

Curriculum and Syllabus [Regulation-23]

Incorporating Guidelines of NEP2020

B.Tech. in Food Technology

(Effective From 2023-2024 Admission Batch)



Guru Nanak Institute of Technology
(NAAC 'A+' Accredited An Autonomous Institute)
(Affiliated to Maulana Abul Kalam Azad University of Technology)

Department: Food Technology

Department: Food Technology
Curriculum Structure & Syllabus
(Effective from 2023-24 admission batch)

1 st Year 1 st Semester									
Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT101	Food Microbiology	3	0	0	3	3
2	ENGG	Minor	EE(FT)101	Basic electrical engineering	2	0	0	2	2
3	SCI	Multidisciplinary	CH(FT)101	Engineering Chemistry	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU101	Professional Communication	3	0	0	3	3
5	HUM	Value Added Course	HU102	Values and Ethics	2	0	0	2	2
6	HUM	Value Added Course	HU103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	FT191	Food Microbiology Lab	0	0	3	3	1.5
2	ENGG	Minor	EE(FT)191	Basic electrical engineering lab	0	0	2	2	1
3	HUM	Ability Enhancement Course	HU191	Professional Communication Lab	0	0	3	3	1.5
4	SCI	Skill Enhancement Course	CH(FT)191	Engineering Chemistry-I Lab	0	0	3	3	1.5
5	ENGG	Skill Enhancement Course	ME(FT)191	Workshop and Manufacturing Practice Lab	0	0	3	3	1.5
Total of Theory and Practical								28	21

***HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project**

1 st Year 2 nd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT201	Chemistry of Food	3	0	0	3	3
2	SCI	Multidisciplinary	PH(FT)201	Engineering Physics	2	0	0	2	2
3	SCI	Multidisciplinary	M(FT)201	Engineering Mathematics	3	0	0	3	3
4	HUM	Value Added Course	HU204	Environmental Science	2	0	0	2	2
5	HUM	Value Added Course	HU205	Indian Knowledge System	1	0	0	1	1
6	ENGG	Skill Enhancement Course	CS(FT)201	Programming for Problem Solving	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	FT291	Chemistry of Food Lab I	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH(FT)291	Engineering Physics Lab	0	0	2	2	1
3	ENGG	Skill Enhancement Course	ME(FT)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CS(FT)291	Programming for Problem Solving Lab	0	0	3	3	1.5
Total of Theory and Practical								25	19.5

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

2 nd Year 3 rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT301	Biochemistry and Nutrition	4	0	0	4	4
2	ENGG	Major	FT302	Food Process Technology–I (Fish, Meat, Poultry)	3	0	0	3	3
3	ENGG	Minor	ME(FT)301	Engineering Thermodynamics and Kinetics	3	1	0	4	4
4	ENGG	Minor	M(FT)301	Applied Statistics and Numerical Methods	2	1	0	3	3
5	HUM	Ability Enhancement Course	HU(FT)301	Principles of management	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	FT391	Chemistry of Food Lab II	0	0	3	3	1.5
2	ENGG	Major	FT392	Biochemistry Lab	0	0	3	3	1.5
3	ENGG	Minor	M(FT)391	Applied Statistics and Numerical Methods Lab	0	0	3	3	1.5
Total of Theory and Practical								25	20.5

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

2 nd Year 4 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT401	Food Process Technology–II (Cereals, Fruits, Vegetables, Beverages)	4	0	0	4	4
2	ENGG	Major	FT402A/B/C	A. Microbial Technology and Food Biotechnology B. Environmental Biotechnology C. Industrial Biotechnology	3	0	0	3	3
3	ENGG	Major	FT403	Principles of Food Preservation	4	0	0	4	4
4	ENGG	Major	FT404	Food Process Technology–III (Milk and Milk Products)	3	0	0	3	3
5	HUM	Minor	HU(FT)401	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	FT491A/B/C	A. Microbial Technology and Food Biotechnology Lab B. Environmental Biotechnology Lab C. Industrial Biotechnology Lab	0	0	3	3	1.5
2	ENGG	Major	FT492	Food Processing Lab I	0	0	3	3	1.5
3	HUM	Ability Enhancement Course	HU(FT)491	Business Communication	0	0	2	2	1.0
Total of Theory and Practical								24	20

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

3 rd Year 5 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT501A/B/C	A. Fluid Mechanics and Heat Transfer B. Mass Transfer I C. Mechanical Operation and Separation Process I	3	1	0	4	4
2	ENGG	Major	FT502	Food Process Technology–IV (Edible Fats and Oils)	3	0	0	3	3
3	ENGG	Minor	CH(FT)501	Industrial stoichiometry	3	1	0	4	4
4	ENGG	Minor	CS(FT) 501A/B/C	A. Data Structure and Algorithms B. Data Base Management System C. Software Engineering	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	FT591	A. Fluid Mechanics and Heat Transfer Lab B. Mass Transfer I Lab C. Mechanical Operation and Separation Process I Lab	0	0	3	3	1.5
2	ENGG	Major	FT592	Food Processing Lab II	0	0	3	3	1.5
3	ENGG	Minor	CS(FT) 591A/B/C	A. Data Structure and Algorithms Lab B. Data Base Management System Lab C. Software Engineering Lab	0	0	3	3	1.5
4	ENGG	Ability Enhancement Course	HU(FT)591	Technical Seminar Presentation	0	0	1	1	0.5
5	PRJ	Project	FT581	Minor Project I	0	0	2	2	1
Total of Theory, Practical and Project								26	20

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT601	Food Packaging Technology	3	0	0	3	3
2	ENGG	Major	FT602A/B/C	A. Mass Transfer II B. Separation Process II C. Transport Phenomena	3	1	0	4	4
3	ENGG	Major	FT603	Bakery, Confectionary and Extruded Foods	4	0	0	4	4
4	ENGG	Minor	CS(FT)601A/B/C	A. Introduction to Artificial Intelligence B. Introduction to Machine Learning C. Introduction to Internet of Things	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(FT)601	Quantitative Aptitude	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	FT 691	Food Analysis and Quality Control Lab	0	0	3	3	1.5
2	ENGG	Major	FT692A/B/C	A. Mass Transfer II Lab B. Separation Process II Lab C. Transport Phenomena Lab	0	0	3	3	1.5
3	PRJ	Internship	PR(FT)691	Industrial Training (Min. 2 weeks)	0	0	0	-	2
4	PRJ	Project	FT681	Minor Project II	0	0	3	3	1.5
Total of Theory, Practical and Project								24	21.5

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

4 th Year7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT701	Principles of Biochemical Engineering.	3	1	0	4	4
2	ENGG	Major	FT702	Food Process Engineering	3	0	0	3	3
3	ENGG	Major	FT703A/B/C	A. Food Additives B. Supply Chain Management and Food Marketing C. Food Security and Sustainability	3	0	0	3	3
4	ENGG	Minor	ECS(FT)701A	Process Instrumentation and Control	3	0	0	3	3
			EE(FT)701B	Renewable Energy Technology					
			EC(FT)701C	Introduction to Nanotechnology					
5	ENGG	Minor	HU(FT)701A	Entrepreneurship Development and Start-Up Management	3	0	0	3	3
			HU(FT)702B	Quality Management System					
			CS(FT)701C	Smart Technologies					
B.PRACTICAL									
1	PRJ	Project	FT781	Major Project-I	0	0	0	7	3.5
Total of Theory, Practical and Project								24	19.5

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

4 th Year 8 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT801	Waste Management of Food Industries	3	1	0	4	4
2	ENGG	Major	FT802A/B/C	A. Project Engineering and Food Plant Layout B. Plant Maintenance, Safety and Hygiene C. Food Equipment and Plant Design	3	0	0	3	3
3	ENGG	Major	FT803A/B/C	A. Functional Foods and Nutraceuticals B. Protein Technology C. Enzyme Technology	3	0	0	3	3
4	ENGG	Minor	HU(FT)801A	Research Methodology	3	0	0	3	3
			HU(FT)802B	Product Design and Development					
			HU(FT)803C	Business Research Method					
B.PRACTICAL									
1			FT881	Grand Viva	0	0	0	0	1
2	PRJ	Project	FT882	Major Project-II	0	0	0	12	6
C.MANDATORY ACTIVITIES/COURSES									
Total of Theory, Practical and Project								25	20

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

Total Credit = 162

FIRST YEAR FIRST SEMESTER

Curriculum Structure & Syllabus

(Effective from 2023-24 admission batch)

1 st Year 1 st Semester									
Sl.No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT101	Food Microbiology	3	0	0	3	3
2	ENGG	Minor	EE(FT)101	Basic electrical engineering	2	0	0	2	2
3	SCI	Multidisciplinary	CH(FT)101	Engineering Chemistry	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU101	Professional Communication	3	0	0	3	3
5	HUM	Value Added Course	HU102	Values and Ethics	2	0	0	2	2
6	HUM	Value Added Course	HU103	Constitution of India	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	FT191	Food Microbiology Lab	0	0	3	3	1.5
2	ENGG	Minor	EE(FT)191	Basic electrical engineering lab	0	0	2	2	1
3	HUM	Ability Enhancement Course	HU191	Professional Communication Lab	0	0	3	3	1.5
4	SCI	Skill Enhancement Course	CH(FT)191	Engineering Chemistry-I Lab	0	0	3	3	1.5
5	ENGG	Skill Enhancement Course	ME(FT)191	Workshop and Manufacturing Practice Lab	0	0	3	3	1.5
Total of Theory and Practical									21

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

Course Name: Food Microbiology

Course Code: FT101

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Biology, Life science

Course Objective:

To familiarize students with procedures and techniques used to detect and enumerate microorganisms in foods and develop an understanding of spoilage microorganisms and their effects on food and integrate their basic knowledge of microbiology, chemistry, biochemistry, food processing.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Classify different types of microorganism which are present in the environment with special reference to food.

CO2: Describe the internal and external factors and predict growth of microorganisms, which can cause food spoilage.

CO3: Interpret the microbiology of various food materials and causes of food borne diseases and their etiology.

CO4: Evaluate the measures required to control undesired microorganisms in food based on the knowledge about disinfection and disinfectants.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	1	1	3	-	-	-	-	3
CO2	-	3	1	2	1	2	3	-	-	-	-	3
CO3	-	2	2	-	2	3	3	-	2	2	2	3
CO4	2	3	2	-	-	2	3	2	2	2	-	3

Course Contents:**Module I:****8L**

Introduction – definition, significance of food microbiology; Microscope; Classification & morphology of microbes including pathogens and non-pathogens; Techniques of pure culture; Bacterial growth kinetics; Bacteriology of water; Antimicrobial agents –physical & chemical–mechanism & action

Module II:**8L**

Disinfection & disinfectants; Thermal inactivation of microbes; Concept, determination & importance of TDT, F, Z & D values; Factors affecting heat resistance; Pasteurization and sterilization.

Module III:**8L**

Microbiology of milk & milk products like cheese, butter, Basic microbiology of meat, fish, poultry, prebiotics and probiotics

Module IV:**8L**

Microbiology of fruits & vegetable and products like jam, jelly, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary.

Revision:**4L****Text Book:**

1. Essentials of Microbiology; K. S. Bilgrami; CBS Publishers, Delhi, First Edition, 2019
2. Food Microbiology; WC Frazier; Tata McGraw Hill, Delhi, 5th Edition, 2017

Reference books:

1. Modern Food Microbiology; James M Jay; CBS Publishers, Delhi, 7th ed. 2004. Corr. 2nd printing 2006
2. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, Delhi, 5th Edition, 2002
3. Food Microbiology; M. R. Adams, 2nd Edition, 2002
4. Hand Book of Microbiology; Bisen, 3rd Edition, 2003

Course Name: Basic Electrical Engineering**Course Code: EE(FT)101****Contact: 3:0:0****Total Contact Hours: 36****Credit: 3****Prerequisite:** Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.**Course Outcomes:** After successful completion of the course, student will be able to**CO1:** Understand and analyze basic electric circuits**CO2:** Study the working principles of electrical machines.**CO3:** Introduce the components of low voltage electrical installations.**CO4:** Study the fundamentals of electrical Power systems and Control Systems.**CO-PO Mapping:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	-	2	2	-	-	-	-	-	-	-	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-	1

Course Content:**Module 1: DC Circuits****8L**

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module 2: AC Fundamentals**8L**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Electrical Machines**10L**

a) Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

b) Rotating Machines:

- i. **DC Machines:** Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.
- ii. **Three-Phase Induction Motor:** Basic concept of three phase circuit and production of

rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module 4: Electrical Installations**3L**

Earthing of Electrical Equipment, ideas of basic components – MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module 5: Fundamentals of Power Systems**5L**

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission- (Derivation is not needed, No Problems). Power Distribution: substation equipment's, primary and secondary transmission and distribution systems- feeder, service mains.

Module 6: Introduction to Control Systems**2L**

Concept control systems, Objectives of control system, Types of control systems, Real examples of

control systems.

Text Books:

1. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle&Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, Dhanpat Rai Publication.
4. Chakrabarti, Nath & Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference Books:

1. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.
V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 1989.

Course Name: Engineering Chemistry

Course Code: CH(FT)101

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: A basic knowledge in 10+2 science with chemistry

Course Objectives:

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Course Outcomes (COs)

After completion of the course students will be able to:

CO1: Apply the basic concepts and terms related to atomic hypothesis, periodic trends, chemical reaction dynamics, molecular configurations, industrial and analytical chemistry

CO2: Understand and formulate fundamental concepts of thermodynamics, chemical kinetics, basic organic reaction principles and energy devices, engineering materials for different engineering applications

CO3: Understand the knowledge of water quality parameters, corrosion control, drug molecule synthesis and molecular behavior for societal and environmental benefits.

CO4: Analyze crystal defects, colloidal properties, reaction mechanisms and optical molecular response pertinent to industrial applications

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	1	-	1	1	1	2
CO2	3	2	2	2	1	3	2	1	1	-	-	2
CO3	3	3	3	2	2	2	3	3	1	1	1	2
CO4	3	1	1	1	3	1	1	-	1	1	-	2

Course Content:**Module- I: Inorganic Chemistry** **8L****(i) Atomic structure**

Quantum treatment of Atomic structure, introduction to Schrodinger equation, Electronic configuration. Defects in Crystals, Band structure of Solids and Doped Semiconductors Basic Periodic trends of the elements.

Module II: Physical Chemistry**(i) Use of free energy in chemical equilibria** **5L**

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Basics of Reaction Kinetics **2L**

Rate of chemical reactions, order and molecularity of a chemical reaction, elementary and complex reactions, zero, first and second order reactions, Arrhenius Equation

(iii) Colloid Chemistry **2L**

Principles of Colloid formation, types of colloids and their properties, Colloid preparation and stability of colloids, association colloids, CMC, emulsion

Module III: Organic Chemistry**(i) Basic Reaction Mechanisms and Intermediates** **4L**

Tetravalency of carbon atoms, Electronic effects, reaction intermediates: carbocations, carbanions, carbene, nirene and introduction to reactions: substitution, addition, elimination, selective organic namereactions

(ii) Stereochemistry **4L**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

Module IV: Industrial Chemistry**(i) Water** **2L**

Hardness, alkalinity, numerical

(ii) Corrosion. **2L**

Types of corrosion: wet & dry, preventive measures

(iii) Polymers **2L**

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Nano materials **1L**

Synthesis of Nano materials, Applications in modern devices

(v) Synthesis of a commonly used drug molecule. **1L**

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3L**Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ¹H Nuclear magnetic resonance spectroscopy, chemical shift.**Text Books**

1. Fundamentals of Engineering Chemistry, 2nd edition by Dr. Sudip Bhattacharyya and Dr. Nirmal Kumar Hazra (Chaya Prakashani)
2. Engineering Chemistry, 17th edition by Dr. P.C Jain and Dr. Monika Jain (Dhanpat Rai Publishing Company (P) Ltd., New Delhi)

Reference Books

1. Concise Inorganic Chemistry, 5th edition by J.D. Lee (Wiley)
2. Physical Chemistry, 2nd edition by Dr. S. Pahari (Volume 1, New Central Book Agency Pvt. Limtd)

Course Name: Professional Communication

Course Code: HU101

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre-requisites:

Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Objectives:

The course aims to impart domain and industry-specific communication skills in a globalized context and to promote the understanding of business communication practices and cross cultural dynamics.

Course Outcomes:

By pursuing this course the students shall be able to

CO1: Define, describe and classify the modalities and nuances of communication in a workplace context.

CO2: Review, appraise and understand the modes, contexts and appropriacy of communicating across cultures and societies.

CO3: Identify, interpret and demonstrate the basic formats, templates of business and official communication.

CO4: Identify, compare and illustrate reading strategies and basic writing strategies.

CO5: Interpret, analyze and evaluate semantic- structural, interpersonal and multicultural dynamics in business communication.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO.1	-	-	-	-	-	2	1	1	2	3	-	2
CO.2	-	-	-	-	-	1	1	2	2	3	-	3
CO.3	-	-	-	-	-	3	3	1	1	3	2	3
CO.4	-	-	-	-	-	3	3	1	-	3	-	3
CO.5						2	2	2	2	3	-	3

Course Content:**Module1:****Verbal and Nonverbal communication****6 L**

Definition, Relevance and Effective Usage

Components of Verbal Communication: Written and Oral Communication

Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage

Barriers to Effective Communication

Module 2:**Workplace Communication Essentials and Cross Cultural Communication****8L**

Communication at the Workplace—Formal and Informal Situations

Language in Use—Jargon, Speech Acts/Language Functions, Syntactical and

Grammatical Appropriacy Cultural Contexts in Global Business: High Context and Low
Context Cultures

Understanding Cultural Nuances and Stereotyping

Achieving Culturally Neutral Communication in Speech and Writing

Module 3:**6L****Reading Strategies and Basic Writing Skills**

Reading: Purposes and Nature of Reading

Reading Sub-Skills—Skimming, Scanning, Intensive Reading

Reading General and Business Texts (Reading for Comprehension and Detailed
Understanding) Basic Writing Skills—Paragraph and Essay writing, writing
technical documents

Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Module 4:**4L****Report Writing**Nature and Function of Reports; Types of Reports Researching for a Business Report Format;
Language and Style Report Documentation**Module 5:****Employment Communication**a. Writing Business Letters— (Enquiry, Order, Sales, Complaint, Adjustment, Job
Application, Offer)**4L**

b. Creating an Employee Profile—Preparing a CV or Résumé.

Creating a Digital/Online Profile–Linked In (Résumé/Video Profile)

2Lc. Writing Other Interoffice Correspondence--E-mails: types, convention, and etiquette,
Memo, Notices and Circulars**2L**

d. Preparing Meeting Documentation—Drafting Notice and Agenda of Meetings,

Preparing Minutes of Meetings.

4L

References:-

1. Meenakshi Raman and Sangeetha Sharma. *Technical Communication*. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. *Cambridge English for Engineering*. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. *Professional English in Use: Engineering*. Cambridge: CambridgeUP, 2009.
4. Lesikaretal. *Business Communication: Connectingina Digital World*. New Delhi: Tata McGraw- Hill, 2014.
5. John Seeley. *Writing Reports*. Oxford: Oxford University Press, 2002.
6. Judith Leigh. *CVs and Job Applications*. Oxford: Oxford University Press, 2002.
7. Judith Leigh. *Organizing and Participating in Meetings*. Oxford: Oxford University Press, 2002.
8. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking*. 8thed. London: Longman, 2001.
10. Diana Booher. *E-writing: 21st Century Tools for Effective Communication*.

Links:-

1. Purdue University's Online Writing Lab(OWL)-<https://owl.purdue.edu/>
2. Business English Pod-<https://www.businessenglishpod.com/>

Course Name: Values and Ethics

Course Code: HU102

Contacts: 2:0:0

Total Contact Hours: 24

Credit: 2

Prerequisite: Nil

Course Outcomes:

After completion of the course students will be able to:

CO1: Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.

CO2: understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories

CO3: understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field

CO4: Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer

CO5: Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	-	-	-	-	-	2	-	3		1	2	1
CO2	-	2	-	-	-	1	-	2	3	3	3	2
CO3	-	-	-	-	-	3	3	2	3	1	3	2
CO4		2				3	3		3		3	2
CO5						3					2	

Course Content:**Module 1:****4L****Value: Definition- Importance and application of Value in life-** Formation of Value- Process of Socialization- self and integrated personality.

Types of values-Social, Psychological, Aesthetic, Spiritual, and Organizational-Value crisis in contemporary society: individual, societal cultural and management level.

Module-2**4L****Effects of Technological Growth-** Rapid Technological growth and depletion of resources, Reports of the Club of Rome.

Problems of Technology transfer- Technology assessment impact analysis.

Human Operator in Engineering projects and industries- Problems of man, machine- interaction- Impact of assembly line and automation-Human centred Technology.

Module-3**4L****Impact of Ethics on Business Policies and Strategies** – Utilitarianism – Principles of Utilitarianism - Criticism of Utilitarianism - Impact on Business Culture - Role of CEO in shaping Business Culture – Ethical Leadership – Characteristics**Module-4****2L****Types of Ethical issues** - Internal Ethics of Business – Hiring Employees – Promotion - Wages –Job discrimination - its nature and extent- Exploitation of Employees – Discipline and Whistle Blowing**Module-5****4L****Markets and consumer Protection** – Consumer rights – Unethical Practices in Marketing – Ethics of Competition and Fair Prices – Ethics in Advertising and False Claims - Environmental Protection and Ethics –Pollution Control – Ecological ethics**Module-6****6L****Social Responsibilities of Business** – Definition and case study of Corporate Compliance; Responsibilities towards Customers, shareholders, employees – Social Audit – Objectives and Need for Social Audit – Methods of Social Audit – Benefits – Obstacles –
Social Audit in India.**Text Books:**

- 1) A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996
- 2) .S. K. Chakraborty: Values and Ethics in Organization, OUP

Reference Books:

- 1) U.C. Mathur, Corporate Governance & Business Ethics, Macmillan, 2005
2. Fernando. A. C., Business Ethics – An Indian Perspective, Pearson Publication, 2009.
- 3) Prem Vir Kapoor, Professional Ethics & Human Values, Khanna Publishing House, New Delhi

Course Name: Constitution of India

Course Code: HU103

Contacts: 1:0:0

Credit: 1

Total Contact Hours: 12

Prerequisite: Nil

Course Outcome: On Completion of this course student will be able to

CO1: Identify and explore the basic features and modalities of Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the centre and state level. CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

CO4: Know the governance composition and its function at different level

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	3	-	1	-	-
CO2	-	-	-	-	-	1	-	2	-	3	-	-
CO3	-	-	-	-	-	3	-	2	-	1	-	-
CO4	-	-	-	-	-	3	-	2	-	1	-	1

Course Contents:**Module 1: History of Making of the Indian Constitution: 3L**

History. Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble Salient Features

Module 2: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy: 6L

The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and 22)
The Right against Exploitation
The Right to freedom of Religion
Cultural and Educational rights
The Right to Property
The Right to Constitutional Remedies
Fundamental Duties

Module 3: Organs of Governance: 3L

Parliament - Composition - Qualifications and Disqualifications - Powers and Functions – Executive- President -Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

Text Book:

- 1) Indian Constitution by D.D. Basu, The Publisher, LexisNexis
- 2) PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books:

- 1) Constitution of India by Subhas C Kasyap, Vitasta Publishing
- 2) The Constitution of India, P.M Bakshi, Universal Law Publishing Co. Ltd, New Delhi, 2003.
- 3) Indian Constitution Text Book - Avasthi, Avasthi, Publisher: LAKSHMI NARAIN AGARWAL
- 4) Introduction to the Constitution of India, Brij Kishore Sharma, PHI

Course Name: Food Microbiology Lab

Course Code: FT191

Contact: 0:0:3

Credit: 1.5

Prerequisites: Biology, Life science

Course Objective:

To help the students understand various methods of isolation, characterization and screening of bacteria, fungi and other related microorganisms and apply different preservation techniques relative to food safety and spoilage.

Course outcome:

After the completion of the Food Microbiology Lab the students will be able to:

CO1: Explain various methods of isolation, characterization and screening of bacteria, fungi and other related organisms

CO2: Develop skills to monitor various microbial food processing operations in food industries.

CO3: Apply different preservation techniques relative to food safety and spoilage.

CO4: Illustrate the growth requirements of common food borne pathogens and spoilage microorganisms.

CO-PO Mapping:

COs	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	3	-	2	-	2	-	-	2
CO2	2	2	1	2	3	1	2	-	1	1	2	2
CO3	2	2	-	-	2	-	3	2	2	2	2	3
CO4	2	-	-	-	3	2	2	2	1	1	-	2

List of Experiments:

1. Study of a compound microscope.
2. Simple staining, Gram Staining and the study of cellular morphology of bacteria.
3. Study of autoclave, preparation and sterilization of nutrient broth.
4. Sub-culturing of a bacterial strain in liquid and solid medium.
5. Study of the growth of *E.coli* by spectrophotometer.
6. Study of micro biological quality of milk by MBRT test.
7. Preparation of synthetic medium for the growth of yeast and mold and inoculation with standard strains of yeasts and molds.
8. Isolation of starch-hydrolyzing organism from soil. Dilution and Plating by spread–plate and pour–plate techniques.
9. Dilution and Plating by spread–plate and pour–plate techniques.
10. Isolation of pure culture.
11. Morphological study of bacteria, yeast & mold and taking of photograph using Binocular Microscope.
12. Preparation and characterization of fermented food products
13. Innovative Experiments

Course Name: Basic Electrical Engineering Laboratory

Course Code: EE(FT)191

Contact: 0:0:3

Credit: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Outcomes: After successful completion of the course, student will be able to

- CO1:** Identify and use common electrical components.
- CO2:** Develop electrical networks by physical connection of various components and analyze the circuit behavior.
- CO3:** Apply and analyze the basic characteristics of transformers and electrical machines.
- CO4:** Evaluate performance of different types of electrical machines

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	1	-	-	1
CO2	-	2	2	2	-	-	-	-	2	-	-	1
CO3	-	2	-	2	-	-	-	-	2	-	-	1
CO4	3	-	-	3	2	-	2	3	3	3	-	2

List of Experiments:

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments.

Course Name: Professional Communication Lab

Course Code: HU191

Contact: 0:0:3

Total Contact Hours: 36

Credit: 1.5

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:

By pursuing this course the students will be able to:

CO1: Recognize, identify and express advanced skills of Technical Communication in English through Language Laboratory.

CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.

CO3: Articulate and present the skills necessary to be a competent Interpersonal communicator.

CO4: Deconstruct, appraise and critique communication behaviors.

CO5: Adapt, negotiate and facilitate with multifarious socio-economical and professional arenas with effective communication and interpersonal skills.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	-	1	1	-	2	3	-	2
CO2	-	-	2	2	-	3	3	-	2	3	-	3
CO3	-	-	2	2	-	3	3	2	2	3	-	3
CO4	-	-	-	-	-	3	3	2	2	3	-	3
CO5	-	-	2	2	-	3	3	2	2	3	-	3

Course Contents:

Module 1: Introduction to the Language Lab

- a. The Need for a Language Laboratory
- b. Tasks in the Lab
- c. Writing a Laboratory Note Book

Module 2: Active Listening

- a. What is Active Listening?
- b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
- c. Listening in Business Telephony

Module 3: Speaking

- a. Speaking—Accuracy and Fluency Parameters
- b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
- c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
- d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
- e. Group Discussion: Principles and Practice
- f. Giving a Presentation—Learning Presentation Basics and Giving Micro Presentations

Module 4: Lab Project Work

- a. Writing a Book Review
- b. Writing a Film Review
- c. Scripting a Short Presentation (2 minutes)
- d. Making a short video CV (1-2 minutes)

References:

1. IT Mumbai, **Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al. *A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

Course Name: Engineering Chemistry Lab

Paper Code: CH(FT)191

Contact : 0:0:3

Total Contact Hours: 36

Credit: 1.5

Prerequisites: A basic knowledge in 10+2 science with chemistry

Course Objectives:

- Study the basic principles solution chemistry and conductometric and pH metric titrations.
- Analysis of water quality parameters relevant to industrial applications.
- Analysis of inorganic and organic samples
- Synthesis Polymeric materials and drugs.

Course Outcomes (COs):

After attending this course, students would be

CO1: To operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CO2: To analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.

CO3: To analyze different parameters of water considering environmental issues.

CO4: To analyze inorganic radicals and organic functional groups in different inorganic and organic samples

CO5: To synthesize drug and polymer materials

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	2	2	-	-	-	-	1	2	2
CO2	3	3	3	2	1	-	2	1	-	1	-	3
CO3	3	3	3	3	3	1	1	1	-	1	-	2
CO4	2	3	3	3	3	-	-	-	-	1	1	2
CO5	3	3	3	3	1	1	1	-	1	-	2	3

Course Content:

1. Preparation of primary and secondary standard solutions and standardization of secondary standard solution against known primary standard solutions
2. Determination of hardness of water
3. Determination of chloride content of water
4. Estimation of iron in Mohr's salt solution by permanganometry (Redox Titration)
5. Determination of the partition coefficient of a substance between two immiscible liquids
6. Determination of cell constant and conductometric titration
7. Determination of relative viscosity of sugar solution by Ostwald Viscometer
8. pH metric titrations
9. Qualitative Chemical analysis of an inorganic salt: Acid and basic radicals
10. Determination of organic function groups in an organic sample
11. Innovative experiments (any one)
 - Synthesis of silver nano-particles
 - Synthesis of a polymer/drug

Course Name: Workshop and Manufacturing Practices Lab

Course Code: ME(FT)191

Contact: 0:0:3

Credits: 1.5

Prerequisite: Physics & Mathematics (10+2 Level)

Course Outcomes (COs):

CO1: Gain basic knowledge of Workshop Practice and Safety useful for our daily living.

CO2: Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc.

CO3: Apply and performing operations like such as Marking, Cutting etc used in manufacturing processes.

CO4: Analyze the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.

CO5: Get hands on practice of in Welding and apply various machining processes which give a lot of confidence to manufacture physical prototype sin project works.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	–	–	–	–	–	2	–	2	2	–	–
CO2	3	–	–	–	–	–	2	–	2	2	–	–
CO3	3	–	–	–	–	–	2	–	2	2	–	–
CO4	3	–	–	–	–	–	2	–	2	2	–	–
CO5	3	2	2	–	–	–	2	–	2	2	–	–

Course Content:

3P

(i) Theoretical discussions:

1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing, 3D Printing
8. Plastic moulding & Glass Cutting

(ii) Workshop Practice:

At least 6 modules should be covered

Module 1-Machinshop 6P

Typical jobs that may be made in this practice module: i. To make a pin from a mild steel rod in a lathe.

ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and/or milling machine.

Module 2-Fitting shop 6P

Typical jobs that may be made in this practice module: To make a Gauge from MS plate.

Module 3-Carpentry Shop 6P

Typical jobs that may be made in this practice module: To make wooden joint and/or A pattern or like.

Module 4-Welding & Soldering shop 6P

Typical jobs that may be made in this practice module:

- i. Arc Welding: To joint with thick (approx 5mm) MS plates by manual metal arc welding.
- ii. Gas Welding: To joint within mild steel plates or sheets by gas welding.
- iii. House wiring, soft Soldering

Module 5-Smithy & Casting 6P

Typical jobs that may be made in this practice module:

- i. A simple job of making a square rod from round bar or similar.
- ii. One/two greens and moulds to prepare, and a casting be demonstrated.

Module 6- CNC Machining & Laser Cutting 6P

Typical jobs that may be made in this practice module:

- i. At least one sample shape on mild steel plate should be made using CNC Milling / CNC Lathe Machine
- ii. At least one sample shape on glass should be made using laser cutting machine.

Module 7 – 3D Printing 6P

- i) Exposure to a 3D printing machine, ii) 3D printing of at least one sample model using available materials.

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

Text Books:

1. Hajra Choudhury S.K. Hajra Choudhury A.K. and Nirjhar Roy S.K.,—Elements of Workshop Technology, Vol.I 2008 and Vol.II 2010, Media promoters and publishers private limited, Mumbai.

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2. Rao P.N., —Manufacturing Technology, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology– I, Pearson Education, 2008.
2. Roy A. Lindberg, —Processes and Materials of Manufacture, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G. C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

Curriculum Structure & Syllabus
(Effective from 2023-24 admission batch)

1 st Year 2 nd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	FT201	Chemistry of Food	3	0	0	3	3
2	SCI	Multidisciplinary	PH(FT)201	Engineering Physics	2	0	0	2	2
3	SCI	Multidisciplinary	M(FT)201	Engineering Mathematics	3	0	0	3	3
4	HUM	Value Added Course	HU204	Environmental Science	2	0	0	2	2
5	HUM	Value Added Course	HU205	Indian Knowledge System	1	0	0	1	1
6	ENGG	Skill Enhancement Course	CS(FT)201	Programming for Problem Solving	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	FT291	Chemistry of Food Lab I	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH(FT)291	Engineering Physics Lab	0	0	2	2	1
3	ENGG	Skill Enhancement Course	ME(FT)291	Engineering Graphics & Design Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CS(FT)291	Programming for Problem Solving Lab	0	0	3	3	1.5
Total of Theory and Practical								25	19.5

FIRST YEAR SECOND SEMESTER
Course Name: Chemistry of Food
Course Code: FT201
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Pre requisites: Engineering Chemistry
Course Objective

The main objectives of this course is for students to differentiate chemical interactions and reactions of food components and their effect on sensory, nutritional, and functional properties of foods, and how processing influences these properties.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Explain the structure and composition of different nutrients.

CO2: Interpret the chemistry underlying the properties and reactions of various food components and along with the function of the nutrients in different food materials.

CO3: Analyze how processing conditions are likely to change the reactivity of food components.

CO4: Apply fundamental concepts to know the principles behind analytical techniques associated with food.

CO-PO Mapping:

COs	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	2	1	-	-	-	-	3
CO2	3	3	3	2	1	2	1	1	2	1	2	3
CO3	3	3	3	3	2	2	2	1	2	2	1	3
CO4	3	3	2	2	2	2	2	2	2	2	1	3

Course Contents:**Module I:****8L**

Importance of food chemistry; Food Groups; Water in foods and its properties: different types of moisture in food; Water activity, Determination of moisture content, water absorption isotherm.

Carbohydrate: Sources of food carbohydrates; Classifications; Structure, Physico-chemical and functional properties: Monosaccharides, Disaccharides, Oligosaccharides, Polysaccharides, homosachharides and heterosachharides; Starch: Structure, sources, properties (hydrolysis, gelatinization, retrogradation, dextrinisation, crystallization); Glycogen: definition, properties, Cellulose, pectin, gums: Occurrences, properties, uses.

Module II:**8L**

Proteins: Sources, Basic structure and physico-chemical and functional properties: Amphoterism, hydration, binding of ions, precipitation with antibiotics, gel formation, Different types of food proteins. Purification of proteins (basic concepts): Electrophoresis, Gel filtration Spectrophotometric analysis, Chromatographic analysis. Amino acids: Essential and non essential amino acids, their structures, deficiency diseases; Acidic and basic amino acids.

Module III**8L**

Fats: Sources; Classifications; Fatty acids: Classifications with examples and structure (SAFA, MUFA, PUFA); Omega 3 and Omega 6 fatty acids.

Physico-chemical and functional properties; Rancidity: Definition, types of rancidity of fats and oils; Reversion of fats; Antioxidants: Definition, examples, roles; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Lipids of biological importance like cholesterol and phospholipids.

Module IV**8L**

Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Provitamins A&D; Vitamins as antioxidants. Food Pigments & Flavouring Agent: Importance, types and sources of pigments (Chlorophyll, Carotenoids, anthocyanin, and flavonoids)– their changes during processing and storages.

Revision:**4L****Text Book:**

1. Food Chemistry by H. K. Chopra & P. S. Panesar, 2nd reprint 2015
2. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2, 2nd edition
3. Food Chemistry by L. H. Meyer, reprint 2004

Reference books:

1. Food Science by Norman N. Potter & Joseph H. Hotchkiss, 5th edition
2. Hand Book of Analysis of fruits & vegetables by S. Ranganna Chemical changes in food during processing by Richardson

Course Name: Engineering Physics

Course Code: PH(FT)201

Contact: 2:0:0

Total Contact Hours: 24

Credits: 2

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students should be able to

- CO1:** Explain basic principles of laser and optical fibers.
- CO2:** Understand the basics of a semiconductor
- CO3:** Application of LASER in the working of holography
- CO4:** Analyze different crystallographic structures according to their coordination number and packing factors.
- CO5:** Justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	--	--	--	--	--	--	--	2
CO2	3	3	2	2	--	--	--	--	--	--	--	2
CO3	3	3	2	2	--	--	--	--	--	--	--	1
CO4	3	2	2	2	--	--	--	--	--	--	--	2
CO5	3	3	3	2	2	--	--	--	--	--	--	1

Course Content:**Module 1:** 12L**Modern Optics**

1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L

1.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle. 2L

1.03-Holography-Theory of holography, viewing of holography, applications 3L

Module 2 (6L) Solid State Physics

Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation. 3L

Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

Module 3 (8L) Quantum Mechanics

Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment, related numerical problems. 4L

Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement). 4L

Text Books for Engineering Physics:**Modern Optics:**

1. A text book of Light- K.G. Mazumder & B. Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-R. Kar, Books Applied Publishers
6. Modern Physics- A Beiser , TMH

Solid State Physics:

1. Solid state physics-Puri&Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Quantum Mechanics:

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuilla (S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

Course Name: Engineering Mathematics

Course Code: M (FT) 201

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) algebra and calculus.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to matrix algebra, probability and Numerical Methods.

CO2: Determine the solutions of the problems related to matrix algebra, probability and Numerical Methods.

CO3: Apply the appropriate mathematical tools of matrix algebra, probability and Numerical Methods.

CO4: Analyze different engineering problems linked with matrix algebra, probability and Numerical Methods.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	3	2	2	-	-	-	-	-	-	-	2

Course Content:**Module I: Numerical Methods****16L**

Introduction to error analysis, Calculus of finite difference. Interpolation: Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Module-II: Probability and Random Variables**[10L]**

Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson, Uniform, Exponential and Normal distributions

Module-III: Matrix Algebra**(10)**

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors, Cayley-Hamilton theorem.

Project Domains:

1. Study on eigenvalues and eigenvectors.
2. Application of Probability in different engineering branches.
3. Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint,
6. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies. 7. 2008.
8. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers
9. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education(India) Private Limited.
2. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International

Publishers

3. Poole, D., *Linear Algebra: A Modern Introduction*, 2nd Edition, Brooks/Cole, 2005.
4. Spiegel, M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGrawHill Book Co.

Course Name: Environmental Science

Course Code: HU204

Contact: 2:0:0

Credits: 2

Contact Hours: 24

Prerequisites: 10+2

Course Objective(s)

This course will enable the students to,

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Able to understand the natural environment and its relationships with human activities

CO2: The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk

CO3: Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues

CO4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

CO – PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	-	2	3	3	-	-	1	2
CO2	3	3	3	1	1	2	3	3	-	-	1	2
CO3	3	3	3	2	1	2	3	3	-	-	1	2
CO4	1	1	1	1	2	2	3	3	-	-	1	2

Course Content:**Module 1 - Resources and Ecosystem (6L)**

1. Resources (2L)

Types of resources, resistance to resources, Human resource, Population Growth models: Exponential Growth, logistic growth

2. Ecosystem (3L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Food chain, Food web.

3. Energy and Environment(1L)

Conventional energy sources, coal and petroleum, Green energy sources, solar energy, tidal energy, geothermal energy, biomass

Module 2 – Environmental Degradation (9L)

1. Air Pollution and its impact on Environment (3L)

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (3L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD, COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal poisoning and toxicity.

3. Land Pollution and its impact on Environment (2L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes

4. Noise Pollution and its impact on Environment (1L)

Types of noise, Noise frequency, Noise pressure, Noise intensity, Noise Threshold limit, Effect of noise pollution on human health.

Module 3 – Environmental Management (6L)

1. Environmental Impact Assessment (1L)

Objectives of Environmental management, Components of Environmental Management, Environmental Auditing, Environmental laws and Protection Acts of India

2. Pollution Control and Treatment**(2L)**

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator, etc., Waste Water Treatment, Noise pollution control.

-
3. Waste Management (3L)
Solid waste management, Open dumping, Land filling, incineration, composting, E-waste management, Biomedical Waste management.

Module 4 – Disaster Management (3L)

1. Study of some important disasters (2L)
Natural and Man-made disasters, earthquakes, floods drought, landside, cyclones, volcanic eruptions, tsunami, Global climate change. Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.
2. Disaster management Techniques (1L)
Basic principles of disasters management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. Basic Environmental Engineering and Elementary Biology (For MAKAUT), Gourkrishna Dasmohapatra, Vikas Publishing.
2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.
3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.
2. Environmental Science (As per NEP 2020), Subrat Roy, Khanna Publisher

Course Name: Indian knowledge System**Course Code: HU205****Contact: 1:0:0****Credit: 1****No. of lectures: 12****Prerequisites: Nil****Course Outcomes:**

CO1: To recall & state thought process of social setting in ancient India to identify the roots and details of some contemporary issues faced by Indians

CO 2: The students are able to identify & inspect the importance of our surroundings & culture to design & formulate sustainable developmental solutions

CO 3: To develop the ability to understanding the issues related to 'Indian' culture, tradition and its composite character to apply the same in the socio-technological developments in present scenario

CO4: The students are able to relate & assess Indian Knowledge System in the health care, architecture, agriculture & other systems .

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	-	-	2	3	-	3	-	2	3	1	-	2
CO2	-	-	2	-	-	3	3	2	3	3	-	
CO3	-	-	2	-	-	3	3	1	3	1	-	2
CO4			2			3	3	2	3			

Course Contents**Module-1****3L**

An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life. Indian philosophical systems: Different schools of philosophy.

Module-2**3L**

Salient features of the Indian numeral system: Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers.

Highlights of Indian Astronomy: Historical development of astronomy in India

Module-3**3L**

Indian science and technology heritage: Metals and metalworking - Mining and ore extraction - Physical structures in India - Irrigation and water management - Dyes and painting technology - Surgical Techniques - Shipbuilding

Module-4**3L**

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, Traditional Knowledge in agriculture, Traditional societies depend on it for their food and healthcare needs.

Text Book:

- 1) Introduction to Indian knowledge system: concepts and applications-Mahadevan B. Bhat, Vinayak Rajat, Nagendra Pavana R.N., PHI

Reference Books:

- 1) Traditional Knowledge system in India, Amit Jha, Atlantic Publishers
- 2) S. N. Sen and K. S. Shukla, *History of Astronomy in India*, Indian National Science Academy, 2nd edition, New Delhi, 2000

Course Name: Programming for Problem Solving

Course Code: CS(FT)201

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Course Outcome(s):

CO1: To identify the working principle of input and output devices of Computers memorize the basic terminology used in computer programming.

CO2: To express programs in C language and use different data types for writing the programs.

CO3: To implement programs using the dynamic behaviour of memory by the use of pointers.

CO4: To explain the difference between call by value and call by address.

CO5: To write programs using basic data files and developing applications for real world problems.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO112
CO1	3	3	3	2	2	-	-	-	-	-	2	3
CO2	2	2	3	3	3	-	-	-	-	-	-	3
CO3	2	3	2	2	2	-	-	-	-	-	-	3
CO4	3	2	2	3	3	-	-	-	-	-	-	2
CO5	2	2	2	1	1	-	-	-	-	-	2	3

Course Content:**Module-1: Fundamentals of Computer****(9L)**

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.

Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in signed magnitude signed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using 1's complement and 2's complement). Representation of Characters-ASCII Code, Basics of Compiler, Interpreter and Assembler

Problem solving – Basic concept of Algorithm. Representation of algorithm using flowchart and pseudo code, Some basic examples.

Module-2: Introduction to C Programming**(5L)**

Overview of Procedural vs Structural language; History of C Programming Language.

Variable and Data Types: The C characters identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational operators, Logical operators, increment and decrement operators, bitwise operators, Assignment operators, conditional operators, special operators-type Conversion, C expressions, precedence and associativity. Input and Output: Standard input and output, formatted output–printf, formatted input scanf.

Module-3: Branch and Loop**(5L)**

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder. Switch Case: break and continue; switch-case, concept of go to and labels Loops- while, for, do while.

Module-4: Program Structures**(4L)**

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.

Storage Class in C: Storage Class-auto, external, static and registers to rage class, scope rules and lifetime of variables

C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer**(7L)**

Arrays: One dimensional array, Two-dimensional arrays Passing an array to a function Pointers: Pointers, Pointer and Array, Pointer and functions.

Strings: Character array and string, array of strings, Passing a string to a function,

String related functions, Pointer and String. Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum (3L)

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C (3L)

Files handling-opening and closing a file indifferent mode, formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. Kanetkar Y.- Let us C, BPB Publication,15 Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad– MASTERINGC, TMH, 2nd Edition

Course Name: Chemistry of Food Lab I

Course Code: FT291

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Chemistry

Course Objective:

To provide an opportunity to the students to define chemistry as the study of the composition, structure, properties of food materials and identify methods and instruments that can be used to study of food chemistry and To focus on the development of skills to control the quality of food by providing an opportunity to the students prioritize different controlling parameters to improve shelf-life of food and to prevent adulteration.

Course outcome:

After the completion of the Chemistry of Food Lab-I the students will be able to:

CO1: Define chemistry as the study of the composition, structure, properties of food materials and including methods and instruments that can be used to study of food chemistry.

CO2: Recognize the importance of proximate analysis.

CO3: Choose different controlling parameters to improve shelf-life of food.

CO4: Evaluate data generated by experimental methods for chemical characterization of food materials.

CO-PO Mapping:

COs	Program Outcomes											
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	2	2	2	1	3	2	2	3
CO2	2	2	1	-	3	2	1	2	3	2	2	3
CO3	2	2	2	2	2	2	2	2	3	1	2	3
CO4	3	2	2	1	-	-	-	-	2	2	2	3

List of Experiment:

1. Determination of Moisture in food sample
2. Determination of Protein in food sample
3. Determination of Ash in food sample
4. Determination of Crude Fat in food sample by Soxhlet apparatus.
5. Determination of fat present in liquid milk by Gerber centrifuge.
6. Determination of Acidity and pH in food sample/beverages
7. Determination of total, non-reducing and reducing sugars in food sample
8. Determination of Vitamin C in food sample
9. Innovative experiment

Text books:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2, 2nd edition
2. Food Chemistry by L. H. Meyer, reprint 2004, 2nd reprint 2015

Reference books:

1. Food Science by Norman N. Potter & Joseph H. Hotchkiss, 5th edition
2. Food Chemistry by H. K. Chopra & P. S. Panesar,
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Chemical changes in food during processing by Richardson

Course Name: Engineering Physics Lab

Course Code: PH(FT)291 Contact

Hours: 0:0:3

Credit: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):

After attending the course students’ will be able to

CO1: demonstrate experiments allied to their theoretical concepts

CO2: conduct experiments using LASER, Optical fiber.

CO3: participate as an individual, and as a member or leader in groups in laboratory sessions actively

CO4: analyze experimental data from graphical representations, and to communicate effectively them in laboratory reports including innovative experiment.

CO5: Design solutions for real life challenges

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	--	--	--	--	--	--	--
CO2	2	3	2	3	3	--	--	--	--	--	--	--
CO3	2	3	2	3	3	--	--	--	--	--	--	--
CO4	2	2	3	2	3	--	--	--	--	--	--	--
CO5	2	2	3	2	3	--	--	--	--	--	--	--

Course Content:**General idea about Measurements and Errors (One Mandatory):**

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.

Experiments on Classical Physics (Any 4 to be performed from the following experiments):

1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of Young's moduli of different materials.
3. Determination of Rigidity moduli of different materials.
4. Determination of wavelength of light by Newton's ring method.
5. Determination of wavelength of light by Laser diffraction method.
6. Optical Fibre-numerical aperture, power loss.

Experiments on Quantum Physics (Any 2 to be performed from the following experiments):

7. Determination of Planck's constant using photoelectric cell.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Stefan's Constant.
10. Study of characteristics of solar cell.

Perform at least one of the following experiments:

11. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
12. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.

**In addition it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Study of dispersive power of material of a prism.
2. Determination of the angle of optical rotation of a polar solution using polarimeter.
3. Any other experiment related to the theory.

Recommended Text Books for Engineering Physics Lab:**Waves & Oscillations:**

1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit Classical & Modern

Optics:

2. A text book of Light- K.G. Mazumder & B. Ghosh (Book & Allied Publisher)

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics:

1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

Course Name: Engineering Graphics & Design Lab

Course Code: ME(FT)291

Contact: 0:0:3

Credits: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO1: Learn the basics of drafting

CO2: Understand the use of drafting tools which develops the fundamental skills of industrial drawings.

CO3: Apply the concept of engineering scales, dimensioning and various geometric curves

necessary to understand design of machine elements.

CO4: Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.

CO5: Evaluate the design model to different sections of industries as well as for research & development.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	-	-	-	-	-	-
CO2	2	-	-	2	-	-	-	-	-	-	-	-
CO3	3	-	-	2	-	-	-	-	-	-	-	-
CO4	3	-	-	3	-	-	-	-	-	-	-	-
CO5	3	2	-	3	2	-	-	-	-	-	-	-

Course Contents:**Basic Engineering Graphics: (3P)**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing (6P)

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections (6P)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids (6P)

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics: (3P)

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics: (3P)

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering (6P)

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers,

changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project (3P)

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kanniah (2008), Text book on Engineering Drawing, Scitech Publishers.

Course Name: Programming for problem solving Lab**Course Code: CS(FT)291****Contact: 0:0:3****Total Contact Hours: 36****Credits: 1.5****Course Outcomes:**

Upon successful completion of this course, the student will be able to:

CO1: Identify the working of different operating systems like DOS, Windows, Linux**CO2:** Express programs in C language**CO3:** Implement programs connecting decision structures, loops**CO4:** Experiment with user defined functions to solve real time problems**CO5:** Write C programs using Pointers to access arrays, strings, functions, structures and files**CO-PO Mapping:**

CO	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO 10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	-	2	3
CO2	2	2	3	3	3	-	-	-	-	-	-	3
CO3	2	3	2	2	2	-	-	-	-	-	-	3
CO4	3	2	2	3	3	-	-	-	-	-	-	2
CO5	2	2	2	1	1	-	-	-	-	-	2	3

Course Content:

Module- 1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

- a) Basic data types
- b) Different arithmetic operators.
- c) Printf() and scanf() functions.

Module-3: Problem based on conditional statements using

- a) if-else statements
- b) different relational operators
- c) different logical operators

Module-4: Problem based on

- a) **for** loop
- b) **while** loop
- c) **do-while** loop

Module-5: Problem based on

- a) How to write a menu driven program using switch-case statement
- b) How to write a function and passing values to a function
- c) How to write a recursive function.

Module-6: Problem based on

- a) How to use array (both 1-D and 2-D).
- b) How to pass an array to a function.

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

- a) How to handle compound variable in C
- b) How to handle file in C
- c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

2. Kanetkar Y.-Let us C, BPB Publication,15 Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India KR Venugopal & S R Prasad–MASTERINGC, TMH, 2nd Edition

2 nd Year 3 rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT301	Biochemistry and Nutrition	4	0	0	4	4
2	ENGG	Major	FT302	Food Process Technology–I (Fish, Meat, Poultry)	3	0	0	3	3
3	ENGG	Minor	ME(FT)301	Engineering Thermodynamics and Kinetics	3	1	0	4	4
4	ENGG	Minor	M(FT)301	Applied Statistics and Numerical Methods	2	1	0	3	3
5	HUM	Ability Enhancement Course	HU(FT)301	Principles of management	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	FT391	Chemistry of Food Lab II	0	0	3	3	1.5
2	ENGG	Major	FT392	Biochemistry Lab	0	0	3	3	1.5
3	ENGG	Minor	M(FT)391	Applied Statistics and Numerical Methods Lab	0	0	3	3	1.5
Total of Theory and Practical								25	20.5

*HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project

SECOND YEAR FIRST SEMESTER
Course Name: Biochemistry and Nutrition
Course Code: FT301
Contact: 4:0:0
Total Contact Hours: 48
Credit: 4
Pre requisites: Chemistry, Biology

Course Objective

To introduce the students to the biological basis of nutrition and the mechanisms by which diet can influence health and help them develop laboratory skills required for modern biochemical and molecular studies of nutrition.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Describe the major metabolic pathways involved in the metabolism of nutrients in the human body.

CO2: Understand the principles of biochemical processes and methods and be able to use them with appropriate application.

CO3: Interpret the basis of reactivity of biologically relevant molecules and their interactions.

CO4: Evaluate the data for different biochemical experimental procedures.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	2	-	-	-	-	3	3	2	3
CO2	3	3	2	2	2	1	-	2	-	-	2	3	3	2	2
CO3	3	3	3	3	2	2	2	-	-	2	-	3	2	3	1
CO4	3	3	3	3	-	-	-	-	2	2	-	3	2	3	3

Course Contents:**Module I:****10L**

Introduction to Biochemistry: Proteins and protein structures; Trans amination; Metabolism of proteins (digestion and absorption); Nitrogen balance and nitrogen pool; Evaluation of quality of proteins: BV, PER, NPU, Chemical Score.

Module II:**11L**

Enzymes; Definition, function, classification, nomenclature & structure; Co-enzymes and its function; Mechanism of enzyme action: Single, bi and multi substrate reactions; Lock and Key model, Induced fit model; Enzyme kinetics: MME, Significance of MM Constant, MME and Allosteric enzyme kinetics; Enzyme inhibition: Reversible and Irreversible; LB Plot, Feedback inhibition, Substrate acts as inhibitor, Turn over number.

Module III:**13L**

Carbohydrates; Metabolic pathways for breakdown of carbohydrates: glycolytic pathway and its importance, energy yield; pentose phosphate pathway and its importance, energy yield; citric acid cycle and its importance, energy yield; Gluconeogenesis; Pathway, importance, energy yield, Cori cycle; Electron transport chain: Pathway, importance, Energy yield, Oxidative phosphorylation, ATP balance. Essential fatty acids, Metabolism of ketone bodies, alpha, beta and omega oxidation of fatty acids; Digestion & absorption of lipids.

Module IV:**10L**

Vitamins & minerals: Physiological function of vitamins and minerals. Introduction to human nutrition; Nutritive values of foods; Basal metabolic rate; Techniques for assessment of human nutrition, Dietary requirements and deficiency diseases of different nutrients, micronutrients, importance of nutraceuticals with some case studies.

Revision:**4L****Text Book:**

1. Lehninger, Nelson & Cox, Principle of Biochemistry, CBS Publication
2. Modern Experimental Biochemistry, Boyer, Pearson Education
3. Lubert stryer, Biochemistry, Freeman & Co, N.Y.

Reference books:

1. Voet & Voet, Fundamentals of Biochemistry, Jonh Willey & Sons
2. Instant Notes in Biochemistry by D. Hames & N. Hooper
3. Biochemistry by Debojyoti Das
4. Textbook of Biochemistry by E. S. West & W. R. Tod

Course name: Food Process Technology – I (Fish, Meat, Poultry)

Course Code: FT302

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Food Chemistry, Food Preservation, Food Microbiology

Course Objective:

To provide an opportunity for students to classify different processing techniques required for preservation of fish, meat, poultry and classify the different by products related to these industries.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Identify the significance different processing techniques required for preservation of fish.

CO2: Classify the different by products related to fish processing industries and describe their use.

CO3: Compare the various components of the meat muscle with special focus on slaughtering and post mortem changes in meat, preservation and to recognize the different processing techniques related to meat processing industry and use of meat byproducts

CO4: Develop a general understanding on the structure, composition, nutritional values and effective preservation methods of eggs.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	-	3	3	3	3	3	-	3	2	3	3
CO2	2	3	3	3	2	3	3	3	3	3	-	3	2	3	3
CO3	3	3	3	3	2	3	3	3	3	3	2	3	2	2	3
CO4	2	3	3	3	2	3	3	3	3	3	2	3	2	3	3

Course Contents:**Module I: 10L**

Classification of fresh water fish and marine fish; Commercial handling, storage and transport of fish; proximate composition and nutritive value of fish; Indices of freshness and its quality assessment, contaminants and toxicants in fish- both endogenous and exogenous,; Spoilage of fish; Methods of Preservation of fish and fish products: Canning, Freezing, Drying, Curing, Smoking, Fermentation (fish sauce) marinating and pickling, irradiation; effect of processing and storage on nutritive value; packaging.

Module II: 6L

Fish byproducts - production of fish meal, fish protein concentrate, and fish protein hydrolysate fish liver oil and fish silage; Production of chitin, chitosan; Production of non- food items from fish; Processing of fish wastes.

Module III: 12L

Slaughtering of animals; Classification, composition and nutritive value of poultry meat; Post mortem changes of meat; Curing and smoking of meat; Fermented meat products (sausages and sauces); Frozen meat & meat storage; By-products from slaughter houses and meat processing industries and their utilization.

Module IV: 4L

Structure, composition and nutritive values of eggs; Quality assessment (defects) of eggs; Processing of eggs; Byproduct Utilization, Utilization of egg- derived products as food ingredients.

Revision: 4L**Text Books:**

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Food Science by B. Srilakshmi

Reference Books:

1. Meat Science and Applications - Y H. Hu., Wai-Kit Nip, Robert W. Rogers& Owen A. Young, Marcel Dekker,2001.
2. Advanced Technologies for Meat Processing - Leo M. L. Nollet& Fidel Toldrá, CRC Press, 2006.
3. Meat; Cole DJA &Lawrie RA; 1975, AVIPub.
4. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA &Pasch S; 1988, Elliswood Ltd.
5. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub.Ltd.
6. Fish & Fisheries of India; Jhingram VG; 1983, Hindustan PubCorp
7. Fish as Food, Vol. I-IV; George Borgstrom, Academic Press

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8. Fish Processing Technology ,Rogestein & Rogestein
 9. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRCPress.
 10. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVIPub.

Course Name: Engineering Thermodynamics and Kinetics

Course Code: ME(FT)301

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Physics, Chemistry and Mathematics

Course Objective:

To introduce the principles of chemical engineering thermodynamics and illustrate their applications in the design of chemical process plants and to learn about reaction kinetics for single, multiple, isothermal, non-isothermal reactions

Course Outcome(s):

After completion of the course students will be able to:

CO1: Understand the basic concept to engineering thermodynamics and their applications in engineering field

CO2: Identify the phase equilibria in two-component and multi-component systems

CO3: Estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture

CO4: Discover the concepts of order and molecularity of chemical reactions.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	2	2	1	3	3	3	3
CO2	3	3	2	2	1	1	2	-	2	2	2	3	3	2	2
CO3	3	3	2	2	2	2	1	2	2	2	2	3	3	2	2
CO4	3	3	1	2	-	-	-	-	2	2	1	3	3	2	3

Course Contents:**Module I****11L**

Review of 1st, 2nd and 3rd law of thermodynamics; PVT behaviour of Pure Substances; Virial Equation of State, Generalized Correlations for Gases and Liquids; Application of the Virial Equations; Cubic Equations of State; The Nature of Equilibrium; The Phase Rule; Duhem's Theorem.

Module II**11L**

Simple model's for vapour/liquid Equilibrium, Rault's Law, Henry's law, Modified Raoult's Law, Vapour Liquid Equilibrium, K-value correlations; VLE from Cubic Equations of State; Equilibrium and Stability; Liquid/liquid equilibrium; Solid/liquid equilibrium; Solid/vapour equilibrium.

Module III**11 L**

Thermodynamics and its Applications: The Chemical Potential and Phase Equilibria Fugacity and Fugacity, Coefficient: for pure species and solution; Generalized correlations for Fugacity, the Ideal Solution, Property Changes and Heat Effects of Mixing Processes. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

Module IV**11 L**

Kinetics: Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrhenius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First and Second order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half-life method.

Revision:**4L****Text Book:**

1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH
2. Richardson, J.F., Peacock, D. G. Coulson & Richardson's Chemical Engineering- Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd.1998

Reference Books:

1. Levenspiel. O., Chemical Reaction Engineering, Wiley Eastern Ltd.
2. Bailey & Olis, Biochemical Engg. Fundamentals, MGH,1990
3. Physical Chemistry: Castellan, Narosa Publishing.
4. Physical Chemistry; Moore, PHI

Course Name: Applied Statistics and Numerical Methods

Course Code: M(FT)301

Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: The students to whom this course will be offered must have the concept of (10+2) standard number system, algebra and calculus.

Course Objective: The purpose of this course is to provide basic understanding of the derivation and the use of the numerical methods and applied statistics.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the distinctive principles of numerical methods and statistics.

CO2: Determine the theoretical workings of numerical methods and applied statistics.

CO3: Apply numerical methods to obtain approximate solutions to intractable mathematical problems such as system of linear and nonlinear equations

CO4: Analyze and interpret the results of numerical techniques, and complex statistical findings

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	2	1	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	3	-	-	-	-	-	-	-	1	3	3	3

Course Contents:**Module I** **8L****Numerical solution of system of linear equations:**

Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.

Numerical solution of algebraic and transcendental equations:

Bisection method, Regula-Falsi, Newton-Raphson method, Secant Method

Module II **16L****Descriptive Statistics:**

Measures of central Tendency, Measures of Dispersion, Skewness and Kurtosis.

Correlation and Regression:

Types of Correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation and Spearman's Rank Correlations, Method of Least Squares, Regression lines.

Module III **12L****Designing Engineering Experiment:**

Concept of Randomization, Completely Randomized Design, Randomized Block Design, Latin square Design.

Analysis of Variance:

Concept, Assumptions, One-way classification and two-way classifications.

Statistical Quality Control: Importance of SQC in food industry, Construction of control charts for variables (mean, range and standard deviation)

Project Domains:

1. Study on numerical solution of system of linear equations in Engineering Field.
2. Application of numerical methods for the relevant field.
3. Mathematical modelling.
4. Statistical analysis of data related to different Engineering Fields.

Text Books: Reference Books:

1. Shishir Gupta & S. Dey, Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
2. C.Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta& Jana: Introductory Numerical Analysis. PHI Learning
4. J.B. Scarborough: Numerical Mathematical Analysis. Oxford and IBH Publishing

Reference Books:

1. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems and Solution)*. New age International Publisher.
2. Prasun Nayek: Numerical Analysis, Asian Books
3. N. G. Das: Statistical Methods, TMH.

Course name: Principles of Management

Course Code: HU(FT)301

Contact: 2:0:0

Total Contact Hours: 24

Credit: 2

Prerequisites: NIL

Course Objective:

1. To understand and apply management principles in to manufacturing organization.
2. To understand concepts of work study, method study, and Quality control method to improve performance of any organization.

Course outcome:

On completion of the course students will be able to:

CO1: To recall and identify the relevance of management concepts.

CO2: To apply management techniques for meeting current and future management challenges faced by the organization

CO3: To compare the management theories and models critically to solve real life problems in an organization.

CO4: To apply principles of management in order to execute the role as a manager in an organization.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	-	3	-	1	2	3
CO2	-	-	-	-	2	2	-	3	3	-	3	3	1	2	3
CO3	-	-	2	-	-	-	-	-	2	-	3	3	2	2	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-	1	2	3

Course Content:**Module-1****4L**

Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow

Module – 2**4L**

Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO, SWOT analysis, McKinsey's 7S Approach. Organising for decision making: Nature of organizing, span of control, Organizational structure –line and staff authority. Basic control process -control as a feedback system – Feed Forward Control – Requirements for effective control – control.

Module – 3**4L**

Group dynamics: Types of groups, characteristics, objectives of Group Dynamics. Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership

Module – 4**4L**

Work Study and work measurement: Definition of work study, Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling

Module-5**2L**

Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy

Module – 6**6L**

Quality management: Quality definition, Statistical quality control, acceptance sampling, Control Charts – Mean chart, range chart, c chart, p chart, np chart, Zero Defects, Quality circles, , Kaizen & Six Sigma , ISO -9000 Implementation steps, Total quality management

Text Books:

1. Essentials of Management, by Harold Koontz & Heinz Weihrich Tata McGraw
2. Production and Operations Management-K. Aswathapa, K . Shridhara Bhat, Himalayan Publishing House

References Books:

1. Organizational Behavior, by Stephen Robbins Pearson Education, New Delhi
2. New era Management, Daft, 11th Edition, Cengage Learning
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication

Course Name: Chemistry of Food Lab II

Course Code: FT391

Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry

Course Objective:

To help students in developing the concept and to learn various methods of estimation of minerals, pigments, crude fibre, antioxidants, pigments etc. by spectrophotometric and chemical analysis.

Course outcome:

After the completion of the Chemistry of Food Lab II the students will be able to:

CO1: Learn various methods to determine different minerals, antioxidant, crude fibre, amino acid content of food materials.

CO2: Measure different food compositions by spectrophotometric analysis.

CO3: Evaluate data generated by experimental methods for chemical characterization of food materials.

CO4: Analyze how the pigments of the food materials change in different conditions.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	3	2	2	1	2	2	2	3	3	3	2
CO2	2	2	1	-	3	2	2	2	2	2	2	3	3	3	2
CO3	3	2	2	2	2	-	-	-	2	2	1	3	3	2	3
CO4	3	2	2	1	1	-	-	-	2	2	-	3	3	2	3

List of Experiments:

1. Determination of pigments in food sample.
2. Estimation of calcium in food sample.
3. Estimation of iron in food products.
4. Estimation of zinc in food sample.
5. Estimation of crude fiber in food sample.
6. Estimation of antioxidant(s) / polyphenol(s) in food sample.
7. Analysis of lysine content in animal /vegetable sources.
8. Estimation of alcoholic acidity present in wheat flour.
9. Innovative Experiments

Text books:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2
2. Food Chemistry by L. H. Meyer

Reference books:

1. Hand Book of Analysis of fruits & vegetables by S. Ranganna
2. Chemical changes in food during processing by Richardson
3. Food Science by Norman N. Potter & Joseph H. Hotchkiss
4. Food Chemistry by H. K. Chopra & P. S. Panesar

Course Name: Biochemistry Lab

Course Code: FT392

Contact: 0:0:3

Credit: 1.5

Pre requisites: Biochemistry

Course Objective:

To assist the students, develop skills to monitor various enzymatic reactions and to learn about association of food protein structure to help the students point out the threat of possible danger to health from contamination in water from effluent.

Course outcome(s):

After the completion of Biochemistry Lab students will be able to:

CO1: Understand the separation of immiscible liquids and solids from liquids including various methods of sugars and amino acids separation.

CO2: Develop skills to monitor various enzymatic reactions.

CO3: Learn association of food protein structure with solubility, viscosity, gelation, texturization, emulsification and foaming.

CO4: Identify the threat of possible danger to health, or the very existence of certain species, for determination of the quality of a water source before water is drawn off for consumption.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	1	2	1	-	-	2	3	3	2
CO2	3	2	2	2	3	-	1	2	1	2	2	2	2	2	2
CO3	3	2	2	2	3	-	1	-	1	1	-	2	3	1	3
CO4	2	2	1	1	-	2	2	-	2	-	2	2	3	3	3

List of Experiment:

1. Separation of amino acids/sugars by Ascending Paper Chromatography.
2. Separation of sugars/amino acids by Thin Layer Chromatography.
3. Separation of sugars /amino acids by Radial Chromatography.
4. Separation of triglyceride, sterols of oil sample by Thin Layer Chromatography.
5. Separation and isolation of proteins/amino acids by Electrophoresis.
6. Preparation of cell-free extract: Bacterial cell by sonication, Chicken liver by homogenization.
7. Assay of enzyme activity (a) Phosphatase assay [Chicken liver] (b) Protease assay
8. Study of an enzymatic reaction.
9. Study on the presence of alkaline phosphatase enzyme in raw and pasteurized milk.
10. Determination of BOD5 of a sample of waste water.
11. Innovative Experiments

Text Books:

1. Modern Experimental Biochemistry, Boyer, Pearson Education

Reference Books:

1. An Introduction to Practical Biochemistry, David T Plummer

Course Name: Applied Statistics and Numerical Methods Lab

Course Code: M(FT)391

Total Contact Hours: 36

Credit: 1.5

Prerequisite:

The students to whom this course will be offered must have the concept of any introductory course on programming language (C / Matlab).

Course Objectives:

The purpose of this course is to provide basic programming skills for solving the problems in numerical methods and applied statistics.

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Apply the programming skills to solve the problems using numerical and statistical approaches.

CO2: Analyze and interpret the results of numerical and statistical approaches using command.

CO3: Judge the multiple numerical approaches in terms of their accuracy level.

CO4: Design and develop effective programs for numerical and statistical approaches to solve the engineering problems.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	3

List of Experiments:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's Rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method.
5. Assignments on ordinary differential equation: Euler's method, Euler's Modified Method, Runge-Kutta Method (4th Order).
6. Assignments on Measures of Central Tendency- Mean, Median, Mode,
7. Assignments on Measures of Dispersion - Variance, Standard Deviation, Mean Deviation.
8. Assignments on Skewness and Kurtosis.
9. Assignments on Correlation Coefficient and Regression lines.
10. Assignments on curve fitting

Implementation of numerical methods and statistics through Software:
C / Matlab / Python / Scilab.

Text Books:

1. Scarborough, J. B., *Numerical Mathematical Analysis*, Oxford University Press.
2. Kanetkar, Y., *Let us C*, BPB Publication, 15th Edition
3. Das, N. G., *Statistical Methods*, TMH.
4. Gupta, S. and Dey, S., *Numerical Methods*, Mc. Grawhill Education Pvt. Ltd.
5. Balagurusamy, E., *Numerical Methods*, Scitech. TMH.

Reference Books:

1. Xavier, C., *C Language and Numerical Methods*, New age International Publisher.
2. Venugopal, K. R. and Prasad, S.R., *Mastering-C*, TMH, 2nd Edition.
3. Sancheti, D. S. and Kapoor, V. K., *Statistics Theory , Method & Application*, Sultan Chand & Sons , New Delhi.
4. Guha, S. and Srivastava, R. *Numerical Methods*, Oxford Universities Press.

2 nd Year 4 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT401	Food Process Technology–II (Cereals, Fruits, Vegetables, Beverages)	4	0	0	4	4
2	ENGG	Major	FT402A/B/C	A. Microbial Technology and Food Biotechnology B. Environmental Biotechnology C. Industrial Biotechnology	3	0	0	3	3
3	ENGG	Major	FT403	Principles of Food Preservation	4	0	0	4	4
4	ENGG	Major	FT404	Food Process Technology–III (Milk and Milk Products)	3	0	0	3	3
5	HUM	Minor	HU(FT)401	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	FT491A/B/C	A. Microbial Technology and Food Biotechnology Lab B. Environmental Biotechnology Lab C. Industrial Biotechnology Lab	0	0	3	3	1.5
2	ENGG	Major	FT492	Food Processing Lab I	0	0	3	3	1.5
3	HUM	Ability Enhancement Course	HU(FT)491	Business Communication	0	0	2	2	1
Total of Theory and Practical								24	20

SECOND YEAR SECOND SEMESTER

Course Name: Food Process Technology – II (Cereals, Fruits, Vegetables, Beverages)

Course Code: FT401

Contact: 4:0:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Food Chemistry, Food Preservation, Food Microbiology

Course Objective:

To provide the students an opportunity to gain knowledge about the storage procedure of different cereals, fruits and vegetables and to help students to understand the different procedure of production of various cereal based, fruit based and vegetable based products.

Course outcome(s):

After completion of the course students will be able to:

CO1: Understand the sustainable Processing and effective storage of cereals, fruits and vegetables.

CO2: Identify suitable equipments for cereals, fruits and vegetables processing for effective use in society

CO3: Summarize the knowledge of processing methods in food and allied industries for cereals, fruits, vegetables, carbonated and non-carbonated nonalcoholic beverages

CO4: Develop ideas about innovative technologies for sustainable product development for daily life uses.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	2	2	-	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:

- Module I:** **10L**
Basic composition and utilization of cereals; Drying of grains; Milling of rice and processes for rice-based products; Milling of wheat and processes of wheat based products; Milling and utilization of corn, barley, oat and millets; Common infestation in grains; Principle and practice of storage of cereals; Storage structures. Quality characteristics influencing final milled product, Parboiling
- Module II:** **10L**
Feed for livestock from wheat bran and germ; Production of starch, modified starch; Extraction of proteins from cereals; Potato processing (potato chips, flakes, powder).
- Module III:** **11L**
Handling and quality assessment of fruits & vegetables; Storage of fruits & vegetables; Production of fruits and vegetable juices/puree/nectar, Intermediate moisture foods from fruits (jam, jelly, marmalade, leathers, candy); Sauce and ketchup from tomato., Dehydrated fruits & vegetables; Utilization of by- products from fruit-based industries – extraction of pectin, fat/oil from peel and seeds, aroma from peel and pomace candied peel. Equipments, cleaning methods, sorting, grading, peeling and blanching of fruits and vegetables before processing, methods of precooling, minimal processing of fruits and vegetables.
- Module IV:** **13L**
Non-alcoholic beverages; Processing of tea, coffee and cocoa, Instant coffee; Production of chocolate and cocoa butter; Extraction of caffeine from tea leaves; Food additives -coloring agents, humectants, anti-caking agents, natural and artificial low calorie sweeteners, pH control agents, thickeners. Processing of spices and herbs.

Revision: **4L**

Text Books:

1. Food Science by Potter
2. Food Science by Mudambi
3. Food Science by B. Srilakshmi
4. Food Additives by Udipi

Reference Books:

1. Postharvest Technology of Fruits & Vegetables (vol 1 & 2): Handling, Processing, Fermentation and Waste Management – L. R. Verma& V. K. Joshi, Indus Pub, New Delhi, 2000.
2. Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices – A. Chakraverty, Arun S. Mujumdar, G. S. V. Raghavan& H. S. Ramaswamy - Marcel Dekker, 2003
3. Postharvest Technology and Food Process Engineering – A Chakraverty & R. Paul Singh, CRC

Press, 2014

4. Fruit and Vegetable Preservation by Srivastava and Sanjeev Kumar
5. Principles of Food Science, Vol-I by Fennma Karrel
6. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Paper Name: Microbial Technology and Food Biotechnology

Paper Code: FT402A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:

To provide an opportunity for students to know about the pathogenic & nonpathogenic beneficial organisms and the use of beneficial organisms in food industry along with genetic engineering.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Use of the idea of biotechnology and microbiological quality of water and food.

CO2: Understand the production method of organic acids, alcoholic beverages and glycerol.

CO3: Apply fermentation method to produce different foods and medicines.

CO4: Understand the basic knowledge on genetic engineering and genetically modified crop.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2	2	-	-	2	-	3	3	2	1
CO2	3	3	-	-	2	2	2	-	2	2	-	3	3	2	2
CO3	3	3	-	-	-	1	-	-	2	-	-	3	2	3	3
CO4	3	3	1	-	3	2	3	2	-	-	2	3	3	3	1

Course Contents:**Module I****8 L**

Methods for the microbiological examination of water and foods, Coliform bacteria, Coliform test; Food borne illnesses and diseases.

Module II**8 L**

Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka).

Module III**8 L**

Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); SCP and mushrooms

Module IV**8 L**

Basics of microbial genetics – Gene, DNA, RNA; Replication, transcription, transformation, transduction, conjugation, translation; Regulation of gene expression; Application in GM foods with case studies.

Revision:**4L****Text Book:**

1. Industrial Microbiology Prescott & Dunn, CBS Publishers
2. Food Microbiology; Frazier WC; 4th ed, Tata-McGrawhill Pub.
3. Modern Food Microbiology by Jay JM, CBS Publishers
4. Microbiology by Pelczar, Chan, and Krieg, TMH

Reference books:

1. Comprehensive Biotechnology by Murray & Mooyoung, Academic press
2. Industrial Microbiology by Casida L.R., New Age International Pvt. Ltd.
3. Fermentation Biotechnology, Principles, Processed Products by Ward OP, Open University Press.

Course Name: Environmental Biotechnology**Course Code: FT402B****Contact: 3:0:0****Total Contact Hours: 36****Credit: 3****Pre requisites:** Chemistry of Food, Food Microbiology, Environmental Engineering**Course Objective:** To help the students understand various toxic and hazardous substances in environment and food safety and safe environment.**Course outcome(s):**

After completion of the course students will able to:

CO1: Describe biotechnology and microbiological quality of water and air.**CO2:** Identify management methods of wastes.**CO3:** Demonstrate about marine pollution.**CO4:** Analyze genetic engineering and genetically modified crop.**Course Contents:****Module I****8L**

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

Module II**8L**

Sources, generation, classification & composition of solid wastes. Solid waste management methods. Coliform test of water.

Module III**8L**

Marine pollution, sources of marine pollution and its control. Effects of pollutants on human beings, plants, animals and climate.

Module IV**8L**

Gene, RNA, DNA, Basic techniques in genetic engineering, GM crop.

Revision:**4L****Text Books:**

1. Environmental chemistry - Sodhi
2. Principals of Environmental chemistry – Manhan

Reference Books:

1. Environmental hazards & human health R.B. Philip



2. Toxicology - principles & applications – Niesink & Jon devries
3. Solid Waste Management CPCB. New Delhi.
4. Principles of Biochemistry - Lehninger

Course Name: Industrial Biotechnology

Course Code: FT402C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of Food, Food Microbiology, Environmental Engineering

Course objectives:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures.

Course Outcomes:

At the end of the course, the students will be able

CO1: To explain the steps involved in the production of bio products and methods to improve modern biotechnology.

CO2: To apply basic biotechnological principles, methods and models to solve biotechnological tasks.

CO3: To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.

CO4: To design and deliver useful modern biotechnology products to the Society.

COs-POs-PSOs Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	3	2	-	-	-	3	3	2	1
CO2	3	-	-	-	1	1	1	-	-	2	-	3	3	2	2
CO3	3	2	2	-	-	2	3	-	2	2	1	3	2	3	3
CO4	3	-	-	2	2	2	3	-	-	-	1	3	3	3	1

Course Contents:**Module I** **8L****Introduction to Industrial Bioprocess:**

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.

Module II **7L****Production of Primary Metabolites:**

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

Module III **7L****Production of Secondary Metabolites:**

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

Module IV **7L****Production of Enzymes and Other Bioproducts:**

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation.

Module V **7L****Production Modern Biotechnology Products:**

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

Text Books:

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3. Balasubramanian, D. et al., "Concepts in Biotechnology" Universities Press Pvt. Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001.
5. Dubey, R.C. "A Textbook of Biotechnology" S. Chand & Co. Ltd., 2006.

References Books:

1. Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.
2. Prescott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.

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3. Cruger, Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Edition, Panima Publishing, 2000.
 4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
 5. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
 6. C.F.A Bryce and EL. Mansi, Fermentation microbiology & Biotechnology, 1999.
 7. K. G. Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S. Chand publications.

Paper Name: Principles of Food Preservation

Paper Code: FT403

Contact: 4:0:0

Total Contact Hours: 48

Credit: 4

Prerequisites: Food Microbiology, Food Chemistry

Course Objective:

To describe students, different principles involved in food preservation and processing and to make them aware about different concepts involved in food spoilage and its prevention by using different food preservation principles and technologies.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Describe actions that need to be taken to maintain foods with the desired properties or nature for as long as needed.

CO2: Identify quality-loss mechanisms by means of biological, chemical, and Physical.

CO3: Develop food handling practices that reduce the potential for food-borne illness.

CO4: Apply traditional and advanced preservation methods relevant to contemporary industrial and society needs

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:

Module I	8L
Introduction to food preservation – Objectives and techniques of food preservation, Canning: Preservation principle of canning of food items, thermal process time calculations for canned foods, spoilage in canned foods	
Module II	10L
Dehydration and drying of food items; cold chain, cold storage preservation, freezing (including cryogenic freezing),	
Module III	7L
Preservation by fermentation and chemical preservatives, curing, pickling, Bio-preservatives, Antibiotics.	
Module IV	7L
Ionization Radiation including UV Radiation.	
Module V	12L
Other non-conventional preservation methods, Hurdle technology Non- thermal preservation processes (High pressure processing, Osmo dehydration, Use of ultrasonic sound, Pulse electric field), minimal processing. Applications of food enzymes in food preservation.	
Revision:	4L

Text Books:

1. Technology of Food Preservation by Desrosier
2. Food Science by Potter
3. Fruits and vegetable processing by Cruess
4. Preservation of Fruits & Vegetables by IRRI

Reference Books:

1. Principles of Food Preservation- Fennema
2. Handbook of Food Preservation-M. Shafiur Rahman

Course Name: Food Process Technology – III (Milk and Milk products)

Course Code: FT404

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:

To provide an opportunity for students to classify different processing techniques required for preservation of milk and classify the different by products related to this industry.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Define milk, its composition, variety and different testing methods to detect adulterant in milk

CO2: Develop understanding about thermal processing of milk and milk products and discuss cleaning and sanitization of different milk industry

CO3: Solve simple problems based on milk drying and to categorize different dried milk products

CO4: Formulate different milk based products and to prepare different traditional Indian dairy products.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	3
CO2	3	2	2	1	-	1	2	1	-	-	-	3	3	2	3
CO3	3	3	2	2	-	-	2	-	-	-	-	3	3	3	2
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2

Course Content:**Module I****10 L**

Definition of milk, Composition of milk, Varieties of milk, Nutritional values, Checks for purity of milk and adulteration in milk, Cleaning and sanitization, HACCP of processing unit.

Module II**10 L**

Thermal processing of fluid milk – Pasteurization (LTLT, HTST & UHT), Packaging of fluid milk, Fermentation of milk and fermented milk products – Cheese, Yogurt, Curd, Kefir, Kumis, Flavored yogurt, Therapeutic value of Fermented Products, concept of Probiotics, prebiotics and probiotics dairy products

Module III**8 L**

Processing of evaporated and dried milk products – Milk powder, Malted milk and Infant formulae. Manufacturing and standardization of Cream, butter/butter oil, ghee, Ice-cream, Cheese, Simple problem based on milk drying, standardization, etc.

Module IV**4 L**

Traditional Indian sweets- Kheer, Paneer, Channa, Srikhand, Dairy processing by-products: and Production of lactose and protein from whey. Application of technologies in dairy industry

Revision:**4L****Text Books:**

1. Outlines of Dairy Technology, De S; Oxford.
2. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.

Reference Books:

1. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
2. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
3. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.

Course Name: Economics for Engineers

Course Code: HU(FT)401

Contact: 2:0:0

Total contact hour: 24

Credits: 2

Prerequisites: NIL

Course Objective:

- To develop decision making skills using basic economic Principles
- To educate the students in evaluating various Business Projects

Course outcome(s):

On completion of the course students will be able to

CO1: Identify various uses for scarce resources

CO2: Understand key economic concepts and implement in real world problems

CO3: Apply critical thinking skills to analyze financial data and their impacts

CO4: Evaluate business performance through the knowledge of cost accounting principles

CO-PO- PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	2	-	1	2	3
CO2	-	-	-	-	-	3	-	-	-	-	2	-	1	2	3
CO3	-	-	2	2	3	-	-	-	-	-	2	2	2	2	3
CO4	-	-	3	-	-	-	-	-	-	-	3	2	1	2	3

Course Content:**Module I****2L**

Introduction to Economics: Meaning, Nature and Scope of Economics

Module II**4L**

Theory of Demand and Supply: Concept of demand, Determinants of demand, Individual and Market Demand, Exception to the law of demand. Concept of Supply, Shift in Demand and Supply Curve, Movement along the demand and supply curve, Determinants of equilibrium price and quantity, Elasticity of Demand and Supply.

Module III**6L**

Theory of Production and Cost: concept of Production function, types of Production function, Laws of return to scale and variable Proportion, Cost Function, Types of Cost Function, Different Cost curves, Relation between Average and marginal cost, Relationship between Short Run costs and Long Run costs, Profit maximisation

Module IV**3L**

Macroeconomic Aggregates and Concepts: GDP, GNP. Concepts of National Income. Concept of Business Cycle

Module V**2L**

Inflation: Concept, Causes and Remedies of Inflation.

Module VI**4L**

Accounting: Basic concept of Journal, Preparation of Income Statement and Balance Sheet

Module VII**3L**

Cost Volume Profit Analysis: Contribution, P/V Ratio, Break-Even Point, Margin of Safety, Short term decision making: Make or Buy, Shut-down point, Export Pricing, Opportunity and Sunk cost.

Text Books:

1. Economics, by Lipsey and Chrystal, Oxford University Press
2. Modern Accountancy, vol.-I-, by Hanif & Mukherjee, Tata McGrawHill

Reference Boks:

1. Modern Economic Theory, by K.K. Dewett, S.Chand
2. Principles of Economics, by H.L. Ahuja, S. Chand
3. Engineering Economics, by R. Paneer Seelvan, PHI
4. Economics for Engineers, by Dr. Shantanu Chakraborty & Dr. Nilanjana Singharoy, Law Point Publication

Course Name: Microbial Technology and Food Biotechnology Lab

Course Code: FT491A

Contact: 0:0:3

Credit: 1.5

Pre requisites: Principles of Food Preservation, Unit Operation, Food Microbiology

Course Objective:

To help the students understand various methods of isolation, characterization and screening of bacteria, fungi and other related organisms and apply different preservation and fermented food productions techniques relative to food safety and spoilage.

Course outcome(s):

After the completion of this course students will be able to:

CO1: Understand biotechnological processing/engineering principles to variety of fermented products.

CO2: Develop new fermented products.

CO3: Interpret the data in scientific format.

CO4: Identify new development in this field with analytical thinking of the various aspects of the new technology.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	2	-	2	-	-	3	3	2	2
CO2	3	2	2	-	-	-	1	-	2	2	2	3	3	2	3
CO3	3	3	2	2	-	-	-	2	1	2	-	3	3	2	3
CO4	3	2	-	-	2	2	-	1	1	-	1	3	2	3	1

List of Experiments:

1. Study of the microbial alcohol fermentation process
2. Study of the organic acid fermentation – Vinegar / citric / lactic acid production
3. Observation of the propagation of the baker's yeast
4. Preparation of fermented dairy products
5. Detection of *E.coli* in food/water sample
6. Production of microbial enzyme
7. Production of amino acid
8. Detection of various types of microorganism in different food items
9. Innovative experiment.

Text Book:

1. Fundamental Principles of Bacteriology – A. J. Salle

Reference Book:

1. Food Microbiology – M. R. Adams, M. O. Moss.

Course Name: Environmental Biotechnology Lab

Course Code: FT491B

Contact: 0:0:3

Credit: 1.5

Pre requisites: Environmental Engineering, Unit Operation, Food Microbiology

Course Objective:

To help the students to measure chemical, and bacteriological parameters of food, water and wastewater. Laboratory methods and interpretation of results with regard to environmental engineering applications such as design and operation of water and wastewater treatment processes, and to the control of the quality of natural water.

Course outcome(s):

After completion of the course students will able to:

CO1: Describe the biochemical processes.

CO2: Explain quality of water and food.

CO3: Interpret data in scientific format.

CO4: Identify development in this field with analytical thinking of the various aspects of the new technology.

COs-POs-PSOs Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	-	1	-	2	-	-	3	3	2	3
CO2	3	3	2	-	3	2	2	-	2	-	-	3	3	2	2
CO3	3	3	3	3	-	-	1	-	2	2	3	3	2	2	3
CO4	3	-	3	2	3	2	2	2	3	3	3	3	3	3	2

List of Experiments:

1. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
2. To prepare an Acetic-Na Acetate Buffer system and validate the Henderson-Hassel bach equation.
3. Enzyme purification of a crude enzyme. a) Ammonium sulphate precipitation. b) Dialysis.
4. Estimation of pesticide of a food sample
5. Estimation of heavy metal(s) in food sample.
6. Coliform Test of water.
7. Innovative experiment.

Text Books:

1. An Introduction to Practical Biochemistry – David T. Plummer
2. Fundamental Principles of Bacteriology – A. J. Salle

Reference Book:

1. Food Microbiology – M. R. Adams, M. O. Moss.

Course Name: Industrial Biotechnology Lab

Course Code: FT491C

Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Microbiology

Course Objective:

To help the students understand various methods of isolation, characterization and screening of bacteria, fungi and other related organisms and apply different preservation and fermented food productions techniques relative to food industry standards.

Course outcome(s):

After the completion of this course students will be able to:

CO1: Understand industrial processing/engineering principles to variety of fermented products.

CO2: Develop new fermented products using biological agents.

CO3: Interpret the data in scientific format.

CO4: Identify new development in this field with analytical thinking of the various aspects of the new technology.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	2	-	2	-	-	3	3	2	2
CO2	3	2	2	-	-	-	1	-	2	2	2	3	3	2	3
CO3	3	3	2	2	-	-	-	2	1	2	-	3	3	2	3
CO4	3	2	-	-	2	2	-	1	1	-	2	3	2	3	1

List of Experiments:

1. Preparation of organic bio fertilizer for crop growth
2. Study of the alcohol fermentation process by yeast from raw grape
3. Study of the growth kinetics of baker's yeast
4. Degradation of vegetable oil by microbes.
5. Preparation of cottage cheese
6. Preparation and Preserving Sauerkraut
7. Entrapment of spice extract in hydrogel
8. Inhibition of microbial growth by antibiotics
9. Detection of adulteration in food sample
10. Innovative experiment.

Text Book:

1. Fundamental Principles of Bacteriology – A. J. Salle

Reference Book:

1. Food Microbiology – M. R. Adams, M. O. Moss.

Course Name: Food Processing Lab I

Course Code: FT492

Contact: 0:0:3

Credit: 1.5

Pre requisites: Principles of Food Preservation, Unit Operation

Course Objectives:

To assist the students in using laboratory techniques common to basic Food Processing and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Apply the principles that make a food product safe for consumption.

CO2: Use laboratory techniques common to basic Food Processing.

CO3: Interpret government regulations pertaining to food manufacturing.

CO4: Evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	2	3	2	-	2	2	3	1	1	3
CO2	2	2	1	1	3	2	2	-	-	1	2	2	1	2	2
CO3	2	1	1	-	-	2	3	-	-	-	-	3	1	1	3
CO4	3	2	2	2	2	-	-	-	3	-	-	3	2	2	2

List of Experiments:

1. Preparation of citrus fruit squash/nectar/concentrated juice.
2. Preparations of fruit jam/mixed jam/marmalade.
3. Preparation of jelly/synthetic jelly.
4. Preparation of tomato ketchup/puree/sauce.
5. Preparation of fruit/vegetable pickles.
6. Preparation of dried vegetable.
7. Design and layout of various food processing systems
8. Preparation of value added different soups
9. Preparation of fermented cereal/vegetable (Sauerkraut) food products
10. Innovative experiment.

Text Books:

1. Food Science by B. Srilakshmi
2. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2

Reference Book:

1. Hand Book of Analysis of fruits & vegetables by S. Ranganna

Course Name: Business Communication

Course Code: HU(FT)491

Contact: 0:0:2

Credit: 1

Pre requisites: A basic knowledge of the forms, formats, discourses and channels of interpersonal workplace communication.

Course Objectives:

- To acquaint students with procedures, templates and strategies of organizational communication in globalized business.
- To facilitate students in achieving gender-neutral and culturally neutral communication across various cultural contexts.
- To enable students to become more empowered communicators in business speech and writing, using ICT and interactive tools in digital era communication.

Course Outcome(s):

After completion of this course the students will be able to

CO1: Select, compare, classify and correlate between modes and modalities of communication in the globalized workplace.

CO2: Develop, apply and make use of interpersonal business strategies, team dynamics, writing templates and workplace procedures.

CO3: Apply, infer, test and develop behavioral and interpersonal skills like problem-solving, decision making and negotiation using workplace situations and case studies.

CO4: Develop, elaborate and justify procedures and modes of interface in globalized business and client partnerships.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	1	1	-	2	3	-	2	2	1	3
CO2	-	-	2	2	-	3	3	-	2	3	-	3	2	1	3
CO3	-	-	2	2	-	3	3	2	2	3	-	3	2	1	3
CO4	-	-	-	-	-	3	3	2	2	3	-	3	1	1	2

Module I**Intrapersonal and Interpersonal Workplace Communication**

- 1.1 The Skills of Interpersonal Communication (Content, Voice, Tone, Register)
- 1.2 Interface with Customers/Clients—Business Telephony (Taxonomy and courtesies of calls, Call Procedures and Phrases, Managing Customer Relations)
- 1.3 Achieving Global Partnerships in Business (Culture sensitivity and achieving culturally neutral communication)
- 1.4 Achieving Gender-Sensitive Communication (Avoiding Gender Bias, Gender Neutral titles and interface in everyday workplace communication)

Module II**People Skills in Business**

- 2.1 Understanding Interpersonal and Team Dynamics—Participating/Engaging in Team Efforts—Projects, Meetings, Presentations and Team Huddles.
- 2.2 Problem-Solving in Teams—Dealing with Problems, Adopting and Testing Solution Strategies, Team-Based Case Studies.
- 2.3 Negotiation Strategies in Client Interactions and Meetings—Negotiation Basics, A Win-Win/Win-Lose and Other Strategic Parameters, Negotiation Examples and Case Studies.
- 2.4 Decision-Making in Business—Basics of Business Decision-Making, Factors involved, Implementing Decisions and Follow-up, Examples and Case Studies.

Module III**Business Etiquette and Behavioral Norms**

- 3.1 Presenting Oneself in the Business Environment—Corporate Dressing, Grooming and Mannerisms
- 3.2 Etiquette relating to Formal/Informal Social Occasions—Dining and Table Etiquette.
- 3.3 Meeting and Netiquette—Examples and Activities.

Module IV**Procedural Interpersonal Interfaces**

- 4.1 Preparing for an Interview/Presentation—Attention-Grabbing Techniques, Using Audio-Visual aids and Rhetorical Techniques.
- 4.2 Presentation Skills—Giving Informational and Persuasive Presentations (Sales and Product Performance Review presentations)
- 4.4 Speaking in an Interview (Assessment parameters—body language, courtesy, voice, tone, attitude)—Interview Case Studies and Mock-Interviews.

Text Books:

1. Peter Hartley, *Interpersonal Communication*. London: Routledge, 1993.
2. Adrian Pilbeam and Nina O'Driscoll, *Meetings and Discussions*. 2nd ed. London: Longman, 1992.
3. Andrew Littlejohn, *Company to Company*. Cambridge: Cambridge University Press, 2005.

Reference Books:

1. Fiona Moore, *Transnational Business Cultures: Life and Work in a Multinational Corporation*. London: Routledge, 2005.
2. Jeanette S. Martin and Lillian H. Chaney, *Global Business Etiquette: A Guide to International Communication and Customs*. Praegar, 2012.
3. Michael Maginn, *Making Teams Work: 24 Lessons for Working Together Successfully*. Mc Graw-Hill, 2004.
4. Eli Mina, *The Business Meetings Sourcebook: A Practical Guide to Better Meetings and Shared Decision Making*, Amacom, 2002.

3 rd Year 5 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT501A/B/C	D. Fluid Mechanics and Heat Transfer E. Mass Transfer I F. Mechanical Operation and Separation Process I	3	1	0	4	4
2	ENGG	Major	FT502	Food Process Technology–IV (Edible Fats and Oils)	3	0	0	3	3
3	ENGG	Minor	CH(FT)501	Industrial stoichiometry	3	1	0	4	4
4	ENGG	Minor	CS(FT) 501A/B/C	D. Data Structure and Algorithms E. Data Base Management System F. Software Engineering	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	FT591	D. Fluid Mechanics and Heat Transfer Lab E. Mass Transfer I Lab F. Mechanical Operation and Separation Process I Lab	0	0	3	3	1.5
2	ENGG	Major	FT592	Food Processing Lab II	0	0	3	3	1.5
3	ENGG	Minor	CS(FT) 591A/B/C	D. Data Structure and Algorithms Lab E. Data Base Management System Lab F. Software Engineering Lab	0	0	3	3	1.5
4	ENGG	Ability Enhancement Course	HU(FT)591	Technical Seminar Presentation	0	0	1	1	0.5
5	PRJ	Project	FT581	Minor Project I	0	0	2	2	1
Total of Theory, Practical and Project								26	20

THIRD YEAR FIRST SEMESTER
Course Name: Fluid Mechanics and Heat Transfer
Course Code: FT501A
Contact: 3:1:0
Total Contact Hours: 48
Credit: 4
Pre requisites: Engineering Mathematics, Basic Physics

Course Objective:

To introduce history, importance and components of fluid mechanics & heat transfer, concepts of unit operations and unit processes, and current scenario of chemical & allied process industries.

Course Outcome(s):

By the end of the course, students will be able to:

CO1: Apply conservation laws to describe fluid behavior in food processing systems.

CO2: Evaluate fluid transport systems such as pipelines and pumps used in food plants.

CO3: Apply fundamental principles of conduction, convection, and radiation heat transfer in food processing scenarios.

CO4: Integrate heat and fluid flow analysis in thermal food operations such as pasteurization, sterilization, evaporation, and drying.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module 1: Fluid Properties and Fluid Statics****4L**

Properties of fluids: density, viscosity, surface tension, compressibility, Pressure and pressure measurement (manometers, Bourdon gauge), Pascal's law, hydrostatic law, buoyancy and stability

Module 2: Fluid Dynamics and Flow Through Pipes**10L**

Types of fluid flow: laminar and turbulent, Reynolds number, Bernoulli's equation and its applications in food plants, Head loss due to friction, minor losses in fittings, Flow through pipes: Darcy-Weisbach equation, Pumps and fans: types, performance curves, NPSH

Module 3: Introduction to Heat Transfer**10 L**

Modes of heat transfer: conduction, convection, radiation, Fourier's law of heat conduction; thermal conductivity of food materials, Newton's law of cooling, heat transfer coefficients, Introduction to radiation heat transfer

Module 4: Conduction and Convection in Food Processing**10 L**

Steady and unsteady state heat conduction: slab, cylinder, sphere, Convection heat transfer: natural vs. forced convection, Boiling and condensation heat transfer, Use of extended surfaces (fins) in heat exchangers

Module 5: Heat Exchangers and Thermal Applications in Food Industry**10L**

Classification and types of heat exchangers (plate, shell-and-tube, scraped surface), Log Mean Temperature Difference (LMTD) and NTU methods, Applications: Pasteurizers, evaporators, dryers, blanchers, Design considerations for heat exchangers in food plants

Revision:**4L****Text Book:**

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Introduction to Chemical Engineering: Walter L. Badger, Julius T. Banchemo, Julius T. Banchemo

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Course Name: Mass Transfer I

Course Code: FT501B

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

- To impart knowledge on the fundamentals of mass transfer phenomenon.
- To explain the principles of mass transfer and their application to separation and purification processes.

Course Outcome(s):

After Completion of the course, students will be able to:

CO1: Understand the principles of molecular and turbulent diffusion and interphase mass transfer in gas, liquid, and solid systems.

CO2: Apply fundamental mass transfer concepts to analyze and design operations like absorption, stripping, humidification, and crystallization.

CO3: Evaluate the performance of mass transfer equipment using equilibrium relationships, empirical correlations, and theoretical models.

CO4: Design basic mass transfer equipment such as packed columns, cooling towers, and crystallizers, considering operational constraints and efficiencies.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module I: Fundamentals of Diffusion and Interphase Mass Transfer 8L**

Molecular and turbulent diffusion, Fick's Law of diffusion, Diffusion coefficient: dependence on temperature, pressure, and composition, Estimation and measurement of diffusivity, Diffusion in multi-component gas mixtures, Diffusion in solids: molecular, Knudsen & surface diffusion

Module II: Interphase Mass Transfer Applications 10L

Interphase mass transfer and mass transfer coefficients, Diffusion between phases, Equilibrium solubility of gases in liquids, Mass transfer theories, Mass transfer in fluidized beds, Flow past solids and boundary layers, Simultaneous heat and mass transfer

Module III: Gas Absorption and Stripping Operations 10L

Gas-liquid equilibrium, Henry's law, Absorption in tray and packed columns, Equipment and solvent selection, HTU, NTU, HETP concepts, Design equations for packed column, Absorption with chemical reaction, Heat and mass transfer in packed columns

Module IV: Humidification and Cooling Techniques 8L

Vapour-liquid equilibrium and vapour pressure-temperature relationships, Vapour-gas mixtures and humidity relations, Humidification and dehumidification fundamentals, Wet bulb temperature, adiabatic & non-adiabatic operations, Evaporative cooling, Design and classification of cooling towers

Module V: Crystallization Principles and Equipment Design 8L

Equilibrium yield and theory of crystallization, Heat and mass transfer in crystallization, Nucleation and crystal growth, Factors affecting crystal properties, Controlled crystal growth, Classification and design of crystallizers

Revision: 4L

Text Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Robert. E. Treybal. —Mass Transfer Operation, 3e, Mc Graw Hill, NY
4. Geankopolis, C.J. —Transport Processes and Unit Operations, 3e, Prentice Hall (I)

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
4. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Course Name: Mechanical Operations and Separation Process I

Course Code: FT501C

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To understand different type of Mechanical operations like crushing and Grinding and Sieve separation technique and to apply their knowledge in different types of separation processes like centrifugation, filtration, extraction, drying and crystallization

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the principles of particle size reduction, mixing, agitation, and mechanical separations like screening and filtration.

CO2: Apply engineering principles to analyze and design unit operations such as centrifugation, sedimentation, and crystallization.

CO3: Evaluate the performance of extraction, leaching, and drying operations using material balances and stage-wise analysis.

CO4: Analyze and assess advanced membrane-based separation technologies for specialized industrial applications.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO 3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO 4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module I: Fundamentals of Mechanical Operations****8L**

Principles of comminution, Types of comminuting equipment, Energy and power requirement in size reduction, Crushers and grinders, Mixing and agitation

Module II: Mechanical Separation Techniques – I**8L**

Screening and classification, Types of screens and screen effectiveness, Filtration: principles of constant pressure and constant rate filtration, Filtration equipment

Module III: Mechanical Separation Techniques – II**10L**

Centrifugation: principles, devices, types (free and hindered settling), Sedimentation and flocculation, Hydraulic and heavy media separation, Introduction to crystallizer design, Material and energy balances in crystallization

Module IV: Extraction and Drying Operations**10L**

Liquid-liquid extraction: selectivity and solvent choice, Equilibrium stages and graphical methods, Leaching: principles and material balances, Batch drying: mechanism and stages

Module V: Advanced Separation Processes**8L**

Dialysis and ultrafiltration, Reverse osmosis and pervaporation, Electrodialysis, Membrane separation: principles and applications

Revision:**4L****Text Books:**

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Introduction to Chemical Engineering: Walter L. Badger, Julius T. Banchoff, Julius T. Banchoff

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
3. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
4. Fundamentals of Food Process Engineering R.T. Toledo CBS publication
5. Food Processing Technology P.J. Fellows CRC press

Course Name: Food Process Technology–IV (Edible Fats and Oils)

Course Code: FT502

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of Food, Principles of Food Preservation

Course Objective:

To study in depth the chemical, physical and nutritional properties of fats and oils and the technologies involved in the production of vegetable oils/fats and their by-products.

Course outcome(s):

After completion of the course students will be able to:

CO1: Analyze the various properties of fats and oils in processing, non-processing and storage condition.

CO2: Explain the different production and refining processes of vegetable oil.

CO3: Identify different technology for manufacture of designer fats.

CO4: Formulate newer methods for analysis of non-oil constituents of oil bearing materials.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	-	2	1	-	-	-	3	3	2	2
CO2	3	2	2	1	2	2	2	2	2	2	2	3	3	3	2
CO3	3	3	2	2	2	1	2	2	2	2	2	3	3	3	2
CO4	3	3	2	2	2	2	2	1	2	2	2	3	3	3	2

Course Contents:**Module I: 8L**

Importance of fats and oils in foods; Extraction of fats and oils from plant sources by Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme- derived oil extraction.

Module II: 8L

Processing of oils – Degumming, refining, dewaxing, bleaching, deodorization, fractionation; Pyrolysis of fats, toxicity of frying oil. Application of enzyme in oil refining process.

Module III: 8L

Plastic fat –hydrogenation, esterification, inter-esterification and emulsification; Application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortenings, margarine processing. Multi-source edible oil.

Module IV: 8L

By-products of fat/oil processing industries; Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its mechanism of application.

Revision: 4L**Text Book:**

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.

Reference books:

1. Food Oils and their Uses; Weiss TJ; 1983, AVI.

Course Name: Industrial Stoichiometry

Course Code: CH(FT)501

Contact: 3:1:0

Credit: 4

Pre requisites: Thermodynamics, Engineering Mechanics

Course Objective:

To help the students develop the concepts of different unit conversions, material balance and energy balances in different engineering systems by applying different mathematical interpretations.

Course Outcome(s):

After completion of the course, the students will be able to

CO1: Understand the stoichiometric importance of an engineering process.

CO2: Analyze with different systems of units and have the skill to convert units from one system to another.

CO3: Apply the concept of enthalpy calculation in heat transfer mechanism.

CO4: Calculate mass and energy balance equations to engineering problems and optimize the process requirements.

CO – PO-PSO Mapping

COs	Program Outcome												Program Specific Outcomes		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	3	3	1	2
CO2	3	3	2	2	2	1	-	-	-	-	-	3	3	2	2
CO3	3	3	3	3	2	2	-	-	-	-	-	3	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

Course Contents:**Module I****11L**

Small units and dimensions, Dimensional analysis by Buckingham Pi-theorem, Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log- log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration

Module II**11L**

Material balance: Introductory Concepts, Simplification of the general mass balance equation for steady processes, Procedure for material balance calculations, Material balance without chemical reactions, Material balance with chemical reaction, Material Balance with recycle, bypass and purge streams.

Module III**12L**

Energy Balance: General energy balance equation for steady and processes, without chemical reaction, with chemical reaction, enthalpy calculation procedures.

Module IV**6L**

Combined Material and Energy Balances: Simultaneous material and energy balances, selected industrial process

Revision:**4L****Text Book:**

1. K. V. Narayanan and B. Lakshmikutty, Stoichiometry and Process Calculations, PHI
2. Ghosal, Sanyal and Dutta, Introduction to Chemical Engineering, TMH

Reference Books:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd Ed, John Wiley.
2. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. PrenticeHall
3. Bhatt and Bhora, Stoichiometry, 4th Ed., TM

Course Name: Data Structure and Algorithm

Course Code: CS(FT)501A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

1. Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory.

Course Outcome(s):

After completion of the course students will be able to

CO1: Differentiate how the choices of data structure & algorithm methods impact the performance of program.

CO2: Solve problems based upon different data structure & also write programs.

CO3: Identify appropriate data structure & algorithmic methods in solving problem.

CO4: Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

CO5: Compare the benefits of dynamic and static data structures implementations.

CO- PO-PSO mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	3	-	-	3	2	2
CO2	-	-	-	-	-	2	3	2	2	-	-	-	3	2	3
CO3	-	-	1	-	-	-	-	-	2	3	-	-	3	3	3
CO4	-	1	-	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	-	-	-	-	3	-	-	-	-	-	-	3	3	3

Course Contents:**Module I****10L****Linear Data Structure**

Introduction (2L):

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code (1L)

Algorithm efficiency and analysis, time and space analysis of algorithms – order notations (1L)

Array (2L):

Different representations – row major, column major (1L)

Sparse matrix - its implementation and usage, Array representation of polynomials (1L) Linked List (6L):

Singly linked list – operations, Doubly linked list – operations (4L)

Circular linked list – operations, Linked list representation of polynomial and applications (2L)

Module II**6L****Linear Data Structure**

Stack and Queue (4L):

Stack and its implementations (using array and linked list) (1L) Applications (infix to Postfix, Postfix Evaluation) (1L)

Queue, circular queue, de-queue (1L)

Implementation of queue- linear and circular (using array and linked list) (1L) Recursion (2L):

Principles of recursion - use of stack, tail recursion. (1L) Applications - The Tower of Hanoi(1L)

Module III**12L****Nonlinear Data structures**

Trees (8L):

Basic terminologies, forest, tree representation (using array and linked list) (1L) Binary trees - binary tree traversal (pre-, in-, post- order) (1L)

Threaded binary tree (1L)

Binary search tree- operations (creation, insertion, deletion, searching) (1L) Concept of Max-Heap and Min-Heap (creation, deletion) (1L)

Height balanced binary tree – AVL tree (insertion with examples only) (1L) Height balanced binary tree – AVL tree (deletion with examples only) (1L)

m –Way Search Tree, B Tree – operations (insertion, deletion with examples only) (1L) Graphs (4L):

Graph theory review (1L)

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward- edge) (2L)

Minimal spanning tree – Prim’s algorithm, Kruskal’s algorithm (basic idea of greedy methods) (1L)

Module IV**8L****Searching, Sorting**

Sorting Algorithms (4L):

Bubble sort, Insertion sort, Selection sort – with notion of complexity (1L) Quick sort, Merge sort – with complexity (2L)

Radix sort – with complexity (1L) Searching (2L):

Sequential search – with complexity (1L)

Binary search, Interpolation Search– with complexity (1L) Hashing (2L):

Introduction to Hashing and Hashing functions (1L) Collision resolution techniques (1L)

Text Books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson

Course Name: Database Management System**Course Code: CS(FT)501B****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisites:**

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives:

1. To learn the data models, conceptualize and depict a database system
2. To design system using E-R diagram.
3. To learn SQL & relational database design.
4. To understand the internal storage structures using different file and indexing techniques.
5. To know the concepts of transaction processing, concurrency control techniques and recovery procedure.

Course Outcomes (COs):

On completion of the course students will be able to

CO1: Apply the knowledge of Entity Relationship (E-R) diagram for an application.**CO2:** Create a normalized relational database model**CO3:** Analyze real world queries to generate reports from it.**CO4:** Determine whether the transaction satisfies the ACID properties.**CO5:** Create the database of an organization.

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CO2	2	3	3	3	3	1	1	1	2	2	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3

Course Contents:**Module I****3L**

Introduction

Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module II**9L**

Entity-Relationship and Relational Database Model

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

Module III**6L**

SQL and Integrity Constraints

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module IV**6L**

Relational Database Design

Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study

Module V**6L**

Internals of RDBMS

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling

Module VI**6L**

File Organization & Index Structures

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc. Graw Hill.
2. Elmasri Ramez and Navathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Ramakrishnan: Database Management System, McGraw-Hill
4. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.
5. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
3. “Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing Edition
4. “Database Management Systems”, Arun K. Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

Course Name: Software Engineering**Course Code: CS(FT)501C****Contact Hours: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisites:**

1. An understanding of basic computer software
2. Object Oriented programming skills.

Course Objectives:

1. To develop basic Knowledge in Software Engineering including software Engineering layered architecture, software process models for software development.
2. To design software requirements and specifications of documents.
3. To understand project planning, scheduling, cost estimation, risk management.
4. To describe data models, object models, context models, behavioral models and coding style and testing issues.
5. To know about the quality checking mechanism for software process and product.

Course Outcome(s):

On completion of the course students will be able to:

CO1: Analyze software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements**CO2:** Specify software requirements through a productive working relationship with various stakeholders of the project**CO3:** Design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.**CO4:** Develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice.**CO5:** Identify modern engineering tools necessary for software project management, time management and software reuse, and an ability to engage in life-long learning.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	-	-	-	-	-	2	-	3	2	2
CO2	2	2	1	-	-	-	-	-	-	1	-	-	3	2	3
CO3	-	-	3	-	-	2	-	2	-	2	-	-	3	3	3
CO4	-	-	-	-	2	-	-	1	3	-	1	2	3	3	3
CO5	-	-	-	-	-	-	-	-	2	1	2	2	3	3	3

Course Contents:**Module I****10L**

Software Engineering–Characteristics, Components, Application, Definitions, Software Process models- Waterfall Model, Prototype model, Spiral., Software Project Planning–Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation: COCOMO (Basic, intermediate, Complete) model

Module II**8L**

System Analysis: Principle of Structure Analysis, Requirement Analysis, DFD, Entity Relationship Diagram, Data Dictionary, Data Modeling, Software Requirements Specification

Software Design Aspects: Objectives, Principles, Concepts, HLD and LLD, Top-Down and Bottom-Up design; Decision tree, decision table and structured English, Structure chart, Transform analysis Functional Vs. Object-Oriented approach.

Module III**10L**

Coding & Documentation–Structured Programming, Modular Programming, Module Relationship-Coupling, Cohesion, Object Oriented Programming, Information Hiding, Reuse, System Documentation. Testing–Levels of Testing, Integration Testing, System Testing.

Test Cases-White Box and Black Box testing Software Quality, Quality Assurance, Software Maintenance, Software Configuration Management.

Module IV**8L**

Software Project Management – Project Scheduling, Staffing, Quality Assurance, Risk Management: Reactive vs. Proactive Risk strategies, Software risks, Risk identification, Risk projection, Risk refinement Project Monitoring.

Text Books:

1. Software Engineering: A practitioner’s approach–Pressman(TM)

Reference Books:

1. Software Engineering-Pankaj Jalote (Wiley-India)
2. Software Engineering-Rajib Mall(PHI)
3. Software Engineering–Agarwal and Agarwal(PHI)

Course Name: Fluid Mechanics and Heat Transfer Lab

Course Code: FT591A

Contact: 0:0:3

Credit: 1.5

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course outcome(s):

After the completion of the laboratory course students will be able to:

CO1: Define process equipment via hands-on learning.

CO2: Analyze the experiments on flow regime and different flow meter

CO3: Measure the Overall heat transfer coefficient of heat exchangers

CO4: Determine the pressure drop for flow through packed bed.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2

Course Contents:

1. Experiments on Reynolds's Apparatus –Determination of flow regime and construction of friction factor against NRE
2. Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orifice meter, (c) Rotameter
3. To determine pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation
4. To determine the rate of heat transfer through double pipe heat exchanger with parallel and countercurrent flow
5. To determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside and outside diameter of the tube
6. To study the viscosity of processed food (Jam, Jelly, Ketchup, Edible oils) with varying shear stress
7. To study the flow characteristics of processed food (Jam, Jelly, Ketchup, Edible oils) by Rheometer and verification of power law with graphical interpretation
8. Innovative Experiments

Text Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Transfer: D.Q. Kern, MGH

Course Name: Mass Transfer Lab I

Course Code: FT591B

Contact: 0:0:3

Credit: 1.5

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

- To impart knowledge about the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course outcome(s):

After the completion of the laboratory course students will be able to:

CO1: Analyze the data on diffusion coefficient and mass transfer coefficient.

CO 2: Study the characteristic of packed bed absorption column

CO 3: Discuss the working of a cooling tower and temperature drop in a fluid inside it.

CO 4: Understand the working mechanism of crystallizer and dryer

CO-PO-PSO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:

1. To determine Mass transfer coefficient / kLa
2. To determine the Gas-phase mass-transfer coefficient in wetted wall column
3. To determine the diffusion co-efficient of an organic vapor (naphthalene) in air.
4. To estimate the Solid liquid mass-transfer coefficient for dissolution of benzoic acid in water.
5. To study the absorption of a gas in a packed column and calculation of NTU and HTU
6. To study flooding and loading characteristic of Packed bed absorption column
7. To find out crystal yield in batch crystallizer
8. To study working and operation of the cooling tower
9. Innovative Experiments

Text books:

1. Robert. E. Treybal. —Mass Transfer Operation, 3e, Mc Graw Hill, NY,
2. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
3. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. J.D. Seader & Henley E. J., “Separation Process Principles” 2e, Wiley India Pvt. Ltd,

Course Name: Mechanical Operations and Separation Process I Lab

Course Code: FT591C

Contact: 0:0:3

Credit: 1.5

Pre requisites: Physics, Chemistry, Mathematics, Engineering Thermodynamics

Course Objective:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course Outcome:

After the completion of the course students will be able to:

CO1: Plan experiments and present the experimental data meaningfully

CO2: Apply theoretical concepts for data analysis and interpretation

CO3: Understand chemical engineering unit operations related to comminution

CO4: Apply different separation processes like centrifugation, filtration, extraction, drying, and crystallization.

CO-PO-PSO Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2

Course Contents:

1. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements
2. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed
3. To determine filter medium resistance & cake resistance in cake filtration.
4. To determine separation coefficient in centrifugation.
5. To determine separation coefficient by vacuum evaporation using Rotary Vacuum Evaporator
6. To determine drying rates of food using different types of driers (Tray Drier, Fluidized bed Drier, Freeze Drier, Spray Drier)
7. Innovative Experiment

Text Books:

1. Robert. E. Treybal. —Mass Transfer Operation, 3e, Mc Graw Hill, NY,
2. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
3. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. J.D. Seader & Henley E. J., “Separation Process Principles” 2e, Wiley India Pvt. Ltd,

Course Name: Food Processing Lab II

Course Code: FT592

Contact: 0:0:3

Credit: 1.5

Prerequisites: Principles of Food Preservation, Unit Operations, Chemistry of Food

Course Objective:

To assist the students to use laboratory techniques common to basic Food Processing and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyze the resulting information.

Course outcome(s):

After completion of this course students will be able to:

CO1: Use of laboratory techniques common to basic Food Processing.

CO2: Apply the principles that make a food product safe for consumption.

CO3: Interpret Statutory & Regulatory body pertaining regulations to food manufacturing.

CO4: Evaluate the effective test methods used in sensory evaluation and the resulting information.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	3	1	3	3	2	3	-	2	2	1	2	2	3	1	1
CO 2	3	3	2	1	-	2	2	3	3	3	3	3	3	2	1
CO3	3	3	2	2	3	2	3	1	2	2	3	3	3	3	3
CO4	3	2	2	2	3	-	-	2	1	3	1	3	3	3	3

List of Experiment:

1. Preparation of dry onion/ chilli/ garlic.
2. Preparation of bread
3. Manufacture of macaroni by extruder.
4. Manufacture of potato powder.
5. Manufacture of ice cream.
6. Manufacture of Rosogolla and Sandesh.
7. Manufacture of candied fruits.
8. Production of milk powder by spray drying
9. Preparation of sponge cake.
10. Preparation of fruit leathers
11. Study and characteristics different herbs and spices
12. Comparison of shelf life (nutritional Value and sensory test) of slow frozen and quick frozen food.
13. Innovative experiment.

Text Books:

1. Food Science by B. Srilakshmi
2. Essentials of Food & Nutrition by Swaminathan, Vol. 1 &2

Reference Book:

1. Hand Book of Analysis of fruits & vegetables by S. Ranganna

Course Code: Data Structures and Algorithm Lab

Course Code: CS(FT)591A

Contact: 0:0:3

Credits: 1.5

Pre requisites: Computer Fundamentals and principal of computer programming Lab

Course Outcomes:

After the completion of the course students will be able to:

CO1: Select appropriate data structure as applied to specified problem definition.

CO2: Handle operations like searching, insertion, deletion, traversing mechanism on various data structures.

CO3: Use practical knowledge on the applications of data structures.

CO4: Able to store, manipulate and arrange data in an efficient manner.

CO5: Implement queue and stack using arrays and linked list. Implementation of queue, binary tree and binary search tree.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	3	-	-	3	2	2
CO2	-	2	2	-	2	-	-	-	-	2	-	2	3	2	3
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	2	-	2	-	-	-	-	-	-	3	-	3	3	3
CO5	-	-	2	1	2	-	-	-	-	-	2	2	3	3	3

List of Experiment:

1. Write a C program to implement Single Link List
 2. Write a C program to implement Double Link List
 3. Write a C program to implement Single Circular Link List
 4. Write a C program to implement Double Circular Link List
 5. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.
 6. Write a C program to convert a given infix expression into its postfix Equivalent.
 7. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
 8. Write a C program to implement Binary Search Tree (BST).
 9. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
 - a. Insertion sort
 - b. Merge sort
 10. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
 - a. Quick sort
 - b. Selection sort
 11. Write C programs for implementing the following searching methods:
 - a. Linear Search
 - b. Binary Search
- Write a C program to implement all the functions of a dictionary (ADT) using hashing.
12. Write C programs for implementing the following graph traversal algorithms:
 - a. Depth first search
 - b. Breadth first search
 13. Innovative experiments

Text Books:

1. Data Structures using C, R. Thareja, 2nd Edition, Oxford University Press.
2. Data Structures Using C E. Balagurusamy, Mcgraw Hill

Reference Books:

1. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson
2. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
3. Data structures using C, A.K.Sharma, 2nd Edition, Pearson
4. Fundamentals of Data Structures of C by Ellis Horowitz, SartajSahni, Susan Anderson-freed 2nd Edition, Universities Press

Course Name: Database Management System Lab**Course Code: CS(FT)591B****Contacts: 0:0:3****Credits: 1.5****Prerequisite:**

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives:

1. To learn the data models, conceptualize and depicts data base system
2. To learn the fundamental concepts of SQL queries.
3. To understand the concept of designing a data base with the necessary attributes.
4. To know the methodology of Accessing, Modifying and Updating data& information from the relational databases
5. To learn database design as well as to design user interface and how to connect with database.

Course Outcome(s):

On completion of the course students will be able to

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.**CO2:** Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.**CO3:** Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.**CO4:** Analyze database system concepts and apply normalization to the database.**CO5:** Apply different transaction processing and concurrency control applications.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CO2	2	3	3	3	3	1	1	1	2	2	3	3	3	2	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3

Course Contents:

- **Structured Query Language**

Module1: **6L**

Creating Database Creating a Database

Creating a Table Specifying Relational Data Types Specifying Constraints Creating Indexes

Module2: **3L**

Table and Record Handling INSERT statement

Using SELECT and INSERT together DELETE, UPDATE, TRUNCATE statements DROP, ALTER statements

Module 3: **6L**

Retrieving Data from a Database The SELECT statement

Using the WHERE clause

Using Logical Operators in the WHERE clause

Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause Using

Aggregate Functions Combining Tables Using JOINS Sub-queries

Module 4: **3L**

Database Management Creating Views

Creating Column Aliases Creating Database Users Using GRANT and REVOKE

Module 5: **6L**

PL/SQL

Module 6: **6L**

Database design using E-R model and Normalization

Module 7: **6L**

Design and implementation of some on line system [Library Management System]

Text Books:

- 1) SQL, PL/SQL by Ivan Bayross, BPB Publications
- 2) Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

Course Name: Software Engineering Lab**Course Code: CS(FT)591C****Contact Hours: 0:0:3****Credits: 1.5****Prerequisites:**

For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

Course Objectives:

- To learn software development skill through various stages of software life cycle. .
- To ensure the quality of software through software development with various protocol based environment.

Course Outcomes:

On completion of the course students will be able to:

CO1: Handle software development models through rational method.**CO2:** Prepare SRS document, design document, test cases and software configuration management and risk management related document.**CO3:** Develop function oriented and object oriented software design using tools like rational rose.**CO4:** Perform unit testing and integration testing**CO5:** Apply various white box and black box testing techniques

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	3	3	2	2
CO2	3	2	3	-	-	-	-	-	-	-	-	2	3	2	3
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	3	3

Course Contents

Assignments to be given from the following

1. Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admission system). DFD of standard application problems.
2. Project Schedule preparation. Software Requirement Analysis: Describe the individual Phases/modules of the project, Identify deliverables.
3. Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose. (For standard application problems)
4. Software Development and Debugging. Estimation of project size using Function Point(FP) for calculation.
5. Design Test Script/Test Plan (both Black box and White Box approach)
6. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.)
Cost Estimation models. COCOMO

Text Book:

1. Software Engineering: A practitioner's approach–Pressman(TM)

Reference Book:

1. Software Engineering-Pankaj Jalote (Wiley-India)

3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT601	Food Packaging Technology	3	0	0	3	3
2	ENGG	Major	FT602A/B/C	A. Mass Transfer II B. Separation Process II C. Transport Phenomena	3	1	0	4	4
3	ENGG	Major	FT603	Bakery, Confectionary and Extruded Foods	4	0	0	4	4
4	ENGG	Minor	CS(FT)601A/B/C	A. Introduction to Artificial Intelligence B. Introduction to Machine Learning C. Introduction to Internet of Things	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU(FT)601	Quantitative Aptitude	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	FT 691	Food Analysis and Quality Control Lab	0	0	3	3	1.5
2	ENGG	Major	FT692A/B/C	A. Mass Transfer II Lab B. Separation Process II Lab C. Transport Phenomena Lab	0	0	3	3	1.5
3	PRJ	Internship	PR(FT)691	Industrial Training (Min. 2 weeks)	0	0	0	-	2
4	PRJ	Project	FT681	Minor Project II	0	0	3	3	1.5
Total of Theory, Practical and Project								24	21.5

**HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project*

THIRD YEAR SECOND SEMESTER
Course Name: Food Packaging Technology
Course Code: FT601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Pre requisites: Chemistry of Food, Food Process Engineering, Principles of Food Preservation

Course Objective:

To help the students identify the importance of packaging in the food industry and understand the recent developments in food packaging.

Course outcome(s):

After completion of the course students will be able to:

CO1: Define food packaging and explain its function for different food packaging materials.

CO2: Identify potential use of different packaging materials in context to industry and environment.

CO3: Perceive knowledge of bio composite and biodegradable materials for safe food packaging including active and intelligent packaging.

CO4: Adapt rules of different statutory and regulatory bodies in food packaging and disposal protocols for food packaging in industries.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	3	3	3	3	1	1	2	2	2	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO3	3	1	2	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:

Module I:	8L
Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging film; Methods of packaging and packaging equipment	
Module II:	8L
Mechanical strength of different packaging materials; Printing of packages; Barcodes & other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.	
Module III:	7L
Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.	
Module IV:	9L
Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing equipment; Labelling; Aseptic and shrink packaging; Secondary and transport packaging. Advances in Packaging Technologies; MAP, CAP, Active packaging, Intelligent Packaging, Nano-Packaging, Irradiated food Packaging.	
Revision:	4L

Text Books:

1. Food Packaging: Principles and Practice by G. L. Robertson. Taylor & Francis Inc.
2. Food Packaging Technology by Richard Coles, Derek MC Dowell and Mark J. Kirwan. Blackwell Publishing, CRCpress.
3. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC,1988.)

Reference Books:

1. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series -365, April 5-10, 1987, American chemical society, Washington DC,1988.)
2. Packaging foods with plastics by winter A. Jenkins & James P Harrington – Technomic publishing co. Inc, Lancaster. Basel.
3. Flexible food packaging (Question & Answers) by Arthur Hirsch VNB – Van Nostrand Reinhold, New York (An AVI Book), ISBN0-442-00609-8.
4. Food Packaging and Preservation (theory & practice) by M. Mathlouthi-Elsevier Applied science publisher, London and New York.
5. Food Packaging Materials (Aspect of Analysis & Migration of contaminants) by N. T. crosby applied science publishers LTD. London.
6. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.

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7. Packaging (specifications, purchasing & Quality Control) 3rd edition by Edmond A Leonard-Marcel Dekker, INC- Newyork & Basel.
 8. Plastics in packaging by forwarded by H.B Ajmera & M.R Subramanium – Indian institute of packaging. Published by A. P. Vaidya, Secretary II, E2, MIDC, Industrial Area (Andheri (East),Bombay-400093.
 9. Food Packaging- Stanley Sacharois & Roger C. Griffin- The AVI Publishing company Inc. 1970.
 10. Principles of packaging development- Griffin & Sacharow. (The AVI Publishing company, Inc. 1972).

Course Name: Mass Transfer II

Course Code: FT602A

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Engineering Thermodynamics, Mass Transfer I

Course Objective:

- To impart knowledge on fundamentals of mass transfer phenomena and to apply those concepts to real engineering problems.
- To explain the principles of mass transfer and their application to separation and purification processes

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the basics of distillation process for separation.

CO2: Analyze the distillation process for binary and multi component mixtures

CO3: Determine the number of stages required for separation of liquid-liquid and solid- liquid extraction process.

CO4: Explain the concept and mechanism of drying operations.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	3
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module I: Distillation****11L**

Pressure-composition, Temperature-concentration, Enthalpy-concentration diagrams for ideal and non-ideal solutions, Raoult's law and its application, 8 Maximum and minimum boiling mixtures, concept of relative volatility, Single Stage Distillation, Differential distillation, Flash vaporization, Vacuum, molecular and steam distillation.

Module II: Continuous Distillation of Binary Mixtures**11L**

Multistage contact operations, Characteristics of multistage tower, McCabe Thiele method, Reflux, maximum, min. and optimum reflux, Use of open steam, Tray efficiency, Determination of height and column diameter, Multistage batch distillation; Principles of azeotropic and extractive distillation

Module III: Extraction**11L**

Liquid-Liquid Extraction: Ternary liquid equilibrium, Triangular graphical representation concept of theoretical or ideal stage, Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation Super critical fluid extraction.

Solid /Liquid Extraction: Leaching, Solid liquid equilibrium, Equipment used in solid-liquid extraction, Single and multistage cross current contact and counter current operations. Application of different extraction technologies in food industries

Module IV: Drying**11L**

Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers. Application of drying methods in food industries.

Revision:**4L****Text Books:**

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Robert. E. Treybal. —Mass Transfer Operation, 3e, Mc Graw Hill, NY
4. Geankopolis, C.J. —Transport Processes and Unit Operations, 3e, Prentice Hall (I)

Reference Books:

1. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
2. Heat Transfer: D.Q. Kern, MGH
3. Foust, A.S., Wenzel, L.A., et.al. Principles of Unit Operations, 2nd edition, JWS
4. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Course Name: Separation Process II

Course Code: FT602B

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Thermodynamics, Separation Process I

Course Objective:

To learn conceptual design of separation processes and design of equipment involved.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the principles of molecular diffusion and basic laws of mass transfer.

CO 2: Study the characteristic of packed bed absorption column

CO3: Understand the basics of distillation process for separation

CO4: Solve the problems of separation by diffusion, absorption and distillation

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	3
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module I:****15L**

Principles of molecular diffusion and diffusion between phases, Fick's Law, Diffusivity, Equation of continuity, Diffusion in solids. Definition of Mass transfer coefficient, Correlation of mass transfer coefficients, Theories of Mass Transfer, mass transfer across interfaces. The application of mass transfer across interfaces in food processing.

Module II:**15L**

Introduction, Mechanism of absorption, Absorption equipment, Diameter and height calculations for packed columns, Kremser equation, H. E. T. P., H. T. U. , and N. T. U. concepts, Packed tower design, height of column based on conditions in the gas, liquid film, and overall coefficients, plate type towers, number of plates by use of absorption factor.

Module III:**14L**

Introduction, Vapor-liquid equilibria, Relative volatility, Ideal and non -ideal solutions, Batch, differential and equilibrium distillation, Enthalpy concentration diagram, Rectification of binary systems, Design of rectification column, calculation of number of ideal plates in a distillation column by McCabe-Thiele method, importance of reflux ratio, Azeotropic mixture & Extractive Distillations, Introduction to multi-component distillation. Kinetics of different vapour-liquid equilibrium (VLE), liquid-liquid equilibrium (LLE), and solid-liquid equilibrium (SLE).

Revision:**4L****Text Books:**

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn., PHI.
3. Unit Operations in Chemical Engineering : McCabe, Smith, and Harriot. MGH, Sth Edn.

Reference books:

1. Multicomponent Distillation: Holland, C. D., PHI.
2. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.
3. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.
4. Separation Processes: King, C. J. MGH.
5. Design of Equilibrium Stage Processes: Smith, B. D. MGH.
6. Distillation: van Winkle, M., MGH.

Course Name: Transport Phenomena

Course Code: FT602C

Contact: 3:1:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objective:

To be able to analyze various transport processes with understanding of solution approximation methods and their limitations.

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Understand the chemical and physical transport processes and their mechanism

CO2: Apply heat, mass and momentum transfer analysis

CO3: Analyze industrial problems along with appropriate approximations and boundary conditions

CO4: Develop steady and time dependent solutions along with their limitations

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	2	-	-	-	3	3	2	3
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:**Module I:****11L**

Introduction: Concept of unified approach to Momentum, Heat and Mass Transport through Transport Phenomena - Assumptions of Transport phenomena; Similarity of Mass, Momentum and Energy transfer, Diffusivities, Transport Theorem

Module II:**11L**

Momentum Transport: Viscosity, Newton's law of viscosity, calculation of momentum flux, Non-Newtonian fluids – Bingham model, – Flow of a falling film with constant/variable viscosity, Flow through a circular tube, Laminar flow between two flat stationary/moving plates, Shape of the surface of a rotating fluid. Comparison of different flow characteristics of food materials. Concept of Boundary layer and Boundary layer theory. Concept of turbulence.

Module III:**11L**

Energy Transport: Modes of heat transfer; concepts of (a) thermal conductivity – constant and temperature dependent, (b) thermal diffusivity and (c) heat transfer coefficient. Fourier's law of heat conduction. Shell energy balance and boundary conditions – Heat conduction with electrical, nuclear, viscous and chemical heat source, Heat conduction through composite walls. Different mass and energy balance equations.

Module IV:**11L**

Mass Transport: Concentrations, Velocities and Mass and Molar fluxes. Concept of Mass diffusivity and Mass transfer coefficient. Fick's law of diffusion.

Shell mass balance and boundary conditions – Diffusion through stagnant gas film

Revision:**4L****Text Books:**

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn., PHI.
3. Unit Operations in Chemical Engineering : McCabe, Smith, and Harriot. MGH, SthEdn.
4. Multicomponent Distillation: Holland, C. D., PHI.

Reference books:

The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH. 2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.

3. Separation Processes: King, C. J.MGH.
4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

Course Name: Bakery, Confectionary and Extruded Foods

Course Code: FT603

Contact: 4:0:0

Total Contact Hours: 48

Credit: 4

Pre requisites: Chemistry of Food, Food Preservation, Food Microbiology

Course Objective:

To provide an optimum environment for students to gain knowledge on the different functional properties of the ingredients, processes and machinery involved in production of different bakery and confectionery products. Students can also get idea about the safety, hygiene and maintenance of different bakery industries.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Gain knowledge on the ingredients, process and machinery involved in bakery and confectionery technology and extruded products.

CO2: Evaluate the function, properties and interaction of raw materials by manufacturing a range of products and to use a selected range of testing procedures to assess the performance of raw materials in the product.

CO3: Demonstrate a detailed knowledge of the law relating to the composition, labeling and advertising of food and food products within this area sold for human consumption and to analyze production faults and suggest corrective actions and to assess product quality for industry and consumer requirements.

CO4: Remember the technical knowledge for the development of Bakery and Confectionary industry and Extruded products

CO – PO-PSO Mapping

COs	Program Outcome												Program Specific Outcomes		
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	2
CO2	3	2	2	1	-	1	2	1	-	-	-	3	3	2	2
CO3	3	3	2	2	-	-	2	-	-	-	-	3	3	3	3
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2

Course Contents:**Module I****11L**

Introduction to baking; Bakery ingredients and their functions; Machines and equipment for batch and continuous processing of bakery products.

Module II**11L**

Testing of flour; Preparation techniques of different baked products: bread, cake and biscuits; Cake icing techniques, wafer manufacture, cookies, crackers, dusting or breading; Analysis of bakery products;

Module III**11L**

Preparation techniques of confectionary: pies and pastries, doughnuts, chocolates and candies; Chocolates: Introduction. Different ingredients require for chocolate preparation and their functions and value added product; Maintenance, safety and hygiene of bakery plants. ISO rules for bakery industries.

Module IV**11L**

Importance and applications of extrusion in food processing; Pre and post extrusion treatments; Manufacturing process of extruded products: Texturized vegetable protein; Change of functional properties of food components during extrusion. Animal protein replacing by extruded vegetable proteins.

Revision:**4L****Text Books:**

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.

Reference Books:

1. Up to-date Bread Making; Fance WJ & Wrogg BH; 1968, Maclasen & Sons Ltd.
2. Modern Cereal Chemistry; Kent-Jones DW & Amos AJ; 1967, Food Trade Press Ltd.

Course Name: Introduction to Artificial Intelligence**Course Code: CS(FT)601A****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3 Prerequisite:**

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

- The objective of the course is to enable students to
- Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
- Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
- Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
- Design AI-Frameworks for Inferencing based on knowledge base.
- Analyze the effectiveness of an AI-Inferencing Modeling offering solutions to the respective problem.

Course Outcomes(s):

After completion of this course students will be able to:

CO1: Understand and explain the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.**CO2:** Identify and formulate an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Agent Design Frame work within the scope of Artificial Intelligence paradigm.**CO3:** Explore relevant literature and apply the concept of Heuristic Techniques or Inferencing Models of Artificial Intelligence to solve problems.**CO4:** Develop Inferencing Models for proposing solutions to the problems of Artificial Intelligence.**CO5:** Implement Inferencing Models of Artificial Intelligence through developing feasible Igorithms and investigate their effectiveness by analyzing their performances in solving the relevant problems

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	-	-	2	3	3	2	2
CO2	2	3	-	-	-	2	1	-	-	-	-	-	1	3	3
CO3	3	2	3	2	-	-	-	2	3	2	1	-	2	2	3
CO4	2	2	2	3	-	-	3	-	1	-	-	2	2	3	3
CO5	2	2	3	3	2	-	2	-	-	-	3	2	2	2	1

Course Content:**Module-1: Introduction to Artificial Intelligence****1L**

Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

Module-2: Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching**5L**

Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching.

Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-Directional Search.

Module-3: Heuristic Techniques for Goal Searching**8L**

Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search.

Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.

Module-4: Adversarial Search for Game Playing**2L**

Basic Concepts, Minimax Search, Alpha-Beta Pruning.

Module-5: Knowledge Representation and Inference using Propositional Logic and Predicate Logic**5L**

Propositional Logic: Knowledge Representation and Inference using Propositional Logic Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module-6: Slot-and-Filler Structure for Knowledge Representation**2L**

Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames. Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.

Module-7: Reasoning under Uncertainty**5L**

Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model.

Planning [5L]

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm. Introduction to Natural Language Processing [1L]

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.

Module-8: Introduction to Machine Learning**2L**

Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

Course Name: Introduction to Machine Learning**Course Code: CS(FT)601B****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Prerequisite:**

1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization; Statistics; Calculus.

Course Objective(s)

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcome(s):

After completion of this course students will be able to:

CO1: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.**CO2:** Have an understanding of the strengths and weaknesses of many popular machine learning approaches.**CO3:** Understand how to evaluate models generated from data.**CO4:** Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

CO-PO-PSO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	1	-	-	2	3	3	2	3
CO2	-	3	3	2	-	2	1	-	2	-	-	-	3	1	3
CO3	2	3	3	3	1	-	-	2	3	2	1	-	3	2	3
CO4	2	2	3	3	-	-	3	-	1	-	-	2	2	2	2
CO5	3	3	3	3	2	-	2	-	-	-	3	2	3	2	3

Course Contents:**Module 1:****8L**

Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module 2:**5L**

Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)

Module 3:**4L**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module 4:**7L**

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module 5:**7L**

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Module 6:**4L**

Recent trends in various learning techniques of machine learning and classification methods.

Text Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

References Books:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

Course Name: Introduction to Internet of Things

Course Code: CS(FT)601C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcome(s):

On completion of the course students will be able:

CO1: Understand and differentiate the concepts of Internet of Things and Internet

CO2: Identify appropriate MAC protocols and routing protocols while solving a problem

CO3: Analyze and compare the basic protocols in wireless sensor network and IoT

CO4: Solve different real life problems in different domains based upon the concept of IoT and sensor network

CO5: Implement basic IoT applications on embedded platform

CO-PO-PSO–PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	2	-	-	-	3	2	3
CO2	3	3	3	3	2	-	-	2	3	-	-	3	3	1	3
CO3	3	3	3	2	2	-	1	-	-	-	3	2	3	2	3
CO4	3	3	3	3	3	2	2	3	-	-	-	-	2	2	2
CO5	3	3	3	3	3	2	2	-	2	2	1	1	1	2	2

Course Content:**Module 1:****7L**

Fundamental of IoT

The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module 2:**6L**

Wireless Sensor Network

Network & Communication aspects, Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Module 3:**7L**

IoT and M2M

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4:**7L**

IoT Architecture

Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5:**5L**

IoT Applications for Value Creations

Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6:**4L**

Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data- Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text Books:

1. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference Books:

1. Cuno Pfister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 978- 1-4493-9357-1
2. Walteneus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

Course Name: Quantitative Aptitude

Course Code: HU(FT)601

Contact Hours: 1:0:0

Total Contact Hours: 12

Credit: 1

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard algebra.

Course Objectives:

The objective of this course is to familiarize prospective engineers with techniques of using algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well in tackling the aptitude level of mathematics and applications that they would find useful for competitive examinations.

Course Outcome:

CO1: Recall the concept of Algebra.

CO2: Determine the solutions to the problems of Quantitative Aptitude.

CO3: Apply the appropriate mathematical tools to solve the aptitude problems.

CO4: Analyze different aptitude problems with the help of the various tools.

CO-PO-PSO Mapping

CO ^s	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	1	2	-	-	-	-	-	-	-	-	-	2	1	1	2
CO 2	1	3	-	-	-	-	-	-	-	-	-	3	2	2	2
CO 3	2	3	2	2	3	-	-	-	-	-	2	3	2	3	2
CO 4	2	3	2	3	3	-	-	-	-	-	2	3	2	2	2

Course Content:

1. Problems on Number Series, AP and GP
2. Problems on Age
3. Problems on Percentage
4. Problems on Profit and Loss
5. Problems on Ratio & Proportion, Partnership
6. Problems on Chain Rule
7. Problems on Time and Work
8. Problems on Pipe and Cisterns
9. Problems on Time and Distance
10. Problems on Train, Boat and Stream
11. Problems on Simple and Compound Interest
12. Problems on Stock and Share
13. Problems on Calender and Clock

Course Name: Food Analysis and Quality Control Lab

Course Code: FT691

Contact: 0:0:3

Credit: 1.5

Pre requisites: Food Chemistry, Biochemistry

Course Objectives:

To help the students develop practical skill in analyzing various components e.g. carbohydrate, fat, protein, vitamin etc. available in various food materials and to measure the acidity, ash, sugar content, moisture, total solid content, viscosity, unsaturation, volatile fatty acid, hydrolytic rancidity, oxidative rancidity of these food samples.

Course outcome(s):

After the completion of the Food Analysis and Quality Control Lab I the students will be able to:

CO1: Determine the methods of selecting appropriate techniques for analysis of food products.

CO2: Analyze different components present in various food materials.

CO3: Gain the knowledge of food standards, regulations and quality control

CO4: Identify the tests methods to detect adulterant in various food samples

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	1	1	2	2	-	2	3	3	2
CO2	2	2	2	2	3	2	2	2	2	2	2	2	3	3	2
CO3	3	2	2	-	-	2	2	2	-	-	-	2	3	2	3
CO4	3	2	2	1	2	2	2	3	2	2	2	2	3	2	2

List of Experiments:

1. Analysis of portable water.
2. Analysis of jam, jelly, marmalade.
3. Analysis of spices.
4. Analysis of tea including polyphenols/ antioxidant content
5. Analysis of coffee including chicory, polyphenols/ antioxidant content
6. Analysis of milk and dairy products
7. Analysis (lactic acid content) of Sauerkraut.
8. Analysis of oil (a) Iodine value, (b) Saponification value (c) acid value (d) peroxide value, (e) para-Anisidine value.
9. Innovative Experiments

Text Books:

1. FSSAI Manuals
2. Raghuramulu, N. et al., "A Manual of Laboratory Techniques". 2nd Edition. NIN, 2003.
3. Nielson, S. Suzanne. "Food Analysis" 3rd Edition. Springer, 2003.

Reference Books:

1. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis : Theory and Practice". 3rd Edition. Springer, 2000.

Course Name: Mass Transfer II Lab

Course Code: FT692A

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

- To impart knowledge of the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course Outcome:

After the completion of the course students will be able to:

CO1: Analyze the data on vapor-liquid equilibrium and Boiling point diagram

CO2: Discuss the performance of distillation column

CO3: Understand the separation process by Liquid- Liquid Extraction and solid liquid extraction.

CO4: Understand the working mechanism of different type of dryers

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	3	3	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	2	2	-	2	3	3	3	2

Course Contents:

1. To study vapor-liquid equilibrium and prepare Boiling point diagram for a binary liquid mixture.
2. To determine relative volatility of solvent mixtures by distillation.
3. To determine the ternary curve for the system acetic acid-water-carbon tetrachloride
4. To study the solid –liquid extraction system- Soxhlet’s experiment
5. To study the operation on extraction of oil from seed.
6. To determine drying rates of food using different types of driers
 - (i) Tray Drier,
 - (ii) Fluidized bed Drier,
 - (iii) Freeze Drier,
 - (iv) Spray Drier
7. Innovative Experiment

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn., PHI.
3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.
4. Multicomponent Distillation: Holland, C. D.,PHI.

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH. 2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.
2. Separation Processes: King, C. J.MGH.
3. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

Course Name: Separation Process II Lab

Course Code: FT692B

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

- To impart knowledge of the basic fundamental principles of mass transfer by performing different experiments
- To make them correlate theory and practical process by experimentation.

Course Outcome:

After the completion of the course students will be able to:

CO1: Define process equipment via hands-on learning.

CO2: Determine the filter medium resistance & cake resistance

CO3: Estimate separation coefficient in centrifugation and vacuum evaporation

CO4: Compare drying rates of food using different types of driers

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	3	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	1	2	-	2	3	3	3	2

Course Contents:

1. To determine filter medium resistance & cake resistance in cake filtration.
2. To determine separation coefficient in centrifugation.
3. To determine separation coefficient by vacuum evaporation using Rotary Vacuum Evaporator
4. To determine absorption coefficient in a packed tower.
5. To determine drying characteristics of a material under constant drying air condition
6. To compare of drying rates of food using different types of driers Innovative Experiments

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.
3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.
4. Multicomponent Distillation: Holland, C. D., PHI

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.
2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.
3. Separation Processes: King, C. J.MGH.
4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

Course Name: Transport Phenomena Lab

Course Code: FT692C

Contact: 0:0:3

Credit: 1.5

Pre requisites: Engineering Thermodynamics, Mass Transfer, Separation Process

Course Objectives:

To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data.

Course Outcome:

After the completion of the course students will be able to:

CO1: Plan experiments and present the experimental data meaningfully

CO2: Apply theoretical concepts for data analysis and interpretation

CO3: Understand chemical engineering unit operations related to fluid and particle mechanics, and mass transfer

CO4: Understand the experimental techniques related to chemical reaction engineering

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2	1
CO2	3	3	2	2	-	-	-	1	-	-	-	3	3	2	1
CO3	3	3	2	-	3	2	-	-	-	-	1	3	3	2	1
CO4	3	3	3	2	2	-	-	3	2	-	2	3	3	3	2

Course Contents:

1. To determine Drag Coefficient
2. Experiments on Tubing, interconnects flow measurement
3. To determine flow measurement
4. Experiments on Industrial-scale equipment, valving
5. Experiments on Temp and flow control, calibration
6. Experiments on Psychrometric chart, vapor pressure, flow control, humidity sensors
7. Experiments on Dissolved oxygen sensors, spargers
8. Innovative Experiment

Text Books:

1. Mass Transfer Operations: Robert E. Treybal, MGH, International student Edition.
2. Transport process and Unit Operations: Geankoplis. 3rd Edn.,PHI.
3. Unit Operations in Chemical Engfueering : McCabe, Smith, and Harriot. MGH, SthEdn.
4. Multi component Distillation: Holland, C. D.,PHI.

Reference Books:

1. The Elements of Fractional Distillation: Robinson, C. S. and Gilliland, E. R. MGH.
2. Mass Transfer: Sherwood, Pigford, and Wilke, MGH.
3. Separation Processes: King, C. J.MGH.
4. Design of Equilibrium Stage Processes: Smith, B. D.MGH.

4 th Year 7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	FT701	Principles Of Biochemical Engineering.	3	1	0	4	4
2	ENGG	Major	FT702	Food Process Engineering.	3	0	0	3	3
3	ENGG	Major	FT703A/B/C	A. Food Additives B. Supply Chain Management and Food Marketing C. Food Security and Sustainability	3	0	0	3	3
4	ENGG	Minor	ECS(FT)701A	Process Instrumentation and Control	3	0	0	3	3
			EE(FT)701B	Renewable Energy Technology					
			EC(FT)701C	Introduction to Nanotechnology					
5	ENGG	Minor	HU(FT)701A	Entrepreneurship Development and Start-Up Management	3	0	0	3	3
			HU(FT)702B	Quality Management System					
			CS(FT)701C	Smart Technologies					
B. PRACTICAL									
1	PRJ	Project	FT781	Major Project-I	0	0	0	7	3.5
Total of Theory, Practical and Project								24	19.5

FOURTH YEAR FIRST SEMESTER
Course Name: Principles of Biochemical Engineering
Course Code: FT701
Contact: 3:1:0
Total Contact Hours: 48
Credit: 4
Pre requisites: Food Engineering, Food Processing, Unit Operations

Course Objective: To help the students understand the basic principles of various biochemical processes and realize the importance of different design parameters in bioreactor operation

Course outcome(s):

After completion of the course, the students will be able to

CO1: Recognize the industrial implication of biochemical engineering.

CO2: Interpret the kinetics of microbial reactions.

CO3: Develop the design parameters for a bioreactor.

CO4: Illustrate the importance of downstream processing in bioprocess industries and to evaluate the importance of design considerations in a fermentation plant design project and examine scale up operations.

CO – PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	2	3
CO2	3	3	3	2	2	1	2	1	2	2	2	3	2	1	2
CO3	3	3	3	2	1	2	2	2	2	2	2	3	1	2	3
CO4	3	3	3	1	3	1	1	-	-	-	3	3	3	2	3

Course Contents:**Module I****12L**

Introduction to biochemical process industries; Industrial alcohols, antibiotics, acids, alcoholic beverages, vitamins, enzymes, single cell protein, dairy products

Module II**14L**

Bioreactor design: Mechanisms and kinetics (Monod model), Fermentation - types of fermenters, chemostat, chemostat with recycle, turbidostat, PFR, fluidized bed reactor, air lift fermenter, Fed Batch reactions; Mass transfer in microbial reactors. Langmuir, Eadie Hofstee, Hanes- Woolf Lineweaver-Burk kinetic models.

Module III**14L**

Bio product recovery: Downstream processing - separation process for cell mass and product, filtration, centrifuging, membrane processes (reverse osmosis, ultrafiltration, and chromatographic separation), extraction process, and adsorption process. Ion exchange process.

Module IV**4L**

Scale-up of bioprocess; Bioprocess economics and cost analysis, Fermentation plant design project, Bio-product regulation

Revision:**4L****Text Books:**

1. Biochemical Engineering Fundamentals: J.E Bailey, D F Olli, MGH
2. Biochemical Engineering: Aiba S; Academia press, NY
3. Michael L. Shuler and Fikret Kargi: Bioprocess Engineering: Basic Concepts, 2nd Edition

Reference Books:

1. Bioprocess Engineering Principles, Pauline M. Doran
2. Principles of Bioseparation Engineering, Raja Ghosh

Course Name: Food Process Engineering

Course Code: FT702

Contact: 2:1:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Mass balance, Unit Operation

Course Objective:

To help the students design the process parameters for thermal processing, freezing, evaporation, dehydration, separation, extraction and to develop skills in formulating solutions to solve problems in food industry.

Course outcome(s):

After the completion of the course students will be able to:

CO1: Explain the food processing techniques of thermal processing, eg, sterilization, evaporation, dehydration, separation, extraction.

CO2: Build the knowledge of different freezers.

CO3: Know the theory of different dryers.

CO4: Understand basic principles of different types of heat exchangers and extruders.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	3	2	-	2	-	-	3	3	1	2
CO2	3	1	3	2	3	-	2	2	-	2	-	3	3	3	2
CO3	3	3	3	3	3	-	-	-	-	1	2	3	3	2	2
CO4	3	1	2	2	3	-	1	-	1	-	2	3	3	3	1

Course Contents:**Module I****8L**

Batch and continuous sterilization processes (including steps and various machineries involved) used in canning of foods; Commercial sterilization, Constructional and operational features of pasteurizer; homogenizer; Constructional features and principles of single effect evaporators (including mass and energy balances) used for concentration of liquid foods.

Module II**8L**

Constructional features of cold storage and basic design approach; Different types of freezers including plate contact freezer, air blast freezer; Cryogenic freezing; Refrigerated mobile vans.

Module III**8L**

Drying kinetics and constant & falling rate periods in drying; Constructional & operational features of various types of cross-flow, through flow and recirculatory dryers – Tray dryer, roller dryer, drum dryer, spray dryer, fluidized bed dryer, freeze dryer and solar dryer, rotary dryer, tunnel dryer, other grain dryers (LSU-type).

Module IV**8L**

Heat exchangers (Co-current and counter-current heat exchanger); Constructional features of various types of heat exchangers – DPHE; Theory and operation of extrusion systems used in food industry; Cold extrusion and Extrusion cooking systems; Single and twin-screw extruders – constructional and operational features including advantages/disadvantages with case studies.

Revision:**4L****Text Books:**

1. Fundamentals of Food Process Engineering (3rd Ed.) – R. T. Toledo, Springer, 2007.
2. Unit Operations of Chemical Engineering – W.L. McCabe, J. C. Smith & P. Harriott, McGraw Hill International, 1993.
3. Introduction to Chemical Engineering – S. K. Ghosal, S. K. Sanyal, S.Datta.

Reference Books:

1. Introduction to Food Engineering (5th Ed.) – R. P. Sing & D. R. Heldman, Academic Press, 2014
2. Food Process Engineering & Technology (2nd Ed.) – Z. Berk, Academic Press, 2014
3. Food Process Engineering Operations – G. D. Saravacos & Z. B. Maroulis, CRC Press, 2011.
4. Transport Processes & Separation Process Principles – C. J. Geankoplis, PHI, 2003
5. Introduction to Food Process Engineering – A. Ibraiz & G. V. Barbosa-Canovas – CRC Press,

2014.

6. Introduction to Food Process Engineering (2nd Ed.) – P. G. Smith, Springer, 2011.
7. Postharvest Technology and Food Process Engineering- AmalenduChakraverty& R. Paul Singh, CRC Press, 2014.
8. Fundamentals of Food Engineering – D. G. Rao, PHILearning, 2014.
9. Food Process Engineering & Technology – Md. Iffan A. Ansari – Jain Brothers
10. Processing & Food Engineering – M. K. Garg& P. Chandra, Jain Brothers
11. Solved Problems in Food Engineering –Stavros Yanniotis, Springer

Course Name: Food Additives

Course Code: FT703A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Food Chemistry, Food Preservation

Course Objective:

To provide the students an opportunity to gain knowledge of the class, function, and uses of additives, relate the various role of additives, select suitable additives in food composition and categorize uses of additives with regulations and food laws

Course outcome(s):

After completion of the course students will be able to:

CO1: Understand the various roles of additives

CO2: Apply their knowledge in formulation with the uses of different additives.

CO3: Identify suitable additives in food composition

CO4: Categorize uses of additives with regulations and food laws

CO-PO-PSO Mapping

CO(S)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	1	2	2	-	1	-	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	3	3	3	2	3
CO 4	3	3	3	3	2	3	2	3	3	3	2	3	3	3	3

Course Contents:**Module I: 10L**

Definitions of Food Additives, Basic criterion of additives, Classification and Functions, Legitimate uses of Additives in foods, Intentional & Non Intentional additives, Indirect food additives; Food uses and functions in formulations; Toxicological evaluation of food additives (intake assessments), generally recognized as safe (GRAS), Regulations and food laws on food additives, Joint FAO/WHO Expert Committee (JECFA)/CODEX recommendation for harmonization and control of food additives, GFSA

Module II: 10L

Uses & functions of Acid, Base, Buffer systems, Salts, acidulants and Chelating/Sequestering agents, Artificial sweeteners and health implications; Low calorie and non-nutritive sweeteners, Polyols. Antioxidants and chelating agents, Emulsifying and stabilizing agents, Anticaking agents, and Humectants, Thickeners, Firming agents. Flour bleaching agents and Bread improvers. Fat mimetics and replacers

Module III: 6L

Antimicrobial agents / Class I, Class II, and Class III preservatives as per PFA Act. Acceptable Daily Intake (ADI) recommendation by JECFA, Carry-Over of Food Additives from ingredients and raw materials into foods, Clarifying agents. Tracers and other additives

Module IV: 6L

Colours and Flavours (synthetic and natural) Types of flavors, flavor emulsions; essential oils and oleoresins, Flavor enhancer, Method of analysis. Risks and benefits of food additives, Food additives and hypersensitivity, Nutritional additives

Revision: 4L**Text Books:**

1. Gerorge AB. 1996. Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
2. Branen AL, Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.
3. Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.

Reference Books:

1. Fennema OR. 1996. Food Chemistry. Marcel Dekker

Course Name: Supply Chain Management and Food Marketing

Course Code: FT703B

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Basic understanding of management principles and tools, Food Preservation

Course Objective:

- To impart knowledge and understanding on supply chain management and its relevance to today's business decision making
- To enable students to be aware of marketing techniques, schemes, and practices related to food products in place- and nationally and globally.

Course outcome(s):

After completion of the course students will be able to:

CO1: Remember principles of supply chain management principles to find the scope of food businesses

CO2: Interpret the tools and solutions that are being developed to solve arising in a supply chain during food processing problems

CO3: Apply sequential strategic planning involved in managing effective production, operation and distribution, and limitation of different processed foods keeping concerned existing advertising laws, regulations, and policies concerning the supply of safe food to consumers.

CO4: Develop system tools to meet the specific need of Food Product Development and Commercialization with effective supply chain mapping and traceability systems.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	3	2	2	1	1	2	2	2	1	3	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	2	3	2	3	3	3	3	3	3	3	3

Course Contents:**Module I:****9L**

Supply Chain definition, Objectives and Types, Various definitions, Drivers and Need for SCM, SCM decisions and skills, Strategy formulation in SCM, Value in Supply Chain and Tradeoffs, CRM Strategy relationship matrix, Strategic Sourcing, Source evaluation – collaborative perspective, Buyer-Supplier Relationship, Partner Selection, develop of Partnership, the importance of inventory, imbalances and uncertainties, inventory costs

Module II:**12 L**

Transportation Selection, Trade off, modes of transportation, models for transportation and distribution, factors affecting network effectiveness, 3 PL advantages, Indian transport infrastructure, IT solutions, EDI, e-Commerce, e-Procurement, Bar Coding and RFID, Critical business processes and information systems, DBMS, benefits of ERP, information system and bull whip effect, SCM software packages, modeling concepts, Vendor analysis model, Coordinated SCM, Simulation modeling reverse Vs forward supply chain, types of reverse flows, collaborative SCM's and CPFR, agile systems, sources of variability, characteristics

Module III:**5L**

Supply Chain Mapping (based on quantification of customer sensitivity and risk), Supply Chain Management and profitability, quality management, mass customization and globalization, Ethical Supply Chains, e-business and SCM, Balanced Score Card, Benchmarking

Module IV:**6L**

Food marketers act (Advertising law and regulation), Policymakers, food marketing practices, Product Development and Commercialization, Manufacturing Flow Management, Supplier Relationship Management regulation of food markets (e.g. food safety, false advertising, etc.)

Revision:**4L****Text Books:**

1. Mohanty R.P, S.G Deshmuki “Supply Chain Management” Biztantra, New Delhi 936 PAPER IV S

Reference Books:

1. Jacobs F.R, Berry W.L, Whybark D.C, Vollmann T.E., Manufacturing Planning and Control for Supply Chain Management: The CPIM Reference, Second Edition
2. Chopra S., Supply Chain Management: Strategy, Planning, and Operation (7th Edition) (What's New in Operations Management)

Course Name: Food Security and Sustainability

Course Code: FT703C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Environmental science, basic biology, agriculture, geography, microbiology, food processing, quality control, and food regulations

Course Objective:

To enable the students to learn about the severity of depletion of natural resources and its effect on food security and also enlighten about the different practices, policies, and initiatives to ensure food security and sustainability

Course outcome(s):

After completion of the course students will be able to:

CO1: Identify the importance of utilization and preservation of land, water, and other natural resources for Food Security and Sustainability.

CO2: Analyze the different existing and proposed technologies to set up sustainable food eco-systems with compliance to principles to aid in Food Security and Sustainability

CO3: Evaluate food production trends to monitor and explore various avenues to cater to the development of sustainable practices in society

CO4: Develop mass awareness and contribute at various levels as individuals or as active members of organizations to uphold the magnitude of Food Security and Sustainability

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	2	2	2	2	1	2	3	3	2	2
CO 2	3	3	3	3	3	2	3	3	2	2	2	3	3	2	3
CO 3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3

Course Contents:**Module I:****9L**

Food Security and Sustainability - Definition, Elements, Prospects and Challenges, Food production and nutritional aspects, Food –ecosystems, Factors affecting agriculture and crop yield, Indicators of Sustainable food availability, Population pressure and agricultural productivity, GMO, organic farming, vertical farming – principles and practices, Subsistence Food Production Practices, Security of foods of animal origin and its implications,

Module II:**8L**

Performance of major categories of food over the past decades, trends in food production, Decline in total factor productivity growth, Demand and supply projections, Impact of market forces, Sustainable food security indicators and index, Indicator of sustainability of food Security, Path to sustainable development.

Module III:**9L**

Impact of depletion of water resources, Land Resources of India, Population and land, Land utilization, Net Area Sown, changes in cropping pattern, land degradation, Rainfall forecasting - Adequacy of Rainfall for crop growth – Rainfall, Drought and production instability – Irrigation potential – Available, created and utilized – River basins; Watersheds and Utilizable surface water – Utilizable water in future (Groundwater & Surface water)

Module IV:**6L**

International and National policies for Food Security and Sustainability, Schemes, initiatives, and mass awareness programs by Government, PSUs, Case studies on CSR activities of different organizations related to Food Security and sustainability

Revision:**4L****Text Books:**

1. B.K.Desai and Pujari, B.T. Sustainable Agriculture: A vision for future, New India Publishing Agency, New Delhi, 2007.
2. Saroja Raman, Agricultural Sustainability – Principles, Processes and Prospects, CRC Press, 2013

Reference Books:

1. Swarna S.Vepa et al., Atlas of the sustainability of food security. MSSRF, Chennai, 2004.
2. Sithamparamanathan, J., Rengasamy, A., Arunachalam, N. Ecosystem principles and sustainable agriculture, Scitech Publications, Chennai, 1999.
4. Gangadhar Banerjee and Srijeet Banerji, Economics of sustainable agriculture and alternate production systems, Ane Books Pvt Ltd., 2017
5. M. S. Swaminathan, Science and sustainable food security, World Scientific Publishing Co., Singapore, 2010

Course Name: Process Instrumentation & Control

Course Code: ECS(FT)701A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite: Basic Physics

Course Objective:

This course helps the student

1. To have a knowledge on sensors & transducers
2. To understand the procedures of different process variable measurement
3. To have a knowledge of control system blocks
4. To have a knowledge of process control loops & controllers

Course Outcome(s):

After Completion of the course students will be able to:

CO1: Demonstrate the fundamentals of control systems

CO2: Differentiate the operation of sensors & transducers

CO3: Describe operation of different process parameter measurement

CO4: Apply the knowledge of controller in process control loop design

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	2	1	1	1	1	1	3	2	2
CO2	3	2	1	1	2	2	2	2	1	3	2	1	2	3	3
CO3	2	1	3	1	2	1	1	1	2	2	1	3	3	2	3
CO4	3	2	2	3	2	3	2	3	3	1	1	2	3	3	3

Course Contents:**Module 1:****6L**

Operational aspect of instrument system, Control and requisites; Sensors & Transducers, Difference between Sensors & Transducers, Types & classification and selection criteria, Basic principles, Construction and applications of transducer elements, Strain gauge with bridge circuits and calibration procedure

Module 2:**12L**

Temperature Measurement: Temperature measurement by bi-metal thermometers – resistance thermometers, thermistors and thermocouples. Radiation and optical pyrometers Flow measurement: Variable area type flowmeter, variable head type flow meter, magnetic flow meters Pressure Measurement: Low pressure measurement by McLeod Gage and Pirani Gage Moisture measurement cells for granular material, infrared, transmission measurement of moisture

Module 3:**6L**

Control system, Open and closed loop system, transfer function of open loop and closed loop control systems; Concept of Block diagram; Mathematical modelling

Module 4:**12L**

Basic Process Control Loop, Process characteristics, Controller, Controller modes, Pneumatic Controllers, Final control Element, Control valve, Control valve accessories, Actuators, Application of control in heat-exchangers, distillation column.

Text Books:

1. Instrumentation, Measurement and Analysis; Nakra BC & Chaudhury KK; TMH
2. Process System Analysis & Control; Coughanowr DR; MGH
3. D. P. Eckman, Automatic Process control, John Wiley, New York

Reference Books:

1. Surekha Bhanot, Process Control Principal & Application , Oxford
2. G. Stephanopoulos, Chemical process Control, PHI
3. C. D. Johnson, Process Control Instrumentation Technology, PHI

Course Name: Renewable Energy Technology

Course Code: EE(FT)701B

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Basic Environmental Engineering, Food Process Engineering, Unit Operation.

Course Objective:

To help the students develop an overview on the application of non-conventional energy and realize its role in sustainable development.

Course outcome(s):

After completion of the course, the students will be able to

CO1: Define the different biological fuels and biomass as a source of renewable energy

CO2: Explain the phenomenon of thermal combustion of biomass and biogas generation.

CO3: Describe the process of hydrogen production by photosynthetic bacteria.

CO4: Classify the different technologies behind the conversion of biomass to clean fuels and petrochemical substitutes.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	3	-	-	-	-	3	3	-	2
CO2	3	2	2	1	-	2	2	2	-	-	-	2	3	2	2
CO3	3	3	2	2	-	-	2	-	-	-	-	3	2	3	2
CO4	3	3	2	1	-	3	3	2	-	-	-	3	3	2	2

Course Contents:

Module I:	8L
Biological fuel generation; Biomass as a renewable energy source; Types of biomass: forest, agricultural and animal residues; Industrial and domestic organic wastes; Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.	
Module II:	8L
Biogas from anaerobic digestion; Thermal energy from biomass combustion; Ethanol from biomass.	
Module III:	8L
Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.	
Module IV:	8L
Solar energy; Solar collectors, solar pond, photovoltaic cells, chemical storage; Geothermal energy and wind energy; Use of geothermal energy; Operating principles of different types of wind energy mills; Nuclear energy; Nuclear reactions and power generation; Tidal wave energy.	
Revision:	4L

Text Books:

1. J. E. Smith – Biotechnology, 3rd edn. Cambridge Univ Press.
2. S. Sarkar – fuels and combustion, 2nd edn., University Press.

Reference Books:

1. Biochemical Engg. Fundamentals-Baily, Ollis. MGH
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi

Course Name: Introduction to Nanotechnology

Course Code: EC(FT)701C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Basic knowledge of physics, mathematics, mechanics, electronics and chemistry

Course Objective:

- To learn about basis of nano material science, preparation method and different types of nano materials
- To enable the students to learn about potential applications of nano materials in food Research

Course outcome(s):

After the completion of the course students will be able to:

CO1: Familiarize about the science and importance of nano materials and nano particals

CO2: Apply the knowledge acquired for characterization of different nano materials/nano particals

CO3: Analyze the risk assessment and safety issues of nano particals in food and packaging

applications **CO4:** Evaluate further area of research in food nanotechnology/nano encapsulation/ nano packaging

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	3	2	2	1	-	-	3	2	2
CO2	3	3	3	3	-	2	3	3	2	2	2	-	1	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	-	2	2	3
CO4	3	3	2	3	3	3	3	2	3	3	3	3	2	3	3

Course Contents:**Module I****6L**

Back ground of Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires, ultra-thin-films-multilayered materials.

Module II**6L**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal system, self-assembly, High energy milling and grain size analysis.

Module III**8L**

Chemical methods of sol-gel techniques, Gel filtration techniques, Protein gel and nanostructures, Nano porous materials, nano membranes, and carbon nanotubes, Carbohydrates and starch multilayers synthesis, Structure-property relationships applications, Oil water emulsions and liposome structure analysis.

Module IV**6L**

Nanomaterial characterization techniques, Fluorescence Microscope, Nanosurface Analysis techniques and Nanoindentation.

Module V**8L**

Applications of Nano composite materials in active/smart packaging, Nano encapsulation: techniques and targeted controlled release of nutrient/ bioactives delivery systems, Nutraceuticals and nano materials stability and applications in food industries. Safety issues and Legal/legislative/regulatory guidelines for use of nanomaterials in food products; concerns.

Revision:**2L****Text Books:**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications",

Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

Reference Books:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.

2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Name: Entrepreneurship Development and Start-Up Management

Course Code: HU(FT)701A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Food Process Engineering, Unit Operations in Food Technology, Food Processing Technology.

Course Objective:

1. Acquire knowledge in Entrepreneurship Development
2. Able to study and prepare the business plan for any organization
3. Classify and study the organizational structure between small, medium, and large scale manufacturing industries

Course outcome(s):

After completion of the course, students will be able to

CO1: Understand opportunities to set-up Food processing industries

CO2: Identify the market competitors and conduct and prepare survey reports accordingly.

CO3: Design the finance, human resource, and operation strategy for effective market growth

CO4: Develop the effective business ecosystem

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	2
CO 3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:

Module I	10L
Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality Characteristics- Knowledge- Skills- Attitude Requirement; Business Environment- Role of Family and Society- Entrepreneurship Development Training and Other Support Organizational Services- Central and State Government Industrial Policies and Regulations, MoFPI scheme and support to budding food entrepreneurs, Skill Development by Central Government, International Business.	
Module II	9L
Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product- Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the Project- Feasibility Report Preparation and Evaluation Criteria; legal aspect; Selection of land and factory sheds	
Module III	5L
Finance and Human Resource Mobilization- Operations Planning- Market and Channel election- Growth Strategies- Product Launching	
Module IV	8L
Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business, Overview of Startup food business and challenges.	
Revision:	4L
Text Books:	
1) Hisrich, “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2005.	
2) Saravanavel, P., ‘Entrepreneurial Development’, Ess Pee key publishing House, Chennai, 2005.	
References Books:	
1. Khanka, S S., “Entrepreneurial Development”, S. Chand and Co Limited, New Delhi, 2001.	
2. Jain, P C., “Handbook for New Entrepreneurs”, Second Edition, Oxford University Press, New Delhi, 2002.	

Course Name: Quality Management System**Course Code: HU(FT)702B****Contact: 3:0:0****Total Contact Hours: 36****Credit: 3****Prerequisites:** Basic mathematics, basic biology, food preservation, quality control and assurance**Course Objective:**

1. To develop the knowledge of students regarding quality control and management principles, tools and their application
2. To enable the students to be aware of the voluntary and mandatory food standards and certifications in place- globally and nationally

Course outcome(s):

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

CO1: Interpret principles of natural, biological science, and engineering fundamentals with basics food safety and quality management.**CO2:** Apply food safety management principles with an understanding of the limitations in application of the same in food quality and safety maintenance in a food industry.**CO3:** Analyze existing food laws and quality management techniques in relation to follow legal limits and supply safe food to consumers.**CO4:** Develop system tools to meet specific needs of food safety and maintain the effective quality of food during processing taking into consideration public health and safety, cultural, societal and environmental issues.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	3	3	-	2	1	-	2	2	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	2
CO 3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:**Module I:****8L**

Definition of quality, Quality specifications and quality attributes of different foods, Statistical quality control, Quality control programs: History and development, Total quality management (TQM), Quality assurance, Management Principles, ISO 9000 Family (QMS), principles and requirements

Module II:**8L**

Food Safety Management System ISO-22000 – Family, Key role, Principles of FSMS and requirements, HACCP- Prerequisites; GMP/C-GMP, GHP, GLP, Cleaning and Sanitation, Safety practices in the production areas, Pest Control, Withdrawal and Recall Procedures, traceability system, Principles and steps of HACCP Plan, Hazard Identification, Risk assessment, CCP Decision Tree, CAPA Plan, document and records,

Module III:**8L**

Mandatory and voluntary regulations world-wide, CODEX, FDA, WHO, EFSA, WTO, (TBT, SPSs), GATT. Role of regulatory authorities in India - functioning, legal acts and their enforcements- FSSAI (in detail), BIS, AGMARK, Legal Metrology Act, Industry Specific Regulations, ASCI, EPA, Export Quality Control and Inspection Act

Module IV:**8L**

Certification, Certification procedures, Certifying bodies, Accrediting bodies, International bodies. GFSI benchmarking, FSSC 22000, BRC, SQF, IFS, FSMA, OSHA, Auditing procedures- types of audit, Surveillance; Mock audit, third party quality certifying audit, Auditors and Lead auditors.

Revision:**4L****Text Books:**

1. Total Quality Management, M.P. Poonia & S.C. Sharma, Khanna Publishing House (AICTE Recommended Textbook - 2018)
2. Total Quality Management, Poornima M. Charantimath, Pearson Education India
3. Total Quality Management for the Food Industries. WA Gould, Woodhead Publishing
4. Management and control of quality. James R Evans, William M Lindsey. Thomson Southwestern
5. Bioethics and Biosafety, M. K. Sateesh, I. K. International Pvt Ltd.

Reference Books:

1. The Essentials of Quality Control Management, Peter N T Pang, Trafford publishing
2. Guide to Quality Management system for the food industry. Ralph Early

Course Name: Smart Technologies

Course Code: CS(FT)701C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Sensors, System Integration, Cloud and Network Security, Basic Engineering Mathematics, Automation and Control

Course Objective:

To impart necessary and practical knowledge of components of the Internet of Things and develop skills required to build real-life IoT based projects

Course outcome(s):

After completion of the course, students will be able to

CO1: Understand the Internet of Things and its hardware and software components

CO2: Develop real-life IoT based projects

CO3: Integrate mechanical and electrical hardware for a real prototype of the robotic device.

CO4: Select a robotic system for a given application

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PSO 3
CO 1	3	2	2	2	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	2	3	2	2	2	3	3	3	3

Course Contents:**Module I: 9L**

Introduction to IoT, Architectural Overview, Design principles and needed capabilities, IoT applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

Module II: 8L

Introduction to Robotics Types and components of a robot, Robot Actuation Systems, Classification of robots, closed-loop and open-loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Module III: 8L

IoT Application Development and case studies, Solution framework for IoT applications- Implementation of Device Integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

Module IV: 7L

Sensors and Vision System Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Vision applications in robotics

Revision: 4L**Text Books:**

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things, “A Hands on Approach”, University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
5. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media
6. Saha, S.K., “Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference Books:

1. Niku Saeed B., “Introduction to Robotics: Analysis, Systems, Applications”, PHI, New Delhi.
2. Mittal R.K. and Nagrath I.J., “Robotics and Control”, Tata McGraw Hill.
3. Mukherjee S., “Robotics and Automation”, Khanna Publishing House, Delhi.2018
4. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018.

4 th Year 8 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	FT801	Waste Management of Food Industries	3	1	0	4	4
2	ENGG	Major	FT802A/B/C	A. Project Engineering and Food Plant Layout B. Plant Maintenance, Safety and Hygiene C. Food Equipment and Plant Design	3	0	0	3	3
3	ENGG	Major	FT803A/B/C	A. Functional Foods and Nutraceuticals B. Protein Technology C. Enzyme Technology	3	0	0	3	3
4	ENGG	Minor	HU(FT)801A	Research Methodology	3	0	0	3	3
			HU(FT)802B	Product Design and Development					
			HU(FT)803C	Business Research Method					
B.PRACTICAL									
1			FT881	Grand Viva	0	0	0	0	1
2	PRJ	Project	FT882	Major Project-II	0	0	0	12	6
C.MANDATORY ACTIVITIES/COURSES									
Total of Theory, Practical and Project								25	20

***HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ : Project**

FOURTH YEAR SECOND SEMESTER
Course Name: Waste Management of Food Industries
Course Code: FT801
Contact hour: 3:1:0
Total contact hour: 48
Credits: 4
Pre requisites: Basic Environmental Engineering, Unit Operations, Thermodynamics and Kinetics.

Course Objective:

To help the student develop a detailed understanding on waste generated from food industry and its reusability.

Course outcome(s):

After completion of the course students will be able to:

CO1: Classify different industrial waste, nature of the waste and its characteristics.

CO2: Identify different treatment methods for liquid/solid waste and the recovery of useful material from waste as byproducts

CO3: Interpret data regarding different waste treatment method.

CO4: Apply different methods in industry and domestic purpose.

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	2	1	-	2	1	-	1	1	-	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	2	1	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:**Module I: 10L**

Introduction: Types of Pollution, Waste disposal methods – physical, chemical and biological. Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological

Module II: 12L

Treatment methods for liquid wastes from food process industries; Design of activated sludge process, Rotating biological contactors, Trickling filters, UASB, Numerical Problem.

Module III: 10L

Biofilters/ bioclarifiers, Biogas plant, Ion exchange treatment of waste water, Bioremediation, Adsorption process in waste treatment, Recovery of useful materials from effluents by different methods.

Module IV: 12L

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermicomposting pit, Biomanure, Numerical Problem.

Revision: 4L**Text Books:**

1. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.

Reference Book:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
3. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
4. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
5. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, McGraw-Hill International editions.

Course Name: Project Engineering and Food Plant Layout

Course Code: FT802A

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Basic mathematics, food processing, quality control, and food regulations

Course Objective:

1. To develop the knowledge of plant design and layout of specific food industries
2. To enable the students to learn about the regulations governing food plant design
3. To enable the students to learn how to scale up plant designs

Course outcome(s):

After completion of the course students will be able to:

CO1: Demonstrate the concept and different aspect required for food plant design and

CO2: Select appropriate requirement of design and layout for the specific food industry with compliance with FSSAI

CO3: Understand the function of PERT, CPM, ISO and HACCP in food plant design

CO4: Develop a food plant layout with taken into account different legal, economic, social aspects

CO-PO-PSO Mapping

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	2	2	1	2	1	1	1	1	1	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3

Course Contents:**Module 1: 8L**

Basic concepts of plant layout and design including a basic understanding of equipment layout, ventilation; Design consideration for the location of food plants. The material of Construction for food processing equipment; Specifications of processing equipments and accessories; provision for waste disposal, and safety arrangements aspects of plant layout and design Symbols used for food plant design and layout

Module 2: 8L

Introduction to feasibility study and analysis Layout and design aspects of pilot and semi-commercial food processing plants; Reference to the design of bakery and biscuit, fruits, vegetable, and beverage processing, and dairy industries; Hygienic Design of Food Plants; specific FSSAI requirements in food plant layout and design

Module 3: 8L

Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoring; application of ISO, HACCP in food plant, Experimentation in Pilot Plant

Module 4: 8L

Introduction to project engineering; Process design development: Optimum economic design, Feasibility Survey; Preparation of flow sheets for material movement and utility consumption in food plants; Cost estimation for a Food Plant; Scale-up, Food processing enterprise, Plant operation

Revision: 4L**Text Books:**

1. Manufacturing Facilities Design and Material Handling by Fred E. Meyers, and Matthew P. Stephens, 3rd Edition, Pearson Prentice Hall,2000
2. James M Moore, "Plant Layout and Design", Mcmillan& Co.,(1959)

Reference books:

1. Bolz, Harold A George E., "Material Handling Handbook.
2. J M Apple, "Plant layout and Material Handling", John Willey & Sons,(1977)

Course Name: Plant Maintenance, Safety and Hygiene

Course Code: FT802B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre requisites: Principles of Food Preservation, Food Process Engineering

Course Objective:

To help the students understand the importance of maintaining safety and hygiene in different food industry.

Course outcome(s):

After completion of the course students will be able to:

CO1: Describe safety levels in different food industries.

CO2: Understand different industrial parameters that affect the environment in food processing units.

CO3: Apply the HACCP protocols in food industries.

CO4: Create an overall safe environment for food processing industries and safety from adulterated food.

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	2	2	1	2	1	1	1	1	1	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:**Module I:****8L**

Plant maintenance program; Role of maintenance staff and plant operators; Preventive maintenance; Guidelines for good maintenance & safety precautions; Lubrication & lubricants; Work place improvement through '5S'.

Module II:**8L**

The objective of safety, health & environment; Cost of safety; Accident investigation report; Safety promotional activity; Environmental pollution and its control. Safety promotional activity; ISO 45001- Occupational health and safety;

Module III:**8L**

Indian Factories Act on safety; HACCP; Desirable safety features of some food processing equipment; Personal protective equipment; Safety from adulteration of food, Food fraud and Food defense

Module IV:**8L**

Hygiene and sanitation requirement in food processing and fermentation industries; Cleaning, CIP Systems, sanitizing & pest control in food processing; storage and service areas, Safety during receiving-unloading- shifting and storage of food materials and packaging materials

Revision:**4L****Text Books:**

1. Basic Concepts of Industrial Hygiene, Ronald M Scott, CRC Press.
2. Safety design criteria for industrial plants. Maurizio Cumo & Antonio Naviglia. CRC Press.

Reference Books:

1. Industrial Hygiene & Toxicology by Josef Brozek-1948.
2. Food Hygiene, Microbiology & HACCP. S J Forsythe, P R Hayes. Springer.

Course Name: Food Equipment and Plant Design

Course Code: FT802C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Management principles, business ethics and environment

Course Objectives:

To give knowledge about materials of construction for food equipments / accessories, design consideration and design of some food processing equipments. To impart knowledge about plant design considerations, feasibility study, plant location, food plant lay out, process selection, facilities and aggregate planning, financial analysis, process flow analysis and decision analysis.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Demonstrate the concept of food equipment design

CO2: Develop a food plant design with taken into account location consideration

CO3: Explain the design engineering consideration of food processing equipment

CO4: Interpret process design and feasibility analysis of plant design

CO-PO-PSO Mapping:

CO(s)	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	2	2	1	2	1	1	1	1	1	3	3	3	1
CO 2	3	3	3	3	3	2	2	2	1	2	1	3	3	2	1
CO 3	2	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO 4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Contents:**Module I:****8L**

Material selection in design of food processing equipments – their classification and properties; Creep phenomenon; Corrosion and its effect on material properties

Module II:**8L**

Food plant design concepts and general design considerations; Plant location – location factors and their interaction with plant location, location theory models, computer aided selection of location.

Module III:**8L**

Application of design engineering to food processing equipments; Design parameters, codes and material selection, Design of equipments used in handling of foods;

Module IV:**8L**

Feasibility analysis and preparation of feasibility report; Factors affecting plant size and their interactions, estimation of break-even and economic plant size; Process design – process flow charts, computer – aided development of flow charts; Equipment selection including economic analysis of equipment alternatives.

Revision:**4L****Text Books**

1. Chemical Engineers' Handbook. McGraw Hill Book Co. Inc, New York.
2. O.P. Khanna, Production Engineering, and Industrial Management.
3. Peterse and Timmerhaus, Plant Design for Chemical Engineering

Reference Books:

1. Rase and Barrow, Project Engineering, of Process Plant.
2. Farrall, Engineering For Dairy and Food Products.

Course Name: Functional Foods and Nutraceuticals**Course Code: FT803A****Contact: 3:0:0****Total Contact Hours: 36****Credits: 3****Pre requisites:** Basic biology, food chemistry, biochemistry, nutrition, food processing, quality control and food regulations**Course Objective:**

1. To develop the understanding of the concept of Nutraceuticals & Functional Foods
2. To enable the students to learn about the health beneficial properties of Nutraceuticals & Functional Foods
3. To enable the students to learn about the manufacturing processes, regulatory challenges and market trends of Nutraceuticals & Functional Foods.

Course outcome(s):

After Completion of the course students will be able to:

CO1: Understand the fundamental concept of Nutraceuticals and Functional Foods on their origin, presence and functionality.**CO2:** Identify the disease preventing and health enhancing properties of Nutraceuticals and Functional Foods.**CO3:** Apply the basic knowledge to comprehend the manufacturing of various fortified, value-added functional foods and nutraceuticals in different forms for consumption**CO4:** Analyze the toxicological aspect, related risks in formulating dosage and defining consumption patterns of Nutraceuticals and Functional Foods.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	1	1	2	2	2	1	-	3	3	2	2
CO2	3	3	2	3	3	2	3	3	2	2	2	2	2	2	3
CO3	3	2	3	2	3	3	2	3	3	3	3	1	3	2	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

Course Contents:**Module I: 7L**

Definitions of Functional Foods and Nutraceuticals, Types of functional foods and Nutraceuticals, Components like nutrients such as lipids, fibers, amino acids, spices, herbs, polyphenols and bioactive properties, Vitamins and Health, Minerals and Health, Concepts and of Probiotic, prebiotics, synbotics, Supplements like antioxidants and their biochemical functions

Module II: 7L

Nutritional significance: Role of nutraceutical / functional foods in cardiovascular health, diabetes, obesity, immunity, neurodegenerative and age related muscular degeneration, stress management; Nutrition and nutraceuticals for targeted population such as children, woman, adults and elderly.

Module III: 7L

Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods (MSG; Bakery and confectionary products e.g. bread, biscuit and cookies; Breakfast and ready to eat cereals; Infant formulas; Protein mixes; Vegetable Mixes; Dairy product e.g. ice cream; Beverages including diet beverages, Sports drink, Value addition in processed food products

Module IV: 11L

Functional ingredients: Extraction / purification of lycopene, essential oils, isoflavonoids, prebiotics and probiotics glucosamine, phytosterols, and their stability in processing conditions, Manufacturing of dietary supplements in the form of liquid, rehydration powder, tablet, pill, capsule or mix. Principles of toxicology and risk assessment of Nutraceuticals, Dosage levels; adverse effects and toxicity of nutraceuticals Principles of toxicology and risk assessment of Nutraceuticals, Dosage levels; Adverse effects and toxicity of nutraceuticals, Regulatory and labeling issues, CODEX, FDA, FSSAI, Global nutraceuticals/Functional food market. Recent research and patents on nutra-ingredients.

Revision: 4L**Text Books:**

1. Handbook of Nutraceuticals and Functional Foods, Robert E.C. Wildman, CRC Press
2. Nutraceutical and Functional Food Components, Charis Galanakis, Academic Press

Reference Books:

1. Functional Foods and Nutraceuticals (Food Science Text Series), Rotimi E. Aluko, Springer; 2012edition

Course Name: Protein Technology

Course Code: FT803B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre requisites: Engineering Chemistry, Chemistry of Food

Course Objective:

To help the students develop an advanced idea about protein utilization in food and its importance in our daily diet.

Course outcome(s):

After Completion of the course students will be able to:

CO1: Define protein structure and properties and to analyze different sources of protein.

CO2: Describe protein concentrate and isolate and their functions.

CO3: Interpret manufacturing of protein hydrolysates and to develop textured protein.

CO4: Apply different technique to detect and estimate protein.

CO-PO-PSO Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	3	2	2	1	-	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3

Course Contents:**Module I: 8L**

Determination of protein structure; Nutritional and commercial importance of proteins; Physical, chemical and functional properties of proteins; Folding of proteins; Commercial sources of proteins; Creation of new proteins by bio-composite synthesis technique, Introduction to protein engineering; salient features of amino acids and their –R groups; conformation of proteins, the Ramachandran plot, tertiary structure and structural domains and motifs of proteins

Module II: 8L

Process of making protein isolates and concentrates; Factors affecting quality of isolates and concentrates; Treatment to isolate and concentrate; Packaging of protein isolates and concentrates; Food and nonfood uses of isolates and concentrates.

Module III: 8L

Methods of manufacturing protein hydrolysates; Factors affecting quality of hydrolysates; Food uses of hydrolysates; Fibre spinning process of proteins; Textured protein gels and expanded products; Simulated milk products; Restructured protein; Nonconventional sources of protein.

Module IV: 8L

Centrifugation; Cell disruption; Protein precipitation and its recovery; Aqueous two- phase separation; Ion exchange chromatography; Gel filtration; Affinity chromatography; Electrophoresis; Cross filtration; Ultra filtration.

Revision: 4L**Text Books:**

1. Altschul, A.M and Wilcke, , H.L Ed 1978. new protein Foods. Vol III. Academic Press, New York
2. Bodwell, C.E.Ed. 1977. evaluation of proteins for Humans. AVI, Westport
3. Milner, M., Scrimshaw, N.S and Wang, D.I.C.Ed. 1978. Protein Resources and Technology. AVI, Westport
4. Salunkhe, O.K and Kadam, S.S Eds. 1999. Handbook of world legumes; Nutritional Chemistry, Processing Technology and Utilization. Volume I to III, CRC Press ,Florida
5. Salunkhe, D.K. Chavan, J.K., Adsule, R.N Kadam, S.S 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York

Reference Books:

1. Bioseparation Engineering: Principles, Practise and Economics, M.Ladish; Wiley Interscience
 2. Proteolytic enzymes: a practical approach, Beynon, R.J and Bond, J.S; IRL Press, Oxford
- Protein Biotechnology, Franks, F.; Humana Press

Course Name: Enzyme Technology

Course Code: FT803C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Pre requisites: Chemistry of food, food microbiology, food biotechnology

Course Objective:

To help student to gain knowledge about different enzyme production, purification and isolation process as well as the use of enzymes in food technology.

Course outcome(s):

After completion of the course students will able to:

CO1: Explain the enzyme kinetics and the effects of different parameters on enzymes.

CO2: Analyze the production and purification processes of enzyme.

CO3: Identify applications of enzyme in biochemical and food processing industries.

CO4: Apply the concepts of recombinant DNA Technology and immobilized enzymes in biochemical engineering

COs-POs-PSOs Mapping

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	1	2	-	-	-	-	3	3	3	2
CO 3	3	3	3	-	-	2	2	-	-	-	2	3	3	3	3
CO 4	3	3	3	1	3	1	1	-	-	-	3	3	3	2	3

Course Contents:

Module I:	8L
Introduction to enzyme technology; Industrial enzymes – present status and opportunities with special reference to food industries; Catalytic properties of enzymes; Intracellular and extra-cellular enzymes.	
Module II:	10L
Enzyme production technology: Introduction of enzyme reactors and process design. Application of recombinant DNA technique in enzyme technology.	
Module III:	7L
Cell disintegration by physical, chemical and biological methods; Enzyme purification methods: Salting out, organic solvent precipitation, dialysis, reverse osmosis etc.	
Module IV:	7L
Application of enzymes for production in biochemical and food processing industries; Application of immobilized enzymes and cells. Production of Commercial Enzymes.	
Revision:	4L

Text Books:

1. Biochemical Engg. Fundamentals-Baily, Ollis. MGH
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi

Reference Books:

1. Prescott & Dunn's Industrial Microbiology Macmillan
2. Principles of Fermentation Technology-Wittaker and Stanby
3. Methods in Enzymology, Edited by Dan S. Tawfik, ScienceDirect

Course Name: Research Methodology

Course Code: HU(FT)801A

Contact (L: T: P): 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: English, Biology

Course Objective:

To familiarize students with basic concepts of research methodology in food technology. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Describe the concept of research methodology, ethics and plagiarism.

CO2: Interpret the research design and research process.

CO3: Explain the research hypothesis, sampling techniques and statistical methods in quality research.

CO4: Apply data analysis and writing skill in professional research and publication.

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	2	-	-	2	3	2	1	2
CO2	2	2	3	2	1	-	-	-	-	1	2	3	2	2	2
CO3	2	1	2	1	1	-	-	-	1	-	-	3	2	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	3	2	3	3

Course Contents:

Module I	8L
Meaning, Motivation and significance of research, Objectivity in research in academia, Research Process, Types of Research in food technology, Research Ethics, Concept of Novelty, Concept of Plagiarism, Detection and removal of plagiarism.	
Module II	8L
Research gap identification in food and nutrition domain, Experimental and exploratory research designs, DOE, Preparing research proposals: Selection of the topic, Review of literature, Identifying Objectives of the Study, preparing Research Questions, Hypothesis formation, testing of Hypothesis, Case studies and examples.	
Module III	8L
Sources of Data: Primary and Secondary, Methods of collection of data, Types of Sampling of food samples, Analytical instruments and their use in detecting food components, Controllable and uncontrollable parameters, Experiment type and Survey Research, Role of library and Internet.	
Module IV	8L
Validation of Data. Preliminary statistical analysis to understand significant difference, ANNOVA, Writing research paper/proposal, Format of the paper, indexing and publishing process related to food technology domain, Bibliography.	
Revision:	4L

Text Book:

1. RESEARCH METHODOLOGY METHODS AND TECHNIQUES by C. R. KOTHARI, GAURAV GARG, New Age International Publishers, 5th edition.

Reference Book:

1. John W Cresswell& J David Cresswell (2017): Research Design, New Delhi: Sage.

Course Name: Product Design and Development

Course Code: HU(FT)801B

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisite: Process technologies, designing, communication and management.

Course Outcomes: After successful completion of the course, student will be able to

CO1. Understand the product design and development process.

CO2. Apply creative thinking skills for idea generation.

CO3. Translate conceptual ideas into products.

CO4. Present ideas using various types of prototypes

CO-PO-PSO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	2	-	-	2	3	2	1	2
CO2	2	2	3	2	1	-	-	-	-	1	2	3	2	2	2
CO3	2	1	2	1	1	-	-	-	1	-	-	3	2	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	3	2	3	3

Course Contents**Module I****8L**

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Module II**8L**

Product Planning and Identifying Customer Needs: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. Gather raw data from customers, establish the relative importance of the customer needs and reflect on the results and the process.

Module III**8L**

Product Specifications and Concept Generation: What are specifications, when are specifications established, setting the final specifications. The activity of concept generation, clarify the problem, Concept Selection, Overview of methodology and concept screening.

Module IV**8L**

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors. Prototyping, Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Text Books:

- 1.Product Design and Development - Karl.T. Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.
- 2.Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.

Reference Books

1. New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997
- 2.Product Design for Manufacture and Assembly – Geoffery Boothroyd, Peter Dewhurst and Winston Knight – 2002

Course Name: Business Research Method

Course Code: HU(FT)803C

Contact: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisites: Management principles, business ethics and environment

Course Objectives:

1 To familiarize students with the techniques and tools of Business Research.

2 To develop research report writing skills among students.

Course Outcome(s):

After completion of the course students will be able to:

CO1: Describe the concept of research methodology

CO2: Interpret the research design and research focus

CO3: Explain the research hypothesis and sampling technique

CO4: Apply data analysis and statistical methods in professional research

CO-PO Mapping:

COs	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	2	-	-	2	3	2	1	2
CO2	2	2	3	2	1	-	-	-	-	1	2	3	2	2	2
CO3	2	1	2	1	1	-	-	-	1	-	-	3	2	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	3	2	3	3

Course Contents:**Module I:****8L**

Introduction to Research Methodology: Meaning and purpose, Types of research: Exploratory, Analytical, Descriptive, Experimental and Case study, Scientific Method of Research, Recent Trends in Usage of Research in Indian Corporate Sector.

Module II:**8L**

Research Focus: Problem definition, Selection and formulation, Review of Literature, Delimitation of the scope of the study, Setting Objectives, Definition of the concepts, Sources of Data: Nature and Types, Sampling Techniques, Nature and Types, Sampling Errors.

Module III:**8L**

Meaning of Hypothesis, Types of Hypothesis, Sources of hypothesis, Testing of Hypothesis, Errors in Testing, Measurements, Scaling techniques and Scale Construction, Sample size, Sampling error, Sampling Methods and Applications.

Module IV:**8L**

Advance Techniques of Data Analysis: Factor analysis, Cluster Analysis, Correlation and Regression analysis, Pareto chart, fishbone diagram, Histogram, ANOVA.

Revision:**4L****Text Books**

1. Krishnaswamy O R and Ranganatham M. (2014) Methodology of Research in Social Sciences, Himalaya Publication, India.
2. Kothari C R (2014), "Research Methodology: Methods and Techniques", New Age India.
3. Sekaran Uma And Bougie Roger (2010) Research Methods For Business: A Skill Building Approach John Wiley & Sons,2010

Reference Books:

1. Kerlinger Fred And Lee Bhoward (1999), Foundations Of Behavioral Research, S.Chand
2. Hatt K Paul and Goode J William, (2016), Methods InSocial Research, Asia Law House.
3. Cooper R Donald And Schindler (1998) Pamela Business Research Method, sirwin Professional Publishing