

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University, Chennai)
(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)
Coimbatore - 641 032.

B.TECH. FOOD TECHNOLOGY



CHOICE BASED CREDIT SYSTEM

Curriculum & Syllabus

2020-2021

CURRICULUM

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

IM1: To provide academic excellence in technical education through novel teaching methods.

IM2: To empower students with creative skills and leadership qualities.

IM3: To produce dedicated professionals with social responsibility.


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VISION AND MISSION OF THE DEPARTMENT

VISION

To be an excellent Department in training students to become professional Food Technologist who is technically capable of working in food operations sector and discovering licensed food products which could benefit the Eco-friendly society.

MISSION

- M1. To impart students with a vibrant technical and analytical skills.
- M2. To provide students with leadership quality and also the knowledge to handle all the problems relating Food Industry.
- M3. To develop the research and development activities of students to explore the quality food products.


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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

- PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. **Environment and sustainability:** Understand the impact of the professional


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engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.


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PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO 1. Ensure food safety and quality by using the technical skills and other emerging techniques.
- PSO 2. Design and develop the safest food products and equipments needed for the eco-friendly society.
- PSO 3. Integrate various concepts of food processing operations and come out with the best solution for the complex issues in food sector.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1. Utilize the principles of food science and Engineering to face various professional career challenges.
- PEO 2. Analyze and create new food products and process for real world application with technical feasibility.
- PEO 3. Exhibit professional and managerial capabilities with ethical conduct for continuous learning.


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 Coimbatore, Tamil Nadu.



DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.TECH. FOOD TECHNOLOGY (UG)

REGULATION 2016 & 2019

REGULATION-2019

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
3	19ME1101	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
4	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
5	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
6	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19HE1071	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
8	19HE1072	Career Guidance Level - I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
Total:				16	2	8	20	425	375	800
As Per AICTE Norms 3 Weeks Induction Programme is Added in The First Semester as an Audit Course										

SEMESTER II

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100
3	19FT2105	Principles of Microbiology	ES	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
4	19IT2151	Programming in C	ES	2	0	2	3	50	50	100
5	19PH2151	Material Science	BS	2	0	2	3	50	50	100
6	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
PRACTICALS										
7	19ME2001	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100



MANDATORY COURSES										
9	19HE2072	Career Guidance Level – II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
Total:				17	2	12	22	575	425	1000

REGULATION-2019

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER III

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3102	Fourier Analysis and Transforms	BS	3	1	0	4	25	75	100
2	19FT3201	Fluid Mechanics	PC	3	1	0	4	25	75	100
3	19FT3101	Principles of Thermodynamics	PC	3	0	0	3	25	75	100
4	19FT3202	Food Microbiology	PC	3	0	0	3	25	75	100
THEORY AND LAB COMPONENT										
5	19FT3251	Bio Chemistry	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19FT3001	Food Microbiology Laboratory	PC	0	0	3	1.5	50	50	100
7	19FT3002	Food Production Analysis Laboratory	PC	0	0	3	1.5	50	50	100
AUDIT COURSE										
8	19MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
Total				16	2	8	20	350	450	800

SEMESTER IV

S.No	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19FT4201	Fundamentals of Heat and Mass Transfer	PC	3	1	0	4	25	75	100
2	19FT4202	Food Process Calculations	PC	3	1	0	4	25	75	100
3	19FT4203	Engineering properties of food materials	PC	3	0	0	3	25	75	100
THEORY AND LAB COMPONENT										
4	19FT4251	Food Chemistry	PC	2	0	2	3	50	50	100
5	19MA4152	Statistics and Numerical Methods	BS	3	0	2	4	50	50	100
PRACTICAL										
6	19FT4001	Unit Operations Laboratory	PC	0	0	3	1.5	50	50	100
7	19FT4002	Food Process Equipment Design Lab	PC	0	0	3	1.5	50	50	100
AUDIT COURSE										
8	19MC4191	Essence of Indian tradition knowledge/Value Education	MC	2	0	0	0	100	0	100
Total				16	2	10	21	375	425	800



REGULATION-2016

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	Course Category	L	T	P	C	CIA	ESE
1	16FT5201	Food Process Engineering - II	PC	3	1	0	4	25	75
2	16FT5202	Food Quality Assurance and Control	PC	3	0	0	3	25	75
3	16FT5203	Baking and Confectionery Technology	PC	3	0	0	3	25	75
4	16FT5204	Milling Technology for Food Materials	PC	3	0	0	3	25	75
5	16FT5205	Fruits and Vegetable Processing Technology	PC	3	0	0	3	25	75
6	16FT53XX	Professional Elective – I	PE	3	0	0	3	25	75
7	16FT5001	Baking and Confectionery Technology Laboratory	PC	0	0	4	2	50	50
8	16FT5002	Food Process Engineering Laboratory	PC	0	0	4	2	50	50
TOTAL				18	1	8	23	250	550

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	Course Category	L	T	P	C	CIA	ESE
1	16FT6201	Dairy Engineering	PC	3	0	0	3	25	75
2	16FT6202	Food Packaging	PC	3	0	0	3	25	75
3	16FT6203	Poultry, Meat and Fish Process Technology	PC	3	0	0	3	25	75
4	16FT6204	Refrigeration and Cold chain Management	PC	3	1	0	4	25	75
5	16FT63XX	Professional Elective – II	PE	3	0	0	3	25	75
6	16XX6401	Open Elective – I	OE	3	0	0	3	25	75
7	16FT6001	Food Packaging and Fruits & Vegetable Processing Laboratory	PC	0	0	4	2	50	50
8	16FT6002	Dairy Engineering Laboratory	PC	0	0	4	2	50	50
9	16FT6701	Industrial Training	PC	0	0	0	1	0	100
TOTAL				18	1	8	24	250	650

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	16FT5301	Technology of Fats and Oils	PE	3	0	0	3	25	75	100
2	16FT5302	Food Storage and Infestation Control	PE	3	0	0	3	25	75	100
3	16FT5303	Cereal Technology	PE	3	0	0	3	25	75	100
4	16FT5304	Post-Harvest Technology	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE II										
1	16FT6301	Fermentation Technology	PE	3	0	0	3	25	75	100
2	16FT6302	Bioprocess Engineering	PE	3	0	0	3	25	75	100
3	16FT6303	Cane Sugar Technology	PE	3	0	0	3	25	75	100
4	16FT6304	Enzyme Technology	PE	3	0	0	3	25	75	100



LIST OF OPEN ELECTIVE - FOOD TECHNOLOGY										
SEMESTER VI										
S.No.	Course Code	Course Title	Type	L	T	P	C	CIA	ESE	TOTAL
1	16FT6401	Traditional Foods and its importance	OE	3	0	0	3	25	75	100

(L – Lecture, T – Tutorial, P – Practical, C – Credit, CIA – Continuous Internal Assessments, ESE – End Semester Examinations)

Continuous Internal Assessment (CIA) only.

**NCM (Non Credit Mandatory Course)

S Audit Course

@@ MOOC Course (Credit Transfer Course if any approved by Dean Office) -Minimum of 45 Hours from recognized MOOC portal like SWAYAM. Assessment with Score/Credit and Certificate is mandatory.

Colour :

1. HS subjects
2. BS Subject
3. ES Subject
4. PC Subject
5. PE Subject
6. OE Subject
7. VA/EEC Subjects

Credit Distribution R2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	25	25	23	24	22	16	187

Credit Distribution R2019

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

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COIMBATORE - 641 032



SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19HE1101	TECHNICAL ENGLISH (COMMON TO ALL BRANCHES)	2	1	0	3

Course Objective	
	✓ 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 Outcome	
	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:

- T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.
T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCE BOOKS :

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

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

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

Unit	Description	Instructional Hours
	DIFFERENTIAL CALCULUS	
I	Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
	MULTIVARIATE CALCULUS (DIFFERENTIATION)	
II	Total derivatives - Jacobians – Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
	DOUBLE INTEGRATION	
III	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
	TRIPLE INTEGRATION	
IV	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
	MATRICES	
V	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 Outcome
- 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:

- T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.
T2 - Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

- R1- Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition,, Narosa Publishing House, New Delhi.
R2 – Weir, M.D and Joel Hass, " Thomas Calculus" 12th Edition, Pearson India 2016.
R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme **B.TECH.** Course code **19ME1101** Name of the course **BASIC CIVIL AND MECHANICAL ENGINEERING** L T P C **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 EngineeringI, Anuradha Publishers, Kumbakonam, 2000.
2. Shanmugam G and Palanichamy M S, —Basic Civil and Mechanical EngineeringI, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCES:

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19PH1151	APPLIED PHYSICS (COMMON TO ALL BRANCHES)	2	0	2	3

- Course Objective**
1. Enhance the fundamental knowledge in properties of matter
 2. Analysis the oscillatory motions of particles
 3. Extend the knowledge about wave optics
 4. Gain knowledge about laser and their applications
 5. Conversant with principles of optical fiber, types and applications of optical fiber

Unit	Description	Instructional Hours
	PROPERTIES OF MATTER	
I	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.	6
	Determination of Young's modulus by uniform bending method	3
	OSCILLATIONS	
II	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.	6
	Determination of Rigidity modulus – Torsion pendulum	3
	WAVE OPTICS	
III	Conditions for sustained Interference – air wedge and it's applications - Diffraction of light –Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating.	6
	Determination of wavelength of mercury spectrum – spectrometer grating	3
	Determination of thickness of a thin wire – Air wedge method	3
	LASER AND APPLICATIONS	
IV	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.	6
	Determination of Wavelength and particle size using Laser	3
	FIBER OPTICS AND APPLICATIONS	
V	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

After completion of the course the learner will be able to

- Course Outcome
- 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

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CY1151	CHEMISTRY FOR ENGINEERS (COMMON TO ALL BRANCHES)	2	0	2	3
Course Objective		<ol style="list-style-type: none"> 1. The boiler feed water requirements, related problems and water treatment techniques. 2. The principles of polymer chemistry and engineering applications of polymers and composites. 3. The principles of electrochemistry and with the mechanism of corrosion and its control. 4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells. 5. The important concepts of spectroscopy and its applications. 				

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
	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
I	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
II	ELECTROCHEMISTRY AND CORROSION Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pitting – 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 precipitation titration using BaCl₂ and Na₂SO₄. Estimation of Ferrous iron by Potentiometry.	6+9=15
III	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
IV	ANALYTICAL TECHNIQUES Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principle – 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
V	Total Instructional Hours	45

Course
Outcome

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.

CO5: Identify the structure and characteristics of unknown/new compound with the help of spectroscopy.

TEXT BOOKS

T1 - P. N. Madudeswaran and B.Jeyagowri, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd,Chennai

T2 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub. Co., New Delhi (2018).

REFERENCES

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2012).

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


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TEXT BOOKS:

1. 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).
2. S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019.

REFERENCE BOOKS:

1. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus. Wiley India Edition, 2013.
2. Timothy A. Budd, —Exploring Python1, Mc-Graw Hill Education (India) Private Ltd., 2015.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.


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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19CS1151	PYTHON PROGRAMMING AND PRACTICES	2	0	2	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 strategies for 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. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	7+2
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: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.	5+4
IV	LISTS, TUPLES, DICTIONARIES Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.	3+6
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. Illustrative programs: word count, copying file contents.	5+4
Total Instructional Hours		45

Upon completion of the course, students can be able to

- 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.

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19HE1071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- I	0	0	2	1

Course Objective
✓ To enhance student language competency
✓ To train the students in LSRW skills
✓ To develop student communication skills
✓ To empower the trainee in business writing skills.
✓ To train the students to react to different professional situations

Unit	Description	Instructional Hours
I	LISTENING Listening to technical group discussions and participating in GDs, listening to TED talks. Listen to Interviews & mock interview. Listening short texts and memos.	3
II	READING Reading articles from newspaper, magazine. Reading comprehension. Reading about technical inventions, research and development. Reading short texts and memos.	3
III	WRITING E-mail writing: Create and send email writing (to enquire about some details, to convey important message to all, to place an order, to share your joy and sad moment). Reply for an email writing.	3
IV	SPEAKING To present a seminar in a specific topic (what is important while choosing or deciding something to do). To respond or answer for general questions (answer for your personal details, about your family, education, your hobbies, your aim etc.,).	3
V	SPEAKING Participate in discussion or interactions (agree or disagree express your statement with a valid reason, involve in discussion to express your perspective on a particular topics).	3
Total Instructional Hours		15

Course Outcome
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:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCE BOOKS :

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.


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Programme	Course code	Name of the Course	L	T	P	C
B.TECH.	19HE1072	CAREER GUIDANCE LEVEL I Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite		None				Syllabus version 1

Course Objectives:

- Introduce students to building blocks of Logical reasoning and Quantitative Aptitude [SLO 1]
- Train students on essential grammar for placements [SLO 2]
- Introduce students on scientific techniques to pick up skills [SLO 3]
- Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind [SLO 4]

Expected Course Outcome:

Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Student Learning Outcomes (SLO): 1, 2, 3 and 4

Module:1 Lessons on excellence **1 hour** **SLO: 3**
Skill introspection, Skill acquisition, consistent practice

Module:2 Logical Reasoning **7 hours** **SLO: 1**
Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3 Quantitative Aptitude **8 hours** **SLO: 1**
Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

Module:4 Recruitment Essentials **1 hour** **SLO: 4**

II SEMESTER

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19HE2101	BUSINESS ENGLISH FOR ENGINEERS	2	1	0	3

(COMMON TO ALL BRANCHES)

- Course Objectives**
1. Introduce business communication.
 2. Train to respond different professional situations.
 3. Make the learners familiar with the managerial skills
 4. Empower the trainee in business writing skills.
 5. Educate to interpret and expertisedifferent business 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).	9
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.	9
IV	Listening and Speaking - Role play- Reading - Sequencing of sentence Writing - Business report writing (marketing, investigating) Grammar and Vocabulary - Connectors, Gerund & infinitive.	9
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).	9

Total Instructional Hours 45

- Course Outcome**
- CO1- To know different modes of business communication
 - CO2- To understand managerial techniques.
 - CO3- To apply the rules of grammar and vocabulary in effective business communication.
 - CO4-To analyse and interpret business documents.
 - CO5-To draft business reports

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

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, 2001.

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Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5 Verbal Ability

3 hours

SLO: 2

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)


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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19MA2101	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	3	1	0	4

- Course Objective
1. Describe some methods to solve different types of first order differential equations.
 2. Solve ordinary differential equations of certain types using Wronskian technique
 3. Use the effective mathematical tools for the solutions of partial differential equations.
 4. Describe the construction of analytic functions and conformal mapping.
 5. Illustrate Cauchy's integral theorem and calculus of residues

Unit	Description	Instructional Hours
I	FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS Solutions of Equations of the first order and of the first degree – Variable separable method- Homogeneous equations – Exact differential equations (Excluding non 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 co-efficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of paramers. Solution of ODE related to electric circuits, bending of beams.	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		60

- Course Outcome
- 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:


T1- Ravish R Singh, Mukul Bhatt, "Engineering Mathematics", McGraw Hill education (India) Private Ltd., Chennai, 2017 T2- Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

REFERENCE BOOKS :

- R1- Veerarajan T, "Engineering Mathematics", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2016
R2- Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
R3- Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19FT2105	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.	9
IV	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
V	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., Comelissen 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.

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Programme	Course code	Name of the course	L	T	P	C
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. Reema Thareja, — “Programming in C”, Oxford University Press. Second Edition. 2016. ISBN 9780199456147

REFERENCES:

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19PH2151	MATERIAL SCIENCE (COMMON TO ALL BRANCHES)	2	0	2	3

- Course Objective
1. Acquire fundamental knowledge of semiconducting materials which is related to the engineering program
 2. Extend the knowledge about the magnetic materials
 3. Explore the behavior of super conducting materials
 4. Gain knowledge about Crystal systems
 5. Understand the importance of ultrasonic waves

Unit	Description	Instructional Hours
	SEMICONDUCTING MATERIALS	
I	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	6
	Determination of acceptance angle and numerical aperture in an optical fiber	3
		3
	MAGNETIC MATERIALS	
II	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
	PERCONDUCTING MATERIALS	
III	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.	6
	CRYSTAL PHYSICS	
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
	ULTRASONICS	
V	Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Nondestructive testing – Ultrasonic pulse echo system.	6
	Determination of velocity of sound and compressibility of liquid – Ultrasonic wave	3
	Determination of Coefficient of viscosity of a liquid –Poiseuille’s method	3

Total Instructional Hours 45

- Course Outcome
- 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

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TEXT BOOKS:

T1- S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2020

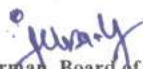
T2 – Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

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


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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19HE2071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II (COMMON TO ALL BRANCHES)	0	0	2	1

- 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.	3
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).	3
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.	3
IV	Listening and Speaking - Role play - Reading - Sequencing of sentence Writing - Business report writing (marketing, investigating) Grammar and Vocabulary - Connectors, Gerund & infinitive.	3
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).	3
Total Instructional Hours		15

- Course Outcome**
- 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, 2016.
- T2- Ian Wood and Anne Willams. “Pass Cambridge BEC Preliminary”, Cengage Learning press 2015.

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, 2001.

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Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course code	Name of the Course	L	T	P	C
B.TECH.	19HE2072	CAREER GUIDANCE LEVEL II	2	0	0	0
Pre-requisite		Personality, Aptitude and Career Development				
		None				
						Syllabus version
						1

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]

Expected Course Outcome:

Enable students to solve questions on Verbal, Logical and Quantitative Aptitude of placement level

Student Learning Outcomes (SLO): 6, 7, 8

Module:1 Logical Reasoning 5 hours SLO: 6

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2 Quantitative Aptitude 8 hours SLO: 7

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3 Verbal Ability 7 hours SLO: 8

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19HE2073	ENTREPRENEURSHIP & INNOVATION	1	0	0	0

Course Objective:

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5. To make students understand organizational performance and its importance.

Module Description

1. Entrepreneurial Thinking
2. Innovation Management
3. Design Thinking
4. Opportunity Spotting / Opportunity Evaluation
5. Industry and Market Research
6. Innovation Strategy and Business Models
7. Financial Forecasting
8. Business Plans/ Business Model Canvas
9. Entrepreneurial Finance
10. Pitching to Resources Providers / Pitch Deck
11. Negotiating Deals
12. New Venture Creation
13. Lean Start-ups
14. Entrepreneurial Ecosystem
15. Velocity Venture

Course Outcome:

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
CO3: Remember effectively and efficiently the potential of new business opportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness.
CO5: Develop a business model for a new venture, including revenue, Margins, operations, working capital, and investment.

TEXT BOOKS

T1: Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).

T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition(2016).

REFERENCE BOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition (2007).

R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second Edition (2017).

R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

WEB RESOURCES

W1: <https://blof.forgeforward.in/tagged/startup-lessons>

W2: <https://blof.forgeforward.in/tagged/entrepreneurship>

W3: <https://blof.forgeforward.in/tagged/minimum-viable-product>

W4: <https://blof.forgeforward.in/tagged/minimum-viable-product>

W5: <https://blof.forgeforward.in/tagged/innovation>

W6: <https://www.youtube.com/watch?v=8vEvL7uKXs&list=PLmP9OrmTNPqBEvKbMSXvwlwn7fdnXe6Lw>


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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	19MA3102	FOURIER ANALYSIS AND TRANSFORMS (COMMON TO EEE, ECE, EIE, AGRI, BM & FT)	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
	FOURIER SERIES	
I	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
	BOUNDARY VALUE PROBLEMS	
II	Classification of PDE - Solutions of one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).	12
	TWO DIMENSIONAL HEAT EQUATIONS	
III	Steady state solution of two dimensional equation of heat conduction in infinite plate and semi circular plate.	12
	FOURIER TRANSFORMS	
IV	Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity(Statement only).	12
	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	
V	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 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018
- T2 - Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007

REFERENCE BOOKS :

- R1 - Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.
- R2 - Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2018.
- R3 - Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.


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Programme B.TECH.	Course code 19FT3201	Name of the course FLUID MECHANICS	L 3	T 1	P 0	C 4
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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. 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
IV	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 EngineeringI, 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 ApplicationsI, 4th Edition, Tata McGraw Hill Publishing Company, 2017.

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Programme B.TECH.	Course code 19FT3101	Name of the course PRINCIPLES OF THERMODYNAMICS	L 3	T 0	P 0	C 3
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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-Planck, 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.


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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.

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Programme B.TECH.	Course code 19FT3251	Name of the course BIOCHEMISTRY	L 2	T 0	P 2	C 3
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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
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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
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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
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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
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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
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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
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TOTAL INSTRUCTIONAL HOURS 45+15=60

COURSE OUTCOMES

- 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 ChemistryI, 3rd Edition, Springer Verley, Berlin, 2008.
2. Jain J.L., Sunjay Jain and Nitin Jain. —Fundamentals of BiochemistryI, S. Chand & Co., NewDelhi, 2008.

REFERENCE BOOKS

1. Rastogi S.C., —BiochemistryI, 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.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19FT3001	FOOD MICROBIOLOGY LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

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

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.
- CO4 - Inoculate, isolate and identify the microorganism from both liquid and solid samples
- CO5 - Select the appropriate equipment for Microbiological works

REFERENCES

1. Yousef A.E. and Carlstrom C., —Food Microbiology: A Laboratory Manuall, Wiley Interscience Publications, 2003.
2. McLandsborough L., —Food Microbiology Laboratory1, CRC Press, 2004.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19FT3002	FOOD PRODUCTION ANALYSIS LABORATORY	0	0	3	1.5

COURSE OBJECTIVES

- Provide knowledge on food quality standards
- Understand role of food additives and their permissible limits
- Know food laws of India for consumer as well as industry

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
- CO4 - Demonstrate simple detection methods of food adulteration
- CO5 - Implement the hygienic practices in food processing industry

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.

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Programme	Course Code	Name of the course	L	T	P	C
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
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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
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The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.

UNIT IV: LOCAL GOVERNANCE	4
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Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article 19 – scope of the right to life and personal liberty under article 21.

UNIT V : INDIAN SOCIETY	4
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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 history of Indian Constitution.
2. Understand the fundamental rights and amendment of Government.
3. Understand the functions of the Indian government.
4. Understand and abide the rules of the Indian constitution.
5. Understand the various constitutional schemes of Indian government.

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.

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IV SEMESTER

Programme	Course code	Name of the course	L	T	P	C
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 equipment.

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 - Understanding the concept of steady state and unsteady state and application of Fourier law of conduction
 - CO2 - Understanding free and forced convection and application of Newtons law of cooling
 - CO3 - Understanding the different types of heat exchangers and its application
 - CO4 - Understand and apply the concepts of radiation and Stephan boltzman’s law
 - CO5 - Understand the mass transfer phenomena using Fick’s law of molecular diffusion

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.


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Programme	Course code	Name of the course	L	T	P	C
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)I, 22nd Edition, Nirali Prakashan Publications, Pune, 2009.

2. Venkataramani V. and Anantharaman N., —Process CalculationsI, Prentice Hall of India, New Delhi, 2003.

REFERENCE BOOKS:

1. Bhatt B.L. and Vora S.M., —StoichiometryI, 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2004.

2. Himmelblau D.M., —Basic Principles and Calculations in Chemical EngineeringI, 6th Edition, Prentice Hall of India, New Delhi, 2003.

3. Narayanan K.V. and Lakshmikutty B., —Stoichiometry and Process CalculationsI, Prentice Hall of India, New Delhi, 2006.

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Programme	Course code	Name of the course	L	T	P	C
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.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	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 fat soluble 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 dextrins. 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

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

REFERENCE BOOKS

- 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.
- Srilakshmi B., - Nutrition Science, 3rd Edition. New Age International Ltd., New Delhi, 2011.
- Damodaran, Srinivasan, and Kirk L. Parkin. Fennema's food chemistry. CRC press, 2017.


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Programme	Course code	Name of the course	L	T	P	C
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:

- T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.
- 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 ", 6th Edition , Khanna

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19FT4001	UNIT OPERATIONS LABORATORY	0	0	3	1.5

Course Objectives

- To impart the knowledge on heat and mass transfer phenomena
- To provide the knowledge on performance of pipes, valves and other accessories
- To demonstrate the principles of free and forced convection

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 (Ev) and thermal efficiency (Et) 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

COURSE OUTCOMES

- CO1 Evaluate the process/performance parameters for mass transfer operations (distillation column, leaching)
- CO2 Determine diffusivity and Stefan Boltzman constant using fundamental principles
- 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 EngineeringI, 7th Edition, McGraw Hill, New York, 2005.
- R2. Perry Robert, —Perry's Chemical Engineers Hand BookI, 8th Edition, McGraw Hill, New York, 2007.
- Treybal R.E., —Mass Transfer OperationsI, 3rd Edition, McGraw Hill, New York, 1981.

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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19FT4002	FOOD PROCESS EQUIPMENT DESIGN LAB	0	0	3	1.5

Course Objectives

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

LIST OF EXPERIMENTS:

1. Studies of symbols and materials used for design and drawing
2. Design of a pressure vessel
3. Design and drawing of storage tanks
4. Design of an extruder
5. Design of a sterilizer
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 tray dryer
10. Design and drawing of freeze dryer
11. Design and drawing of spray drier
12. Design and drawing of belt conveyor

Course Outcomes	CO1 Adapt symbols in plant layout and design
	CO2 Design pipes, process vessels and supports
	CO3 Design heat transfer equipments and dryers
	CO4 Apply and design different drying equipments for food products
	CO5 Understand, apply and design conveying equipments to transfer agriculture produce

REFERENCES:

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


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Programme	Course code	Name of the course	L	T	P	C
B.TECH.	19MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE/VALUE EDUCATION	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.
- 3) Understanding the holistic life style of yoga.
- 4) Understanding the tradition of philosophy.
- 5) Understanding the Indian linguistic and artistic tradition.

REFERENCE BOOKS:

- R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
- R2. Swami Jitmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
- R3. Fritzo Capra, Tao of Physics
- R4. Fritzo Capra, The wave of Life.
- R5. V N Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Amakam
- 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.

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SYLLABUS

V SEMESTER

Programme B.TECH.	Course Code 16FT5201	Name of the Course FOOD PROCESS ENGINEERING - II	L 3	T 1	P 0	C 4
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Course Objectives

- 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 equipments - 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 SEPERATION: Sedimentation in liquids - Gravitational sedimentation – Flootation - Sedimentation of particles in gas. Centrifugal separation – Velocity of particles – Radius of neutral zone – Equipments. Filtration – Constant rate and Constant pressure filtration - Equipments, 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. Equipments - 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 equipments - 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 Equipments. 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

Course Outcomes

Upon completion of the course, students can be able to

- 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 Processingl, Web Edition, Pergamon Press, UK, 2004

REFERENCES BOOKS:

1. —Food Processing Handbookl, 2nd Edition, Wiley VCH, Weinheim, 2011. James G Brennan.
2. Paul Singh R and Dennis R. Heldman. —Introduction to Food Process Engineeringl, 5th Edition, Academic Press, USA, 2014.
3. Sahay K.M. and Singh K.K., —Unit Operations of Agricultural Processingl, 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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5202	FOOD QUALITY ASSURANCE AND CONTROL	3	0	0	3
Course Objectives	• To understand and study about the quality assurance and quality control of food processing					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	FOOD QUALITY 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
II	QUALITY ASSURANCE AND CONTROL 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
III	REGULATION 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
IV	SAMPLING AND STATISTICAL QUALITY CONTROL: Sampling- concept, methods and importance. Statistical Process and Quality Control - concept, importance and tools. Control charts: importance, types, design process, Control limits and errors, Process Capability	9
V	SENSORY EVALUATION: Introduction, sensory panel - screening and selection methods, training of sensory panel, Physiological factors affecting sensory panel, Hedonic rating of food. Sensory Evaluation tests - Difference - Paired Comparison, Triangle, Duo-trio Test, Quantitative - Grading, scaling and ranking.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

Course Outcomes	CO1- Remember the food quality standards
	CO2- Understand the implementation of quality assurance in food industry
	CO3- Understand the regulations for FBO
	CO4- Remember the sampling techniques
	CO5- Remember the methods of sensory evaluation

TEXT BOOKS:

- Inteaz Alli, —Food Quality Assurance: Principles and PracticesI, 2nd Edition, Taylor and Francis, UK, 2014.
- Andres Vasconcellos J. —Quality Assurance for the Food Industry: A Practical ApproachI, CRC Press, New York, 2004

REFERENCES BOOKS:

- David Kilcast, —Sensory Analysis for Food and Beverage Quality Control: A Practical Guidel, Woodhead Publishing Ltd, Cambridge, 2010
- Singh, S. P., —Food Safety, Quality Assurance, and Global Trade: Concerns and StrategiesI, International Book Distributing Company, Lucknow, 2009.
- Manuals of Food Quality Control: Quality Assurance in Food Control Chemical LaboratoryI, FAO, Itlay, 1993.
- Ronald E. Wrolstad. "Handbook of Food Analytical Chemistry" Vol I, John Wiley & sons, 2005

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5203	BAKING AND CONFECTIONERY TECHNOLOGY	3	0	0	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.	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.	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.	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:

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

REFERENCES BOOKS:

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

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Programme B.TECH. **Course Code** 16FT5204 **Name of the Course** MILLING TECHNOLOGY FOR FOOD MATERIALS **L** 3 **T** 0 **P** 0 **C** 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 MILLS: 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:

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

REFERENCES BOOKS:

1. Chakraverty A., Mujumdar A.S., VijayaRaghavan G.S. and Ramaswamy H.S., —Handbook of Postharvest Technology - Cereals, Fruits, Vegetables, Tea, and SpicesI, Marcel Dekker, Inc., New York, 2003.
2. Kulp K. and Pont J.G., —Handbook of Cereal Science and TechnologyI, 2nd Edition, Marcel Dekker, Inc., New York, 2000.
3. Richard D. O'Brien, —Fats and Oils: Formulating and Processing for ApplicationsI, 3rd Edition, CRC Press, London, 2008.
4. Morris, Peter C. and James H Bryce "Cereal Biotechnology". CRC / Woodhead, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5205	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY 3	3	0	0	3
Course Objectives	<ul style="list-style-type: none"> To understand and remember the technology of fruits and vegetable processing 					

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Morphology, structure and composition of fruit and vegetable. Production and processing scenario of fruits and vegetable: India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus	9
II	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	9
III	FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES: General pre processing, different freezing methods and equipments, 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.	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	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.	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:

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

REFERENCES BOOKS:

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

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Programme B.TECH.	Course Code 16FT5001	Name of the Course BAKING AND CONFECTIONARY TECHNOLOGY LABORATORY	L 0	T 0	P 4	C 2
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Course Objectives

- To understand the practical knowledge about the concepts of baking and confectionery

S.No.	DESCRIPTION
1.	Estimation of wet and dry gluten content of wheat flour
2.	Estimation of water absorption power of wheat flour
3.	Determination of sedimentation value of wheat flour
4.	Determination of dough rising capacity of wet and dry yeast
5.	Estimation of quality parameters of bakery ingredients
6.	Experiment on leavening power of baking powder, sodium-bicarbonate and ammonium- bicarbonate
7.	Preparation and analysis of bread
8.	Preparation and analysis of toffee / candy
9.	Preparation and analysis of chocolates
10.	Preparation and analysis of biscuits / cookies

Total Practical Hours 45

Upon completion of the course, students can be able to

- Course Outcomes**
- Understand the processing of baking and confectionery products
 - Assess the role of ingredients in bakery and confectionery products
 - Evaluate the dough characteristics for the preparation of bakery products
 - Assess the preparation of sugar confectionary products
 - Analyze the different properties of prepared baked products

REFERENCE BOOKS:

- Duncan Manley.—Biscuit, Cracker and Cookie Recipes for the Food Industry, Woodhead Publishing, England, 2001.
- Yogambal Ashokkumar, —Text book of Bakery and Confectionery, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
- Samuel A. Matz, —Bakery Technology and Engineering, 3rd Edition, Chapman and Hall, London, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5002	FOOD PROCESS ENGINEERING LABORATORY	0	0	4	2

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.	Determination of fineness modulus for ground material using ball mill
7.	Determination of separation efficiency of inclined belt separator
8.	Determination of conveying efficiency and power requirement of screw conveyor
9.	Experiment on analysis of particle size distribution using hammer mill
10.	Experiment on paddy dehusker to determine the shelling efficiency
11.	Experiment on terminal velocity apparatus
12.	Experiment on drying characteristics of food material using fluidized bed dryer

Total Practical Hours 45

Upon completion of the course, students can be able to

- Course Outcomes
- Understand the Engineering mechanisms of equipment and properties of foods
 - To understand the separation and collection efficiency in different separators
 - To apply various mills for the size reduction of food materials into different sizes
 - To analyze the performance of different mills and distillation equipment
 - To analyze the conveying efficiency of screw conveyors and bucket elevators for designing equipment

REFERENCE BOOKS:

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


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		VI SEMESTER				
Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6201	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:

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

REFERENCES 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.
4. Selia, Jane dos Reis Coimbra and Jose A. Teixer "Engineering Aspects of Milk and Dairy Products".

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Programme B.TECH.	Course Code 16FT6202	Name of the Course FOOD PACKAGING	L 3	T 0	P 0	C 3
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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.	9
II	Metal cans: Raw materials for can making – steel, aluminium. Can making processes - three piece welded cans, DWI, DRD cans – end making processes – coating. Film laminates and inks, metal packages – corrosion and sulphur staining. 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	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. Sealability and closure. Application of plastics for food packaging.	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.	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.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to

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|------------------------|--|
| 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:

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

REFERENCES BOOKS:

- Han Jung H., -Innovations in Food Packagingll, 2nd Edition, Academic Press, USA 2013.
- Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, -Food Packaging Science and Technologyll, CRC press, USA, 2008.
- Otto G. Piringer and A.L. Baner, -Plastic Packaging Materials for Foodll, 1st Edition, Wiley- VCH, Germany, 2008.
- Ahvenainen, Raija, ed. Novel food packaging techniques. Elsevier, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6203	POULTRY, MEAT AND FISH PROCESS TECHNOLOGY	3	0	0	3

Course Objectives

- To study the poultry, egg, meat and fish processing parameters and conditions

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	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	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	12
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.	6
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.	6
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

- 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, Montepier, 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. Mountney, VivianE. Poultry products technology. Routledge, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6204	REFRIGERATION AND COLD CHAIN MANAGEMENT	3	1	0	4

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	12
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.	12
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.	12
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.	12
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.	12
Total Instructional Hours		60

Course Outcomes

Upon completion of the course, students can be able to

CO1- 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-conditioningI, 3rd Edition, S.K. Kataria and Sons (Publishers), Delhi, 2012.
2. Dellino C.V.J., —Cold and Chilled Storage TechnologyI, 2nd Edition, Springer, US, 2011.

REFERENCES BOOKS:

1. Arora C.P., —Refrigeration and Air ConditioningI, 2nd Edition, Tata McGraw-HillPublishing Company Ltd., Delhi, 2008.
2. Khurmi R.S. and Gupta J.K., —Textbook of Refrigeration and Air ConditioningI, 5th Edition, S. Chand Publishers, New Delhi, 2006.
3. Narayanan K.V., —A Textbook of Chemical Engineering ThermodynamicsI, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2013
4. Evans, Judith A., ed. *Frozen food science and technology*. John Wiley & Sons, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6001	FOOD PACKAGING AND FRUITS & VEGETABLE PROCESSING LABORATORY	0	0	4	2

- Course Objectives**
- To understand the impact of packaging material on various products and also to know the processing of fruits and vegetables

S.No.	DESCRIPTION
1.	Experiment on juice extractor and pulper
2.	Experiment on osmotic dehydration of fruits and vegetables
3.	Preparation and analysis of jam/jelly, sauce
4.	Preparation and analysis of squash
5.	Estimation of bursting strength of packaging materials
6.	Experiment on canning of fruits and vegetables
7.	Determination of tear / puncture resistance of packaging materials
8.	Determination of tensile strength of different packaging materials
9.	Estimation of water absorption capacity of paper based packaging materials
10.	Estimation of water vapour permeability of different packaging materials
11.	Determination of overall migration of different plastic packaging materials
12.	Determination of shelf life of modified atmospheric packed food

Total Practical Hours 45

- Course Outcomes**
- Upon completion of the course, students can be able to
- CO1 - Understand the knowledge on extraction, pulping, dehydration and prepare fruit/vegetable based products
 - CO2 - Understand the mechanical properties of packaging materials
 - CO3 - Understand the water barrier properties of packaging materials
 - CO4 - Demonstration on canning of fruits and vegetables
 - CO5 - Determining the shelf life of food products after treating in MAP and CAP

REFERENCE BOOKS:

- Ranganna S., —Handbook of Analysis and Quality Control for Fruit and Vegetable, Tata McGraw-Hill, 2001.
- Gordon L. Robertson, —Food Packaging and Shelf Life: A Practical Guidel, CRC Press, USA, 2009.


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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6002	DAIRY ENGINEERING LABORATORY	0	0	4	2

- 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

- Understand the analysis of Dairy products
 - Understand the processing of dairy products
 - Analyze the presence of macro components in milk and detect the adulterants in milk
 - Apply the unit operations in milk processing: separation, standardization, homogenization, pasteurization methods, spray drying
 - Evaluate the efficiency of various equipment for the processing of milk
- Course Outcomes**

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.


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PROFESSIONAL ELECTIVES

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5301	TECHNOLOGY OF FATS AND OILS	3	0	0	3

Course Objectives • 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
 Upon completion of the course, students can be able to
 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

TEXT BOOKS:

- 1.Fereidoon Shahidi, —Bailey’s Industrial Oil and Fat ProductsI, 6th Edition, Wiley - Interscience, New Jersey, 2005.
- 2.Richard D. O'Brien, —Fats and Oils: Formulating and Processing for ApplicationsI, 3rd Edition, CRC Press, London, 2010.

REFERENCES BOOKS:

- 1.Casimir C. Akoh and David B. Min, —Food Lipids: Chemistry, Nutrition and BiotechnologyI, CRC Press, USA, 2008.
- 2.Wolf Hamm and Richard J. Hamilton, —Edible Oil ProcessingI, Wiley - Blackwell, UK, 2013.
3. Bockisch, Michael, ed. Fats and oils handbook (Nahrungsfette und Öle). Elsevier, 2015.
4. Hamilton, Richard John, ed. Recent advances in chemistry and technology of fats and oils. Springer Science & Business Media, 2012.


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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5302	FOOD STORAGE AND INFESTATION 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	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
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

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

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

REFERENCES BOOKS:

1. Hagstrum D.W., and Subramanyam B., —Fundamentals of Stored Product Entomology, American Association of Cereal Chemists Inc., 2006.
2. Subramanyam B., —Integrated Management of Insects in Stored Products, CRC Press, 1995.
3. Slansky Jr. F., and Rodriguez J.G., —Nutritional Ecology of insects, mites, spiders and related invertebrates, John Wiley, 1987.
4. Taub, Irwin A., and R. Paul Singh, eds. Food storage stability. CRC Press, 1997.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT5303	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 - Pearl, 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 rice and 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". II Edition, CRC Press, 2000.
2. Morris, Peter C. and James H Bryce "Cereal Biotechnology". CRC / Woodhead, 2000
3. Owens, Gavin, ed. Cereals processing technology. CRC Press, 2001.
4. Hamaker, Bruce R., ed. Technology of functional cereal products. Elsevier, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH	16FT5304	POST HARVEST TECHNOLOGY	3	0	0	3

Course Objectives

- To develop the knowledge of students in the area of post-harvest processing of various foods and related technology. This course will enable students to appreciate the application of scientific principles in the processing of these 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, pretreatments, modified atmosphere packaging, chilling. General pre-processing, different freezing methods and equipment, problems associated with specific fruits and vegetables; Dehydration- General preprocessing, 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 – Pasteurization, homogenization, 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.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6301	FERMENTATION TECHNOLOGY	3	0	0	3

Course Objectives

- To understand the fermentation concepts with the applications.

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	FOOD FERMENTATION: Origin and history of food fermentation, Micro-organisms for fermentation, Starter Cultures and fermented Products, Manufacture of fermented products, Quality and flavour of fermented products.	9
II	TYPES OF FERMENTATION: Types of fermentation submerged/solid state. Sterilization-air sterilization, media sterilization. Batch/continuous fermentation, scale up in fermentation. Maintenance of aseptic conditions.	9
III	AERATION AND AGITATION IN FERMENTATION: Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, bubble aeration, mechanical agitation, correlation between mass-transfer coefficient and operating variables.	9
IV	PRODUCTION OF FERMENTED PRODUCTS: Semi solid cultured dairy products- principles and applications- packaging quality assurance and sanitation. Meat fermentation- principles and application. Fermented cereal food and beverages.	9
V	PRODUCTION OF FERMENTED PRODUCTS: Production of vitamins, amino acids, organic acids, enzymes and antibiotics, alcohols. Industrial production of beer, wine, enzymes-amylase, pectinase, proteases, vitamins, antibiotics, baker's yeast, single cell protein. Fermented foods: Sauerkraut, yoghurt, cheese, miso, tempeh, tofu, idli, dosa.	9
Total Instructional Hours		45

Course Outcomes

Upon completion of the course, students can be able to

CO1- Understand the principles of microbiology in the production of fermented foods
 CO2- Understand the classification of fermentation process and maintain aseptic conditions in a fermentation process
 CO3- Understand the process parameters in aeration and agitation of a fermentation operation
 CO4- Understand the use of concepts of fermentation in dairy, meat, cereal and beverage products
 CO5- Understand processes involved in production of various fermented products

TEXT BOOKS:

1. Y.H.Hui, Lisbeth Meunier-Goddik, Jytte Josephsen, Wai-Kit Nip and Peggy S. Stanfield., "Handbook of Food and Beverage Fermentation Technology", CRC Press, UK, 2004
2. Robert W. Hutkins., "Microbiology and Technology of Fermented Foods", CRC Press, UK, 2004

REFERENCES BOOKS:

1. Gutierre, Gustavo F., —Food Science and Food BiotechnologyI, CRC Press, New York, 2003.
2. Crueger W. and Crueger A., —Biotechnology: A Textbook of Industrial MicrobiologyI, Science Tech. Madison, USA, 1984.
3. Najafpour, D. Ghasem, —Biochemical Engineering and BiotechnologyI, Elsevier, USA, 2007.
4. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.

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Programme **B.TECH.** Course Code **16FT6302** Name of the Course **BIOPROCESS ENGINEERING** L **3** T **0** P **0** C **3**

Course Objectives • To learn the bioprocess engineering concepts in the food processing applications

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	BIOREACTOR: Basic configuration of bioreactor and ancillaries. Types of reactor- Air Lift Reactor, Bubble Column Reactor, Immobilized enzyme reactors- packed bed, fluidized bed and membrane reactors.	9
Total Instructional Hours		45

Upon completion of the course, students can be able to
 Course Outcomes
 CO1- Understand the kinetics of enzymatic reactions, enzyme inhibition and enzyme immobilization
 CO2- Understand the microbial strain preservation and improvement techniques
 CO3- Remember the stoichiometric calculation of microbial growth and product formation
 CO4- Understand the appropriate fermentation process and sterilization methods
 CO5- Understand the working of bioreactors

TEXT BOOKS:

1. Trevor Palmer and Philip L.R. Bonner, —Enzymes: Biochemistry, Biotechnology, Clinical Chemistr, 2nd Edition, Woodhead Publishing, Cambridge, 2007.
2. Stanbury P.F., Whitaker A. and Hall S.J., —Principles of Fermentation Technology, 2nd Edition, Pergamon, USA, 1995

REFERENCES BOOKS:

1. Shuler M.L. and Kargi F., —Bioprocess Engineering: Basic Concepts, 2nd Edition, PHI, New Delhi, 2002.
2. Najafpour, D. Ghasem, —Biochemical Engineering and Biotechnology, Elsevier, USA, 2007.
3. Doran, Pauline M. Bioprocess engineering principles. Elsevier, 1995.
4. Gabelman, Alan. Bioprocess production of flavor, fragrance, and color ingredients. Wiley, 1994.

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Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6303	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 BYPRODUCTS: 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

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Programme **B.TECH.** Course Code **16FT6304** Name of the Course **ENZYME TECHNOLOGY** L **3** T **0** P **0** C **3**

Course Objectives • This course enable the student to know the different types of enzymes and its food application

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	MECHANISM OF ENZYME ACTION Specificity-types of specificity-role of 3D structure -active site-substrate and enzyme concentration relationships-different effects -pH and temperature.	9
III	ENZYME KINETICS MM equation, Line weaver 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	APPLICATION OF 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

Course outcomes
 Upon completion of the course, students can be able to
 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- Remember the enzyme kinetics
 CO5- Remember the action of enzymes

TEXT BOOKS:


1. Price, N. L. and Steven L., "Fundamentals of Enzymology". Oxford Scientific 2000.
2. Godfrey T. West S (Eds), "Industrial Enzymology" 2nd Edition Mac Millan Press, London 1996.

REFERENCE:

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


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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.TECH.	16FT6401	TRADITIONAL FOODS AND ITS IMPORTANCE	3	0	0	3

Course Objectives

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

UNIT	DESCRIPTION	INSTRUCTIONAL HOURS
I	TRADITIONAL METHODS OF FOOD PROCESSING: Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.	9
II	TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS: Production, formulation, preparation and processing of Indian traditional sweet and snack food products: -Rasgolla, Gulabjamun; formulation and preparation of namkeen, papads, vada, potato chips, banana chips, samosa etc. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing; milk-based puddings/ desserts	9
III	TRADITIONAL FERMENTED FOOD PRODUCTS: Idli, Tempe, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol-based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing procedures to reduce loses of nutrients	9
IV	COMMERCIAL PRODUCTION OF TRADITIONAL FOODS: Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods &-types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters	9
V	HEALTH ASPECTS OF TRADITIONAL FOODS: Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.	9
	Total Instructional Hours	45

Course Outcomes

Upon completion of the course, students can be able to

- CO1- Justify the processing methods of traditional foods in terms of its health benefits
- CO2- Assess the production methods of traditional sweets, snacks and dairy products
- CO3- Differentiate Traditional fermented foods products based on its raw material
- CO4- Implement a large-scale production of tradition foods for its increased consumption
- CO5- Compare the health aspects of traditional foods with modern foods

TEXT BOOKS:

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.

REFERENCES BOOKS:

1. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
2. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

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SEMESTER V

16FT5201 Food Process Engineering - II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	1	1	-	1	1	-	1	1	1	2
CO2	3	2	3	2	1	1	1	1	3	1	2	1	1	2
CO3	3	2	3	2	1	1	1	1	1	1	1	1	1	2
CO4	3	2	3	2	1	1	1	1	1	1	2	1	1	2
CO5	3	2	3	2	1	1	2	1	1	1	2	1	1	2
Avg	3	2	3	2	1	1	1.25	1	1.5	1	1.75	1	1	2

16FT5202 Food Quality Assurance and Control

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			3			2	1	1				1	3	1
CO2	1		2			2		1				1	2	1
CO3	1		3			2		1				1	2	1
CO4			3			2	1	1				1	2	1
CO5	1		3			2	1	1				1	2	1
Avg	1		2.8			2	1	1				1	2.2	1

16FT5203 Baking and Confectionery Technology

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		2			3	2	3				3		2	3
CO2	2	3	3	2	3		2							3

CO3	2	3	3	1			2						1	3
CO4	3	2	1	2									1	3
CO5	2	3	3				1							2
Avg	2.25	2.75	2.5	1.66	3		1.6						1	2.75

16FT5204 Milling Technology for Food Materials

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3	1	2			2							3	2
CO3		1	2	2									3	1
CO4	3		2									1	3	2
CO5	1	3	3	3								1	3	2
Avg	2.5	1.75	2.2	2.5	0	2						1	3	1.8

16FT5205 Fruits and Vegetable Processing Technology

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1	1	1				1			2	1	2
CO2	1	2	2	1	1							1	1	2
CO3	1	1		1	1							2		3
CO4	1	1	1	1	1							1		2
CO5	1	1	3	1								2		3
Avg	1	1.25	1.75	1	1				1			1.6	1	2.4

16FT5304 Post Harvest Technology

PO&	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO	PO	PO		
----------------	------------	------------	------------	------------	------------	------------	------------	------------	------------	-----------	-----------	-----------	--	--

CO1	3	2	2										3	2
CO2	3	1	2			2							3	2
CO3		1	2	2									3	1
CO4	3		2									1	3	2
CO5	1	3	3	3								1	3	2
Avg	2.5	1.75	2.2	2.5		2						1	3	1.8

16FT6204 Refrigeration and Cold chain Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	2
CO2	3		2			2							3	2
CO3		1	2	2										3
CO4	3		2									2		3
CO5	1	3	3	3								2		3
Avg	2.3	2	2.25	2.5		2						2	3	2.75

16FT6303 Cane Sugar Technology

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	1									1	1	
CO2	1	2	1				1			1		1	1	
CO3	1	2	1				1			1		1	1	
CO4	1	2	1				1			1		1	1	
CO5	1	2	2				2			1		1	3	
Avg	1	2	1.2				1.25			1		1	1.4	

16FT6401 Traditional Foods

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	1	-	1	1	2	-	-	-	1	1	2
CO2	2	1	2	2	-	1	1		-	-	-	2	1	2
CO3	3	3	2	3	-	1	1	1	-	-	-	2	1	2
CO4	2	3	2	1	-	1	1		-	-	-	2	1	2
CO5	2	1	2	3	-	1	1	3	-	-	1	3	3	2
Avg	2.2	2.0	1.8	2	-	1	1	2	-	-	1	2	1.4	3

16FT6001 Food Packaging and Fruits & Vegetable Processing Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	-	-	1	1	-	1	1	-	1	2	-
CO2	1	1	1	-	1	1	1	-	1	1	-	1	2	-
CO3	1	2	1	-	-	1	1	-	1	1	-	1	1	-
CO4	2	2	2	1	1	1	1	-	1	1	-	1	1	2
CO5	2	2	3	1	1	1	1	-	1	1	-	1	1	-
Avg	1.5	1.75	1.75	1	1	1	1		1	1		1	1.25	2

16FT6002 Dairy Engineering Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	2		2					2	2	2

CO2	2	1	2	2	2		2				2	3	2	2
CO3	2	2	2	2	2		2				2	2	2	2
Avg	2	1.5	2	2	2		2				2	2.5	2	2

Mapping of Course Outcome and Programme Outcome:

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12		
I	I	16MA1101 Engineering Mathematics – I (Matrices and calculus)	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2		
		16PH1101 Engineering Physics	3	3	3	2.6	2.8	-	-	-	-	-	-	-	2	
		16CY1101 Engineering Chemistry	3	2.2	2	1.6	2	1.3	-	-	-	-	-	-	1	
		16HE1101 English for Engineers – I	3	2	2	2	2	1	1	-	-	-	-	-	1	
		16GE1103 Problem Solving and Python Programming	3	1	1	-	-	1	-	-	-	-	-	-	1	
		16GE1102 Engineering Graphics	2	3	3	-	2	-	-	-	-	2	-	-	2	
		16PS1001 Physical Sciences Lab – I	2.8	3	2.6	1	1	2	1	-	-	-	1	1	1	
		16GE1004 Problem Solving and Python Programming Lab	3	3	3	2.6	2.8	-	-	-	-	-	-	-	-	2
		16GE1002 Engineering Practices Lab														
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12		
I	II	16MA2101 Engineering Mathematics – II	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8		
		16PH2102 Physics of Materials	3	3	3	2.4	2.4	-	-	-	-	-	-	-	2	
		16FT2101 Fundamentals of Biochemistry	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	-	1	
		16HE2102 Essential English for Engineers - II	2	1	1.7	-	-	1	2	3	2	-	-	-	2	
		16GE2101 Engineering Mechanics	1	2	1					1			1		1	
		16CY2102 Environmental Science	2	3	3.0	-	2	-	-	-	-	-	-	-	-	2
		16PS2001 Physical Sciences Laboratory – II	3		3		3					1				

		16FT200 Biochemistry Lab															
Year	Sem	Course code & Name	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
II	III	16MA3111 Fourier Analysis and Z Transforms	3	2.8	3	1.4	1.4	2	-	-	-	-	-	2.2	2.2	2.2	
		16FT3201 Fluid Mechanics	2.8	1.8	1	1.3			1						1	1	1
		16FT3202 Food Process Calculations	2.8	1.8	1	1.3			1						1	1	1
		16FT3203 Food Microbiology	2.8	1.8	1	1.3			1						1	1	1
		16FT3204 Food Chemistry	2.5	2	2.3	2	3	2	2	2				3		1.3	2.8
		16FT3001 Food Microbiology Laboratory	2	1.7	1.7	2	2		2						2	2	2
		16FT3002 Food Production Analysis Laboratory	2	1	1	1	2	2	2	-	1	1	-	2		1.2	0.4
Year	Sem	Course code & Name	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
II	IV	16MA4112 Applied Statistics & Numerical Methods	1	1.25	1.75	1	4				1			1.6	1	2.4	
		16FT4201 Engineering Properties of Food Materials	1	1.25	2	1.6	1.5					2			2.2	3	2.6
		16FT4202 Fundamentals of Heat and Mass Transfer materials	2	1.2	2.2	2.5		2							2	3	2.6
		16FT4203 Food Process Engineering - I	2.8	1.8	1	1.3			2.2	2.8	1.6	2.2	2	2.6	1.4		2
		16FT4204 Food Analysis	3	2.8	3	2	2								2.2	2.2	2
		16HE4101 Total Quality Management	1.6	1.5	2.5	1.7	2					2.6			2.4	2	
		16FT4001 Food Analysis Laboratory	2.25	2.75	2.5	1.66	3			1.6						1	2.75
		16FT4001 Food Analysis Laboratory	1	1.25	1.75	1	1					1			1.6	1	2.4
Year	Sem	Course code & Name	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	

II	V	16FT5201 Food Process Engineering - II	3	2	3	1	2	2	1.25				1.75	1	1	2	
		16FT5202 Food Quality Assurance and Control	1		2.8				2	1	1				1	2.2	1
		16FT5203 Baking and Confectionery Technology	2.25	2.75	2.5	1.66	3			1.6						1	2.75
		16FT5204	2.5	1.75	2.2	2.5	0	2							1	3	1.8
		16FT5205 Unit Operations in Food Processing	1	1.25	1.75	1	1					1			1.6	1	2.4
		16FT5306 Milling Technology for Food Materials	1	2	1.2					1.25			1		1	1.6	
		16FT5001 Baking and Confectionery Technology Laboratory	2.25	2	2	2.25			1	1	2			1	2.25	1.5	2.25
		16FT5002 Food Process Engineering Laboratory	2.5	1.75	2.2	2.5									1	3	1.8
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
III	VI	16FT6201 Dairy Engineering	3	2	3	1	2	2	1.25				1.75	1	1	2	
		16FT6202 Food Packaging	3	1	2	2			2						2	3	2.6
		16FT6203 Poultry, Meat and Fish Process Technology	2.5	1.75	2.2	2.5			2						1	3	1.8
		16FT6204 Refrigeration and Cold chain Management	2.3	2	2.25	2.5			2						2	3	2.75
		16FT6301 Beverage Technology	1	2	1.2					1.25			1		1	1.4	
		16FT6401 Traditional Foods	2.2	2.0	1.8	2	-	1	1	2	-	-	1	2	1.4	3	
		16FT6001 Food Packaging and Fruits & Vegetable Processing Laboratory	1.5	1.75	1.75	1	1	1	1	1		1	1		1	1.25	2
		16FT6002 Dairy	2	1.5	2	2	2	2		2					2	2.5	2

		Engineering Laboratory															
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
IV	VII	16HE7101 Professional Ethics	2.2	2.8	1.6	2.2	2	2.6	1.4		2	1.8	1	3	3	1.8	
		16FT7201 Food Additives	2.2	2.8	1.6	2.2	2	2.6	1.4		2	1.8	1	3	3		
		16FT7202 Plantation crops & Spices Product Technology	3	2	3	2	1	1	1.25	1	1.5	1	1.75	1	1	1	2
		16FT7306 Technology of Snacks and Extruded Foods	2.2	2.8	1.6	2.2	2	2.6	1.4		2	1.8	1	3	3	1.8	
		16FT7308 Food Process Plant Layout and safety	2.5	1.75	2.4	2.5		2								3	1.8
		16FT7401 Food Product Development	2.8	2.2	1.8	1.8	1.4	2.2	1.4		2	1		3	3	2	
		16FT7001 Food Process Equipment Design Laboratory	1.6	1.5	2.5	1.7	2	-	-	-	2.6	-	-	2.4	2	2	
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
IV	VIII	16FT8306 Waste Management and By-product Utilization in Food Industries	3	2.6	2.5	1.5	2.2	1	1	-	1	-	1.6	2.2	1	1	
		16FT8308 Emerging Non-Thermal Processing of Foods	3	2.6	2.5	1.5	2.2	1	1	-	1	-	1.6	2.2	1	1	

CO'S, PO'S & PSO'S MAPPING-(R 2019)

Semester – I

Course Code & Name : 19HE1101/ TECHNICAL ENGLISH

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
CO4	1	1	-	1	1	1	1	1	2	3	1	2	3	3
CO5	-	1	1	1	1	1	1	2	2	3	1	2	2	2
Avg	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4

Course Code & Name : 19MA1101/ CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	2	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name : 19MA1102/ CALCULUS AND LINEAR ALGEBRA

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name : 19MA1103/ CALCULUS AND DIFFERENTIAL EQUATIONS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

Course Code & Name : 19PH1151/ APPLIED PHYSICS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	2	-	-	-	-	-	-	1	3	3
CO4	3	2	3	2	3	1	-	-	-	-	-	1	2	2
CO5	3	2	3	2	2	2	-	-	-	-	-	1	2	3
Avg	3	2.2	2	1.6	2	1.333333	-	-	-	-	-	1	2.4	2.4

Course Code & Name : 19CY1151/ CHEMISTRY FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	1
CO2	3	2	2	-	2	1	-	-	-	-	-	1	1	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	1	1
CO5	3	2	2	-	2	1	-	-	-	-	-	1	1	1
Avg	3	2	2	2	2	1	1	-	-	-	-	1	1	1

Course Code & Name : 19ME1101/BASICS OF CIVIL AND MECHANICAL ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	1	1	-	-	1	-	-	-	-	-	1	3	3
CO2	3	1	1	-	-	1	-	-	-	-	-	1	3	2
CO3	3	1	1	-	-	1	-	-	-	-	-	1	2	2
CO4	3	1	1	-	-	1	-	-	-	-	-	1	3	2
CO5	3	1	1	-	-	1	-	-	-	-	-	1	3	2
Avg	3	1	1	-	-	1	-	-	-	-	-	1	2.8	2.2

Course Code & Name : 19CS1151/PYTHON PROGRAMMING PRACTICES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2

CO4									1		1		3	0
CO5			1	1	1								3	0
Avg	3	3											3	3

Semester –II

Course Code & Name : 19HE2101/ BUSINESS ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
CO4	2	2	1	1	2	2	2	2	3	3	1	3	1	1
CO5	1	1	1	1	1	2	2	1	2	3	1	3	1	1
Avg	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1

Course Code & Name : 19MA2101/ DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.4	2.4	-	-	-	-	-	-	2	2	2

Course Code & Name : 19MA2102/ COMPLEX VARIABLES AND TRANSFORM CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	1.8

Course Code & Name : 19MA2103/ LINEAR ALGEBRA, NUMERICAL METHODS AND TRANSFORM CALCULUS

PO&	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9		PO11			
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PSO										PO10		PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	1
CO2	3	2	3	2	3	-	-	-	-	-	-	2	1	2
CO3	3	2	3	3	3	-	-	-	-	-	-	3	2	3
CO4	3	3	2	2	2	-	-	-	-	-	-	2	1	2
CO5	2	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	2.8	2.6	2.8	2.4	2.6	-	-	-	-	-	-	2.2	1.6	1.8

Course Code & Name : 19MA2104/ DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	2	3
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	2	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2.6	2	-	-	-	-	-	-	2	2	2.2

Course Code & Name : 19PH2151/ MATERIAL SCIENCE

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
CO4	3	3	1	2	2	1	-	-	-	-	-	1	2	2
CO5	3	2	2	3	2	1	2	-	-	-	-	1	2	3
Avg	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2

Course Code & Name : 19CY2151/ ENVIRONMENTAL STUDIES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO2	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO3	2	1	1	-	-	2	3	3	2	-	-	2	-	-
CO4	2	1	2	-	-	2	3	3	2	-	-	2	-	-
CO5	2	1	2	-	-	2	3	3	2	-	-	2	-	-
Avg	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-

Course Code & Name : 19FT2105/ PRINCIPLES OF MICRO BIOLOGY

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
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CO1	1	2	1				1					1	2	
CO2	1	2	1				1			1		1	1	
CO3	1	2	1				1			1		1	1	2
CO4	1	2	1				1			1		1	1	
CO5	1	2	1				1			1		1	3	
Avg	1	2	1				1			1		1	1.6	2

Course Code & Name : 19IT2151/ PROGRAMMING IN C

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
Avg	2	3	3.0	-	2	-	-	-	-	-	-	2	2	2

Course Code & Name : 19ME2001/ ENGINEERING PRACTICES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO11	PSO12
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2														
CO3														
CO4														
CO5														
Avg	3		3		3				1				1	2

Semester – III

19MA3102 Fourier Analysis and Transforms

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	1
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	3
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
CO4	3	3	3	1	2	2	-	-	-	-	-	2	2	2
CO5	3	3	3	2	1	1	-	-	-	-	-	2	2	3

CO4			2	2									1	1
CO5		2	2	2	2								1	1
Avg	2.8	1.8	1	1.3		1							1	1

19FT3251 Bio Chemistry

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		2			3	2	3				3		2	3
CO2	3	2		2	3		2							3
CO3	2	1	3	2			2						1	3
CO4	3	2	1	2									1	3
CO5	2	3	3				1							2
Avg	2.5	2	2.3	2	3	2	2				3		1.3	2.8

19FT3001 Food Microbiology Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	2		2					2	2	2
CO2	2	2	2	2	2		2					2	2	2
CO3	2	1	2	2	2		2					2	2	2
Avg	2	1.7	1.7	2	2		2					2	2	2

19FT3002 Food Production Analysis Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	1	2	2	2	-	1	1	-	2	3	1
CO2	2	1	1	1	2	2	2	-	1	1	-	2	2	1
CO3	2	2	1	1	2	2	2	-	1	1	-	2	1	-

Avg	2	1	1	1	2	2	2	-	1	1	-	2	1.2	0.4
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SEMESTER IV

19FT4201 Fundamentals of Heat and Mass Transfer

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1	1	1				1			2	1	2
CO2	1	2	2	1	1							1		2
CO3	1	1		1	1							2		3
CO4	1	1	1	1	1							1		2
CO5	1	1	3	1								2		3
Avg	1	1.25	1.75	1	4				1			1.6	1	2.4

19FT4202 Food Process Calculations

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1	1	1				2			2	3	2
CO2	1	2	2	2	1							3		3
CO3	1	1		2	3							3		3
CO4	1	1	2	2	1							1		2
CO5	1	1	3	1								2		3
Avg	1	1.25	2	1.6	1.5				2			2.2	3	2.6

19FT4203 Engineering properties of food materials

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO	PSO
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													1	2
CO1	3	2	2										3	2
CO2	3		2			2							3	2
CO3		1	2	2										3
CO4	3		2									2		3
CO5	1	3	3	3								2		3
Avg	2	1.2	2.2	2.5		2						2	3	2.6

19FT4251 Food Chemistry

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	1		1	1	2				1	1	2
CO2	2	1	2	2		1	1					2	1	2
CO3	3	3	2	3		1	1	1				2	1	2
CO4	2	3	2	1		1	1					2	1	2
CO5	2	1	2	3		1	1	3			1	3	1	2
Avg	2.8	1.8	1	1.3		1						1	1	1

19MA4152 Statistics and Numerical Methods

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	1	-	-	-	-	-	-	3	2	2
CO3	3	3	3	1	1	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3		-	-	-	-	-	2	2	2
CO5	3	3	3	3	3		-	-	-	-	-	2	2	2
Avg	3	2.8	3	2	2							2.2	2.2	2

19FT4001 Unit Operations Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2		1					3			2		
CO2	1		2						3			2		
CO3	1		3	2	2				2			2		
CO4	2				2				2			3	2	
CO5	2	1		2					3			3	2	
Avg	1.6	1.5	2.5	1.7	2				2.6			2.4	2	

19FT4002 Food Process Equipment Design Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3							3			3		3
CO2	2		2						3			2		3
CO3	2		2						3			2		3
Avg	2.33	3	2						3			2.3		3

Mapping of Course Outcome and Programme Outcome:

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12
I	I	19HE1101/ TECHNICAL ENGLISH	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2
		19MA1102/ CALCULUS AND LINEAR ALGEBRA	3	3	3	2.6	2.8	-	-	-	-	-	-	2
		19PH1151/ APPLIED PHYSICS	3	2.2	2	1.6	2	1.3	-	-	-	-	-	1
		19CY1151/ CHEMISTRY	3	2	2	2	2	1	1	-	-	-	-	1

		FOR ENGINEERS															
		19ME1101/ BASIC OF AND MECHANICAL ENGINEERING	3	1	1	-	-	1	-	-	-	-	-	-	1		
		19CS1151/ PYTHON PROGRAMMING PRACTICES	2	3	3	-	2	-	-	-	2	-	-	2			
		19ME1152/ ENGINEERING DRAWING	2.8	3	2.6	1	1	2	1	-	-	1	1	1			
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12			
I	II	19HE2101/ BUSINESS ENGLISH FOR ENGINEERS	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8			
		19MA2101/ DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	3	3	3	2.4	2.4	-	-	-	-	-	-	-	2		
		19PH2151/ MATERIAL SCIENCE	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	-	1		
		19CY2151/ ENVIRONMENTAL STUDIES	2	1	1.7	-	-	1	2	3	2	-	-	-	2		
		19FT2105/ PRINCIPLES OF MICRO BIOLOGY	1	2	1					1			1		1		
		19IT2151/ PROGRAMMING IN C	2	3	3.0	-	2	-	-	-	-	-	-	-	-	2	
		ENGINEERING PRACTICES	3		3		3					1					
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
II	III	19MA3102 Fourier Analysis and Transforms	3	2.8	3	1.4	1.4	2	-	-	-	-	-	2.2	2.2	2.2	
		19FT3201 Fluid Mechanics	2.8	1.8	1	1.3		1						1	1	1	
		19FT3101 Principles of Thermodynamics	2.8	1.8	1	1.3		1						1	1	1	
		19FT3202 Food Microbiology	2.8	1.8	1	1.3		1						1	1	1	
		19FT3251 Bio Chemistry	2.5	2	2.3	2	3	2	2				3		1.3	2.8	
		19FT3001	2	1.7	1.7	2	2		2					2	2	2	

		Food Microbiology Laboratory															
		19FT3002 Food Production Analysis Laboratory	2	1	1	1	2	2	2	-	1	1	-	2	1.2	0.4	
		19FT4002 Food Process Equipment Design Laboratory	2.3 3	3	2						3			2.3		3	
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
II	IV	19FT4201 Fundamentals of Heat and Mass Transfer	1	1.25	1.75	1	4				1			1.6	1	2.4	
		19FT4202 Food Process Calculations	1	1.25	2	1.6	1.5				2			2.2	3	2.6	
		19FT4203 Engineering properties of food materials	2	1.2	2.2	2.5		2							2	3	2.6
		19FT4251 Food Chemistry	2.8	1.8	1	1.3		1							1	1	1
		19MA4152 Statistics and Numerical Method	3	2.8	3	2	2								2.2	2.2	2
		19FT4001 Unit Operations Laboratory	1.6	1.5	2.5	1.7	2					2.6			2.4	2	
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
II	V	19FT5201 Baking and Confectionery Technology	3	2	3	1	2	2	1.25					1.75	1	1	2
		19FT5202 Food Additives	1		2.8			2	1	1					1	2.2	1
		19FT5203 Poultry, Meat and Fish Process Technology	2.25	2.75	2.5	1.66	3		1.6							1	2.75
		19FT5204 Principles of Food Processing	2.5	1.75	2.2	2.5	0	2							1	3	1.8
		19FT5205 Unit Operations in Food Processing	1	1.25	1.75	1	1					1			1.6	1	2.4
		19FT5306 Milling Technology	1	2	1.2					1.25				1		1	1.6

		for Food Materials															
		19FT5001 Baking and Confectionery Technology Laboratory	2.25	2	2	2.25		1	1	2			1	2.25	1.5	2.25	
		19FT5002 Unit Operations in Food Processing Laboratory	2.5	1.75	2.2	2.5								1	3	1.8	
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
III	VI	19FT6201 Dairy Engineering	3	2	3	1	2	2	1.25				1.75	1	1	2	
		19FT6202 Plantation crops and Spices Products Technology	3	1	2	2			2						2	3	2.6
		19FT6203 Fruits and Vegetable Processing Technology	2.5	1.75	2.2	2.5			2						1	3	1.8
		19FT6181 Professional Ethics in Engineering	2.3	2	2.25	2.5			2						2	3	2.75
		19FT6301 Beverage Technology	1	2	1.2					1.25			1		1	1.4	
		19FT6401 Traditional Foods	2.2	2.0	1.8	2	-		1	1	2	-	-	1	2	1.4	3
		19FT6001 Dairy Engineering Laboratory	1.5	1.75	1.75	1	1	1	1	1			1	1	1	1.25	2
		19FT6002 Fruits and Vegetable Processing Technology Laboratory	2	1.5	2	2	2	2		2					2	2.5	2

Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
IV	VII	19FT7201 Food Analysis and Quality Control	2.2	2.8	1.6	2.2	2	2.6	1.4		2	1.8	1	3	3	1.8	
		19FT7202 Food Packaging	2.2	2.8	1.6	2.2	2	2.6	1.4		2	1.8	1	3	3		
		19FT7203 Food Plant Layout and Management	3	2	3	2	1	1	1.25	1	1.5	1	1.75	1	1	1	2
		19FT7307 Emerging Non-Thermal Processing of Foods	2.5	1.75	2.4	2.5			2							3	1.8
		19FT7401 Open Elective – II	2.8	2.2	1.8	1.8	1.4	2.2	1.4			2	1		3	3	2
		19FT7001 Food Packaging Laboratory	1.6	1.5	2.5	1.7	2	-	-	-		2.6	-	-	2.4	2	2
		19FT7002 Food Analysis and Quality Control Laboratory	3	3	2	2	1	1							2	3	3
Year	Sem	Course code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
IV	VIII	19FT8312 Total Quality Management	3	2.6	2.5	1.5	2.2	1	1	-	1	-	1.6	2.2	1	1	
		19FT8308 Emerging Technologies in Food Processing	3	2.6	2.5	1.5	2.2	1	1	-	1	-	1.6	2.2	1	1	