols in plant layout and design
	CO2 Design pipes, process vessels and supports
	CO3 Design heat transfer equipments and dryers

REFERENCES:

- R1. Joshi M.V. and Mahajan V.V., —Process Equipment Designl, 4th Edition, MacMillan India, New Delhi, 2009.
- R2. Dawande S.D., —Process Equipment Design Volume 1 and 2l, 5th Edition, Denett and Company, India, 2015.
- R3. Perry R.H. and Green D.W., —Chemical Engineers Handbookl, 8th Edition, McGraw-Hill, New York, 2007.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course code	Name of the course	L	T	P	C
B.TECH/B.E	19MC4191	Essence of Indian Traditional Knowledge	2	0	0	0

Course Objectives:

- 1) The course aims at imparting basic principles of thought process, reasoning and inferencing.
- 2) Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- 3) Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
- 4) The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

UNIT	DESCRIPTIVE	INSTRUCTIONAL HOURS
UNIT I :	Basic Structure of Indian Knowledge System	4
UNIT II :	Modern Science and Indian Knowledge System	4
UNIT III :	Yoga and Holistic Health care	4
UNIT IV :	Philosophical tradition	4
UNIT V :	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic tradition and Case Studies.	4

TOTAL INSTRUCTIONAL HOURS : 20

Course Outcomes:

- 1) Ability to understand the structure of Indian system of life.
- 2) Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.

REFERENCE BOOKS:

- R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
- R2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
- R3. Fritzof Capra, Tao of Physics
- R4. Fritzof Capra, The wave of Life.
- R5. V N Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
- R6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
- R7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.
- R8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.
- R9. P R Sharma (English translation), Shodashang Hridayam.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

V SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5201	FOOD PROCESS ENGINEERING-I	3	1	0	4
Course Objectives	<ul style="list-style-type: none"> To understand and remember the various techniques and mechanisms in food processing with concepts. 					
UNIT	DESCRIPTION		INSTRUCTIONAL HOURS			
I	PROCESSING OPERATIONS: Post-harvest losses in field crops – Cleaning - Wet and Dry cleaning, Screen Cleaners, Air Screen Cleaners. Peeling - Flash steam, Knife, Abrasion, Caustic and Flame peeling. Grading and Sorting - Principles, types and equipments. Moisture content – free moisture, bound and unbound moisture. Equilibrium moisture content - determination methods, models, Importance and hysteresis effect. Water activity and its importance.		12			
II	DRYING: Theory and mechanism of drying - Drying characteristics of materials. Psychrometric chart – applications. Thin layer and deep bed drying. Methods of drying agricultural materials - batch and continuous drying. Drying equipment design and performance of various drying equipments.		12			
III	TYPES OF DRYERS: Tunnel Dryer, Belt Dryer, Drum Dryer, Spray Dryer, Fluidized Bed Dryer, Spouted bed dryer, Pneumatic Dryer, Rotary Dryer, Vacuum Drying, Freeze Drying, Heat Pump drying, Di-electric drying and Micro wave drying.		12			
IV	PRESERVATION BY HEATING: Methods of applying heat to food - Blanching, Pasteurization, Sterilization. Thermal death time relationships (D, Z and F values). Process calculations: General method, Ball's formula method. Sterilization – methods and equipments. UHT sterilization.		12			
V	PRESERVATION BY COOLING: Chilling - Equipments, Cold storage. Freezing - Thermodynamics of food freezing, Phase diagrams, Ice crystals formation, Properties of frozen foods. Freezing time calculations, Freezing equipments. Freeze concentration		12			
			Total Instructional Hours			60
Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1- Remember the food processing operations</p> <p>CO2- Remember the concepts drying mechanisms</p> <p>CO3- Remember the principles of dryer</p> <p>CO4-Understand the importance of preservation by heating</p> <p>CO5- Understand the importance of preservation by cooling</p>					

TEXT BOOKS:

- Fellows P.J., —Food processing Technology: Principles and Practicel, 3rd Edition, Woodhead Publishing Ltd., New Delhi, 2009
- Earle R.L., —Unit Operations in Food Processingl, Web Edition, Pergamon Press, UK, 2004.

REFERENCES BOOKS:

- James G Brennan, —Food Processing Handbookl, 2nd Edition, Wiley VCH, Weinheim, 2011.
- Paul Singh R and Dennis R. Heldman, —Introduction to Food Process Engineeringl, 5th Edition, Academic Press, USA, 2014
- Sahay K.M. and Singh K.K., —Unit Operations of Agricultural Processingl, 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
- Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.2003

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5202	FOOD ANALYSIS AND QUALITY CONTROL	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> To understand and remember the analysis of food with quality control procedures 					
UNIT	DESCRIPTION		INSTRUCTIONAL HOUR			
1	GENERAL AND CARBOHYDRATE ANALYSIS Proximate analysis of foods- Moisture in foods, Ash content of foods - determination by different methods; Titratable Acidity in foods, Determination of dietary fibre and crude fibre, Carbohydrate analysis- Colorimetric Quantification methods of Mono and Di-Saccharides, HPLC of Mono and Di-Saccharides using refractive index detection; Starch- Enzymatic quantification and Determination of Total amylose content; Cell wall polysaccharides-Determination of uronic acid content and β -Glucan content, Degree of Methylation and Acetylation of pectin.		9			
2	LIPIDS AND PROTEINS ANALYSIS Determination of Total fat in foods by different methods; Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants. Determination of Proteins Concentration- Colorimetric methods, Determination of Total nitrogen, Spectrophotometric determination; Protein Characterization- Electrophoresis and Isoelectric focussing; Analysis of Protein quality – Protein Efficiency Ratio (PER), Net Protein Utilization (NPU), Biological Value, Protein Digestibility-Corrected Amino acid Score (PDCAAS), <i>In vitro</i> Protein digestibility for C-PER; Measurement of Functional properties of proteins- Protein hydration properties, Surface properties of protein, Protein gel properties. Calculation of proximate and ultimate composition of foods.		9			
3	FOOD QUALITY AND STANDARDS: Quality of Foods, Quality Standards - mandatory and optional standards, Food Safety Systems - ISO 9000, ISO 14000, ISO 22000, Mechanism of developing and fixing food standards, Good Manufacturing Practice, HACCP, Standards of Weights and Measures		9			
4	QUALITY ASSURANCE IN FOOD INDUSTRY: Objectives, importance and functions of quality control, Concept of Quality Assurance and Quality Control, Quality Control procedures, Quality Assurance procedures, International organizations: ISO, CAC, WTO, USFDA, Codex, EIC. National organizations: BIS, CCFS, Agmark, MMPO and APEDA, Good Laboratory Practices.		9			
5	REGULATIONS FOR FOOD BUSINESS OPERATOR: Food adulteration and food safety, Food laws - Food Safety and Standards Act (FSSAI), Prevention of Food Adulteration Act, Packaged Commodities Rules, Functions of Food Business Operator, QA Audit, IPR and Patents, Issues affecting consumers and industry - Genetically Modified Foods, Fortification, Pesticide Residues, Organic Foods, Food Additives		9			
	TOTAL		45			
	Upon completion of the course, students can be able to					
Course Outcomes	CO1- Remember the quality analysis procedures					
	CO2- Remember the procedure for lipid and protein analysis					
	CO3- Understand the concepts of food quality standards					
	CO4- Remember the concepts of food quality assurance in industry					
	CO5- Remember the regulations for food bussines operator					
TEXT BOOKS:						
1.Pomeranz, Yeshajahu. "Food Analysis Theory and Practice". 3rd Edition. Aspen Publishers / Springer, 2000.						
2.Inteaz Alli, —Food Quality Assurance: Principles and Practicessl, 2nd Edition, Taylor and Francis, UK, 2014.						
REFERENCES BOOKS:						
1.David Kilcast, —Sensory Analysis for Food and Beverage Quality Control: A Pracial Guidel, Woodhead Publishing Ltd, Cambridge, 2010.						
2.Singh, S. P., —Food Safety, Quality Assurance, and Global Trade: Concerns and Strategiesl, International Book Distributing Company, Lucknow, 2009.						
3. Manuals of Food Quality Control: Quality Assurance in Food Control Chemical Laboratoryl, FAO, Itlay, 1993.						
4.Ronald E. Wrolstad. "Handbook of Food Analytical Chemistry" Vol I, John Wiley & sons, 2005						

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5203	MILLING TECHNOLOGY FOR FOOD MATERIALS	3	0	0	3

Course Objectives

- To understand and remember the milling technology of food materials with by-products

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	STRUCTURE, STORAGE AND PEST MANAGEMENT OF GRAINS: Grains - Definition. Importance. Physical properties of grains. Structure, Composition and Nutritional value – paddy, wheat, maize, oat, sorghum. Grain storage systems - farm level storage, bagged storage, bulk storage, hermetic storage, outdoor storage. Losses during storage, Grain protection methods – physical and chemical methods. Integrated stored grain pest management.	9
II	MILLING OF PADDY: Rice milling flow sheet. Cleaning. Parboiling- traditional and improved methods, Physio-chemical changes during parboiling, Effect of parboiling on rice quality. Husking- Methods of husking, Huskers/Shellers – impact type, centrifugal dehusker, under runner disc huller, rubber roll sheller. Separation – indented tray and compartment type separator. Whitening – friction type and abrasive type whiteners. Color sorter. New quality control instruments. Byproducts from rice milling	9
III	MILLING OF WHEAT: Types of wheat. Wheat milling – Simple and detailed flow sheet. Preparation of Wheat for Milling – wheat blending, tempering or conditioning, Roller milling – break rolls and reduction rolls, operation and corrugation specification, Sifting – Plan sifters, Purifying - purifier. Milling performance evaluation. Functional properties of flour. Flour treatment – Enrichment, Enhancement of flour appearance, Improvement of functional properties. By products from wheat milling.	9
IV	MILLING OF CORN AND PULSES: Types of corn. Dry milling – Tempering, dehulling, degermination and milling. Wet milling – Steeping, Germ, fiber, starch and gluten separation, starch refinement. By products from corn milling. Legumes – Structure, Types, Nutritional and Anti-nutritional factors. Pulse Milling – Conditioning, Pitting, Oil/water treatment, drying, dehuskers – Tangential Abrasive Dehulling Device (TADD), Central Institute of Agricultural Engineering (CIAE) design, Schule design, CFTRI mini dhal mill, Husk separation and grading, Splitting – Equipments. Milling - Dry and wet milling, Dehulling efficiency.	9
V	MILLING OF OIL SEEDS: Types of Oil seeds. Oil seed processing - Mechanical extraction – Hydraulic press, Screw press, Filter press. Mechanical extraction of coconut oil and palm oil. Cold pressing and Hot Pressing. Solvent extraction – Flow sheet. Factors influencing extraction. Refining of oil – Degumming, Dewaxing, Neutralization, Bleaching, Filtration and Deodorization. Hydrogenation. Winterization. Oil seed flour concentrates and isolate	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the structure and storage of grains
 - CO2- Remember the processing of paddy
 - CO3- Remember the processing of wheat
 - CO4- Understand the importance of milling of pulses
 - CO5- Understand the milling process of oil seeds

TEXT BOOKS:

- Chakravarthy A., —Post-Harvest Technology of Cereals, Pulses and Oil Seeds, 3rd Edition, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi, 2008.
- Sahay K.M. and Singh K.K., —Unit Operations of Agricultural Processing, 2nd Edition, Vikas Publishing House, New Delhi, 2008.

REFERENCES BOOKS:

- Chakraverty A., Mujumdar A.S., VijayaRaghavan G.S. and Ramaswamy H.S., —Handbook of Postharvest Technology - Cereals, Fruits, Vegetables, Tea, and Spices, Marcel Dekker, Inc., New York, 2003.
- Kulp K. and Pont J.G., —Handbook of Cereal Science and Technology, 2nd Edition, Marcel Dekker, Inc., New York, 2000.
- Richard D. O'Brien, —Fats and Oils: Formulating and Processing for Applications, 3rd Edition, CRC Press, London, 2008.
- Delcour, Jan A. and R. Carl Hoskeny. “Principles of Cereal Science and Technology”. 3rd Edition. American Association of Cereal Chemists, 2010.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5251	BAKING AND CONFECTIONERY TECHNOLOGY	2	0	2	3

- Course Objectives**
- To understand and remember the technology of baking and confectionery

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION TO BAKING: Classification of bakery products. Bakery ingredients and their functions-Essential ingredients: Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants. Experiment on leavening power of baking powder, sodium-bicarbonate and ammonium-bicarbonate	9
II	EQUIPMENTS: Introduction to utensils and equipments used in bakery industry with their purpose.Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating-Fermentation enclosures and brew equipment - Ovens and Slicers; Extrusion. Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph.	9
III	BREAD MAKING PROCESS: The Chemistry of dough Development. Bread making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process- Dough retarding and freezing-emergency No time process. Advantages and disadvantages of various methods of bread-making. Characteristics of good bread: Internal characters; external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention. Determination of dough rising capacity of wet and dry yeast. Estimation of quality parameters of bakery ingredients	9
IV	BAKERY PRODUCT: Production of cakes and cookies/biscuits. Types of biscuit dough's –Developed dough, short dough's, semi-sweet, enzyme modified dough's and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking. Estimation of wet and dry gluten content of wheat flour. Estimation of water absorption power of wheat	9
V	CONFECTIONERY PRODUCTS: Definition, importance of sugar confectionery. General technical aspects of industrial sugar confectionery manufacture - compositional effects. Manufacture methods of high boiled sweets: - Ingredients -. prevention of recrystallization and stickiness Types of confectionery products-Caramel, Toffee and Fudge and other confections:- ingredients - Formulation – Processing method- Quality control- Aerated confectionery- Methods of aeration- Manufacturing process- Chemistry of Hydrocolloids, Hydrocolloid pre treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products	9
Total Instructional Hours		45

Course Outcomes	Upon completion of the course, students can be able to
	CO1- Understand the basic concepts of baking
	CO2- Understand the mechanisms behind equipment used for baking and confectionary
	CO3- Remember the processing of bread
	CO4 - Understand the role of ingredients in bakery products
	CO5- Understand the role of ingredients in confectionery products

TEXT BOOKS:

- Matz, Samuel A., "Bakery Technology and Engineering", III Edition, Chapman & Hall, London.
- Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", II Edition Aspen publication. Maryland, 1999

REFERENCES BOOKS:

- Edwards W.P. "Science of bakery products", RSC, UK,2007
- Samuel A. Matz., "Equipment for Bakers", Pan Tech International Publication. 1988.
- Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition, Blackie Academic and professional, Glasgow,1995.
- Bernard. W. Minifie., PhD "Chocolate, Cocoa, and confectionery" (Science and Technology), 3rd edition, CBS publishers and Distributors, New Delhi

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5252	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY	2	0	2	3

Course Objectives

- To understand and remember the technology of fruits and vegetable processing

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	STORAGE OF FRESH FRUITS AND VEGETABLES Physical, Textural characteristics, structure and composition. Maturity standards; Importance, methods of Maturity determinations maturity indices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Storage practices: Control atmospheric, Bead atmosphere, hypotactic storage, cool store, Zero emerge cool chamber, stores striation. Commodity pre-treatment's - chemicals, wax coating, prepackaging, phytonutrients in fruits and vegetables grading, cleaning, Physiological post-harvest diseases chilling injury and disease. Handling and packaging of fruits and vegetables. Analysis of fruits and vegetables.	9
II	REFRIGERATING FRUITS & VEGETABLES Introduction to Refrigeration - Unit of Refrigeration and C.O.P- Desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical. Cryogenics, application of cryogens in food. Production of low temperatures Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization. Chloroflouro Carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants - application of refrigeration.	9
III	FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES: General pre processing, different freezing methods and equipment, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance. Experiment on osmotic dehydration of fruits and vegetables.	9
IV	CANNING, PUREES AND JUICES: Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/ pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance. Experiment on canning of fruits and vegetables	9
V	FRUIT AND VEGETABLE PRODUCTS: Ready to eat fruit and vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic, Dried Onion, Powder. Garlic: Dried Garlic, Powder, Oil. Potato: Wafer; starch, Papad, Carrot: Preserve, candy, Pickle, Jam. Cauliflower and cabbage: Dried cauliflower and cabbage, Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves).Bitter gourd: Pickle, Dried bitter gourd. Indian Food Regulation and Quality assurance. Preparation and analysis of jam/jelly, sauce, squash	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the agricultural aspects of fruits and vegetables
 - CO2- Understand the nature of fresh fruits and vegetables
 - CO3- Remember the concepts of freezing and dehydration
 - CO4- Understand the processing of canning
 - CO5- Understand the processing of fruits and vegetable products

TEXT BOOKS:

- Fellows, P J. "Food Processing Technology: Principles and Practice". 2nd Edition, CRC/ Woodhead, 1997
- Salunke, D. K and S. S Kadam "Hand Book of Fruit Science and Technology: Production, Composition, Storage and Processing". Marcel Dekker, 1995.

REFERENCES BOOKS:

- "Food Processing & Preservation", Prentice Hall of India, 2002.
- Wim Jongen, -Fruit and Vegetable Processing- Improving Quality, Wood Head Publishing Ltd, England, 2002
- Thompson A.K., -Fruits and Vegetable - Harvesting, Handling and Storage, Blackwell Publishing, USA, 2003.
- Lal G., Siddappa G. and Tondon G.L., -Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5001	FOOD ANALYSIS AND QUALITY CONTROL LABORATORY	0	0	3	1.5

Course Objectives

- To understand the practical knowledge about the processing of dairy products

S.No.	DESCRIPTION
1.	Estimation of consistency, viscosity and Specific gravity for given food samples
2.	Detection and estimation of preservatives in food materials.
3.	Extraction and estimation of fat content in fried food samples
4.	Measurement and analysis of Cooking Quality Parameters
5.	Flavour profile comparison of the given food materials by ranking scale method
6.	Sensory analysis of food materials by overall difference test
7.	Quality analysis of raw materials used for bakery products
8.	Study on estimation of food additives present in the given food sample
9.	Estimation of total Polyphones in tea/coffee extract
10.	Isolation and estimation of synthetic food colors
11.	Estimation of total sugar content in fruits

Total Practical Hours 45

Upon completion of the course, students can be able to

Course Outcomes

- Understand and estimate the various food additives present in the food samples
- Understand the analysis of quality of food products

REFERENCE BOOKS:

1. "Manual of methods for the Analysis of Foods", Ministry of Health and Family Welfare, Government of India, New Delhi, 2005.

2. Morris B. Jacobs., "The chemical Analysis of Foods and Food products" Third edition, CBS publishers & distributors, New Delhi, 2005

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5002	FOOD PROCESS ENGINEERING LABORATORY-I	0	0	3	1.5

Course Objectives

- To understand the practical knowledge about the engineering concepts of food materials

S.No.	DESCRIPTION
1.	Determination of size, roundness, sphericity and 1000 grain weight of food grains
2.	Determination of bulk density, true density and porosity
3.	Determination of angle of repose for grain sample
4.	Determination of coefficient of friction for grain sample
5.	Experiment on drying characteristics of food material using tray dryer
6.	Experiment on freeze drying of food
7.	Determination of separation efficiency of inclined belt separator
8.	Experiment on sterilization
9.	Experiment on freezing
10.	Experiment on size reduction of food material

Total Practical Hours 45

Course Outcomes **Upon completion of the course, students can be able to**

- Understand the Engineering mechanisms of equipment and properties of foods

REFERENCE BOOKS:

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

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

VI SEMESTER

programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6201	FOOD PROCESS ENGINEERING II	3	1	0	4
Course Objectives	<ul style="list-style-type: none"> To understand and remember the concept of food processing and also to know the mechanisms 					
UNIT	DESCRIPTION		INSTRUCTIONAL HOURS			
I	SIZE REDUCTION: Fibrous foods, Dry foods and Liquid foods – Energy Used in Grinding. New Surface Formed by Grinding. Grinding and Cutting equipment - Crushers, Hammer mills, Fixed head mills, Ball mills, Plate mills and Roller mills. Cutters - Slicers, Dicers, Shredder and Pulper. Size reduction in liquids		12			
II	MECHANICAL SEPARATION: Sedimentation in liquids - Gravitational sedimentation – Floatation - Sedimentation of particles in gas. Centrifugal separation – Velocity of particles – Radius of neutral zone – Equipment. Filtration – Constant rate and Constant pressure filtration - Equipment, Sieving effectiveness and Applications		12			
III	CRYSTALLIZATION: Crystallization Equilibrium – Nucleation – Meta stable region – Seed Crystals. Heat of Crystallization - Rate of crystal growth. Stage equilibrium crystallization. Equipment - Types – Applications.		12			
IV	MIXING: Characteristics of mixtures. Measurement of mixing - sample size, sample composition. Particle mixing and Liquid Mixing - mixing index. Mixing of different quantities. Rate of Mixing and Energy Input in Mixing. Mixing equipment - Liquid Mixers, Powder and Particle Mixers, Dough and Paste Mixers.		12			
V	EXTRUSION: Theory - Rheological properties and Operating Characteristics. Single and Twin screw extruders - Ancillary Equipment. Applications and Effects on Foods. Material handling: Types of handling and conveying system for food products - Belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.		12			
Total Instructional Hours			60			

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand size reduction techniques for solids and liquids
 - CO2- Understand the mechanical separation in food processing
 - CO3- Understand the crystallization process
 - CO4- Understand the mixtures and mixing equipment
 - CO5- Understand extrusion process and material handling systems .

TEXT BOOKS:

1. Fellows P.J., —Food processing Technology: Principles and Practicel, 3rd Edition, Woodhead Publishing Ltd., New Delhi, 2009
2. Earle R.L., —Unit Operations in Food Processing, Web Edition, Pergamon Press, UK, 2004.

REFERENCES BOOKS:

1. James G Brennan, —Food Processing Handbook, 2nd Edition, Wiley VCH, Weinheim, 2011.
2. Paul Singh R and Dennis R. Heldman, —Introduction to Food Process Engineering, 5th Edition, Academic Press, USA, 2014
3. Sahay K.M. and Singh K.K., —Unit Operations of Agricultural Processing, 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
4. Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.2003

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6202	PLANTATION CROPS AND SPICES PRODUCTS TECHNOLOGY	3	0	0	3

Course Objectives • To learn about the plantation crops and spices product technology

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PROCESSING OF PLANTATION CROPS: Importance of plantation crops – cashew –harvesting – uses of cashew – cashew nut processing. Coconut – harvesting – Processing. Cocoa bean - Occurrence – Chemistry of the cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor	9
II	PROCESSING OF TEA: Types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process - Grading of tea.	9
III	PROCESSING OF COFFEE: Coffee – Occurrence – chemical constituents– fermentation of coffee beans – Process flow sheet for the manufacture of coffee powder. Export and Import Duties of plantation crops.	9
IV	PROCESSING OF SPICES: Importance of Spices- Processing of Spices- Pepper, cardamom, ginger and turmeric, cumin, coriander, cinnamon, fenugreek, garlic, clove and vanilla –method of manufacture of oleoresins and essential oils	9
V	PROCESSING OF TUBER CROPS: Chemical composition and processing of tuber crops - tapioca, sugar beet, potato and yam - starch and sago production- Grades. Other by-products-Applications and Processing.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Remember the steps involved in processing of plantation crops
	CO2- Understand the processing of tea and coffee
	CO3- Understand the appropriate techniques for processing of spices
	CO4- Understand the use of food processing operations in the processing of tuber crops
	CO5- Understand the biosynthesis of flavors

TEXT BOOKS:

1. Pandey P.H., —Post-Harvest Engineering of Horticultural Crops through Objectives, Saroj Prakasam, Allahabad, 2003.
2. Kumar K., Md Abdul Kadar JBM., Rangaswamy P. and Irulappan I., "Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants, Oxford and IBH Publishing, 2006.

REFERENCES BOOKS:

1. Minifie Bernard W., —Chocolate, Cocoa and Confectionery Technology, 3rd Edition, Springer Netherlands, 2012.
2. Shanmugavelu K.G., Kumar N. and Peter K.V., —Production Technology of Spices and Plantation Crops, Jodhpur Agrobios (India) Agro House, 2005
3. National Institute of Industrial Research (NIIR) Board, —Handbook on Spices, Asia Pacific Business Press Inc., New Delhi, 2004.
4. Pruthi, J.S. Spices and Condiments Chemistry, Microbiology and Technology. 1st Edition. Academic Press Inc., New York, USA. 2011.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6181	PROFESSIONAL ETHICS	3	0	0	3

- Course Objectives**
- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	HUMAN VALUES: Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	9
II	ENGINEERING ETHICS: Senses of ‘Engineering Ethics’ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	9
III	ENGINEERING AS SOCIAL EXPERIMENTATION : Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	9
IV	SAFETY, RESPONSIBILITIES AND RIGHTS : Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	9
V	GLOBAL ISSUES: Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the human values
 - CO2- Understand the Engineering Ethics
 - CO3- Understand and relate engineering and social experimentation
 - CO4- Remember the responsibilities
 - CO5- Understand the ethical global issues

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES BOOKS:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	16FT6251	FOOD PACKAGING	2	0	3	3.5

Course Objectives

- To Understand the concepts of packaging for various food products

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	BASICS IN FOOD PACKAGING: Definitions and basic functions of a food package. Food package design and development. Packaged product quality and shelf life. Current status in food packaging in India. Package standards and regulation. Labelling, Bar coding. Estimation of bursting strength of packaging materials	9
II	METAL CANS: Raw materials for can making – steel, aluminum. Can making processes - three piece welded cans, DWI, DRD cans – end making processes – coating. Film laminates and inks, metal packages – corrosion and Sulphur staining. Application of metal containers in food industries. Glass containers: Definition and composition. Glass container manufacture – melting, forming, surface treatments. Closure selection. Glass bottle design and specification. Application of glass containers in food industries. Determination of tear / puncture resistance of packaging materials	9
III	PLASTIC PACKAGING: 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. Seal ability and closure. Application of plastics for food packaging. Determination of tensile strength of different packaging materials	9
IV	PAPER AND PAPERBOARD PACKAGING: Properties of paper and paperboard. Paper and paperboard manufacture - SBB, SUB, FBB, 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. Estimation of water absorption capacity of paper based packaging materials.	9
V	TRENDS IN FOOD PACKAGING: Active packaging, modified atmosphere packaging - vacuum and Inert gas Packaging, Biodegradable and edible packaging, Aseptic packaging, Shrink wrapping, Nano packaging, Antimicrobial packaging, self-heating and cooling cans. Determination of shelf life of modified atmospheric packed food.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Understand basic concepts in food packaging
	CO2- Understand and choose appropriate metal and glass containers for food packaging
	CO3- Understand the classification of plastics and elaborate their properties
	CO4- Understand the use of paper and paperboards for various food applications
	CO5- Remember the recent trends in food packaging

TEXT BOOKS:

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 Practicell, 3rd Edition, Marcel Dekker Inc, USA, 2012.

REFERENCES BOOKS:

1. Han Jung H., -Innovations in Food Packaging, 2nd 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. Mathlouthi, M. "Food packaging and Preservation". Aspen Publications, 2013

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6001	FOOD PROCESS ENGINEERING LABORATORY - II	0	0	3	1.5

Course Objectives

- To understand the practical knowledge about the engineering concepts of food materials

S.No.	DESCRIPTION
1.	Determination of fineness modulus using burr mill.
2.	Experiment on texture analyzer
3.	Experiment on foam mat drying
4.	Determination of fineness modulus using Hammer mill
5.	Determination of fineness modulus using ball mill.
6.	Determination of shelling efficiency of paddy dehusker.
7.	Experiment on drying characteristics of food material using tray dryer.
8.	Experiment on osmotic dehydration characteristics of food materials.
9.	Experiment on drying characteristics of food material using fluidised bed dryer.
10.	Experiment on drying characteristics of food material using microwave dryer.

Total Practical Hours 45

Course Outcomes **Upon completion of the course, students can be able to**

- Understand the Engineering mechanisms of equipment and properties of foods

REFERENCE BOOKS:

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

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

VII SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7201	FOOD ADDITIVES	3	0	0	3

Course Objectives

- To expose the students to the use of different chemical additives in foods during food processing and preservation

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION : Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.	9
II	ACIDITY REGULATORS AND PRESERVATIVES: Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations	9
III	EMULSIFIERS, STABILIZERS AND THICKENERS: Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications	9
IV	ANTIOXIDANTS AND ANTI-CAKING AGENTS: Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anti-foaming and propellants, Anti-caking agents – definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.	9
V	COLOR AND ARTIFICIAL SWEETENERS: Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, list of colors, usage levels and food application. Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Understand the need of food additives and preservatives
	CO2- Understand the importance of acidity regulators and preservatives
	CO3- Understand the role of emulsifiers, stabilizers and thickeners
	CO4- Understand the antioxidants and anticaking agents
	CO5- Understand about colors and sweeteners

TEXT BOOKS:

- Lal and Siddappa., “*Fruit and Vegetable preservation*”, ICMR 1986.
- Manoranjan Kalia and Sangita, “*Food preservation and processing*”. Kalyani Publishers. Ludhiana 1996.

REFERENCES BOOKS:

- Fellows, P.J, “*Food Processing Technology*” 2001.
- Leninger, H.A. and Beverlod, W.A. “*Food Process Engineering*”, D.Reicle Pub. Corp.
- Srivastha R.P. and Sanjeev kumar, “*Fruit and vegetable Preservation*” 1998.
- Titus A. M. Msagati. “*The Chemistry of Food Additives and Preservatives*”, Wiley-Blackwell, 2013.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7202	DAIRY ENGINEERING	3	0	0	3

- Course Objectives**
- To understand the processing of milk and milk products along with the equipment used for it

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PROPERTIES OF Milk: Indian Dairy industry, Milk - Definition, types of market milk, Composition of milk, Factors affecting composition of milk, System of pricing of milk, Nutritive value of milk, Physico-chemical properties of milk: Color, Flavour, Specific Gravity, Boiling point, Freezing point, Refractive Index, Acidity and pH, Viscosity, Surface Tension.	9
II	Raw Milk Collection, Transportation and Reception: Raw milk collection system, Cooling and Transportation of milk, Platform tests of milk: Smell, Appearance, Temperature, Sediment, Acidity, Lactometer Reading, Fat, Solids-Not-Fat, Dye Reduction Test: MBRT test, Resazurin tests, Mastitis test, Filtration/Clarification of raw milk, Bactofugation of milk, Cooling and storage of raw milk, Bulk transportation technologies – carbon dioxide impregnation.	9
III	Design of Equipment: Selection of Accessories - Pipes, Aseptic valves, Filters, Pumps, Blenders, Storage Tank. Design of dairy equipment – Heat exchangers, Homogenizer, Spray dryer, Bulk coolers, Evaporators, Butter churner, Separators. Calculation of Refrigeration Load. Process Automation.	9
IV	Fluid Milk Processing: Milk Standardization, Cream separation, Homogenization, Milk Pasteurization: HTST and Batch Pasteurization, Milk Sterilization, Bottling/Packaging of milk, Liquid milk filling, Aseptic filling of milk. Milk Products: Manufacture of cheese, ice-cream, yoghurt, condensed milk, milk powder.	9
V	Cleaning and Sanitization of Dairy Equipment: Basic principles, Cleaning and Sanitizing – agents and methods. Can washer - Rotary type and Straight through type. Selection and maintenance of can washers, CIP - Types of CIP system, Design of CIP system, CIP of dairy equipment.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Remember the constituents of milk
 - CO2- Understand the pre-handling of milk
 - CO3- Understand the processing of milk
 - CO4- Understand the equipment used for processing of milk
 - CO5- Understand the cleaning process in dairy plant

TEXT BOOKS:

- Sukumar De, —Outlines of Dairy Technology, Royal Oxford University Press, Delhi, 2010.
- Tufail Ahmed, —Dairy Plant Engineering and Management, Kitab Mahal, New Delhi, 2012

REFERENCES BOOKS:

- Jane Selia dos Reis Coimbra, Jose A. Teixeira, —Engineering Aspects of Milk and Dairy Products, CRC Press, New York, 2010.
- Robinson R.K., —Modern Dairy Technology: Advances in Milk Products, Volume 2, Springer London Ltd., 2012.
- Hui, Y.H., —Dairy Science and Technology Handbook: Applications Science, Technology and Engineering, Volume 3, Wiley, New Delhi, 2014.
- Selia, Jane dos Reis Coimbra and Jose A. Teixeir “Engineering Aspects of Milk and Dairy Products”. Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7251	POULTRY, MEAT AND FISH PROCESS TECHNOLOGY	2	0	2	3

Course Objectives			
UNIT	DESCRIPTION		INSTRUCTIONAL HOURS
I	POULTRY PROCESSING: Types and characteristics of poultry products. Unit operation in poultry processing. Pre-slaughter factors affecting poultry meat quality. Types of poultry cuts. Factors affecting the shelf-life of poultry meat. Sensory quality of poultry meat- color, texture and flavor. Preservation techniques: chemical treatments, heating, drying and irradiation. Analysis of Nutritional content in poultry foods		9
II	EGG PROCESSING: Structure, composition, nutritive value of egg. Functional properties of eggs, Factors affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing-spray drying, Foam mat drying. Determination of protein content in egg. Analysis of quality of egg.		9
III	MEAT PROCESSING: Types of Meat and its sources, composition, structure of meat. Ante mortem handling, slaughtering of animals, inspection and grading of meat. Introduction to Halal. Post-mortem changes of meat. Meat -Tenderization, Aging. Meat quality evaluation. Wholesale and retail cuts. Preservation of meat-curing, smoking, drying, freezing. Processed meat products- Hamburgers, sausages and meat balls. Experiment on tenderization of meat.		9
IV	FISH PROCESSING: Types of fish, composition and nutritive value of fish. Harvesting of fish. Spoilage factors of fish. Post-mortem changes in fish. Preservation- Freezing and Individual quick freezing, Canning and smoking operations, Salting and drying of fish, pickling. Experiment to check the quality of fish.		9
V	HYGIENE AND SANITATION: Handling and maintenance of tools and core equipment. Meat plant layout. Meat processing hygiene. Cleaning and sanitation in meat plants. Food safety measures –GMP and GHP.		9
Total Instructional Hours			45
Upon completion of the course, students can be able to			
Course Outcomes	CO1- Understand the process parameters poultry processing		
	CO2- Understand the structure and processing of egg		
	CO3- Understand the processing of meat and meat products		
	CO4- Understand the different processing and preservation operations of fish		
	CO5- Remember safety measures and hygienic conditions		

TEXT BOOKS:

- 1.Panada P.C., —Text book on Egg and Poultry Technologyl, 1st Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 1996.
- 2.Gunter Heinz and Peter Hautzinger, —Meat Processing Technologyl, 1st Edition, Rap Publication, Monteplier, 2007.

REFERENCES BOOKS:

- 1.Ionnis S. Boziaris, —Seafood Handbook: Technology, Quality and Safetyl, Wiley Blackwell, UK, 2014.
- 2.Mead G.C., —Poultry Meat Processing and Qualityl, 1st Edition, CRC Press, London, 2004.
- 3.Alan R. Sams, —Poultry Meat Processingl, 1st Edition, CRC Press, London, 2001.
- 4.Joseph Kerry, John Kerry and David Ledwood. —Meat Processingl, Woodhead Publishing Limited, England (CRC Press), 2002.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7001	DAIRY ENGINEERING LABORATORY	0	0	3	1.5

Course Objectives

- To understand the practical knowledge about the processing of dairy products

S.No.

DESCRIPTION

1. Studies on milk sampling, judging and grading of milk.
2. Determination of acidity, specific gravity and clot-on-boil test of milk
3. Determination of fat, SNF and total solids content in milk.
4. Determination of MBRT and alcohol index test of milk.
5. Determination of pasteurization efficiency of milk.
6. Estimation of homogenization efficiency
7. Estimation of surface tension of milk.
8. Determination of total milk protein content in milk
9. Determination of churning efficiency of butter churner.
10. Determination of efficiency of spray dryer

Total Practical Hours

45

Upon completion of the course, students can be able to

Course Outcomes

- Understand the analysis of Dairy products
- Understand the processing of dairy products

REFERENCE BOOKS:

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

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7002	FOOD PROCESSING AND PRESERVATION LABORATORY	0	0	3	1.5

Course Objectives

- To develop skills and also use various techniques related to preservation

S.No.	DESCRIPTION
1.	Filtration and concentration of fruit juices
2.	Production of extruded products.
3.	Spray drying of juices/milk
4.	Pasteurization of milk
5.	Retort processing of foods
6.	Osmotic drying of foods with salt and sugar.
7.	Canning & bottling of vegetable and fruit products
8.	Preparation of custard, puddings, mousse, flan, pie, tarts, doughnuts, biscuits
9.	Candies, toffees, fudges, pralines & brittles – Sugar crystallization & inhibition of crystal formation & soft centered sweets
10.	Chocolates – role of ingredients and processing

Total Practical Hours 45

Course Outcomes **Upon completion of the course, students can be able to**

- Understand the techniques for food preservation
- Understand the processing of various foods

REFERENCE BOOKS:

1. Rahman, M.S. “Handbook of Food Preservation”, Marcel Dekker, 1999.
2. Ranganna, S. “Handbook of Canning and Aseptic Packaging” Vol. I, II & III, Tata McGraw – Hill, New Delhi, 2000
3. Pandey, H. et al., “Experiments in Food Process Engineering”. CBS Publishers, 2004.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

PROFESSIONAL ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5301	TECHNOLOGY OF FATS AND OIL	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> • To study the technology, processing, analysis of fats and oils 					
UNIT	DESCRIPTION					INSTRUCTIONAL HOURS
I	PROPERTIES OF OILS AND FATS: Oils and fats – sources, composition. Nutritional importance of fats and oils. Physical properties of fats and oils - color, odour, consistency, melting point, flash point, smoke point. Chemical properties of fats and oils - iodine value, saponification value, free fatty acids, peroxide value.					9
II	VEGETABLE OIL AND ANIMAL FAT PRODUCTION: Industrial production of oils- seed handling and storage. Preparation of seed for extraction of oil. Processing- peanut oil, rice bran oil, sunflower oil and soy bean oil. Production of cod liver oil. Method of extraction- cold pressing and hot pressing, Equipments- Filter press, hydraulic press. Production of margarine. Production of Lard.					9
III	SOLVENT EXTRACTION AND REFINING OF OILS: Solvent extraction – prepress and direct extraction, removal and recovery of solvent from miscella and extracted residue. Physical refining, Chemical Refining, Degumming - types, dewaxing/winterization, bleaching – deodorizing, hydrogenation.					9
IV	EDIBLE OIL, FAT PRODUCTS AND MODIFICATION OF OILS: Modification of oils - Refined oil – fractionation- Blending – Interesterification – Types – Chemical and Enzymatic, Applications. Margarines, spreads, mayonnaise. Shortenings in bakery products and confectionery lipids. Fat substitutes and its types.					9
V	PACKAGING AND STORAGE OF OIL: Changes during storage of oil. Role of fat or oil in frying .Selection of frying oil. Applications of frying oil .Rancidity - atmospheric oxidation and enzyme action. Quality standards of oil - Packaging of oils and fats.					9
	Total Instructional Hours					45
Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1 -Understand the physical and chemical properties of fats and oils CO2- Remember the mechanical methods for oil extraction CO3- Understand the solvent extraction and refining of oils CO4-Understand and develop edible oil, fat products and modified oil CO5- Understand and choose an appropriate package and storage for oils</p>					
TEXT BOOKS:	<ol style="list-style-type: none"> 1.Fereidoon Shahidi, —Bailey’s Industrial Oil and Fat Productsl, 6th Edition, Wiley - Interscience, New Jersey, 2005. 2. Richard D. O'Brien, —Fats and Oils: Formulating and Processing for Applicationsl, 3rd Edition, CRC Press, London, 2010. 					
REFERENCES BOOKS:	<ol style="list-style-type: none"> 1. Casimir C. Akoh and David B. Min, —Food Lipids: Chemistry, Nutrition and Biotechnologyl, CRC Press, USA, 2008. 2.Wolf Hamm and Richard J. Hamilton, —Edible Oil Processingl, Wiley - Blackwell, UK, 2013. 3. Kanes K. Rajah, —Fats in Food Technologyl, Sheffield Academic Press, UK, 2002. 4. Gunstone, Frank D. “The Chemistry of Oils and Fats Sources, Composition, Properties and Uses” Blackwell Publishing, 2004. 					

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5302	FOOD STORAGE AND INVESTATION CONTROL	3	0	0	3

Course Objectives

- To understand the raw material and preserve it by storing in a proper environment

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	FUNDAMENTALS OF STORAGE INFESTATION: Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post-harvest losses - total production of food grains in India. Scientific and socio-economic factors responsible for grain losses. Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products.	9
II	ECOLOGY OF INSECTS AND STORAGE LOSSES: Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.	9
III	GRAIN STORAGE AND MANAGEMENT: Grain storage types of storage structures - traditional, improved and modern storage structures in current usage. Ideal seeds and commodities storage conditions. Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Pest Birds – role and its management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods.	9
IV	PEST CONTROL MEASURES: Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative. Pesticides – characteristics, uses and precautions in handling. Integrated approaches to stored grain pest management.	9
V	QUALITY CONTROL IN GRAINS: Detection of insect infestation in stored food grains, losses in stored food grains – weveiled and unweveiled grains, determination of moisture content in stored food grains, Quality control aspects in FCI godowns, central warehouse. Demonstration of preventive and curative measures including fumigation techniques; treatment of packing materials and their effect on seed quality.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Remember and identify possible sources of pest infestation in storage
 - CO2- Understand and interpret ecology of region specific insects and its impact on storage
 - CO3- Understand and recommend appropriate storage structures and preventive measures for pests
 - CO4- Understand and elect integrated pest management approach and curative measures in grain storage
 - CO5- Understand the suitable quality control techniques in grain storage

TEXT BOOKS:

- Mohan and Awaknavar J.S., —Pest Management in Store Grainsl, Satish Serial Publishing House, New Delhi, 2009.
- Nair K.R., —Integrated Production and Pest Managementl, DK Publishers and Distributors, Delhi, 2007.

REFERENCES BOOKS:

- Hagstrum D.W., and Subramanyam B., —Fundamentals of Stored Product Entomologyl American Association of Cereal Chemists Inc., 2006
- Subramanyam B., —Integrated Management of Insects in Stored Productsl, CRC Press, 1995.
- Slansky Jr. F., and Rodriguez J.G., —Nutritional Ecology of insects, mites, spiders and related invertebratesl, John Wiley, 1987.
- Chakravarty et al Handbook of Post-Harvest Technology Marcel Dekker. 2003.

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5303	REFRIGERATION AND COLD CHAIN MANAGEMENT	3	0	0	3

Course Objectives • To study the storage systems such as refrigeration and cold storage

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Introduction to refrigeration, unit of refrigeration capacity. Review of Second law of thermodynamics and interpretation. Production of low temperatures - principles and process. Refrigerants - classification and thermodynamic properties. Ozone depletion potential. Reversed Carnot cycle. Limitations of reversed Carnot systems.	9
II	REFRIGERATION SYSTEMS: Refrigeration cycle – simple vapour compression, vapour absorption cycle, p-h and T-s diagrams, COP. Energy ratios and Power consumption of a refrigerating machine. Standard rating cycle and effect of operating conditions. Air refrigeration system – reversed Brayton cycle.	9
III	COMPONENTS OF A REFRIGERATION SYSTEM: Evaporator- dry and flooded type, liquid cooling evaporator. Condenser- water cooled, air cooled and evaporative condenser. Compressor - Reciprocating type compressors. Expansion valve - thermostatic expansion valve	9
IV	LOW TEMPERATURE STORAGE SYSTEMS: Pre-cooling systems, Cold storage- construction, insulation and operation. Design of cold storage unit. Calculation of refrigeration load in cold store. Prefabricated systems, walk-in-coolers. Frozen storage, Cryogenics – Linde and Claude system for liquefaction of air.	9
V	COLD CHAIN: Introduction, Components of cold chain. Refrigerated distribution and transport systems, Cold chain in retail, Traceability- Application of RFID in cold chain. Role of refrigeration in food production - candy manufacture, beverage processing, bakery products, meat products, poultry products, fishery products, fruit /vegetables and dairy products.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1-I Understand the basics of refrigeration with thermodynamic principles and Carnot cycle
	CO2- Understand the concept of refrigeration cycles
	CO3- Remember the various components of refrigeration system and its types
	CO4- Understand the concept of low temperature storage systems for foods
	CO5- Understand and apply cold chain and refrigeration for food products

TEXT BOOKS:

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

REFERENCES BOOKS:

1. Arora C.P., —Refrigeration and Air Conditioning, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., Delhi, 2008
2. Khurmi R.S. and Gupta J.K., —Textbook of Refrigeration and Air Conditioning, 5th Edition, S. Chand Publishers, New Delhi, 2006.
3. Narayanan K.V., —A Textbook of Chemical Engineering Thermodynamics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2013.
4. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th Edition, 2009.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5304	POST HARVEST TECHNOLOGY	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> • To understand and identify the specific processing technologies used for different foods and the various products derived from these materials. • To understand the application of scientific principles in the processing technologies specific to the materials. 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	CEREALS AND PULSES: Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control, Processing; Wheat - milling, (Atta and maida), quality aspects of flour, wheat proteins and their function; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, malting and malt products; Rice- Milling, Parboiling, Quick cooking rice. Pulses - Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products– puffed, flakes, flour, soya milk, soy protein Isolate.	9
II	VEGETABLES AND FRUITS: Climacteric and non-climacteric fruits, ripening process, phytonutrients in fruits and vegetables; Handling, transportation, controlled atmosphere ripening process, grading, cleaning, pre treatments, modified atmosphere packaging, chilling. General pre-processing, different freezing methods and equipment, problems associated with specific fruits and vegetables; Dehydration– General pre processing, different methods of drying, osmotic dehydration and other modern methods. Canning - General pre-processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates Vegetable Purees/pastes.	9
III	OIL SEEDS, NUTS AND SUGARS: Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, hydrogenation; oil blends. Honey- Composition and Quality aspects; Sugars- Manufacture of table sugar, High Fructose corn syrup and Glucose syrup; Jaggery – sources, manufacture.	9
IV	MILK AND MILK PRODUCTS: Processing of Milk – Pasteurisation, homogenisation, sterilization, HTST and UHT processes; Processing and preservation of milk products - cream, sour cream, butter, ghee, skimmed milk concentrate and skimmed milk powder, whey concentrate and whey powder, yoghurt, cheese and other products.	9
V	MEAT, FISH & POULTRY: Pre and post slaughter handling, meat inspection and grading. Structure and composition of meat, carcass chilling, ageing; storage of fresh meat - Modified atmosphere packaging, packaging of retail cuts; Processing and preservation - artificial tenderizing, chilling, freezing, curing, smoking, ready-to-eat meats and meat products; Marine and fresh water fish, shell fish - composition and nutrition; spoilage factors, ship board operations, storage and transport. Processing and Preservation - chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils. Processing plant operations - slaughter, bleeding, scalding, de-feathering, eviscerating, chilling, packaging; composition and nutrition, poultry meat products Eggs- structure, composition, quality factors, storage, pasteurization, freezing and drying, egg substitutes.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the concepts and processing of cereals and pulses
 - CO2- Remember the insight and reduce fruit and vegetable losses during processing after harvesting
 - CO3- Understand the specific processing technologies used especially for oil seeds, nuts and sugars
 - CO4- Understand the post-harvest processing of milk and milk products
 - CO5- Remember the meat, fish and poultry processing technologies

TEXT BOOKS:

1. Hamm, Wolf and Hamilton, R, J. “Edible Oil Processing”, Blackwell / Ane Books, 2004.
2. Morris, Peter C and Bryce, J.H. “Cereal Biotechnology”, CRC / Wood Head, 2000.

REFERENCES BOOKS:

1. Rajah, Kanes K. “Fats in Food Technology”, Blackwell / Ane Books, 2004.
2. Mead G.C., —Poultry Meat Processing and Quality, 1st Edition, CRC Press, London, 2004.
3. Sukumar De, —Outlines of Dairy Technology, Royal Oxford University Press, Delhi, 2010.
4. Alzamora, S.M., Tapia, M.S. and Lopez – Malo, A. “Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications”, Springer, 2005.

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT5305	CANE SUGAR TECHNOLOGY	3	0	0	3

Course Objectives • To understand the technology of cane sugar

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION AND PREPROCESSING OPERATION: Brief account of sugar industry- composition of sugar cane, manufacturing process of sugarcane juice, types of cane sugar, terminology. Harvesting indices, Cane cutting – Manual and Mechanical, Transportation, Cane conveyor, Washing, Shredding	9
II	JUICE EXTRACTION AND JUICE CONCENTRATION: Crushing –Types of crushers, crushing efficiency. Extraction of juice – methods. Accumulators – types. Maceration. Theory of cane diffusivity. Types of diffusers. Weighing of juice - Maxwell Boulogne Scale and Magnetic Flow Meters. Concentration - Importance- types of heaters- construction and working of tubular heater, Direct Contact Heater (DCH), Plate Heater (PHE), advantages and disadvantages. Evaporator- types- performance measures.	9
III	CLARIFICATION: Clarification – importance, methods, clarifying agent, bleaching agent. Role of pH, non-sugars, colloids and gums in cane juice clarification. Lime - specification, storage. Preparation of milk of lime, rotary lime slacker, classifier, MOL tanks, lime pumps, use of hydrated lime powder. Sulphur - specification and storage, production of sulphur dioxide gas, construction and working of sulphur burner, film type sulphur burner.	9
IV	CRYSTALLIZATION AND REFINING: Sugar boiling, Nucleation and crystal growth, super saturation and meta stable stage, seeding – shock seeding, true seeding. Crystallizers. Refining - Brown sugar, importance of refining, Affination, clarification, carbonation, sulphitation, phosphitation, decolorization, centrifugation - dewatering of sugar. Drying. Bagging and storage. Factors affecting sugar refining process.	9
V	MANUFACTURING OF JAGGERY/ GUR AND OTHER BY PRODUCTS: Extraction of Juice, Clarification of Gur, Concentration of Juice, Drying and grading of Gur, Storage of Gur. Byproducts - Drying and uses of Bagasse - Back strap Molasses - Characteristics of Molasses. Direct Utilization of Molasses - Distilling Industries - Applications in animal feed – Biogas – Biofertilizers production- Inverted syrup.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Remember the sugar cane constituents and apply preprocessing operations
	CO2- Understand the suitable cane juice extraction and concentration methods
	CO3- Understand the appropriate clarification methods for sugarcane juice
	CO4- Remember crystallization and refining techniques
	CO5- Understand the knowledge for manufacturing of cane sugar by-products

TEXT BOOKS:

1. Paturau J.M., —By-Products of the Cane Sugar Industry, 2nd Edition, Elsevier Publishing Company, New York, 1989.
2. Baikow V.E., —Manufacturing and Refining of Raw Cane Sugar, 2nd Edition, Volume - I and II, Elsevier Publishing Company, New York, 1967.

REFERENCES BOOKS:

1. Heriot T, H. P., —The Manufacture of Sugar From The Cane and Beet, Read Books, New York, 2007.
2. Ram Behari Lal and Mathur, —Hand Book of Cane Sugar Technology, Oxford and IBH Publishing Company, New Delhi, 1995.
3. Chung Chi Chou, —Handbook of Sugar Refining: A Manual for the Design and Operation of Sugar Refining Facilities, John Wiley and Sons, 2000.
4. Jenkins, George Horner. *Introduction to cane sugar technology*. Elsevier, 2013.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6301	BEVERAGE TECHNOLOGY	3	0	0	3

- Course Objectives**
- To gain knowledge on machinery and process involved in beverage technology and fermentation process involved in making beverage process.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	BASIC INGREDIENTS IN BEVERAGES : Beverage-definition-why we drink beverages-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.	9
II	BEER AND WINE MANUFACTURE: Ingredients- Malt- hops- adjuncts- water, yeast. Beer manufacturing process, distillation, malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and Spoilage.Wine-fermentation-types –red and white. Wine defects and spoilage	9
III	CARBONATED BEVERAGES : Procedures- carbonation equipment-ingredients- preparation of syrups-Filling system-packaging containers and closures	9
IV	NON CARBONATED BEVERAGE: Coffee bean preparation-processing- brewing-decaffeination- instant coffee-Tea types- black, green and oolong- fruit juices, nectars, quash, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages	9
V	QUALITY CONTROL : Effective application of quality controls, brix, acidity to brix ratio, single strength of juice- sanitation and hygiene in beverage industry- Quality of water used in beverages - threshold limits of various ingredients according to PFA, EFSA and FDA – Absolute requirements of Soluble solids and titrable acidity in beverages.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the role of ingredients used in beverage processing
 - CO2- Understand the processing of beer and wine processing
 - CO3- Understand the procedure of carbonated beverages
 - CO4- Understand the procedure of non-carbonated beverages
 - CO5- Understand the steps for quality control

TEXT BOOKS:

- Ashurst, P.R, “Chemistry and technology of Soft drink and fruit juices”, 2nd edition, Blackwell Publishing Ltd. 2005.
- Steen, D.P and Ashurst, P.R, “Carbonated soft drinks – Formulation and manufacture”, Blackwell Publishing Ltd. 2000.

REFERENCES BOOKS:

- Amalendu Chakraverty et al, “Handbook of Post Harvest Technology”, Ed:., Marcel Dekker Inc. (Special Indian edition) 2000.
- Robert.W.Hutkins, “Microbiology and Technology of Fermented foods”, IFT Press, Blackwell Publishing Ltd. 2006.
- Shankunthala Manay, N. and Shadakdharaswamy, M, “Foods – Facts and Principles”, New Age International Pvt. Ltd, 3rd revised edition 2000.
- Charles, W.Bamforth, “Food, fermentation and microorganisms”, Blackwell Science Publishing Ltd. 2005

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6302	TECHNOLOGY OF SNACKS AND EXTRUDED FOODS	3	0	0	3

Course Objectives

- To study about the snack products by extrusion process and also the health aspects of organic foods

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION: Current status of snack food industry in India. Types of snack food – Raw Vegetable Snack, Formed dough products from potato and maize derivatives, Half Products, Directly expanded extruded snack, Puffed Snacks and other. Types and Functions of ingredients – structure forming materials, dispersed phase/filling materials, plasticizers/lubricants, soluble solids, nucleating substances, coloring and flavouring substances.	9
II	POTATO AND RICE BASED SNACKS: Potato Chip - Pre cleaning and peeling, slicing, drying/frying, salting and seasoning, quality control. Fabricated potato snacks – potato flakes, potato granules, potato starch, ground and crushed dehydrated potato. Rice based Snacks – Products using whole grains – Gun puffed rice. Products using flours	9
III	CORN AND EXTRUSION BASED SNACKS: Tortilla chip – Corn soaking and smoking, Grinding, Masa flour, Sheeting and Cutting, Baking and Frying. Popcorn – Popping methods, oil popping and dry popping. Commercial and industrial popcorn process. Flavorings and Applicators. Extruder components – Single and Twin screw, Single and Multiple die extruders. Second generation and Third generation snacks, Co extruded snacks, Masa based snacks, Flat bread, Crisp bread.	9
IV	PASTA PRODUCTS: Raw materials. Preparation of raw materials for extrusion. Spaghetti, noodles, macaroni and similar products. Dry and frozen pasta products. Pretzel – Types – Formulation and Processing - mixing, extrusion, proofing, cooking, surface salting, baking and drying. Problems in pretzel manufacture.	9
V	HEALTH ASPECTS 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. Organic foods types of organic foods, identifying organic foods, organic food & preservatives	9

Total Instructional Hours TOTAL: 45

Upon completion of the course, students can be able to

Course Outcomes
CO1-Understand the preprocessing operations
CO2-Understand the mechanism behind extrusion
CO3-Understand the concepts of extruded foods
CO4-Understand the preparation of corn, rice and paddy products
CO5-Understand the health aspects of organic foods

TEXT BOOKS:

1. Edmund W. Lusas and Lloyd W. Rooney, —Snack Food Processingl, 1st Edition, CRC Press, Florida, 2001.
2. Robin Guy, —Extrusion cooking: Technologies and Applicationsl, 1st Edition, CRC Press, Florida, 2001.

REFERENCES BOOKS:

1. Panda H., —The Complete Technology Book on Snack Foodsl, National Institute of Industrial Research, New Delhi, 2003.
2. Sergio O. Serna-Saldivar, —Industrial Manufacture of Snack Foodl, Woodhead Publishing, New Delhi, 2008.
3. Mian N. Riaz., —Extruders in Food Applicationl, CRC Press, Florida, 2000.
4. Davidar, Ruth N. “Indian Food Science A Health and Nutrition Guide to Traditional Recipes, East West Books, 2001.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6303	FOOD BIOTECHNOLOGY	3	0	0	3

- Course Objectives**
- To understand application of biotechnology in food processing industries, understand downstream processing concepts, process involving production of enzymes

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION TO BIOTECHNOLOGY Introduction -Biotechnology relating to the food industry – application of genetics to food production – role of bio process engineering in biotechnology industry. Regulatory and Social aspects of biotechnology of foods.	9
II	MICROBIALGENETICS Microbial genetics – mutation – induction of mutation – conjugation, transformation, transduction – heterokaryoses – paraosexuality – General mechanism of gene transfer techniques in genetic engineering. Principles of immunology – Antigen and antibody reaction – Development of vaccines – Microbial products and industrial application of microorganisms in foods.	9
III	PRODUCTIONOF PRIMARY AND SECONDARY METABOLITE The process of production of some commercially important organic acids – citric acid, lactic acid, acidic acid, gluconic acid, amino acids and alcohol– Bio products for food industries – Natural bio-preservatives – Nisin.	9
IV	DOWNSTREAM PROCESSING Principle of downstream processing –stages in downstream processing- solid liquid separation flotation-flocculation-filtration-types-centrifugation-cell disruption-concentration-evaporation liquid - liquid extraction-membrane filtration- precipitation-adsorption-purification by chromatography.	9
V	APPLICATIONOF BIOTECHNOLOGY TO TRADITIONAL FERMENTED FOODS Milk derivatives- fermented milks-past, present and future-plant derivatives-biotechnology application in cassava processing-animal derivatives-fish meat sausage-human health safety and nutrition considerations-future directions.	9

Total Instructional Hours TOTAL: 45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1 - Understand the introduction to biotechnology
 - CO2 - Remember the concepts of microbial genetics
 - CO3 - Understand the production of primary and secondary metabolites
 - CO4 - Remember the operations behind downstream processing
 - CO5 - Understand the application of biotechnology to traditional fermented foods

TEXT BOOKS:

- Rita Singh, “Food Biotechnology”. Global vision publication house, Delhi 2004.
- Sarah Elderidge, “Food Biotechnology; Current issues and perspectives”. Nova science pub. Inc. 2003.

REFERENCES BOOKS:

- Kalaichelvan, P.T, “Bioprocess technology”, MJP publishers, Chennai 2007.
- Sathnarayana U, “Biotechnology”, Arunavhazan publishers, kolkatta 2006.
- National Research Council, “Application of biotechnology to traditional fermented foods”, National academy press, Washington 1992.
- Najafpour, D. Ghasem. “Biochemical Engineering & Biotechnology”. Elsevier, 2007

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6304	BIOPROCESS ENGINEERING	3	0	0	3

Course Objectives

- To study the immobilization, inhibition process of microbes

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	ENZYME: Introduction, Single and Multi-substrate reactions - mechanisms and kinetics; turnover number; Enzyme Inhibition and Kinetics- competitive, non-competitive and uncompetitive; Enzyme Immobilization – Physical and chemical methods	9
II	MICROBIAL STRAIN IMPROVEMENT: Media – composition, design, formulation and optimization. Microbial Strains: Isolation, cultivation and preservation techniques; strain selection and improvement - Recombinant DNA Techniques and Cloning Strategies	9
III	STOICHIOMETRY OF CELL GROWTH AND PRODUCT FORMATION: Elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation.	9
IV	FERMENTATION AND STERILIZATION: Batch, fed batch and continuous fermentation. Main parameters to be monitored and controlled in fermentation processes. Microbial growth kinetics model - Simple unstructured and Monod model. Sterilization methods, Thermal death kinetics of microorganisms, batch and continuous heat sterilization, filter sterilization.	9
V	REACTOR TYPES & MODES OF OPERATION Batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking- piret models. Types of reactor- Air Lift Reactor, Bubble Column Reactor, Immobilized enzyme reactors- packed bed, fluidized bed, membrane reactors.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1-Understand the enzymes concept
	CO2-Understand the microbial stains
	CO3-Understand the stoichiometry of cell growth
	CO4-Understand the process of fermentation
	CO5-Understand the knowledge for reactor

TEXT BOOKS:

- Shuler, M.L. and Kargi, F. "Bioprocess Engineering Basic Concepts", 3rd Edition, PHI, 2017
- Palmer, Trevor "Enzymes Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East- West Press Pvt. Ltd., 2004.

REFERENCES BOOKS:

- Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 3rd Edition, Butterworth – Heinemann (an imprint of Elsevier), 2016.
- Doran, P.M. "Bioprocess Engineering Principles", 2nd Edition Academic Press, 2013.
- Najafpour, D. Ghasem. "Biochemical Engineering & Biotechnology". Elsevier, 2007.
- Bryce, C.F.A and EL. Mansi. "Fermentation Microbiology & Biotechnology, 1999.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6305	ENZYME TECHNOLOGY	3	0	0	3

Course Objectives

- To know about Isolation and Purification of enzymes, understand the concept of enzyme immobilization techniques and the application of enzymes in food industries.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION Introduction-Definition-Historical highlights-classification of enzymes nomenclature-structural features of enzyme-Methods of extraction and purification of enzymes.	9
II	MECHANISMOF ENZYME ACTION Specificity-types of specificity-role of 3D structure -active site-substrate and enzyme concentration relationships-different effects –pH and temperature.	9
III	ENZYMEKINETICS MM equation, Lineweaver Plot, - kinetics. Immobilization-need for immobilization advantages–disadvantages-immobilization techniques- - effects of pH, temperature, substrate concentration, stability, kinetic properties-role of immobilized enzymes in food processing-commercial food application	9
IV	ENZYMES OF FOOD IMPORTANCE Endogeneous enzymes in food quality-color- lipoxynase, chlorophyllase, polyphenol oxidase ,texture- Pectic enzymes, Amylases, cellulases, proteases,flavour and aroma-nutritional quality	9
V	APPLICATIONOF ENZYMES IN FOOD INDUSTRIES Mechanism and application of enzymes in food processing-enzymatic browning. Application of enzyme in meat industry, fruit and vegetable industry,dairy industry- bakery industry.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes

CO1- Understand the enzyme structure and nomenclature
CO2- Remember the importance of enzyme in foods
CO3- Understand the application of enzyme in food industries
CO4- Understand the appropriate staining techniques
CO5- understand the cell production mechanism

TEXT BOOKS:

- Price, N. L. and StevenL., “*Fundamentals of Enzymology*”, Oxford Scientific 2000.
- Godfrey T. West S (Eds), “*Industrial Enzymology*” 2nd Edition Mac Millan Press, London 1996

REFERENCES BOOKS:

- Colowick,S.P.and Kalpan,N.O.(Eds), “*Methods of enzymology*” Academic press 1977.
- Tauber ph.D and Hentry,“*Enzyme technology*” 2000
- Marangoni, A.G, “*Enzyme Kinetics*”. A modern approach A John Wiley & Sons 2003.
- Trevor Palmer. Understanding Enzymes. Fourth Edition. Prentice Hall,LondonRobert L. Ory, Allen J. St. Angelo, “*Enzymes in food and beverage processing*” American chemical society 1977

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7301	FUNCTIONAL FOODS AND NUTRACEUTICALS	3	0	0	3

- Course Objectives**
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
 - To understand the role of Nutraceuticals and functional food in health and disease

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION AND SIGNIFICANCE : Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes	9
II	ANALYSIS OF PHYTOCHEMICALS : Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.	9
III	ASSESSMENT OF ANTIOXIDANT ACTIVITY : In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources	9
IV	ROLE IN HEALTH AND DISEASE : Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.	9
V	SAFETY ISSUES : Health Claims, regulations and safety issues- International and national	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the significance of functional foods and nutraceuticals
 - CO2- Understand the analysis of phytochemicals
 - CO3- Understand the procedures for assessing antioxidant activity
 - CO4- Understand the role of nutraceuticals in health and disease
 - CO5- Understand the safety issues

TEXT BOOKS:

- Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals", II Edition, CRC, 2001.
- Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC, 2006.

REFERENCES BOOKS:

- Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2007.
- Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.
- Gibson, G.R. and C.M. Willams. "Functional Foods: Concept to Product". Woodhead, 2000.
- Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society of Chemistry, 2003.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7302	BIOLOGY AND CHEMISTRY OF FOOD FLAVOURS	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> • To understand the flavour compounds involved in development of flavor • To understand the analytical techniques involved in flavor analysis 					
UNIT	DESCRIPTION					INSTRUCTIONAL HOURS
I	INTRODUCTION : Problems in flavour research – classification of food flavours; chemical compounds responsible for flavor					9
II	FLAVOUR COMPOUNDS : Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.					9
III	THE CHEMICAL SENSES : Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.					9
IV	FLAVOUR ANALYSIS : Subjective versus Objective methods of analysis; psychophysics and sensory evaluation and its types, ENOSE, ETONGUE; Instrumental analysis; sample handling and artifacts; data handling					9
V	TEACHING FLAVOUR CONCEPTS : Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench					9
Total Instructional Hours						45
Upon completion of the course, students can be able to						
Course Outcomes	CO1- Understand the problems in flavor research					
	CO2- Understand the compounds responsible for flavours					
	CO3- Understand the chemical senses					
	CO4- Understand the flavor analysis procedures					
	CO5- Understand the flavor concepts and applications					

TEXT BOOKS:

1. Fisher, Carolyn and Thomas R. Scott. "Food Flavours: Biology and Chemistry". The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. "Flavor Chemistry and Technology". CBS Publishers, 1996.

REFERENCES BOOKS:

1. Hofmann, Thomas. "Challenges in Taste Chemistry and Biology". American Chemical Society Publications, 2004.
2. Charalambous, G. "Food Flavors: Generation, Analysis and Process Influence". Elsevier, 1995.
3. Reineccius, Gary. "Flavor Chemistry and Technology". II Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. "Flavor Chemistry of Ethnic Foods". Kluwer Academic / Plenum, 1999.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7303	FOOD TOXICOLOGY AND ALLERGY	3	0	0	3

- Course Objectives**
- To study various food laws, importance and functions of food safety management systems, to impart knowledge on food laws and safety in food processing.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION TO FOOD TOXICOLOGY: Definition and need for understanding food toxicology; Hazards -Microbiological, nutritional and environmental. Basics of immune response - humoral and cell mediated response. Allergen and mechanism of allergic response.	9
II	NATURAL TOXINS, FOOD ALLERGY AND SENSITIVITY: Toxins – Natural toxin and poison, difference between toxin, poison and natural toxin, toxin foods, unsafe food, bio-toxin, toxin characteristics, classification of natural toxin. Chemistry of food allergens, food disorders associated with metabolism, biotransformation and Elimination of Toxicants, lactose intolerance, celiac disease and asthma.	9
III	TOXICANTS FORMED DURING FOOD PROCESSING: Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colors, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action.	9
IV	ASSESSMENT OF TOXICANTS IN FOOD SAMPLING: Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants. Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.	9
V	INSTRUMENTATION TECHNIQUES TO DETECT TOXINS: Chromatography, Principles, procedure and applications of Thin layer chromatography, Gas chromatography column chromatography, Ion exchange chromatography and High performance liquid chromatography, PCR Techniques, ELISA. Spectrophotometry, Principles, instrumentation and applications of atomic absorption spectrophotometry (AAS) and atomic emission spectrophotometry (AES), Centrifugation; Principles, instrumentation and applications of preparative and ultracentrifuge.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the concepts of food toxicology
 - CO2- Understand the reactions of natural toxins
 - CO3- Remember the toxicants during food processing
 - CO4- Understand the procedures of sampling
 - CO5- Understand the instrumentation techniques to detect toxins

TEXT BOOKS:

- Helferich, William and Carl K.Winter “Food Toxicology” CRC Press, 2001.
- Alluwalla, Vikas “Food Hygiene and Toxicology” Paragon International Publishers, 2007

REFERENCES BOOKS:

- Labbe, Ronald G. and Santos Garcia “Guide to Food Borne Pathogens” John Wiley & Sons, 2001.
- Cliver, Dean O. and Hans P.Riemann “Food Borne Diseases” 2nd Edition., Academic Press / Elsevier, 2002.
- Riemann, Hans P. and Dean O. Cliver “Food Borne Infections and Intoxications” 3rd Edition., Academic Press/Elsevier, 2006.
- Shibamoto, Taka yuki and Leonard F.Bjeldanzes “Introduction to Food Toxicology” 2nd Edition.Academic Press, 2009.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7304	ADVANCED DRYING TECHNOLOGY	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> To study the advanced drying technologies used for specific food material according to its nature 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Introduction to Drying: Drying and dehydration - principles - Mechanism of drying. Drying curves - Internal and external conditions of drying -Drying rate characteristic curve. Diffusion theories of drying - Effective Fickian diffusivity, Alternative effective diffusion theories. Water activity – Hysteresis, water activity predictive models, Determination of sorption isotherms – Gravimetric method, Manometric method and Hygroscopic methods.	9
II	Spray and Freeze drying: Spray drying – concept, components of spray drier, mechanism of atomization – drop size and drop distribution. Drying of droplets – Fundamentals, drying kinetics, residence time. Heat and mass balance. New developments in Spray drying. Freeze drying- principle - types - heat and mass transfer, design consideration. Freeze drying – Concept. Stages in freeze drying. Industrial freeze dryers. Advances in freeze drying.	9
III	Drying on inert particles: Mechanism and process considerations. Pneumatic and flash drying – principles and its applications. Fluidized bed drying (FBD) - principles of fluidization, Components of fluidized bed system, Classification of fluidized bed dryers – conventional and modified FBD.	9
IV	Superheated steam drying: Principles, classification, selection, applications. Heat pump drying (HPD) – principle, low temperature HPD, chemical HPD, Developments and trends. Contact-Sorption drying- Mechanism, Characteristics of sorbents/carriers. Airless drying. Fry drying. Conveyor dryers.	9
V	Microwave and dielectric drying: basic concept, Generators, applicators and other control devices, industrial applications. Infra red drying – principles, industrial dryers, applications. Sonic drying. Impingement drying. Slush drying. Refractance Window drying.	9
Total Instructional Hours		45
Course Outcomes	<p>Upon completion of the course, students can be able to</p> <p>CO1- Understand the the mechanism of drying and various dehydration techniques</p> <p>CO2- Remember the knowledge on freeze and spray drying</p> <p>CO3- Understand the concepts of drying on inert particles, fluidized and pneumatic drying</p> <p>CO4- Understand the insight on superheated steam drying, heat pump drying and other novel drying techniques</p> <p>CO5- Understand the knowledge on microwave, infra-red and sonic drying techniques</p>	

TEXT BOOKS:

1. A.S.Mujumdar. Handbook of Industrial drying – Third edition, CRC press, Taylor and Francis group.UK.2007.
- 2.Potter, N. N. and Hotchkiss, J. H., —Food Science. Fifth Edition, CBS Publishers and Distributors, New Delhi. 1996.

REFERENCES BOOKS:

- 1.Kudra, T and A.S. Mujumdar. Advanced Drying Technologies. Second Edition, CRC press, Taylor and Francis Group. UK. 2009.
- 2.Rao, M. A. and Rizvi, S.S.H., —Engineering Properties of Foods, Marcel Dekker, Inc. New York. 1986.
3. Sahay K.M. and Singh K.K., —Unit Operations of Agricultural ProcessingI, 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
4. Albert Ibarz and Gustavo V. Barbosa-Cánovas. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.2003

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7305	CEREAL TECHNOLOGY	3	0	0	3

- Course Objectives**
- To develop the knowledge of students in the area of Cereal processing and technology.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PRODUCTION, STRUCTURE AND COMPOSITION: Status, major growing areas and production of cereals and millets in India and the world, structure, Physical properties; Density, Bulk density, Angle of repose, Hardness, asperity, porosity, stack of milling and moisture on physical properties. Chemical composition, Distribution of nutrients and Aroma of cereals and millets; anti-nutritional factors	9
II	WHEAT AND RICE : Wheat: Morphology, Physicochemical properties, Wheat Quality, Wheat Milling, quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Milling of rice: Conventional Milling, Modern milling, Advantages and disadvantages of milling machineries, By products of rice milling, Parboiling of rice: Aging of rice: Enrichment: - Need of Enrichment, Methods of enrichment, Enrichment levels, fortification of amino acids. -Processed Foods from rice: Breakfast cereals, flakes, puffing, canning and instant rice.	9
III	OTHER CEREALS : Corn - Morphology, Physico-chemical properties, Corn milling - Wet and dry milling, Milling fractions and modify starches Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; HFCS; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Rye bread; Traditional and Fermented cereal products	9
IV	MILLETS: Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - storage, insect control; processing - Pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.	9
V	BAKED AND EXTRUDED PRODUCTS: Baked foods - chemical dough development, mechanical dough development, sheeting extrusion other rapid methods; Bread staling – theory, manifestation, retardation measures; Indian Confectionery. Extrusion processing – methods and products	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand and identify the specific processing technologies used for cereals
 - CO2- Understand the application of scientific principles in the processing technologies specific to the materials.
 - CO3 –Understand the processing of millet
 - CO4 –Understand the importance of baked and extruded product
 - CO5 – Understand the processing of wheat

TEXT BOOKS:

- 1.Matz, Samuel A. “ The Chemistry and Technology of Cereals as Food and Feed” II Edition, CBS, 1996
2. Delcour, Jan A. and R. Carl Hosney. “Principles of Cereal Science and Technology”. III Edition. American Association of Cereal Chemists, 2010.

REFERENCES BOOKS:

- 1.Kulp, Karel “Handbook of Cereal Science and Technology”. IIEdition,CRC Press, 2000.
2. Morris, Peter C. and James H Bryce “Cereal Biotechnology”. CRC / Woodhead, 2000
3. Chakraverty A. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.2006
- 4.Araullo, E.V., dePadna, D.B. and Graham, Michael. Rice Post Harvest Technology. International Development Res. Centre, Ottawa, Canada. 1976.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme B.Tech	Course Code 19FT8301	Name of the Course FOOD PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	L 3	T 0	P 0	C 3
----------------------------	--------------------------------	--	---------------	---------------	---------------	---------------

- Course Objectives**
- To introduce the students about the process economics and industrial management principles
 - To improve the management and planning skills in students thus enabling them for functional role in industries

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PRODUCTION MANAGEMENT AND ORGANISATION Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.	9
II	ENGINEERING ECONOMICS FOR PROCESS ENGINEERS-INTEREST, INVESTMENT COSTS AND COST ESTIMATION Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.	9
III	PROFITABILITY, INVESTMENT REPLACEMENT Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.	9
IV	ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.	9
V	ECONOMIC BALANCE AND QUALITY CONTROL Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the concept of production management and organization
 - CO2- Understand the Engineering Economics for process Engineers
 - CO3- Understand the profitability, investment replacement concepts.
 - CO4- Understand the principles of accounting and analysis of performance growth
 - CO5- Understand the concepts of economic balance and quality control

TEXT BOOKS:

- 1.Peters, M. S. and Timmerhaus, C. D., "Plant Design and Economics for Chemical Engineers", 5th Edition., McGraw Hill, 2002.
- 2.Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", 2nd Edition., John Wiley, 1983.

REFERENCES BOOKS:

- 1.Allen, L.A., "Management and Organization", McGraw Hill, 1958.
- 2.Perry, R. H. and Green, D., "Chemical Engineer's Handbook ", 9th Edition., McGraw Hill, 2018.
- 3.Narang, G.B.S. and Kumar, V., "Production and Costing", Khanna Publishers, New Delhi, 1988.
4. Bournlakis, Michael A., and Paul WH Weightman, eds. Food supply chain management. Blackwell Pub., 2004.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8302	FOOD LAWS AND SAFETY	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> To study various food laws, importance and functions of food safety management systems, to impart knowledge on food laws and safety in food processing 					
UNIT	DESCRIPTION	INSTRUCTIONAL HOURS				
I	HISTORICAL PERSPECTIVES INCLUDING NECESSITY OF FOOD LAWS : Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products; Urbanisation of population and necessity of processed and preserved foods and the necessity of ensuring quality of food to prevent adulteration. Prevention of Food Adulteration Act 1954 & Rules 1955 established in India to enforce safety and purity of food products; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment; Standards of various food products; FPO; Infant Milk Substitute Act; Laws relating to vegetable oils; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants etc. Food Safety & Standards Act 2006 and the provisions therein; Integrated Food Law - Multi departmental multilevel to single window control system, consumer protection Act.	9				
II	FOOD SAFETY IN PROCESSING : Building and equipment design; microbiological quality of water, air; Safety in food procurement, storage, handling and manufacture; Food safety in retail food businesses; international food service operators, institutional food service operators; application of the PRINCIPAL/Deans of modern hygiene; Food handlers, habits, clothes, illness	9				
III	KEY SAFETY PRINCIPLES: Training & Education for safe methods of handling food; cleaning and sanitization of processing plants; principles of cleaning and sterilization; sterilization & disinfection different methods used-detergents, heat, chemicals; selecting and installing equipment; Cleaning of equipment and premises. Safety limits of sanitizers; pest control; management and disposal of waste	9				
IV	FOOD SAFETY MANAGEMENT SYSTEM : Food safety and quality management systems- Physical, chemical and Microbial hazards and their control in food industry; Good laboratory practice (GLP); Quality systems standards including ISO; - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP)	9				
V	MANAGEMENT : Good Manufacturing Practice and HACCP; Surveillance networks, Consumer and food service operator education; GM Foods, safety and labeling; International Food Standards ISO 9000 and related standards; Impact of food safety on global trade.	9				
		Total Instructional Hours	45			
Course Outcomes	Upon completion of the course, students can be able to					
	CO1- Understand the safety during processing					
	CO2- Understand the key safety principles					
	CO3- Understand the manufacturing practices					
	CO4- Understand the need of food laws					
	CO5- Understand the management systems					

TEXT BOOKS:

1. Rees, Naomi and David Watson —International Standards for Food Safety , Aspen Publication, 2000.
2. Schmidt, Ronald H. and Rodrick, G.E. —Food Safety Handbook , Wiley Interscience, UK, 2005.

REFERENCES BOOKS:

1. Mehta, Rajesh and J. George —Food Safety Regulations, Concerns and Trade :The Developing Country Perspective, Macmillan, 2005.
2. The Prevention of Food Adulteration Act, 1954 , Commercial Law Publishers India) Pvt. Ltd.,
3. Oyarzabal, Omar A., and Steffen Backert, eds. Microbial Food Safety: An Introduction. Springer Science & Business Media, 2011.
4. Dreyer, Marion, and Ortwin Renn. Food safety governance. Berlin: Springer, 2009.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8303	WASTE MANAGEMENT AND BY-PRODUCT UTILIZATION IN FOOD INDUSTRIES	3	0	0	3

Course Objectives

- To understand the concepts of waste management and its utilization in food industries

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	IMPORTANCE AND CHARACTERISTICS OF INDUSTRIAL WASTE: Classification of waste, characterization of waste, magnitude of waste generation in different food processing industries, importance of waste management, Economical aspects of waste treatment and disposal, Strategies for minimizing waste, Application of 3R's and life cycle assessment (LCA).	9
II	WASTE TREATMENT METHODS: Membrane separation, advanced oxidation/reduction, electrolytic methods, up-flow anaerobic sludge blanket (UASB), aerobic and anaerobic methods, activated sludge treatment, sludge thickening, sludge conditioning, sludge dewatering, composting and incineration, land filling, vermicomposting.	9
III	BY PRODUCTS FROM OIL SEED AND TUBER PROCESSING INDUSTRIES: Oil processing industries – Introduction, De-oiled cake, animal feed, fertilizer, bio sorbents, waxes, soap stock, cocoa butter replacer. Tuber processing industries- Introduction, enzyme production, biogas, bakers yeast, bio-ethanol, animal feed, corn syrup, organic acids, nutraceuticals.	9
IV	BY PRODUCTS FROM ANIMAL PRODUCT BASED INDUSTRIES: Dairy industry - Introduction- opportunities – whey, bio surfactants, bacteriocin. Meat, fish, poultry processing industries- bio active peptide, protein extract, gelatin, heparin, pepsin, bio molecule from bone and blood, keratin from animal hair, bone meal, meat meal, chondroitin sulfate, squalene, fish oil, micro nutrients- vitamins and minerals, pigments.	9
V	BY PRODUCTS FROM MILLING, FRUITS AND VEGETABLES PROCESSING INDUSTRIES: Milling industries- introduction, bran utilization- dietary fibre, substrate for mushroom cultivation and enzyme production, briquettes, edible oils. Fruits and vegetable processing industries- current scenario in waste generation- anti oxidants, natural colorants and flavors, pectin and other poly saccharides, organic acids, adsorbent, phyto chemicals.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes

CO1- Understand the classification of food waste and recommend the strategies for waste minimization
CO2- Understand and identify the method for treatment of liquid and solid waste
CO3- Understand and utilize residues from oil seed and tuber processing industries
CO4- Understand the by-product production from animal product based industries
CO5- Understand and develop by-products from grain, fruits and vegetables processing

TEXT BOOKS:

- 1.Chandrasekaran M., —Valorization of Food Processing By-Products, CRC Press, 2013.
- 2.VassoOreopoulou and Winfried Russ, —Utilization of By-Products and Treatment of Waste in the Food Industry, Springer Science Business Media, USA, 2007.

REFERENCES BOOKS:

- 1.Keith Waldron, —Handbook of waste management and co-product recovery in food processing, Wood head Publishing Ltd., England, 2007.
- 2.Green J.H. and Kramer A., —Food Processing Waste Management, AVI Publishing Company, Malaysia, 1981.
- 3.Nelson L. Nemerow and Franklin J. Agardy, —Strategies of Industrial and Hazardous Waste Management, John Wiley and Sons, 1998.
- 4.Anal, Anil, ed. *Food processing by-products and their utilization*. John Wiley & Sons, Incorporated, 2018.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8304	INSTRUMENTATION AND PROCESS CONTROL	3	0	0	3

Course Objectives

- To learn about the process control methods and systems

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	LAPLACE TRANSFORM AND FIRST ORDER SYSTEM: Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, Linearization and its application in process control.	9
II	SECOND ORDER SYSTEM: Second order systems - Interacting system and non-interacting system, manometer, damped oscillator, dynamic response of second order system, Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems.	9
III	CONTROLLERS AND DYNAMIC RESPONSE: Controllers - Proportional, Proportional Integral, Proportional Derivative and Proportional Integral Derivative (PID). Dynamic behavior of feedback controlled processes. Effect of proportional, Integral, Derivative and composite control actions on the response of controlled processes. Automation: Control components of SCADA, working of SCADA, comparison of SCADA with DCS, comparison of PLC with RTU.	9
IV	STABILITY ANALYSIS AND FREQUENCY RESPONSE: Stability for linear systems, Routh stability criterion and its limitations. Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, Bode stability criterion, phase and gain margin, Ziegler- Nichols optimum controller settings and its limitations.	9
V	PROCESS INSTRUMENTS: Principles of measurements - Static and dynamic response of instruments, Temperature measurements – Expansion Thermometer, filled system thermometers, thermocouple, thermistors, optical pyrometers, radiation pyrometers. Pressure measurements - Manometers, bourdon gauge and bellow gauge, pressure transducers, pressure measurement by vacuum. Level measurement – sight glass level indicator, float and tape liquid level gauge.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the use of Laplace transformation for first order control systems
 - CO2- Understand the Laplace transformation for second order control systems and determine its dynamic response
 - CO3- Understand the concepts of feedback controller, its dynamic response and automation
 - CO4- Understand the stability criteria for various controllers
 - CO5- Understand the temperature and pressure measuring instruments

TEXT BOOKS:

- Vyas R.P., —Process Control and Instrumentation, 6th Edition, Central Techno Publications, Nagpur, 2011.
- Eckman D.P., —Industrial Instrumentation, Wiley Eastern Ltd, New Delhi, 2004.

REFERENCES BOOKS:

- Stephanopoulos S.G., —Chemical Process Control: An introduction to Theory and Practice, Prentice Hall of India, New Delhi, 1997.
- Coughanowr Donald R., —Process Systems Analysis and Control, 3rd Edition, McGraw Hill, New York, 2009.
- Singh S.K., —Industrial Instrumentation and Control, 2nd Edition, Tata McGraw-Hill, New Delhi, 2006.
- Johnson, Curtis D. *Process control instrumentation technology*. Prentice Hall PTR, 1999.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8305	ECONOMICS AND MANAGEMENT	3	0	0	3

- Course Objectives**
- To enable the students to understand the various concepts of economics, process development, design consideration and cost estimation in chemical industry.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTEREST AND PLANT COST: Time value of money - equivalence, Depreciation, Depletion, estimation of capital cost, Capital requirement for complete plant, cost indices, capital recovery.	9
II	PROJECT PROFITABILITY AND FINANCIAL RATIOS: Estimation of project profitability, Investment alternatives, income statement and financial ratios, balance sheet preparation- problems.	9
III	ECONOMIC BALANCE IN EQUIPMENTS: Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipment	9
IV	PRINCIPLES OF MANAGEMENT: Principles of management, planning, organizing, staffing, coordinating, directing, controlling and communicating. Types of organizations, Management information systems (MIS).	9
V	PRODUCTION PLANNING CONTROL: Work measurement techniques, motion study, principles of time study, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory and control, role of control charts in production and quality control.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the capital cost and the value of money for the complete plant
 - CO2- Understand the profitability of the project and balance sheet preparation
 - CO3- Understand the economic operation of the equipment
 - CO4- Understand the planning and management
 - CO5- Understand the production planning, control chart preparation and quality control

TEXT BOOKS:

- Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, 2004.
- Schweyer. H.E, "Process Engineering Economics", Mc Graw Hill, 1969.

REFERENCES BOOKS:

- F.C. Jelen and J.H. Black, "Cost and Optimization Engineering", McGraw Hill, 3rd Edn., 1992
- Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.
- Zimmer and Scarborough, —Essentials of Entrepreneurship and Small Business Managementl, 5th Edition, PHI Learning Pvt. Ltd., 2009.
- Supply Chain Management, Chopra and peter, Pearson, 5th edition, 2013

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8306	FOOD PROCESS PLANT LAYOUT AND SAFETY	3	0	0	3

Course Objectives

- To understand and design with the safety measures for processing industry

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	SELECTION OF PLANT LAYOUT: Introduction and classification of food plants, Site selection of plant. Plant location factors plant lay out advantages types of layout-characteristics of an efficient layout. Techniques of plant layout. General requirements and considerations for construction, materials and floors. Drains and drain layout. Ventilation, fly control, mould prevention, illumination in food plants.	9
II	INDUSTRIAL SAFETY: Process industries, potential hazards, toxic chemicals and physical safety analysis, high pressure, high temperature operation, radioactive materials, safe handling and operation of machineries.	9
III	SAFETY PERFORMANCE: Safety Appraisal, effective steps to implement safety procedures, periodic inspection and safety procedures; proper selection and replacement of handling equipment, personal protective equipment	9
IV	ACCIDENTS: Industrial accidents – accident costs – identification of accident spots, remedial measures, identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.	9
V	HEALTH HAZARDS AND LEGAL ASPECTS: Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Understand and design the plant layout
	CO2- Understand the different industrial hazards
	CO3- Remember the industrial safety performance and safety procedures
	CO4- Remember the acquired knowledge for prevention of industrial accidents
	CO5- Understand the health hazards and legal aspects in industries

TEXT BOOKS:

1. Handley William, —Industrial Safety Hand Bookl, 2nd Edition, McGraw Hill, New York, 1969.
2. Fawatt H.H. and Wood W.S., —Safety and Accident Prevention in Chemical Operationl, 2nd Edition, Interscience, New York, 1984.

REFERENCES BOOKS:

1. Heinrich H.W., Dan Peterson P.E. and Nester Rood, —Industrial Accident Preventionl, 2nd Edition, McGraw-Hill Book Co., 1980.
2. Blake R.P., —Industrial Safetyl, 3rd Edition, Prentice Hall Inc., New Jersey, 1993.
3. Amit Gupta, _Industrial Safety and Environmentl, 2nd Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2006.
4. “Food plant engineering system” by Theunis C. Robberts, II Edition, CRC Press, Washington, 2013.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8307	ENERGY MANAGEMENT IN PROCESS INDUSTRIES	3	0	0	3

- Course Objectives**
- To understand the concepts of energy management in process industries

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Energy and Energy Analysis: Energy, unit of energy, energy consumption and GDP, energy and environment – carbon dioxide emission, depletion of ozone layer. Energy supply: Primary energy, delivered energy, electricity supply, natural gas, fuel oils, renewable energy. Energy analysis – Annual Energy Consumption, Normalized Performance Indicators, Time-Dependent Energy Analysis. Energy Management - Organizational Structure, Energy Policy and Planning.	9
II	Energy Audits and Surveys: Energy Audit - types, Preliminary Energy Audits, Comprehensive, Energy Surveys and Audit report. Energy Monitoring, Targeting and Waste Avoidance - Concept of monitoring and targeting, Computer-Based M and T, Monitoring and Data Collection, Energy Targets, reporting techniques, Diagnosing Changes in Energy Performance, waste avoidance, Prioritizing.	9
III	Energy Conservation in Thermal Systems: Energy conservation in steam generation –energy analysis, energy recovery - through optimal design, from flue gas, from blow down water. Steam distribution system – heat loss, energy efficiency and energy conservation. Waste heat recovery – heat pumps, heat exchangers. Thermal energy storage- storage systems, storage materials, hot thermal energy and cooling energy storage.	9
IV	Energy Conservation in Power, Electrical and Mechanical Systems: Sources of energy loss – low power factor, improper motor load, poor control. Energy conservation - Power Factor Improvement, Replacement with High-Efficiency Motors and electronic adjustable speed motors. Energy Conservation in Mechanical systems: Compressed air system – sources of energy losses. Energy conservation – high efficiency motor, repairing of air leaks, reduced air pressure and air inlet temperature. Localized air delivery system.	9
V	Energy Conservation in Food Processing Units: Dairy Processing - Potential Energy Conservation measures in pasteurization, cooling, concentration and drying. Fruit and Vegetable Processing – energy flow in canned products, energy conservation measures in blanching, pasteurization, sterilization. Energy conservation in Baking and confectionery units. Thermochemical Conversion of Food Processing Wastes for Energy Utilization – pyrolysis, gasification and liquefaction.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the procedure for analyzing energy
 - CO2- Understand the role of energy conservation in thermal system
 - CO3- Understand the role of energy in power, electrical and mechanical systems
 - CO4- Understand the energy conservation in food processing unit
 - CO5- Understand the procedures for energy audits and surveys

TEXT BOOKS:

- Beggs Clive, —Energy: Management Supply and Conservation, 2Nd Edition, Butterworth Heinemann, USA, 2002.
- Lijun Wang, —Energy Efficiency and Management in Food Processing Facilities, CRC Press, 2008.

REFERENCES BOOKS:

- Wayne C. Turner, —Energy Management Handbook, 4Th Edition, The Fairmont Press, Inc, 2001.
- Klemes J, R. Smith, Santa Barbara, J-K Kim, —Handbook of Water and Energy Management in Food Processing, 1st Edition, Woodhead Publishing, 2008.
- Chakrabarti Allan, —Energy Engineering and Management, PHI Learning Pvt. Ltd., 2011.
- Caffall, Clive. *Learning from experiences with Energy Management in Industry*. No. BOOK. Centre for the analysis and dissemination of demonstrated energy technologies, 1995.

CHAIRMAN/BOARD OF STUDIES

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8308	EMERGING TECHNOLOGIES IN FOOD PROCESSING	3	0	0	3

Course Objectives

- To study the various emerging techniques in food processing

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	HIGH PRESSURE PROCESSING OF FOODS: High Pressure Processing – Principle - Description, Packaging requirements, Uses and Effects on food quality. High Pressure Regulations. Other applications of high pressure - High pressure freezing, High Pressure thawing, High Pressure non-frozen storage. Pulsed Electric Field Processing: Principle - Mechanism of action. PEF treatment systems - processing parameters. Applications. Safety aspects, Problems and challenges in PEF.	9
II	HIGH INTENSITY PULSED LIGHT TECHNOLOGY: Principles of Pulsed Light Technology, Effect of Pulsed Light Technology on food products, enzymes and food properties. Systems for Pulsed Light Technology. Irradiation of Foods: Fundamentals of food irradiation - Definition, Doses of Irradiation. Biological effects of irradiation – effect on micro-organisms, parasites and insects, viruses, ripening and sprouting inhibition	9
III	ULTRASOUND: Fundamentals of ultrasound, ultrasonic processing equipment, Inactivation of micro-organisms and enzymes. Application- mixing and homogenization, foam formation and destruction, precipitation of airborne powders, filtration and drying, extraction. Ozonation: Solubility, stability and reactivity of ozone. Antimicrobial properties of ozone. Ozone Treatment System. Food applications.	9
IV	OHMIC HEATING: Ohmic Heating - fundamentals, electrical conductivity. Generic Configurations - Batch Configuration, Transverse Ohmic heating and Collinear Ohmic heating. Product suitability for thermal treatments. Di-electrical Heating: Dielectric properties of foods. Dielectric heating, difference between MW and RF. Microwave heating – working principle. Microwave processing of foods – baking, thawing, drying, pasteurization and sterilization. Radio-frequency heating – material properties, adopting RF technology, heating and drying application.	9
V	NOVEL HYBRID DRYING TECHNOLOGIES: Need for hybrid drying systems. Hybrid systems - Heat pump drying, fluidized bed drying, combined microwave and vacuum drying, infra-red drying, superheated steam drying, pressure regulating drying, rotating jet spouted bed drying. Automation: Automation process control for food industry – introduction. Recent trends in tools of automation – Computer vision systems, On-line sensors, Expert systems, Robot Technology, Computer Integrated manufacturing	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Understand the concepts and effects of high pressure processing
	CO2- Understand the experiment with pulsed electric field and pulsed light technology for foods
	CO3 – Understand and adapt ultrasound and ozone techniques for foods
	CO4- Understand and apply ohmic heating principle in food processing
	CO5- Understand the novel drying techniques and adapt automation in food processing

TEXT BOOKS:

- 1.Da-Wen Sun, —Emerging Technologies for Food Processing, 2nd Edition, Elsevier Academic Press, London, 2014.
- 2.Howard Q. Zhang, Gustavo V. Barbosa-Canovas, Balasubramaniam V.M., Dunne C. P., Farkas D.F. and Yuan J.T.C., —Non-thermal Processing Technologies for Food, 1st Edition, John Wiley and Sons Ltd., UK, 2011.

REFERENCES BOOKS:

- 1.Han, Jung H., —Packaging for Non-thermal Processing of Food, Wiley-Blackwell, Oxford, 2007.
- 2.Mujumdar A.S., —Handbook of Industrial drying, 4th Edition, CRC Press, UK, 2014.
- 3.Lelieveld H.L.M., —Food Preservation by pulsed electric fields: From research to application, Wood Head Publishing Ltd., England, 2007.
4. Yam, Kit L., and Dong Sun Lee, eds. Emerging food packaging technologies: Principles and practice. Elsevier, 2012.

Chairman, Board of Studies

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8309	SEPARATION TECHNIQUES IN FOOD PROCESSING	3	0	0	3

Course Objectives

- To study the separation techniques in food processing

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	Mechanism of Separation and Filtration Processes: Review of conventional processes. Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances. Process concept, theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid – liquid separations involving a second liquid, Sirofloc filter.	9
II	Membrane Separation: Types and choice of membranes, membrane module- Plate and frame, tubular, spiral wound and hollow fibre. Membrane processes - dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis. Membrane fouling – cleaning techniques.	9
III	Adsorption and Chromatography: Mechanism, Types and choice of adsorbents, adsorption techniques – pressure swing and temperature swing cycles. Affinity and Immuno-chromatography. Large scale chromatography – theory and general system.	9
IV	Ionic Separation and Permeation: Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electro dialysis. Separations involving pervaporation and permeation techniques for solids, liquids and gases.	9
V	Other Separation Processes: Zone melting, Adductive crystallization, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment by modern techniques.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Understand the concepts of separation and filtration techniques
	CO2- Understand and select the suitable membrane process and cleaning techniques
	CO3- Understand the classification of adsorption techniques
	CO4- Understand the concepts of ionic separation and permeation
	CO5- Understand and elaborate other separation processes and effluent treatment

TEXT BOOKS:

1. Seader J.D., Ernest J. Henley and Keith Roper D., –Separation Process Principles, 3rd Edition, John Wiley and Sons Inc., New York, 2011.
2. Roussel Ronald W., –Handbook of Separation Process Technology, John Wiley, New York, 2008

REFERENCES BOOKS:

1. Scott K. and Hughe R., – Industrial Membrane Separation Technology, Blackie Academic and Professional Publications, Glasgow, 1996.
2. Schoen H.M., –New Chemical Engineering Separation Techniques, Inter-science Publishers, New York, 1972.
3. Humphrey Jimmy L., George E. Keller II., –Separation Process Technology, McGraw-Hill Publishing Company Ltd., USA, 1997.
4. Grandison, Alistair S. Separation processes in the food and biotechnology industries. CRC Press, 1996.

Chairman, Board of Studies

PRINCIPAL/Dean

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT8310	ANALYTICAL INSTRUMENTS IN FOOD INDUSTRIES	3	0	0	3

- Course Objectives**
- To learn about the various analytical instruments used for food analysis

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	SPECTROMETRY: Classification of Instrumental methods– Electromagnetic radiation – electromagnetic spectrum, Interaction of electromagnetic radiation with matter. Visible spectrometry and Colorimetry – 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.	9
II	ATOMIC ABSORPTION AND NMR SPECTROSCOPY: AAS - Principle, Instrumentation and applications. NMR spectroscopy – Principle, Instrumentation, Chemical shift and applications. Thermal methods: Thermogravimetry, Differential thermal analysis, Differential Scanning Calorimetry – Principle, Instrumentation and Applications	9
III	X-RAY AND FLAME PHOTOMETER: X-ray diffraction - Principle, instrumentation, detectors and applications. Flame photometer - Theory, Instrumentation and applications. Polarimetry- specific rotation, optical activity, Principle and instrumentation. Saccharimetry- Analysis of Sugar.	9
IV	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.	9
V	CHROMATOGRAPHIC TECHNIQUES: Introduction, Paper chromatography, Thin Layer Chromatography, Column Chromatography - Gas chromatography, HPLC – reverse phase and normal phase - Principle, Instrumentation and Applications.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- Course Outcomes**
- CO1- Understand the application of UV-Visible and IR spectroscopy in food analysis
 - CO2- Understand and make use of AAS, NMR and thermal methods to analyze different food materials
 - CO3- Understand and apply X- ray diffraction, flame photometers and Polarimetry in food analysis
 - CO4- Remember and recognize the usage of conductance and potential measurements for analysis of components
 - CO5- Understand and infer the chromatographic principles to separate and analyze materials

TEXT BOOKS:

- Chatwal, Gurdeep R., and Anand, Sham K., —Instrumentation Methods of Chemical Analysis, 2nd Edition, Himalaya Publications, Bombay, 2003.
- Willard H.H, Merritt L.L, Dean J.A, and Settle F.A., —Instrumental Methods of Analysis, 7th Edition, CBS Publishers and Distributors, New Delhi, 1988.

REFERENCES BOOKS:

- Skoog Douglas A., West Donald M., Holler F James, and Crouch Stanley R., —Analytical Chemistry: An Introduction, 7th Edition, South-Western, Australia, 2000.
- Rouessac F., —Chemical Analysis: Modern International Method and Techniques, 3rd Edition, Wiley, New Delhi, 1999.
- Banwell G.C., —Fundamentals of Molecular Spectroscopy, 2nd Edition, Tata McGraw-Hill, New Delhi, 1992.
- Kress-Rogers, Erika, and Christopher JB Brimelow, eds. Instrumentation and sensors for the food industry. Vol. 65. Woodhead Publishing, 2001.

Chairman, Board of Studies

PRINCIPAL/Dean

OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT6401	PRINCIPLES OF FOOD SCIENCE	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> • To understand the different methods applied to processing foods. • To understand the significance of food processing and the role of food and beverage industries in the supply of foods 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	PROCESSING OF FOOD AND ITS IMPORTANCE Source of food - food of plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods	9
II	METHODS OF FOOD HANDLING AND STORAGE Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods	9
III	LARGE-SCALE FOOD PROCESSING Milling of grains and pulses; edible oil extraction; Pasteurization of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods	9
IV	FOOD WASTES IN VARIOUS PROCESSES Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.	9
V	FOOD HYGIENE Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training & Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

- | | |
|------------------------|--|
| Course Outcomes | CO1- Understand the concepts of food hygiene |
| | CO2- Remember the processing of wastes from industry |
| | CO3- Understand the importance of food |
| | CO4- Understand the difficulties in food handling |
| | CO5- Understand the various processing of foods |

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”. Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”. Surbhi Publications, 2001.

REFERENCES BOOKS:

1. Singh, R. Paul, and Dennis R. Heldman. Introduction to food engineering. Gulf Professional Publishing, 2001.
2. Potter, Norman N., and Joseph H. Hotchkiss. Food science. Springer Science & Business Media, 2012.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

Programme	Course Code	Name of the Course	L	T	P	C
B.Tech	19FT7401	FOOD PRODUCT DEVELOPMENT	3	0	0	3

Course Objectives

- To study the various issues related to Creativity, Innovation and New Product Development

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	INTRODUCTION : The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving – brain storming - different techniques	9
II	PROJECT SELECTION AND EVALUATION : Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)	9
III	NEW PRODUCT PLANNING : Design of proto type - testing - quality standards - marketing research - introducing new products	9
IV	NEW PRODUCT DEVELOPMENT : Research and new product development - Patents - Patent search - Patent laws – International code for patents - Intellectual property rights (IPR).	9
V	MODEL PREPARATION & EVALUATION : Creative design - Model Preparation - Testing - Cost evaluation - Patent application	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes

CO1- Remember the concepts for technological innovation
CO2- Understand the selection and evaluation process
CO3- Understand the planning steps
CO4- Understand the steps for developing a new product
CO5- Understand the model for development

TEXT BOOKS:

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.

REFERENCES BOOKS:

1. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.
2. Khandwalla, N. – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997
4. Eskin, Michael, and David S. Robinson, eds. Food shelf life stability: chemical, biochemical, and microbiological changes. CRC Press, 2000.

Chairman, Board of Studies

PRINCIPAL/Dean