



**RAJALAKSHMI
ENGINEERING COLLEGE**

An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai



CHOICE BASED CREDIT SYSTEM

**CURRICULUM AND SYLLABUS
(2023-27 Batch)**

B.TECH. FOOD TECHNOLOGY

REGULATION

2023

CURRICULUM AND SYLLABUS

B.TECH. FOOD TECHNOLOGY

REGULATION 2023

Institute Vision

- To be an institution of excellence in Engineering, Technology and Management Education & Research
- To provide competent and ethical professionals with a concern for society

Institute Mission

- To impart quality technical education imbued with proficiency and humane values
- To provide right ambience and opportunities for the students to develop into creative, talented and globally competent professionals
- To promote research and development in technology and management for the benefit of the society

Department Vision

- To develop food technologists with academic excellence focused on education, research and development to cater the needs of industry as well as society

Department Mission

- To impart quality technical education in the different areas of Food technology
- To provide a platform for overall development of the students, to be more creative, innovative and globally competent ethical professionals
- To promote research and develop technologies for the sustenance and wellbeing of the society

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

This program enables Food Technology students to

1. Adapt the fundamental concepts of science, technology and engineering to excel in their professional career
2. Solve problems, develop feasible products and process technology to cater the needs of the society
3. Develop the professional and ethical values to pursue higher education and nurture innovative research

2. PROGRAMME OUTCOMES (POs):

After completion of four years of study, the Food Technology graduates will be able to:

PO	Graduate Attribute	Programme Outcome
1	Engineering Knowledge	Apply knowledge of mathematics, basic science and engineering.
2	Problem Analysis	Identify, formulate and solve problems using Technology.
3	Design/ development of solutions	Design a system or process for improvement of performance, satisfying the constraints.
4	Conduct investigations of complex Problems	Conduct experiments & collect, analyze and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interact with industry, business and society in a professional and ethical manner.
9	Individual and team work	Ability to work in a multidisciplinary team.
10	Communication	Proficiency in oral and written communication.
11	Project management and finance	Implementation of cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs) :

By the completion of Food Technology B. Tech program, the student will

- 1) Apply theoretical and practical knowledge in the area of Food Technology as well as acquire effective communication and cognitive skills
- 2) Analyse and solve pivotal problems in order to effectively address the challenges in food industry
- 3) Implement the multidisciplinary approach to ensure food safety and quality for wellbeing of the society

**CURRICULUM B.TECH. FOOD TECHNOLOGY
REGULATION 2023: BATCH: 2023-27**

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	HS23111	Technical Communication I	2	0	0	2	2	HS
2	MA23112	Algebra and Calculus	3	1	0	4	4	BS
3	CY23132	Chemistry for Technologists	3	0	2	5	4	BS
4	GE23111	Engineering Graphics	2	0	4	6	4	ES
5	GE23121	Engineering Practices - Civil and Mechanical	0	0	2	2	1	ES
6	MC23112	Environmental Science and Engineering	3	0	0	3	0	MC
7	GE23117	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	1	HS
TOTAL			14	1	8	23	16	

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	HS23221/ HS23222	Technical Communication II / English for Professional Competence	0	0	2	2	1	HS
2	MA23212	Differential Equation and Complex Variables	3	1	0	4	4	BS
3	EE23133	Basic Electrical and Electronics Engineering	3	0	2	5	4	ES
4	PH23231	Physics for Bioscience	3	0	2	5	4	BS
5	GE23233	Problem Solving and Python Programming	2	0	4	4	4	ES
6	FT23201	Food Chemistry	3	0	0	3	3	PC
7	MC23111	Indian Constitution and Freedom Movement	3	0	0	3	0	MC
8	GE23217	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	1	HS
9	FT23211	Food Chemistry Laboratory	0	0	4	4	2	PC
TOTAL			18	1	14	31	23	

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	MA23311	Transforms and Applied Partial Differential Equations	3	1	0	4	4	BS
2	FT23301	Food Microbiology	3	0	0	3	3	PC
3	FT23302	Biochemistry and Nutrition	3	0	0	3	3	PC
4	FT23303	Thermodynamics for Food Technologists	3	0	0	3	3	ES
5	FT23304	Food Process Calculations	3	0	0	3	3	ES
6	FT23305	Food Additives	3	0	0	3	3	PC
7	FT23311	Food Microbiology Laboratory	0	0	4	4	2	PC
8	FT23312	Biochemistry and Nutrition Laboratory	0	0	4	4	2	PC
TOTAL			18	1	8	27	23	

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	MA23431	Probability, Statistics and Reliability	3	0	2	5	4	BS
2	FT23401	Unit Operations in Food Industries	3	0	0	3	3	PC
3	FT23402	Food Processing and Preservation Technology	3	0	0	3	3	PC
4	FT23403	Fluid Mechanics in Food Processes	3	0	0	3	3	ES
5	FT23404	Refrigeration and Cold Chain Management	3	0	0	3	3	PC
6		Open Elective - I	3	0	0	3	3	OE
7	FT23411	Unit Operations in Food Industries Laboratory	0	0	4	4	2	PC
8	FT23412	Food Processing and Preservation Laboratory-I	0	0	4	4	2	PC
9	CS23422	Python Programming for Machine Learning	0	0	4	4	2	ES
10	GE23421	Soft Skills – I	0	0	2	2	1	EEC
TOTAL			18	0	16	34	26	

SEMESTER V

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	FT23501	Food Analysis	3	0	0	3	3	PC
2	FT23502	Food Process Engineering	3	0	0	3	3	PC
3	FT23503	Heat and Mass Transfer in Food Processing	3	0	0	3	3	PC
4		Professional Elective I	3	0	0	3	3	PE
5		Professional Elective II	3	0	0	3	3	PE
6	GE23311	Fundamentals of Management for Engineers	3	0	0	3	3	HS
7	FT23511	Food Analysis Laboratory	0	0	4	4	2	PC
8	FT23512	Food Processing and Preservation Laboratory-II	0	0	4	4	2	PC
9	GE23521	Soft Skills-II	0	0	2	2	1	EEC
TOTAL			18	0	10	28	23	

SEMESTER VI

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	FT23601	Food Product Technology	3	0	0	3	3	PC
2	FT23602	Food Packaging Technology	3	0	0	3	3	PC
3	FT23603	Start-up Ecosystems for Food Technologists	3	0	0	3	3	PC
4		Professional Elective III	3	0	0	3	3	PE
5		Professional Elective IV	3	0	0	3	3	PE
6	FT23611	Food Packaging Technology Laboratory	0	0	4	4	2	PC
7	FT23612	Food Product Technology Laboratory	0	0	4	4	2	PC
8	GE23627	Design thinking and Innovation	0	0	4	4	2	EEC
9	FT23613	Microfluidics Laboratory for Food Technology	0	0	2	2	1	PC
10	GE23621	Problem Solving Techniques	0	0	2	2	1	EEC
TOTAL			15	0	16	31	23	

SEMESTER VII

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	FT23701	Food Quality, Safety Standards and Certification	3	0	0	3	3	PC
2	FT23702	Comprehension in Food Technologists	3	0	0	3	3	PC
3	FT23703	Functional Foods and Nutraceuticals	3	0	0	3	3	PC
4		Open Elective – II	3	0	0	3	3	OE
5		Professional Elective V	3	0	0	3	3	PE
6		Professional Elective VI	3	0	0	3	3	PE
7	FT23711	Problem Solving using AI-ML for Food Technologists	0	0	4	4	2	EEC
8	FT23712	Internship	0	0	2	2	1	EEC
TOTAL			18	0	6	24	21	

SEMESTER VIII

S. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
1	FT23811	Project Work	0	0	20	20	10	EEC
TOTAL			0	0	20	20	10	

TOTAL CREDITS: 165

Note: 0-Theory, 1-Laboratory, 2-LOT

SUMMARY

S. No.	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3	2			3				8
2.	BS	8	8	4	4					24
3.	ES	5	8	6	5					24
4.	PC		5	13	13	13	14	9		67
5.	PE					6	6	6		18
6.	OE				3			3		6
7.	EEC				1	1	3	3	10	18
8	MC									
Total		16	23	23	26	23	23	21	10	165

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII
Dairy Technology	Meat, Marine and Poultry Technology	Grain Science Technology and Plantation Crops	Technology for Fruit, Vegetable and Beverages	Food Biotechnology	Baking and Confectionery Technology	Advanced Food Processing Technology
FT23A01 Basic Principles of Dairy Processing	FT23B01 Meat and Poultry Processing	FT23C01 Processing of Cereals, Oil Seeds and Pulses	FT23D01 Post-Harvest Technology of Fruits and Vegetables	FT23E01 Microbial Technology	FT23F01 Bakery Ingredients and Flour Rheology	FT23G01 Radiation in Preservation and Processing of Food Products
FT23A02 Technology of Milk Products	FT23B02 By-Products in Meat and Poultry Processing	FT23C02 Infestation and Pest Control in Grain Storage	FT23D02 Value-Added Fruit and Vegetable Products	FT23E02 Bioprocess Technology	FT23F02 Technology of Bread, Buns, Cakes and Pastries	FT23G02 Non- Thermal Processing Techniques
FT23A03 Frozen and Fermented Dairy Products	FT23B03 Preservation Technology of Eggs, Meat and Poultry	FT23C03 Oils and Fats Processing Technology	FT23D03 Packaging and Storage Techniques in Fruit and Vegetable	FT23E03 Food Allergens and Toxicology	FT23F03 Technology of Biscuits, Crackers, and Cookies	FT23G03 Food Process Equipment Design and Plant Layout
FT23A04 Traditional Dairy Products	FT23B04 Marine Food Processing	FT23C04 Spice Processing Technology	FT23D04 Carbonated Beverages	FT23E04 Enzyme Technology	FT23F04 Sugar and Gum Based Confectionery Technology	FT23G04 Food Sensors
FT23A05 Dairy by Products Technology	FT23B05 Technology of Packaging Meat, Poultry and Marine Products	FT23C05 Plantation Crops	FT23D05 Non-Alcoholic Beverages	FT23E05 Food Fermentation Technology	FT23F05 Cocoa and Chocolate Based Confectionery Technology	FT23G05 3D Printing of Foods
FT23A06 Dairy Plant Design and Layout	FT23B06 Quality, Laws and Regulations in Meat, Poultry and Seafood Industries	FT23C06 Quality Standards and Regulatory Compliance in Grain and Crop Processing Industries	FT23D06 Fermented Beverages	FT23E06 Genetic Engineering and Genetically Modified Foods	FT23F06 Shelf-Life and Regulatory Aspects of Bakery and Confectionery Products	FT23G06 Applications of Nano Technology and Cryogenics in Food Processing

Registration of Professional Elective Courses from Verticals:

- Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization. Students are permitted to choose all Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.
- The registration of courses for B.E./B.Tech (Honors) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honors) or Minor degree also. For more details on B.E./B.Tech (Honors) or Minor degree refer to Regulations 2021 Clause 4.10.

Subject Code	Subject Name	Category	L	T	P	C
HS23111	TECHNICAL COMMUNICATION I	HS	2	0	0	2
Common to all branches of B.E/B. Tech programmes – First Semester						

Objectives:
To facilitate students develop their comprehension skills
To enable students to improve their receptive skills
To equip learners with better vocabulary and enhance their writing skills
To aid students speak effectively in all kinds of communicative contexts.
To improve the learners' basic proficiency in workplace communication

UNIT-I	DEVELOPING COMPREHENSION SKILLS	6
Listening: Introduction to Informational listening – Listening to Podcasts, News Reading: Intentional Reading - Short Narratives and Passages. Speaking: Introducing Oneself, Narrating a Story / Incident. Writing: Sequential Writing – connecting ideas using transitional words (Jumbled Sentences), Process Description Grammar: Verbs – Main & Auxiliary: Simple Tenses – Form, Function and Meaning. Vocabulary: Word formation – Prefix, Suffix, Compound Words.		
UNIT-II	LISTENING AND EXTENDED READING	6
Listening: Deep Listening – Listening to Talk Shows and Debates Reading: In-depth Reading - Scanning Passages Speaking: Describing Current Issues, Happenings, etc... Writing: Note Making, Note Taking – Paragraph Writing Grammar: Continuous Tenses, Prepositions, Articles Vocabulary: One Word Substitutes, Phrasal Verbs.		
UNIT-III	FORMAL WRITING AND VERBAL ABILITY	6
Listening: Listening to Lectures and Taking Notes Reading: Interpretation of Tables, Charts and Graphs Speaking: SWOT Analysis on Oneself Writing: Formal Letter Writing and Email Writing Grammar: Perfect Tenses, Phrases and Clauses, Discourse Markers Vocabulary : Verbal Analogy / Cloze Exercise		
UNIT-IV	ENHANCING SPEAKING ABILITY	6
Listening: Listening to eminent voices of one's interest (Martin Luther King, APJ Abdul Kalam, etc..) Reading: Timed Reading, Filling KWL Chart. Speaking: Just a Minute, Impromptu Writing: Check-list, Instructions. Grammar: 'Wh' Questions / 'Yes' or 'No' Questions, Imperatives Vocabulary: Synonyms, Antonyms, Different forms of the same words.		
UNIT-V	LANGUAGE FOR WORKPLACE	6
Listening: Extensive Listening (Audio books, rendering of poems, etc.) Reading: Extensive reading (Jigsaw Reading, Short Stories, Novels) Speaking: Short Presentations on Technical Topics Writing: Recommendations, Essay Writing Grammar: Impersonal Passive, Reported Speech, Concord Vocabulary : Informal Vocabulary and Formal Substitutes		
Total Contact Hours: 30		

Course Outcomes:
On completion of the course students will be able to
apply their comprehension skills and interpret different contents effortlessly
read and comprehend various texts and audio visual contents
infer data from graphs and charts and communicate it efficiently in varied contexts
participate effectively in diverse speaking situations
to present, discuss and coordinate with their peers in workplace using their language skills

SUGGESTED ACTIVITIES

- Ice breaker
- Just A Minute
- Ship wreck
- Hot seat
- Vocabulary building
- Chinese whispers
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):

1. Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2. Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/st. Martin's: Fifth Edition (June 28, 2004)
3. Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:

1. Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers 2nd Edition by Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor)
2. Reading Development and Difficulties By Kate Cain
3. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK
4. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Hardcover by Ann Handley (Author)

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
HS23111. 1	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 2	-	-	-	1	-	-	-	-	-	3	-	-	1	-	-
HS23111. 3	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 4	-	-	-	2	-	-	-	-	1	3	-	-	1	-	-
HS23111. 5	-	-	-	1	-	-	-	-	1	3	-	-	1	-	-
Average	-	1	-	1.2	-	-	-	-	1	3	-	-	1	-	-

Subject Code	Subject Name	Category	L	T	P	C
MA23112	ALGEBRA AND CALCULUS	BS	3	1	0	4
Common to I sem. B.E. - AERO, AUTO, MECH, MCT, R&A, CIVIL and B.Tech. - BT, FT & CHEM						

Objectives:

- To introduce the matrix techniques and to illustrate the nature of the matrix.
- To address data and synthesis of the information to provide valid conclusions.
- To explain techniques of calculus which are applied in the solutions of engineering problems.
- To analyse special types of integrals by analytical methods and numerical techniques.
- To practice the techniques of Integration in finding area and volumes.

UNIT-I	MATRICES	12
Matrices - Eigenvalues and eigenvectors - Diagonalization of matrices using orthogonal transformation - Cayley-Hamilton Theorem(without proof) -Quadratic forms- Reduction to canonical form using orthogonal transformation- Numerical computation of Eigen value using Power method		
UNIT-II	FUNCTIONS OF SEVERAL VARIABLES	12
Partial differentiation–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions– Taylor’s series for functions of two variables–Maxima and minima of functions of two variables–Lagrange’s method of undetermined multipliers.		
UNIT-III	INTEGRAL CALCULUS	12
Integral Calculus: Definite Integrals as a limit of sums - Applications of integration to area, volume - Improper integrals: Beta and Gamma integrals - Numerical computation of integrals: Trapezoidal rule - Gaussian Two point quadrature		
UNIT-IV	MULTIPLE INTEGRALS	12
Double integrals – Change of order of integration – Area enclosed by plane curves–Triple integrals– Volume of solids– Numerical computation of double integrals: Trapezoidal rule.		
UNIT-V	REGRESSION	12
Scatter diagram - Karl Pearson coefficient of correlation for raw data –Spearman rank correlation coefficient - Lines of regression - Regression equation X on Y and Y on X- Curve fitting by Principle of least squares - Fitting a straight line $y = ax + b$ and a parabola $y = ax^2 + bx + c$.		
Total Contact Hours:60		

Course Outcomes:

On completion of the course students will be able to

- Demonstrate the matrix techniques in solving the related problems in engineering and technology.
- Analyse and interpret data, and synthesize information to provide valid conclusions.
- Interpret the problems in Engineering and Technology using the principles of mathematical calculus.
- Apply the analytical methods and numerical techniques to solve the related engineering problems.
- Evaluate multiple integrals to conduct investigations of complex problems.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):

1.	Grewal B.S., “ Higher Engineering Mathematics ”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Gupta S.C. and Kapoor V.K.”Fundamentals of Mathematical Statistics”, Sultan and Sons 10 th Edition,2000.
3.	T Veerarajan, Engineering Mathematics –I , Mc Graw Hill Education, 2018.

Reference Books(s) / Web links:

1.	Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
2.	T Veerarajan ,Fundamentals of Mathematical Statistics , yesdee publications, 2017.
3.	Erwin Kreyszig , " Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23112.1	3	2	1	-	-	-	-	-	-	-	1	-	-	-	1
MA23112.2	3	2	-	1	-	-	-	-	-	-	1	1	1	-	-
MA23112.3	2	2	-	-	-	-	-	-	-	-	1	1	-	-	-
MA23112.4	3	3	1	-	-	-	-	-	-	-	1	1	-	-	-
MA23112.5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.6	2.2	1	1	-	-	-	-	-	-	1	1	-	-	-

Subject Code	Subject Name	Category	L	T	P	C
CY23132	CHEMISTRY FOR TECHNOLOGISTS	BS	3	0	2	4
Common to B.TECH. - CHEMICAL ENGG., FOOD TECH. & BIO TECH						

Objectives:
<ul style="list-style-type: none"> To acquire knowledge on Surface chemistry for industrial and domestic uses. To impart the knowledge on principles of electrochemistry for engineering applications. To provide an insight into the latest Nanotechnology to pursue further research. To appreciate the need for and importance of Polymer materials and Heterocyclic compounds. To enhance the knowledge in line with the modern techniques for material analysis.

UNIT-I	SURFACE CHEMISTRY	9
Introduction – Adsorption- difference between adsorption and absorption - types of adsorption - Factors influencing adsorption - Adsorption from solutions- Types of adsorption isotherms - Freundlich adsorption isotherm - Langmuir adsorption isotherm - Industrial applications of adsorption – Adsorption Chromatography - Role of adsorption in Catalysis - Enzyme catalysis-Michael’s Menten equation.		
UNIT-II	ELECTROCHEMISTRY	9
Terminology involved in electrochemistry – Types of Cells - Galvanic and concentration cells- Derivation of Nernst equation - Applications of Electrochemical series - Types of Electrodes - Hydrogen, Calomel, ion-selective electrode - Determination of pH using glass electrode - Determination of electrode potentials - Conductometric titrations - Potentiometric titration-Redox titration.		
UNIT-III	NANO CHEMISTRY	9
Basic Definitions - Distinction between nanoparticles and bulk materials - size-dependent properties - Mechanical, Chemical, Optical, Electrical and Magnetic properties – Nanoparticles - nanoclusters, nanorods, nanotubes and nanowires - Synthesis of nanoparticles - Precipitation method - Hydrothermal synthesis - Solvothermal synthesis - Sonochemical synthesis - Chemical vapor deposition – Electrodeposition - biogenic synthesis - Applications of nanomaterials.		
UNIT-IV	POLYMERS AND HETEROCYC	9
Polymers – Introduction - Polymerization - Types of Polymerization - Condensation, Addition, Coordination, Copolymerization - Mechanism of Polymerization - Free Radical Mechanism - Biopolymers - PLA and PHB - Synthesis properties and applications. Heterocyclic compounds - Synthesis and electrophilic and nucleophilic substitution reactions of pyrrole - furan - thiophene- pyridine- quinoline - isoquinoline.		
UNIT-V	ANALYTICAL TECHNIQUES	9
Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions - Thermal methods of analysis - TGA, DTA – Principle, instrumentation and applications - Spectro Analytical methods - Colorimetry, IR, UV-visible spectroscopy - Principles instrumentation and applications.		
Total Contact Hours:45		

Total Contact Hours:30

Description of the Experiments

1. Construction and determination of EMF of simple electrochemical cells and concentration cells
2. Estimation of acids by pH metry
3. Determination of corrosion rate on mild steel by weight loss method
4. Estimation of mixture of acids by conductometry
5. Estimation of extent of corrosion of iron pieces by potentiometry
6. Estimation of copper / ferrous ions by spectrophotometry
7. Estimation of DO by using sensors
8. Estimation of concentration of ions in the given sample solution.
9. Determination of molecular weight of a polymer by viscometry method
10. Synthesis of nanomaterials by simple precipitation method
11. Verification of adsorption isotherms (acetic acid on charcoal)
12. Determination of phase change temperature of a solid.

Course Outcomes:

On completion of the course students will be able to

- Explore the applications of Surface Chemistry in domestic and industrial uses.
- Employ the basic principles of Electrochemistry in our daily life appliances.
- Synthesize Nano materials for modern engineering applications.
- Recognize the need of advanced polymer and heterocyclic compounds in industrial applications.
- Identify the structure of unknown/new compounds with the help of spectroscopy.

SUGGESTED ACTIVITIES

- Electroplating process can be done by a group of students.
- Determination of alkali content in the soap.
- Biogenic synthesis of nanomaterials

SUGGESTED EVALUATION METHODS

- Continuous assessment tests
- Assignments
- Model lab examination
- End semester examination

Text Book(s):

1. P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015
2. O.G.Palanna, "Engineering Chemistry", McGraw Hill Education (India) Pvt, Ltd, New Delhi, 2017
3. Shikha Agarwal "Engineering Chemistry-Fundamentals and applications", Cambridge University Press, New Delhi, 2015

Reference Books(s)

- A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
- B.K. Sharma, "Industrial chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2016.
- Polymer Science, V R Gowariker, N V Viswanathan, Jayadev, Sreedhar, Newage Int. Publishers, 4th Edition, 2021.
- PradeepT, "A Text Book of Nanoscience and Nanotechnology", Tata McGraw Hill, New Delhi, 2012
- An Introduction to nanomaterials and nanoscience (PB 2020) : Asim K DAS, Mahua Das, CBS publishers and distributors Pvt. Ltd.
- Laboratory Manual Engg. Chemistry, Anupma Rajput, Dhanpat Rai & Co

Weblinks:

1. NPTEL course Elementary Electrochemistry course url
https://onlinecourses.nptel.ac.in/noc23_cy19/preview
2. For downloading text/reference books the weblink is given below can be used
<http://libgen.rs/>
3. <https://nptel.ac.in/courses/104/103/104103019/>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CY23132.1	2	1	1	-	-	-	1	1	-	-	-	-	-	1	-
CY23132.2	2	2	1	-	-	-	-	-	-	-	-	1	1	-	-
CY23132.3	3	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CY23132.4	2	2	1	-	-	-	1	1	-	-	-	-	-	1	-
CY23132.5	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.2	1.6	1.2	-	-	-	1	1	-	-	-	1	1	1	-

Subject Code	Subject Name	Category	L	T	P	C
GE23111	ENGINEERING GRAPHICS	ES	2	0	4	4

Objectives:	
<input type="checkbox"/>	To understand the importance of the drawing in engineering applications
<input type="checkbox"/>	To develop graphic skills for communication of concepts, ideas and design of engineering products
<input type="checkbox"/>	To expose them to existing national standards related to technical drawings.
<input type="checkbox"/>	To improve their visualization skills so that they can apply this skill in developing new products.
<input type="checkbox"/>	To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination)

1

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.

UNIT-I	PLANE CURVES AND PROJECTION OF POINTS	11
Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloidal Curves–Construction of cycloid, epicycloid and hypocycloid – Construction of involutes of square and circle–Drawing of tangents and normal to the above curves. Principles of Projection and Projection of points.		
UNIT-II	PROJECTION OF LINES AND PLANE SURFACE	12
Projection of straight lines (First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
UNIT-III	PROJECTION OF SOLIDS AND DEVELOPMENT OF SURFACE OF SECTIONED SOLIDS	12
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method. Sectioning of solids in simple vertical position when the cutting plane is inclined to HP and perpendicular to VP. Development of lateral surfaces of sectioned solids – Prisms, pyramids cylinders and cones		
UNIT-IV	ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTIONS	12
Orthographic projection– Principles–Principal planes – Layout of views –.Orthographic projection from pictorial views of objects Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones		
UNIT-V	PERSPECTIVE PROJECTIONS AND BUILDING DRAWING	12
Perspective projection of simple solids-Prisms, pyramids, cylinder and cone by visual ray method.		

Building Drawing-Conventional signs , symbols and component parts of the residential buildings , Drawing of detailed working plan, elevation and section of a single storey residential building from a given line plan or from the given data showing details of foundations, roof and parapet		
		Total Contact Hours : 60

Course Outcomes:	
After learning the course, the students should be able	
<input type="checkbox"/>	To construct different plane curves and to comprehend the theory of projection
<input type="checkbox"/>	To draw the basic views related to projection of lines and planes
<input type="checkbox"/>	To draw the projection of simple solids and to draw the projection of development of surfaces of Sectioned solids in simple vertical position
<input type="checkbox"/>	To draw the orthographic projection from pictorial objects and Isometric projections of simple solids
<input type="checkbox"/>	To visualize Perspective view of simple solids and to draw Plan view, Elevation view and Cross sectional view of single storey building

Text Book (s):	
1	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50 th Edition, 2010.
2	Natrajan K.V., “A text book of Engineering Graphics”, DhanalakshmiPublishers, Chennai, 2017.

Reference Books(s) / Web links:	
1	Varghese P I., “Engineering Graphics”, McGraw Hill Education (I) Pvt.Ltd., 2013.
2	Venugopal K. and PrabhuRaja V., “Engineering Graphics”, New Age International (P)Limited, 2008.
3	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2017.
4	BasantAgarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill Publishing Company Limited, New Delhi, 2018.

Publication of Bureau of Indian Standards	
1	IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2	IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3	IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4	IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5	IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special Points Applicable to End Semester Examination on Engineering Graphics	
1	There will be five questions, each of either or type covering all units of the syllabus
2	All questions will carry equal marks of 20 each making a total of 100.
3	The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size
4	The examination will be conducted in appropriate sessions on the same day

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23111.1	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1
GE23111.2	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1
GE23111.3	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1
GE23111.4	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1
GE23111.5	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1
Average	3	2	2	1	-	1	-	2	2	2	-	2	1	2	1

Subject Code	Subject Name	Category	L	T	P	C
GE23121	ENGINEERING PRACTICES – CIVIL AND MECHANICAL	ES	0	0	2	1

Objectives:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering

List of Experiments

CIVIL ENGINEERING PRACTICE	
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3.	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.
Carpentry Works:	
4.	Study of joints in roofs, doors, windows and furniture.
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.
MECHANICAL ENGINEERING PRACTICE	
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
7.	Gas welding practice.
Basic Machining:	
8.	Simple Turning and Taper turning
9.	Drilling Practice
Sheet Metal Work:	
10.	Forming & Bending:
11.	Model making – Trays and funnels
12.	Different type of joints.
Machine Assembly Practice:	
13.	Study of centrifugal pump
14.	Study of air conditioner
Total Contact Hours	
: 30	

Course Outcomes:

•	Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
•	Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
•	Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
•	Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine

•	Able to perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.
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PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23121.1	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.2	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.3	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.4	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.5	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
Average	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1

Subject Code	Subject Name	Category	L	T	P	C
MC23112	ENVIRONMENTAL SCIENCE AND ENGINEERING Common to all branches of B.E./B.Tech. courses (Except B.Tech-CSBS)	MC	3	0	0	0

Objectives:

- To develop the understanding of environmental and associated issues
- To develop an attitude of concern for the environment
- To promote enthusiasm in participating environmental protection initiatives
- To nurture skills to solve environmental degradation issues

UNIT-I	AIR AND NOISE POLLUTION	9
Definition –sources of air pollution –chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, ozone depletion, particulate pollutants-Air quality standards-Air quality indices - control of particulate air pollutants-gravitational settling chambers,cyclone separators, wet collectors, fabric filters (Bag-house filter), electrostatic precipitators (ESP)-catalytic converters. Noise pollution –sources - health effects - standards- measurement and control methods.		
UNIT-II	WATER POLLUTION AND ITS MANAGEMENT	9
Definition-causes-effects of water pollution-point and nonpoint sources of wastewater-marine pollution - thermal pollution - Control of water pollution by physical, chemical and biological methods – wastewater treatment-primary, secondary and tertiary treatment-sources and characteristics of industrial effluents-zero liquid discharge.		
UNIT-III	SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT	9
Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options fromwaste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization,incineration and final disposal. E-waste-definition-sources-effects on human health and environment- E-waste management- steps involved - Role of E-waste management within the initiatives of the Govt. of India- Swachh Bharat Mission.		
UNIT-IV	SUSTAINABLE DEVELOPMENT	9
Sustainable development- concept-dimensions-sustainable development goals - value education- gender equality – food security - poverty – hunger - famine - Twelve principles of green chemistry - Green technology - definition, importance - Cleaner development mechanism - carbon credits, carbon trading, carbon sequestration, eco labeling-International conventions and protocols-Disaster management.		

UNIT-V	ENVIRONMENTAL MANAGEMENT AND LEGISLATION	9
Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment- life cycle assessment- human health risk assessment - Environmental Laws and Policy- Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technology in environment and human health.		
Total Contact Hours : 45		

Course Outcomes:	
On completion of the course, the students will be able to	
CO1	Associate air and noise quality standards with environment and human health.
CO2	Illustrate the significance of water and devise control measures for water pollution.
CO3	Analyze solid wastes and hazardous wastes.
CO4	Outline the goals of sustainable development in an integrated perspective.
CO5	Comprehend the significance of environmental laws.

Text Books:	
1	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016
2	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
3	Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books	
1	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. Edition 2010.
2	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3	Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017.Elsevier

Web links:	
1	https://onlinecourses.nptel.ac.in/noc19_ge22/
2	NPTEL
3	https://news.mit.edu/2013/ewaste-mit

Suggested activities

1. Case studies presentation

Method of evaluation

1. Classroom presentations on case studies (or) Site visits, instead of CAT-I (or)CAT-II or CAT III

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
MC23112.1	1	2	3	1	-	2	2	2	1	1	1	2	-	-	-
MC23112.2	1	2	3	1	-	2	2	2	1	1	1	2	-	-	-
MC23112.3	-	-	3	1	-	2	3	2	1	-	1	2	-	1	-
MC23112.4	-	1	2	1	1	3	3	2	1	1	1	2	-	-	-
MC23112.5	-	1	2	-	-	2	2	2	1	2	2	2	-	-	-
Average	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	-	0.2	-

Subject Code	Subject Name	Category	L	T	P	C
GE23117	தமிழர் மரபு/ HERITAGE OF TAMILS	HS	1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம்:	3
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழிக் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிறிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.	
அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை: 3	3
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளூர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.	
அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:	3
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	
அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்:	3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.	
அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:	3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிக்கள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.	

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi – ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Subject Code	Subject Name	Category	L	T	P	C
HS23221	TECHNICAL COMMUNICATION - II	HS	0	0	2	1
Common to all branches of B.E/B. Tech programmes –Second Semester						

Objectives:
• To facilitate students to improve their vocabulary for a better communication
• To enable learners to understand and reproduce language
• To aid students to write technical reports in a convincing manner
• To expose students to different sentence structures
• To equip learners to present their ideas in an efficient manner

UNIT-I	VOCABULARY FOR BETTER COMMUNICATION	6
Listening: Telephonic Conversations and TV News Reading: Newspapers and Magazines Speaking: Conversational Practice: Speaking in a given situation, Asking permission and requesting etc..., Writing: Job Application Letter and Resume Grammar: Reference words: pronouns and determiners Vocabulary: Guessing meanings of words in different contexts.		
UNIT-II	FUNCTIONAL LANGUAGE ASPECTS	6
Listening: Motivational listening – listening to real life challenges Reading: Articles and Technical reports Speaking: Using Polite Expressions, Indirect Questions Writing: Paraphrasing a Text, Poem Grammar: Purpose Statements, Cause and Effect Expressions Vocabulary: Neologisms.		
UNIT-III	TECHNICAL REPORTWRITING	6
Listening: Empathetic Listening – Giving Solutions to Problems Reading: Inferential Reading Speaking: Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc..., Writing: Report Writing Grammar: Functional Usage of Expressions – used to, gone / been, etc..., Vocabulary: Words Often Confused		
UNIT-IV	STRUCTURAL GRAMMAR	6
Listening: Comprehension (IELTS practice tests) Reading: Intensive Reading for specific information Speaking: Pick and Talk Writing: Proposals Grammar: Sentence Structures – Simple, Compound, Complex Sentences		

Vocabulary: Replacing dull words with vivid ones	
UNIT-V	PRESENTATION SKILLS 6
Listening: Discriminative listening – sarcasm, irony, pun, etc., Reading: Practice of chunking – breaking up reading materials Speaking: Mini presentation on some topic Writing: Minutes of the meeting Grammar: Correction of Errors Vocabulary: Advanced vocabulary – fixing appropriate words in the given context.	
Total Contact Hours: 30	

Course Outcomes:
On completion of the course students will be able to
<ul style="list-style-type: none"> • communicate effectively using appropriate vocabulary • use the acquired language skills to comprehend various types of language contents • evaluate different texts and write effective technical content • use appropriate sentence structures to convey their thoughts in varied contexts • present their concepts and ideas in an effective manner

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> • Story Lines • One truth and two lies • Hang Man • Pictionary • Word Scramble • Case study

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> • Assignment topics • Quizzes • Class Presentation/Discussion • Continuous Assessment Tests

Text Book(s):
5. Raymond Murphy, “Intermediate English Grammar,” Second Edition , Cambridge University Press, 2018
6. Meenakshi Raman & Sangeeta Sharma, “Technical Communication” Third Edition, Oxford University Press, 2015
7. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:
1. Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor), “Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers” 2nd Edition
2. Dale Carnegie, “The Art of Public Speaking,” Insight Press
3. Jack C. Richards & Theodore S. Rodgers, “ Approaches and Methods in Language Teaching, Second Edition, Cambridge University Press

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	HS23221. 1	-	-	-	1	-	-	-	-	-	2	-	-	-	-
HS23221. 2	-	-	-	1	-	-	-	-	-	3	-	-	1	-	-
HS23221. 3	-	2	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221. 4	-	-	-	1	-	-	-	-	2	3	-	-	1	-	-
HS23221. 5	-	-	-	1	-	-	-	-	2	2	-	-	1	-	-
Average	-	2	-	1	0	0	0	0	2	2.6	-	-	1	-	-

Subject Code	Subject Name	Category	L	T	P	C
HS 23222	ENGLISH FOR PROFESSIONAL COMPETENCE Common to all branches of B.E/B. Tech programmes – Second Semester	HS	0	0	2	1

Objectives:

●	To facilitate the learners in acquiring listening and reading competence
●	To enable the learners to communicate effectively through written and oral medium
●	To assist the learners in preparing for competitive examinations
●	To train the students in acquiring corporate skills
●	To inculcate professional standards among the students and make them realize their responsibility in addressing the challenges

UNIT-I	RECEPTIVE SKILLS	6
Listening – Comprehensive Listening – Watching the news – Listening to a peer giving presentation, etc. – Critical Listening – Watching a televised debate, Listening to poems – Reading – Extensive Reading – Short stories and One-act Plays – Intensive Reading – Articles or Editorials in Magazines, Blog posts on topics like science and technology, arts, etc.		
UNIT-II	PRODUCTIVE SKILLS	6
Speaking – Demonstrative Speaking – Process description through visual aids – Persuasive Speaking – Convincing the listener with the speaker’s view – Writing – Descriptive Writing - Describing a place, person, process – Subjective Writing – Autobiography, Writing based on personal opinions and interpretations		
UNIT-III	ENGLISH FOR COMPETITIVE EXAMS	6
An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.		
UNIT-IV	CORPORATE SKILLS	6
Critical Thinking and Problem Solving – Case Study, Brainstorming, Q & A Discussion – Team work and Collaboration – Activities like Office Debates, Perfect Square, Blind Retriever, etc. Professionalism and Strong Work Ethics – Integrity, Resilience, Accountability, Adaptability, Growth Mind set		
UNIT-V	PROJECT WORK	6
Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution		
Total Contact Hours		30

Course Outcomes:

On completion of the course, students will be able to

- interpret and respond appropriately in the listening and reading contexts.
- express themselves effectively in spoken and written communication
- apply their acquired language skills in writing the competitive examinations
- exhibit their professional skills in their work place
- identify the challenges in the work place and suggest strategies solutions

SUGGESTED ACTIVITIES

- Online Quizzes on Vocabulary
- Online Quizzes on grammar
- Communication Gap Exercises
- Presentations
- Word Building Games
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):

1	How to Read Better & Faster, Norman Lewis, Goyal Publishers
2	Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
3	The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
4	The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK

Reference Books(s) / Web links:

1.	Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.
2.	Hartley, Mary. "The Power of Listening," JaicoPublishing House; First Edition (2015).
3.	Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS O2	PS O3
HS23222. 1	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 2	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 4	-	-	-	-	-	-	2	2	-	3	-	-	-	-	-
HS23222. 5	-	-	1	-	-	-	2	-	-	3	-	-	2	-	-
Average	-	1	1	-	-	-	2	2	-	3	-	-	2	-	-

Subject Code	Subject Name	Category	L	T	P	C
MA23212	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	BS	3	1	0	4
Common to II Sem. B.E. –AERO, AUTO, BME, CIVIL, EEE, ECE, MECH, MCT, R&A and B. Tech. - BT, FT & CHEM						

Objectives:

● To provide students with an introduction to the theory of ordinary differential equations through applications, methods of solution, and numerical approximations.
● To introduce students to how to solve linear Partial Differential with different methods.
● To enable the students to study the Laplace Transforms, properties of Laplace Transform, inverse Laplace Transform and some applications to solve the differential equations and integral equations.
● To explain the concept of a vector integration in a plane and in space.
● To describe basic properties of complex variables and to have the ability to compute complex integrals.

UNIT-I	ORDINARY DIFFERENTIAL EQUATIONS	12
Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Legendre’s linear equations – Numerical solution of ODE - Single Step methods: Taylor’s series method, Euler’s method.		
UNIT-II	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations - Classification of PDE – Solutions of standard types of first order partial differential equations - Lagrange’s linear equation –Linear homogeneous partial differential equations of second and higher order with constant coefficients.		

UNIT-III	LAPLACE TRANSFORM	12
Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques		
UNIT-IV	VECTOR CALCULUS	12
Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stokes’ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.		
UNIT-V	COMPLEX VARIABLES	12
Analytic functions — Construction of analytic function - Bilinear transformation –Singularities – Cauchy’s integral theorem (without proof) - Residues – Residue theorem (without proof) - Simple problems - Contour integral over $ z =1$.		
Total Contact Hours:		60

Course Outcomes: On completion of the course students will be able to
<ul style="list-style-type: none"> ● Apply the methods as a potent tool in the solution of a variety of problems in the natural sciences and technology.
<ul style="list-style-type: none"> ● Develop specific methodologies, techniques and resources in Partial differential equations to conduct research and produce innovative results in the area of specialisation.
<ul style="list-style-type: none"> ● Use Laplace transform and inverse transform techniques to solve the complex problems in engineering and technology.
<ul style="list-style-type: none"> ● Apply the concepts in multivariable analysis, including space curves; directional derivative; gradient; multiple integrals; line and surface integrals; vector fields; divergence, curl ; the theorems of Green and Stokes, and the divergence theorem in different fields of engineering.
<ul style="list-style-type: none"> ● Demonstrate the concept of Analytic functions, conformal mapping and complex integration in solving Engineering problems.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> ● Problem solving sessions ● Activity Based Learning

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> ● Problem solving in Tutorial sessions ● Assignment problems ● Quizzes and class test ● Discussion in classroom

Text Book(s):	
1.	Grewal B.S., “ Higher Engineering Mathematics ”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2.	Veerarajan. T, Engineering Mathematics –II, Mc Graw Hill Education, 2018.
3.	Erwin Kreyszig, " Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
4.	Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th Edition, New Delhi, 2011.
5.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, 5 th Edition, New Delhi, 2017.

Reference Books(s) / Web links:	
1.	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2.	T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.

3.	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 4 th Edition 2006.
4.	Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23212.1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
MA23212.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	-
MA23212.3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
MA23212.4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
MA23212.5	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
Average	2.8	2	1	-	-	-	-	-	-	-	-	1	1	-	-

Subject Code	Subject Name	Category	L	T	P	C
EE23133	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	ES	3	0	2	4

Objectives:

- To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
- To impart knowledge on the analysis of AC circuits
- To expose the principles of electrical machines and electronic devices.
- To teach the concepts of different types of electrical measuring instruments and transducers.
- To experimentally analyze the electrical circuits and machines, electronic devices and transducers.

UNIT-I DC CIRCUITS 9

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff 's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT-II AC CIRCUITS 9

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 resonance. Three phase balanced circuits, voltage and current relations in star and delta connections

UNIT-III ELECTRICAL MACHINES 9

Construction, Principles of operation of DC machines, Single phase Transformers, Synchronous machines, Single phase induction motors.

UNIT-IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction diode–Forward and Reverse Bias – Bipolar Junction Transistor – Common Emitter characteristics –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier.

UNIT-V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Piezoelectric, - Classification of instruments - PMMC and MI Ammeters and Voltmeters – Digital Storage Oscilloscope.

Contact Hours : 45

List of Experiments

- 1 Verification of Kirchoff's Laws.
- 2 Load test on DC Shunt Motor.
- 3 Load test on Single phase Transformer.
- 4 Load test on Single phase Induction motor.
- 5 Characteristics of P-N junction Diode.
- 6 Characteristics of CE based NPN Transistor.

7	Characteristics of LVDT, RTD and Thermistor.			
		Contact Hours	:	30
		Total Contact Hours	:	75
Course Outcomes:				
On completion of the course, the students will be able to				
●	analyse DC circuits and apply circuit theorems.			
●	calculate the power and power factor in AC circuits			
●	understand the principles of electrical machines.			
●	comprehend the principles of different types of electronic devices, electrical measuring instruments and transducers.			
●	experimentally analyze the electric circuits and machines, electronic devices, and transducers.			
Suggested Activities				
●	Problem solving sessions			
Suggested Evaluation Methods				
●	Quizzes			
●	Class Presentation / Discussion			
Text Book(s):				
1	J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria& Sons Publications, 2002.			
2	Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Schaum Series and Systems", Schaum's Outlines, Tata McGrawHill, Indian. 5th Edition, 2017			
3	Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008			
Reference Books(s) / Web links:				
1	Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007			
2	John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006			
3	Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition, 2006			
4	Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006			
5	A.E.Fitzgerald, David E Higginbotham and Arvin Gabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009			
6	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint, 2016			
7	https://nptel.ac.in/courses/108108076			

Lab Equipment Required:

Sl. No.	Name of the Equipment	Quantity Required (For a batch of 30 students)
1.	Verification of ohms and Kirchhoff's Laws 1. DC Regulated Power supply (0 - 30 V variable) 2. Bread Board 3. Resistors 4. Multimeter 5. Connecting wires	1 1 As per Circuit diagram 1 As Required
2.	Load test on DC Shunt Motor. 1. Ammeter MC (0-20A) 2. Voltmeter MC (0-300)V 3. Tachometer 4. Field Rheostat 500 Ω, 1.5 A 5. Connecting wires	1 1 1 1 As Required
3.	Load Test on Induction Motor 1. Ammeter MI (0-20A) 2. Voltmeter MI (0-300)V 3. Wattmeter – 300V, 30 A 4. Tachometer – Digital 5. Connecting Wires 6. Single phase Induction motor	1 1 1 1 As Required 1

4.	Load test on Single phase Transformer 1. Ammeter (0-30) A, (0-5) A 2. Voltmeter (0-150)V, (0-300)V 3. Wattmeter – 300V, 5A, UPF 4. Autotransformer 5. Single phase Transformer 6. Connecting Wires	1 1 1 1 1 As Required
5.	Characteristics of PN and Zener Diodes 1. PN Diode (IN4007), Zener diode (6.8V, 1A) 2. Resistor 1 K Ω , 100 Ω 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	1 1 1 1 1 As Required
6.	Characteristics of BJT 1. Transistor (BC107) 2. Resistors- 1k Ω , 470K Ω , 1M Ω 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	1 1 1 1 1 As Required
7.	Measurement of displacement of LVDT, RTD and Thermistor 1. LVDT Kit 2. RTD 3. Thermistor 4. Multimeter	1 1 1 1 1

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE23133.1	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1
EE23133.2	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1
EE23133.3	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1
EE23133.4	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1
EE23133.5	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1
Average	3	3	3	3	-	3	1	1	2	1	1	1	1	1	1

Subject Code	Subject Name	Category	L	T	P	C
PH23231	PHYSICS FOR BIOSCIENCE Common to - B.E. – Biomedical Engineering and	BS	3	0	2	4
Objectives:						
●	To enhance the fundamental knowledge of oscillations, Ultrasonic wave properties and its applications.					
●	To strengthen the basic information of semiconducting materials, characteristic and its applications.					
●	To study the behaviour of superconducting materials and optical fibres for medical applications.					
●	To understand the properties of nuclear radiation and elementary particles.					
●	To study the advanced analytical techniques.					
UNIT-I	WAVES AND ULTRASONICS					9
Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation – Fundamentals of sound– generation of ultrasound – magnetostriction and piezo-electric method – properties - acoustical grating- velocity of Ultrasonics- Non-destructive Testing						

– pulse echo system through transmission and reflection modes - A,B and C – scan displays.			
UNIT-II	PHYSICS OF SEMICONDUCTORS	9	
Fundamentals of semiconductors– Intrinsic semiconductor– carrier concentration in an intrinsic semiconductor – variation of Fermi level with temperature – band gap determination-Extrinsic semiconductor- carrier concentration of N-type and P-type –variation of Fermi level with temperature and impurity concentration –Hall effect – Determination of Hall coefficient – Formation of PN junction -LED and Solar cells.			
UNIT-III	MATERIALS FOR MEDICAL APPLICATIONS	9	
Introduction to Superconductivity - Properties of Superconductors - BCS theory (qualitative) – Type-I and Type II Superconductors - Applications-Cryotron-Josephson devices- SQUID-MRI scan and Magnetic Levitation. Magnetism in materials - magnetic field and magnetic induction –permeability - susceptibility– types of magnetic materials – Dia, Para, Ferro, anti-ferro and ferrites-hysteresis. Fiber optics –Total internal reflection, Numerical aperture and acceptance angle - types of fibers -Temperature and displacement sensors- endoscopy.			
UNIT-IV	NUCLEAR AND PARTICLE PHYSICS	9	
Radioactivity - characteristics of radioactive material – isotopes - probing by isotopes, reactions involved in the preparation of radioisotopes, the Szilard-Chalmer’s reaction – radiochemical principles in the use of tracers - nuclear medicines – Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation. Gamma-Ray Spectrometry- Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters.			
UNIT-V	ADVANCED ANALYTICAL TECHNIQUES	9	
Theory, Instrumentation and Applications of: Thermogravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry. Surface analysis – Electron microscope-magnification-resolving power- Scanning electron microscope, Atomic force microscope - Transmission electron microscope,– Principle, instrumentation and applications			
			Contact Hours : 45
List of Experiments			
1	Determination of Velocity of ultrasound and compressibility of given liquid – Ultrasonic interferometer.		
2	Determination of wavelength of diode laser and angular divergence.		
3	Determination of Band gap of given semiconducting material.		
4	Determination of Hall coefficient of the given semiconducting material.		
5	Determination of solar cell characteristics.		
6	Determine the energy loss of material by using B-H curve set up.		
7	Determination of free space permeability using Helmholtz coil.		
8	Determination of Numerical aperture and angle of acceptance of the optical fiber cable.		
9	Spectrometer – Wavelength of Hg spectrum by diffraction grating.		
10	Spectrometer – Determine refractive index of a prism.		
			Contact Hours : 30
			Total Contact Hours : 75
Course Outcomes:			
On completion of the course, the students will be able to			
●	Apply the knowledge of oscillating particles and generation of waves in real time applications.		
●	Comprehend the principles of semiconductors and their device fabrication.		
●	Make use the properties of superconductors and optical fibre in engineering and technology.		
●	Apply the characteristics of nuclear and elementary particles to develop innovative instruments.		
●	Utilize the concepts of advanced analytical techniques.		
Suggested Activities			
●	Problem solving sessions		
Suggested Evaluation Methods			
●	Quizzes		
●	Class Presentation / Discussion		
Text Book(s):			
1	Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2017.		
2	Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2014.		
3	Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.		
4	B.H Brown, R.H.Smallwood, D.C Barber . P.V Lawford Medical physics and Biomedical		

	Engineering, CRC Press 1998.
Reference Books(s) / Web links:	
1	S. O. Pillai, Solid state Physics (Multi colour Edition), New Age International Publisher, 2018.
2	Arthur Besier and S. Rai Choudhury, Concepts of Modern Physics (SIE), 7 th Edition, 2017.
3	B.L.Theraja, Modern Physics, 16th edition, S.Chand, 2018.
4	J.B.Rajam, Atomic Physics, 7th edition, S.Chand, 2010.
5	Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2012.
6	Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.

List of Equipment Available
(Common to B.E. BME and B.Tech. - Bio –Tech. and Food Tech.)

S. No	Name of the equipment	Quantity Required	Quantity Available	Deficiency
1	Young's modulus by Uniform bending method Travelling Microscope	6	13	-
2	Young's modulus by Non-Uniform bending method Travelling Microscope	6	13	-
3	Rigidity Modulus - Torsional Pendulum Setup	6	19	-
4	Band gap of a semiconductor Setup	6	19	-
5	Determination of Plank's constant - Rheostat, Multimeter, LED	6	10	-
6	B-H curve Setup and CRO	6	7	-
7	Determination of permeability of free space - Helmholtz coil setup	5	5	-
8	Refractive index of Prism – Spectrometer	6	12	-
9	LCR circuit kit	6	7	-
10	Wavelength of Laser and Characteristics -Laser source and grating	6	12	-

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	PH23231.1	3	2	1	-	-	-	-	-	-	-	-	-	1	1
PH23231.2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
PH23231.3	3	2	1	-	-	-	-	-	-	-	-	-	1	1	-
PH23231.4	3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
PH23231.5	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
Average	3	2	1	-	-	-	-	-	-	-	-	-	1	1	-

Subject Code	Subject Name	Category	L	T	P	C
GE23233	PROBLEM SOLVING AND PYTHON PROGRAMMING	ES	2	0	4	4

Objectives:	
<input type="checkbox"/>	To know the basics of algorithmic problems solving
<input type="checkbox"/>	To develop Python programs with conditionals and loops
<input type="checkbox"/>	To define Python functions and call them
<input type="checkbox"/>	To use Python data structures--lists, tuples, dictionaries
<input type="checkbox"/>	To do input/output with files in Python

UNIT-I	ALGORITHMIC PROBLEM SOLVING	6
Introduction to computers-characteristics-basic organization of a computer– algorithms-building blocks of algorithms (instructions / statements, state, control flow, functions)-notation (pseudo code, flow chart, programming language) - algorithmic problem solving - simple strategies for developing algorithms (iteration, recursion).		
UNIT-II	DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW	6
Python interpreter and interactive mode - values and types - data types – variables – keywords – expressions and statements- python I/O - operators- precedence of operators– comments. Conditionals: conditional(if)- alternative(if-else)-chained conditional (if- elif- else)–nested conditional.		
UNIT-III	CONTROL FLOW – II AND FUNCTIONS	7
Iteration: while – for - break – continue – pass. Illustrative programs: exchange the values of two variables- circulate the values of n variables-test for leap year. Function calls – type conversion– math function– composition- definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion.		
UNIT-IV	STRINGS	5
Strings: string slices – immutability - string functions and methods – string comparison. Illustrative programs: square root–GCD– exponentiation-sum the array of numbers linear search- binary search.		
UNIT-V	LISTS, TUPLES AND DICTIONARIES	6
Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value. Dictionaries: operations and methods– dictionaries and tuples– dictionaries and lists. Advanced list processing- list comprehension. Illustrative programs: Sorting.		
Contact Hours		: 30

List of Experiments			
1	Introduction to Python Programming and Python IDLE/Anaconda distribution.		
2	Experiments based on Variables, Data types and Operators in Python.		
3	Coding Standards and Formatting Output.		
4	Algorithmic Approach: Selection control structures.		
5	Algorithmic Approach: Iteration control structures.		
6	Experiments based on Strings and its operations.		
7	Experiments based on Lists and its operations.		
8	Experiments based on Tuples and its operations.		
9	Experiments based on Sets and its operations.		
10	Experiments based on Dictionary and its operations.		
11	Functions: Built-in functions.		
12	Searching techniques: Linear and Binary.		
13	Sorting techniques: Bubble and Merge Sort.		
			Contact Hours
			: 60
			Total Contact Hours
			: 90

Course Outcomes:	
On completion of the course, the students will be able to	
<input type="checkbox"/>	Understand the working principle of a computer and identify the purpose of a computer programming language and ability to identify an appropriate approach to solve the problem.
<input type="checkbox"/>	Write, test, and debug simple Python programs with conditionals and loops.
<input type="checkbox"/>	Develop Python programs step - wise by defining functions and calling them.
<input type="checkbox"/>	Use Python lists, tuples, dictionaries for representing compound data.
<input type="checkbox"/>	Apply searching, sorting on data and efficiently handle data using flat files.

Textbooks:	
1.	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, second edition, Updated for Python3, Shroff/ O’Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2.	Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python3.2, Network Theory Ltd., 2011.

Reference Books:	
1.	John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press,2013.
2.	Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt.Ltd., 2016.
3.	Timothy A.Budd, Exploring Python, Mc-Graw Hill Education(India)PrivateLtd.,2015.
4.	Kenneth A. Lambert, Fundamentals of Python: First Programs, CengageLearning,2012.
5.	Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition,2013.
6.	Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python3, Second edition, Pragmatic Programmers, LLC, 2013.

PO/PSO CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
GE23233.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
GE23233.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
GE23233.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
GE23233.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
GE23233.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	1.8	1.6	2.2	1.6	1.8	-	-	-	-	-	1.4	1	2.4	2.4	2

Subject Code	Subject Name	Category	L	T	P	C
FT23201	FOOD CHEMISTRY	PC	3	0	0	3

Course Objectives:

- To gain an understanding of the fundamental concepts of carbohydrates.
- To explore the composition and properties of proteins.
- To investigate the nomenclature and function of lipids in food processing.
- To examine the chemical composition of food and its influence on food properties.
- To analyze the role of phytochemicals in the overall composition of foods..

UNIT-I	CARBOHYDRATES	10
The principal carbohydrates in the human diet. Chemical properties of carbohydrates-dehydration, caramelization, Maillard reaction. Types Simple Sugars: mono and disaccharides, solubility; Artificial sweeteners; Glucose syrup, fructose syrup, Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Maltodextrins and dextrins; Structure of glycogen. Fiber- Cellulose & hemicellulose Pectins: Gums & seaweeds- gel formation & viscosity.		
UNIT-II	PROTEINS	9

The principal proteins in the human diet. Review of protein structure & conformation; Optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Properties & reactions of proteins in food systems and Food enzymes and its role in food spoilage, application of food enzymes; Texturized proteins; Functional role and uses in foods.			
UNIT-III	LIPIDS		9
Review of structure, composition and nomenclature of fats. Properties of fats & oils: Edible oil refining processes, winterization, melting points, plasticity, isomerisation, hydrolysis of triglycerides, Saponification number, iodine value, Reichert-Meissl number. Types of fatty acids; Modification of fats: hydrogenation-cis and trans isomers, inter-esterification, acetylation, Hydrolytic rancidity & oxidative rancidity; Shortening power of fats, tenderization, frying - smoke point, auto oxidation, polymerization, lipids having emulsifying properties, its application in food industry and detergents; Shortening power of fats, chemistry of steroids, types of fat substitute.			
UNIT-IV	FOOD COMPOSITION, WATER, MINERALS AND VITAMINS		7
Proximate composition of food, water activity in food, moisture content of food, water quality for food processing. Mineral & vitamin content of foods- stability & degradation during food processing.			
UNIT-V	AROMA & IMPORTANT PHYTOCHEMICALS IN FOOD		9
Naturally occurring colours/pigments in food and impact on antioxidant level, Synthetic food grade Colours, enzymatic browning of food, flavour & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables & fermented products; and Naturally similar /artificial flavours, Threshold values, off flavours & food taints. Antinutritional factors in food, protease inhibitors, bioactive components: phytates, polyphenols, saponins, phytoestrogens etc.			
			Total Contact Hours : 45

Course Outcomes:
On completion of course, students will be able to
<ul style="list-style-type: none"> • Understand the basic principles of carbohydrates and their role in food chemistry. • Describe the composition, properties, and functional significance of proteins in food systems. • Identify the nomenclature of lipids and evaluate their role during food processing. • Analyze the chemical composition of food and understand its impact on food characteristics and quality. • Assess the contribution of phytochemicals to the composition and nutritional value of foods.

Text Book (s):	
1	Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 4th Revised Edition, Springer-Verlag, 2009.
2	John M. deMan. "Principles of Food Chemistry". 3rd Edition, Springer, 1999.
3	Chopra, H.K. and P.S. Panesar. "Food Chemistry". Alpha Science International Limited, 2010

Reference Books(s) / Web links:	
1	Meyer, Lillian Hoagland "Food Chemistry". CBS Publishers, 1987.
2	Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". 4 th Edition, Kluwer-Academic,

	Springer, 2014.
3	Richard Owusu-Apenten “Introduction to Food Chemistry” CRC Press, 2005.
4	Srinivasan Damodaran, Kirk L. Parkin, “Fennema’s Food Chemistry “5 th Edition, CRC Press, 2008.
5	Peter Chi Keung Cheung, Bhavbhuti M. Mehta, “ Handbook of Food Chemistry” Springer, 2015

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23201.1	3	1	2	2	3	1	1	1	2	2	3	3	2	2	2
FT23201.2	3	2	2	3	2	2	2	2	3	3	3	3	2	3	2
FT23201.3	3	3	3	3	2	3	1	3	2	2	3	3	3	3	2
FT23201.4	3	3	3	2	3	2	2	1	1	1	3	3	3	3	2
FT23201.5	2	1	1	1	1	3	3	3	3	3	2	3	1	3	1
Average	2.8	2.3	2.2	2.2	2.2	2.2	1.8	2	2.2	2	2.8	3	2.2	2.8	1.8

Subject Code	Subject Name	Category	L	T	P	C
MC23111	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	3	0	0	0
Common to all branches of B.E/B. Tech Programmes – First / Second/third Semester						

Objectives:
<ul style="list-style-type: none"> To apprehend the sacrifices made by the freedom fighters. To inculcate the values enshrined in the Indian constitution. To instil a sense of responsibility as the citizens of India. To familiarise about the functions of the various levels of Government. To be informed about Constitutional and Non- Constitutional bodies.

UNIT-I	INDIAN FREEDOM MOVEMENT	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India- Indian Freedom Struggle under Mahatma Gandhi -Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
UNIT-II	CONSTITUTION OF INDIA	9
Historical Background – Indian Constitution: Constitution’ meaning of the term, Sources and constitutional history, Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-III	STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-IV	STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY	9
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials.		
UNIT-V	CONSTITUTIONAL FUNCTIONS AND BODIES	9
Indian Federal System – Centre – State Relations – President’s Rule – Constitutional Functionaries –		

Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.

Total Contact Hours: 45

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

- Appreciate the sacrifices made by freedom fighters during freedom movement.
- Be responsible citizens and abide by the rules of the Indian constitution.
- Be aware of the functions of the Indian government.
- Be knowledgeable about the functions of the state Government and the Local bodies.
- Apply the knowledge on constitutional functions and role of constitutional bodies and non-constitutional bodies.

SUGGESTED ACTIVITIES

- Famous speeches from around the world relating to independence
- Case study
- Quiz on Portfolio and Cabinet
- Discussions on International Associations like the UN, BRICS, QUAD
- Presentation on issues around the world

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous assessments (CAT)

Text Book(s):

1. M. Laxmikanth , “Indian Polity:, McGraw-Hill, New Delhi.
2. Durga Das Basu, “Introduction to the Constitution of India “, Lexis Nexis, New Delhi. 21sted 2013.
3. P K Agarwal and K N Chaturvedi ,PrabhatPrakashan, New Delhi, 1sted , 2017.

Reference Books(s) / Web links:

1. Sharma, Brij Kishore, “Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar
3. Bipan Chandra, India’s Struggle for Independence, Penguin Books, 2016.
4. Maciver and Page, “Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.2nded, 2014.
5. Bipan Chandra, History of Modern India, Orient Black Swan, 2009.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC23111.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MC23111.2	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
MC23111.3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
MC23111.4	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
MC23111.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-

Subject Code	Subject Name	Category	L	T	P	C
GE23217	தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	HS	1	0	0	1

அலகு I	நெசவு மற்றும் பாணைத் தொழில்நுட்பம்	3
சங்க காலத்தில் நெசவுத் தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்		
அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:	3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.		
அலகு III	உற்பத்தித் தொழில் நுட்பம்	3
கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்		
அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3
அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கல்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.		
அலகு V	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3
அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.		
Total Contact Hours		: 15

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
 8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
 9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
 10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
 11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

Subject Code	Subject Name	Category	L	T	P	C
FT23211	FOOD CHEMISTRY LABORATORY	PC	0	0	4	2

Course Objectives:

To recognize the important reactions in food chemistry and their consequences.

To get familiar with methods to measure chemical reactions involved in foods

To reporting the results in an appropriate format.

To design and conduct an experiment to understand a simple food chemistry problem.

To understand the complex interactions between the different components of foods.

List of Experiments

1	Experiment to study the properties of carbohydrates- caramelization, Maillard reaction.
2	Experiment on enzymatic and acid hydrolysis of sucrose
3	Preparation of emulsions and study its stability
4	Determination of Foaming properties of proteins
5	Determination of Solubility, specific gravity and Refractive index of oils
6	Estimation of free fatty acid content of oil
7	Determination of peroxide value and Anisidine value of fats.
8	Experiment to study the effect of heat on proteins.
9	Determination of Iso-electric point of casein
10	Experiments to study the gelling properties of starch
11	Experimental study of gluten formation using wheat flour
12	Experimental study on enzymatic Browning in foods
Total Contact Hours	
: 60	

Course Outcomes:

<input type="checkbox"/>	Students successfully completing this class will be able to: Recognize the important reactions in food chemistry and their consequences.
<input type="checkbox"/>	Be familiar with methods to measure these reactions.
<input type="checkbox"/>	Be capable of reporting the results in an appropriate format.

<input type="checkbox"/>	Be capable of designing and conducting an experiment to understand a simple food chemistry problem.
<input type="checkbox"/>	Able to understand the complex interactions between the different components of foods.

References:	
1.	Weaver, C.M, and J.R. Daniel. "The Food Chemistry Laboratory – A Manual for Experimental Foods, Dietetics & Food Scientists." 2nd Edition, CRC Press, 2005.

COs/ POs & PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23211.1	3	3	3	2	1	1	1	1	1	1	1	1	2	1	2
FT23211.2	3	3	3	2	1	1	1	1	1	1	1	1	2	1	2
FT23211.3	3	3	3	3	2	1	1	1	1	1	1	2	1	2	2
FT23211.4	3	3	2	3	2	1	1	1	1	1	1	2	1	1	1
FT23211.5	2	3	2	1	1	1	1	1	1	1	1	1	1	1	1
Average	2.8	3	2.6	2.5	1.5	1	1	1	1	1	1	1.5	1.4	1.3	2

Subject Code	Subject Name	Category	L	T	P	C
MA23311	TRANSFORMS AND APPLIED PARTIAL DIFFERENTIAL EQUATIONS	BS	3	1	0	4
Common to III sem. B.E. - AERO, MCT, R&A and B.Tech. – BT, FT and CHEM						

Objectives:
<ul style="list-style-type: none"> To express Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory. To show continuous function arising in wave and heat propagation, signals and systems using Fourier Transforms. To obtain solution of one dimensional wave equation with finite difference techniques. To solve one and two dimensional heat flow equations using finite difference methods and numerical techniques. To make use of Z-transform to illustrate discrete function arising in wave and heat propagation, signals and systems.

UNIT-I	FOURIER SERIES	12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic analysis.		
UNIT-II	FOURIER TRANSFORMS	12
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application to boundary value problems.		
UNIT-III	WAVE EQUATION	12
Solution of one-dimensional wave equation - Finite difference techniques for the solution for PDE- One Dimensional Wave Equation by Explicit method		
UNIT-IV	HEAT EQUATION	12
One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges)- Numerical computation: One dimensional heat flow equation by implicit and explicit methods		
UNIT-V	Z-TRANSFORMS	12
Z- transforms - Elementary properties – Inverse Z - transform (using residues) - Formation of difference		

equations – Solution of difference equations using Z- transform.

Total Contact Hours: 60

Course Outcomes:

On completion of the course, students will be able to

- Demonstrate Fourier series to study the behaviour of periodic functions and their applications in engineering problems such as system communications, digital signal processing and field theory.
- Apply the shifting theorems, Fourier integral theorems, Inverse Fourier sine and cosine transforms appropriate problems in engineering and technology.
- Evaluate solution of one-dimensional wave equation arising in various field of engineering using finite difference techniques.
- Apply the numerical techniques of differentiation to solution of heat flow equations arising in various branches of engineering.
- Use Z-transform to illustrate discrete function arising in wave and heat propagation, signals and systems.

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Online MATLAB session can be implemented

SUGGESTED EVALUATION METHODS

- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Books:

1	Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015.
2	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2012.
3	Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
4	Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
5	P. Kandasamy, K. Gunavathy, Thilagavathy., "Engineering Mathematics Transforms and Partial Differential Equations", S.Chand & Company, 2002.

Reference Books / Web links:

1	N. Subramaniam, K. S. Ramaswami., "Transforms and Partial Differential Equations", Pearson Education, 2018.
2	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3	Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
4	Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), 7th Edition, New Delhi, 2009.
5	Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7 th Edition, New Delhi, 2012. https://drspmths.files.wordpress.com/2020/01/advanced-engineering-mathematics-peter-v.-o-neil.pdf

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23311.1	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23311.2	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
MA23311.3	3	3	3	3	2	-	-	-	-	-	-	2	1	2	2
MA23311.4	3	3	2	3	2	-	-	-	-	-	-	2	1	-	1
MA23311.5	2	3	2	-	-	-	-	-	-	-	-	-	1	1	-
Average	2.8	3	2.6	2.5	1.5	-	-	-	-	-	-	1.5	1.4	1.3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23301	FOOD MICROBIOLOGY	PC	3	0	0	3

Course Objectives:

•	To learn basic microbial structure and growth requirements
•	To understand the role of microbes in spoilage and pathogenesis.
•	To understand the beneficial role of microbes.
•	To gain knowledge on the methods of isolating and characterizing microbes associated with foods
•	To understand the methods used to detect pathogens in foods.

UNIT-I	MICROBES - STRUCTURE AND MULTIPLICATION	9
<p>Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy ;Structural organization and multiplication of bacteria, viruses, algae and fungi; Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.</p>		
UNIT-II	ROLE OF MICROBES IN SPOILAGE OF FOODS AND THEIR CONTROL	9
<p>Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products. Physical methods- Low and high temperatures, drying, radiation and high pressure; Tolerance of microbes to chemical and physical methods in various foods. Control of microorganisms: Physical agents, Chemical agents and their mode of action. Role of antibiotics.</p>		
UNIT-III	BENEFICIAL MICROBES IN FOODS	9
<p>Microbes of importance in food fermentations, – Homo & hetero-fermentative bacteria, yeasts fungi; Lactic acid bacteria fermentation and starter cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, Fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idly, soy products, fermented vegetables and meats.</p>		
UNIT-IV	MICROBIAL AGENTS OF FOOD BORNE ILLNESS	9
<p>Food borne infections and food poisoning, Microbial toxins - types, Gram Negative and Gram positive food borne pathogens – Salmonella, Coliforms, E. coli, Shigella, Vibrio cholera, Staphylococcus aureus; Clostridium botulinum; Listeria monocytogenes Toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.</p>		
UNIT-V	MICROBIAL EXAMINATION OF FOODS	9
<p>Detection & Enumeration of microbes in foods, Microbial Load assessment: Standard Plate Count, Most Probable Number calculations, Direct Microscopic Count, Dye Reduction test, ATP measurement. Immunological methods: PCR, Fluorescent Antibody, ELISA.</p>		
Total Contact Hours		45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Understand the basics of microbiology
<input type="checkbox"/>	Identify the various microbes associated with food spoilage and pathogenesis
<input type="checkbox"/>	Understand and identify the role of these microbes in food preservation.
<input type="checkbox"/>	Comprehend the various techniques for isolation and characterization of microbes.
<input type="checkbox"/>	Apply the learnt techniques to detect the pathogens associated with the foods.

Text Books:	
1	Vijaya Ramesh “Food Microbiology”. MJP Publishers, 2007
2	Jay, J.M. “Modern Food Microbiology”. 4th Edition. CBS Publishers, 2003
3	Adams, M.R and M.O. Moss. “Food Microbiology”. New Age International, 2002

Reference Books / Web links:	
1	Pawsey, R.K. “Case Studies in Food Microbiology for Food Safety and Quality”. The Royal Society of Chemistry, 2001.
2	Forsythe, S.J. “The Microbiology of Safe Food”. Blackwell Science, 2000.
3	Harrigan, W.F. “Laboratory Methods in Food Microbiology” 3rd Edition, Academic press, 1998

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23301.1	3	2	2	2	3	3	3	3	2	-	3	3	3	3	3
FT23301.2	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3
FT23301.3	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3
FT23301.4	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3
FT23301.5	3	3	3	3	3	3	2	-	3	-	3	3	3	3	3
Average	3	2.6	2.6	2.8	3	3	2	2	2.8	-	3	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23302	BIOCHEMISTRY AND NUTRITION	PC	3	0	0	3

Objectives:	
<input type="checkbox"/>	To develop knowledge on basics of nutrition for Diet planning based on RDA
<input type="checkbox"/>	To understand functional role of carbohydrates and its health effects.
<input type="checkbox"/>	To gain knowledge on protein quality assessment and functional role of lipids
<input type="checkbox"/>	To understand the physiological role of vitamins and minerals
<input type="checkbox"/>	To familiarize with non-communicable diseases associated with lifestyle.

UNIT-I	AN OVERVIEW OF NUTRITION	9
Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis; Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.		
UNIT-II	CARBOHYDRATES	9
Carbohydrates definition, classification and functions: mono and disaccharides, oligosaccharides, Polysaccharides; Digestion and absorption of carbohydrates (mono, di and polysaccharides), physiological functions and metabolism (Glycolysis, Gluconeogenesis, Glycogenolysis), Dietary fibres: Digestion, absorption and metabolism; Glycemic and Non-glycemic carbohydrates, Blood glucose regulation, Recommendations of sugar intake for health, Recommended Dietary Allowances.		
UNIT-III	PROTEINS & LIPIDS	9
Protein: Chemical Composition, Properties, Classification– nutritional classification of proteins and amino acids, Physiological function, Digestion and Absorption, Quality of proteins, scoring systems, Complementary value of proteins, Requirements, Recommended Dietary Allowances. Lipid: Chemical composition, Classifications, Fats in body, Fats in food, Physiological functions, Digestion and Absorption, Intestinal resynthesis of triglycerides, Types of fatty acids: Role and nutritional significance (SFA, MUFA, PUFA), Recommended Dietary Allowances.		
UNIT-IV	VITAMINS & MINERALS	9
Water & Fat Soluble Vitamins- Sources, Functions, absorption and metabolism, Factors affecting absorption of vitamins, Deficiency, Recommended Dietary Allowances. Macro minerals (Calcium, Phosphorus)- Functions, Absorption and metabolism, Factors affecting bioavailability, Sources, Deficiency, Overdose toxicity, Recommended Dietary Allowances. Micro minerals (Iron, Iodine) - Functions, Absorption and metabolism, Factors affecting bioavailability, Sources, Deficiency, Overdose toxicity, Recommended Dietary Allowances.		
UNIT-V	ENERGY METABOLISM	9
Energy Balance: Definition, units, Determination of energy values of foods, Determination of energy requirements, Basal Metabolic Rate, Measurement of basal metabolism, Resting Energy metabolism, Non-caloric methods, Thermic effect of foods, Factors affecting thermic effect of foods, Recommended Dietary Allowances for energy. Health implications of high energy foods: Obesity, BMI calculations, Weight Control; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.		
Total Contact Hours		45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Apply knowledge of nutrition in diet planning.
<input type="checkbox"/>	Provide the dietary recommendations for NCD's
<input type="checkbox"/>	Asses the quality of proteins and lipids from various sources.
<input type="checkbox"/>	Comprehend the physiological and toxicological effects of vitamins and minerals.
<input type="checkbox"/>	Apply the learnt techniques to assess the lifestyle related NCD's.

Text Books:	
1	B. Srilakshmi. "Nutrition Science". II Edition, New Age International (P) Ltd., 2002.
2	Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
3	Gibney, Michael J., et al., "Introduction to Human Nutrition". 2 nd Edition. Blackwell,2009.
4	Gropper, Sareen S. and Jack L. Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

Reference Books / Web links:	
1	Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2	Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3	Belitz,H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, SpringerVerlag, 2004.
4	Walstra, P. "Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5	Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
FT23302.1	3	2	2	2	3	3	3	3	2	-	3	3	3	3	3
FT23302.2	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3
FT23302.3	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3
FT23302.4	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3
FT23302.5	3	3	3	3	3	3	2	-	3	-	3	3	3	3	3
Average	3	2.6	2.6	2.8	3	3	2	2	2.8	-	3	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23303	THERMODYNAMICS FOR FOOD TECHNOLOGISTS	ES	3	0	0	3

Objectives:	
•	To identify and use units and notations in thermodynamics
•	To state and illustrate first and second laws of thermodynamics
•	To understand the concepts of entropy, enthalpy, reversibility and irreversibility
•	To get conversant with properties of steam, thermodynamic vapour cycles, and performance estimation
•	To get conversant with psychrometric chart and psychrometric processes.

UNIT-I	Thermodynamic Law and Properties of Fluids	9
Zeroth law of thermodynamics, First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non-ideal behaviour; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.		
UNIT-II	Thermodynamic Properties Of Solutions	9
Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; Henry's Law and dilute solutions concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.		
UNIT-III	Phase equilibria	9
Criteria for phase equilibria; VLE calculations for binary and multi component systems; Duhem's Theorem, Constant pressure equilibria and Constant temperature equilibria		
UNIT-IV	Chemical Reaction Equilibria	9
Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.		
UNIT-V	Thermodynamic Description for Microbial Growth and Product Formation	9
Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the		

Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.

Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- Apply various thermodynamic laws to the real system
- Calculate the entropy changes in the system
- Analyse basic thermodynamic cycles
- Demonstrate the interrelationship between thermodynamic cycles
- Solve problems using the properties and relationships of thermodynamic fluids

Text Books:

- 1 Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VI Edition. Tata McGraw-Hill, 2003.
- 2 Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
- 3 Christiana D. Smolke, "The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

Reference Books / Web links:

- 1 Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley, 1989.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23303.1	3	2	2	2	2	3	3	-	-	-	3	3	3	-	3
FT23303.2	3	3	2	2	2	2	2	-	-	-	-	3	3	-	-
FT23303.3	3	3	3	2	3	2	2	-	-	-	3	3	3	-	3
FT23303.4	3	3	2	2	3	2	2	-	-	-	3	3	3	-	3
FT23303.5	3	3	3	3	3	3	3	-	-	-	3	3	3	-	3
Average	3	2.8	2.4	2.2	2.6	2.4	2.4	-	-	-	2.4	3	3	-	2.4

Subject Code	Subject Name	Category	L	T	P	C
FT23304	FOOD PROCESS CALCULATIONS	ES	3	0	0	3

Objectives:

- To understand the basic units in food processing.
- To perform basic humidity calculations.
- To perform material balance for process operations.
- To make energy balance in food technology.
- To understand the heat content and enthalpy in food processing.

UNIT-I UNITS AND DIMENSIONS

9

Units and Dimensions: Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws – Gas constant - calculations of pressure, volume and temperature using ideal gas law. Pressure measuring devices in food industry.

UNIT-II	HUMIDITY CALCULATIONS	9
Fundamental food process Calculations and Humidity: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying of foods - Humidity chart, dew point. Applications of humidifiers and dehumidifiers in food industry.		
UNIT-III	STOICHIOMETRY AND MATERIAL BALANCE	9
Basic Principles of Stoichiometry - Importance of material balance and energy balance in a food Industry- Dimensions, Units, conversion factors and their use –Data sources. Material Balance: Stoichiometric principles, Application of material balance in food operations like distillation, evaporation, crystallization, drying, extraction, Leaching.		
UNIT-IV	ENERGY BALANCE	9
Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats for food products.		
UNIT-V	ENTHALPY	9
Enthalpy Changes: Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

<input type="checkbox"/>	Understand the basic units in food processing.
<input type="checkbox"/>	Perform basic humidity calculations.
<input type="checkbox"/>	Perform material balance for process operations.
<input type="checkbox"/>	Make energy balance in food technology.
<input type="checkbox"/>	Understand the heat content and enthalpy in food processing.

Reference Books / Web links:

- | | |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Venkataramani, V. and Anantharaman, N., —Process Calculations, Prentice Hall of India, New Delhi, 2003.
Himmelblau, D.M., —Basic Principles and Calculations in Chemical Engineering, Sixth |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Text Books:

- | | |
|---|--------------------------------------------------------------------------------------------------------------|
| 1 | Bhatt, B.L and Vora, S.M., —Stoichiometry, Third Edition, McGraw-Hill, New York, 1996. |
| 2 | Gavhane, K.A —Introduction to Process Calculations (Stoichiometry) NiraliPrakashan Publications, Pune, 2006. |

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23304.1	2	3	3	3	3	-	-	2	1	-	-	2	2	3	2
FT23304.2	2	3	3	3	3	-	-	2	1	-	1	2	3	3	2
FT23304.3	2	2	1	2	1	1	2	1	-	2	-	2	3	3	2
FT23304.4	3	3	2	3	2	-	-	-	2	-	-	2	2	3	2
FT23304.5	3	3	2	2	3	-	2	-	2	-	-	2	2	3	2
Average	2.4	2.8	2.2	2.4	2.4	0.2	0.8	1	1.2	0.4	0.2	2	2.4	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23305	FOOD ADDITIVES	PC	3	0	0	3
Objectives:						
<input type="checkbox"/>	To learn the Indian laws and regulations pertaining to food additives.					
<input type="checkbox"/>	To familiarize with the safety assessment of food additives					
<input type="checkbox"/>	To gain knowledge on permitted food additives and its functional role.					
<input type="checkbox"/>	To study the effects of food additives on food matrix.					
<input type="checkbox"/>	To understand the role of natural ingredients as food additives.					

UNIT-I	ADDITIVES AND FOOD SAFETY	9
Food additives: definition, role, classification based on their role, risks, and benefits. INS numbering system. Legal and regulatory: general standards for food additives, FSSAI, CODEX and GMP to maintain the safety requirements of food additives. Food additive intake assessment methods, the role of JECFA in the safety assessment of food additives, ADI Calculation and procedures to fix ADI, permitted levels of food additives.		
UNIT-II	PRESERVATIVES	9
Preservatives: definition, types, mode of action, factors affecting their performance, active forms of preservatives, necessity in food and levels of usage, permitted preservatives, and their food applications. Acidity Regulators: definition, chemical structure, role and importance, levels of usage, food applications and permitted acidity regulators. Antioxidants: definition, natural and artificial antioxidant and their chemical structure, watersoluble and oil soluble antioxidants and their chemical structure, mechanism of action, permitted antioxidants permitted levels, and food application.		
UNIT-III	EMULSIFIERS, STABILISERS AND THICKENERS	9
Emulsifier and Stabiliser: Introduction, emulsion and its types, surface tension, hydrophilic and lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, role of different stabilisers and other substances in emulsion stability, emulsion formation process and equipment, permitted level of emulsifiers and stabilisers used in the food industry, and its food applications. Thickeners: definition, chemical structure, role in food processing, product end characteristics, list of permitted thickeners and food applications		
UNIT-IV	COLOR, FLAVORS, FLAVOR ENHANCERS AND SWEETENERS	9

Color: natural and synthetic food colors, their chemical structure, permitted list of colors, usage levels, and food application. Flavoring agents: natural and synthetic flavorings, flavors from vegetables, cocoa, chocolate, coffee, vanilla beans and spices; usage level and food application; Essential oils, Oleoresins and their extraction methods; Flavor enhancers: chemical properties, functions in foods, biochemical properties & toxicology. Sweeteners: artificial and natural, structure, taste profile, permitted usage levels, and food applications.

UNIT-V	OTHER FOOD ADDITIVES & FOOD INGREDIENTS	9
Definition, role, mode of action, and food application of anticaking agents, antifoaming agents, glazing agents, bulking agents, humectants, firming agents, softening agents, crystal modifiers, flour improvers, flour treatment agents, dough conditioners, and enzymes. Proteins, starches and lipids as functional ingredients, functional properties and their applications in foods.		
		Total Contact Hours: 45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Comprehend laws related to food additives.
<input type="checkbox"/>	Assess the safety level of food additives.
<input type="checkbox"/>	Utilize the additives for novel product development.
<input type="checkbox"/>	Analyse the effect of food additives on food matrix.
<input type="checkbox"/>	Utilize the proteins and sugars as food additives.

Text Books:	
1	Branen, A. L. "Food Additives" 2nd Edition, CRC press, 2002
2	Mahindru, S. N. "Food Additives- Characteristics Detection and Estimation", TATA McGraw-Hill, 2000
3	Titus A. M. Msagati. "The Chemistry of Food Additives and Preservatives", Wiley-Blackwell, 2013

Reference Books / Web links:	
1	Thomas. E. Furia, "CRC Handbook of food additives" 2 nd edition, Volume 1, CRC press, 1978
2	Thomas. E. Furia, "CRC Handbook of food additives" 2 nd edition, Volume 2, CRC press, 1980
3	P. Michael Davidson, John N. Sofos, and A. L. Branen, "Antimicrobials in food", 3 rd edition, CRC press 2005
4	Peter A Williams and Glyn O Philips, "Gums and stabilizers for the Food Industry", RSC, 2006.
5	Madhavi, D. L., "Food antioxidants", CRC Press, 1996
6	Helen Mitchell, "Sweeteners and sugar alternatives in food technology", Blackwell, 2006
7	Carmen Socaciu, "Food Colorants", CRC Press, 2008
8	Gary Reineccius, "Flavor chemistry and technology", 2 nd edition, CRC Press, 2005

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23305.1	3	3	3	3	3	3	-	3	3	-	2	3	3	3	3
FT23305.2	3	3	3	3	3	3	-	2	3	-	2	3	3	3	3
FT23305.3	3	2	3	3	3	2	-	2	3	-	2	3	3	3	3
FT23305.4	3	3	2	3	3	2	-	3	3	-	2	3	3	3	3
FT23305.5	3	3	3	3	3	2	-	2	3	-	2	3	3	3	3
Average	3	3	3	3	3	2.4	-	2.8	3	-	2	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23311	FOOD MICROBIOLOGY LABORATORY	PC	0	0	4	2

Course Objectives:	
<input type="checkbox"/>	To learn basic microbiological techniques.
<input type="checkbox"/>	To learn pure culture isolation techniques.
<input type="checkbox"/>	To learn culture preservation techniques.
<input type="checkbox"/>	To understand the principles of microscopy and its operation.
<input type="checkbox"/>	To isolate and enumerate the microbes associated with the foods.

List of Experiments	
1	Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media-Types and Use; Preparation of Nutrient broth and agar.
2	Preparation of different culture media and microbial isolation using serial dilution technique
3	Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques - Simple, Differential- Gram’s Staining
4	Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC
5	Microbiological quality of water (MPN)
6	Microbiological quality of milk
7	Enumeration of Lactic acid bacteria from fermented foods
8	Enumeration of Yeast & Mold from fruits
9	Enumeration of spores from pepper
10	Inhibitory effect of spices on microbial load in fish & flesh foods
11	Enumeration & Isolation of E. coli from processed meat/chicken
12	Thermal destruction of microbes: TDT & TDP
13	Enumeration & Isolation of Staphylococci from ready to eat street foods
14	Effect of cleaning and disinfection on microbial load
Total Contact Hours : 60	

Course Outcomes:

The students will be able to	
<input type="checkbox"/>	Prepare the microbial growth media and sterilize it.
<input type="checkbox"/>	Isolate pure culture and preserve them.
<input type="checkbox"/>	Operate microscope and use it for detection of microbes.
<input type="checkbox"/>	Isolate and enumerate spoilage organisms.
<input type="checkbox"/>	Detect the presence of food borne pathogens.

References:	
1.	Harrigan, W.F. "Laboratory Methods in Food Microbiology" Academic Press, 2011

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required		
S.No.	Name of the equipment	Quantity
1.	Laminar Air Flow Chamber	2
2.	Hot Air Oven	1
3.	Autoclave	2
4.	Microbiological Incubator	2
5.	BOD Low Temperature Incubator	1
6.	Refrigerator	1
7.	Deep Freezer (-18°C)	1
8.	Analytical Weighing balance	5
9.	Homogenizer	1
10.	pH Meter	3
11.	Hot Plate	1
12.	Shaking water bath	1
13.	Quebec Colony counter	3
14.	Magnetic stirrer	2
15.	Vortex mixer	2
16.	Light Microscope	5
17.	Anaerobic Incubator	1

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23311.1	3	3	2	2	3	3	3	3	2	-	3	3	3	3	3
FT23311.2	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3
FT23311.3	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3
FT23311.4	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3
FT23311.5	3	3	3	3	3	3	2	-	3	-	3	3	3	3	3
Average	3	2.6	2.6	2.8	3	3	2	2	2.8	-	3	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23312	BIOCHEMISTRY AND NUTRITION LABORATORY	PC	0	0	4	2

Objectives:	
<input type="checkbox"/>	To learn basic measurement in food biochemistry.
<input type="checkbox"/>	To learn basic chemical analysis
<input type="checkbox"/>	To understand basic chemistry involved in food testing.
<input type="checkbox"/>	To gain knowledge in anthropometry.
<input type="checkbox"/>	To understand the different clinical requirements.

List of Experiments	
1	Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
2	Preparation of buffer –titration of a weak acid and a weak base.
3	Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
4	Qualitative method for amino acid estimation using ninhydrin.
5	Estimation of alpha amino nitrogen by Sorenson's formal titration.
6	Protein estimation by Biuret method.
7	Protein estimation by Lowry method.
8	Extraction of lipids and analysis by TLC.
9	Nutritional anthropometry - Standards for reference – WHO, Body Mass Index and reference value
10	Techniques of measuring height, weight, head, chest and arm circumference, waist to hip ratio, skin-fold thickness, Calculation of percent Body fat using skin folds calipers.
11	Calculation of the calories from nutrient composition of foods
12	Comparison of Food Composition data bases
Total Contact Hours	
: 60	

Course Outcomes:	
The students will be able to	
<input type="checkbox"/>	Learn basic measurement in food processing.
<input type="checkbox"/>	Learn the basic chemical analysis
<input type="checkbox"/>	Apply the learnt basic chemistry involved in food testing.
<input type="checkbox"/>	Assess the nutritional anthropometry
<input type="checkbox"/>	Assess the clinical status of the individuals.

Text Books:	
1.	R.C. Gupta and S. Bhargavan. "Practical Biochemistry", CBS Publishers, 1992

2.	David T. Phummer. "Introduction to Practical Biochemistry", II Edition, Tata McGraw-Hill, 1988
3.	Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.

References:

1.	Thomas M. Devlin. "Textbook of Biochemistry with clinical correlations" VII Edition, Wiley Liss Publishers, 2010
2.	Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required

S.No.	Name of the equipment	Quantity
1.	Colorimeter	1
2.	UV- Visible Spectrophotometer	1
3.	Weighing Scale	1
4.	Stadiometer	1
5.	Skin Fold Calipers	5
6.	Measuring Tapes	5
7.	Analytical Weighing Balance	4

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23312.1	3	3	2	2	3	3	3	3	2	-	3	3	3	3	3
FT23312.2	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3
FT23312.3	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3
FT23312.4	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3
FT23312.5	3	3	3	3	3	3	2	-	3	-	3	3	3	3	3
Average	3	2.6	2.6	2.8	3	3	2	2	2.8	-	3	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
MA23431	PROBABILITY, STATISTICS AND RELIABILITY	BS	3	1	0	4
Common to IV sem. B.Tech. - BT, FT and CHEM						

Objectives:

- To introduce the basic concepts of probability, one dimensional random variables.
- To solve the problems those are faced in testing of a hypothesis with reference to the errors in decision making.
- To analyse the different mathematical models with the help of statistical designs and appropriate data and made valuable conclusions by proper evaluation.
- To explain the concepts of quality control in industry and to apply various tools to examine the quality of a process and product.
- To analyse statistical experiments leading to reliability modelling and to identify reliability testing components for assessment of reliability in engineering design.

UNIT-I	PROBABILITY	9
One dimensional Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Uniform and Normal distributions, Two dimensional Discrete and continuous random variables – Conditional and Marginal densities.		
UNIT-II	STATISTICAL TESTING	9
Maximal Likelihood estimation – Parameters of Binomial and Poisson distribution - Tests of significance –		

Z test: Single mean, difference of means- Chi square - F test.		
UNIT-III	ANOVA	9
Design of Experiments - Completely randomized design – Randomized block design –Latin square design.		
UNIT-IV	STATISTICAL QUALITY CONTROL	9
Control charts for measurements (\bar{X} and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling		
UNIT-V	RELIABILITY	9
Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve - Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions - Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model- Distribution functions and reliability analysis.		
Total Contact Hours: 45		

S.No	List of Experiment (using R Software)	Total Contact Hours: 30
1	Basic Functions in R and plotting	
2	Mathematical functions in R – Integration	
3	Control flow – Loops in R	
4	Probability Distributions using R- PDF, CDF for Binomial, Poisson, Exponential, Uniform and Normal Distributions.	
5	Testing of Hypothesis – Z testing	
6	Testing of Hypothesis – F and chi square testing	
7	ANOVA – one way and two way	
8	Statistical quality control – p, np , c, \bar{X} charts	
9	Reliability – MTTF, MTBF	
10	Reading , Writing data in R and working with inbuilt data sets in R	

Course Outcomes:
on completion of the course, the students will be able to
<ul style="list-style-type: none"> ● Have the critical thinking in the theory of probability and its applications in real life problems. ● Apply the different testing tools like t-test, F-test, chi-square test to analyse the relevant real life problems. ● Analyse the different mathematical models with the help of statistical designs and appropriate data and made valuable conclusions by proper evaluation. ● Use various tools to examine the quality of a process and product in engineering and technology. ● Illustrate the basic concepts and techniques of modern reliability engineering tools.

SUGGESTED ACTIVITIES
<ul style="list-style-type: none"> ● Problem solving sessions ● Smart Class room sessions

SUGGESTED EVALUATION METHODS
<ul style="list-style-type: none"> ● Problem solving in Tutorial sessions ● Assignment problems ● Quizzes and class test ● Discussion in classroom

Text Book(s):
1. Veerarajan T, 'Probability, Statistics and Random Processes with Queuing Theory and Queuing Networks'.
2. McGraw Hill, 2016. 2 Johnson R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
4. Kandasamy P., Thilagavathi and K. Gunavathi., "Statistics and Numerical Methods", S. Chand & Company Ltd. (2010).

Reference Books(s) / Web links:	
1.	Jhon wiley& Sons .Erwin Kreyszig., "Advanced Engineering Mathematics", Pearson Education, Asia, 7th Edition, 2007.
2.	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
3.	Gupta. R.C, "Statistical Quality control", Khanna Publishers, 1997
4.	Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23431.1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA23431.2	2	2	1	1	-	-	-	-	-	-	-	1	-	1	-
MA23431.3	2	2	-	2	-	-	-	-	-	-	-	1	-	1	-
MA23431.4	2	2	2	2	-	-	-	-	-	-	-	1	-	1	-
MA23431.5	2	2	2	1	-	-	-	-	-	-	-	1	-	1	-
Average	2	2	1.6	1.5	-	-	-	-	-	-	-	1	-	1	-

Subject Code	Subject Name	Category	L	T	P	C
FT23401	UNIT OPERATIONS IN FOOD INDUSTRIES	PC	3	0	0	3

Objectives:	
<input type="checkbox"/>	To learn basic principles of evaporation.
<input type="checkbox"/>	To understand the mechanism of mechanical separators.
<input type="checkbox"/>	To gain knowledge on size reduction operations.
<input type="checkbox"/>	To familiarize with the concepts of mixing.
<input type="checkbox"/>	To understand the extraction and crystallization process.

UNIT-I	EVAPORATION	9
Unit operations in food processing – evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator		
UNIT-II	MECHANICAL SEPARATION	9
Filtration – definition and types –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter medium and cake resistance-filtration equipment – rotary vacuum filter – filter press. Sedimentation – Stoke’s law, gravitational sedimentation of particles in a liquid –sedimentation of particles in a gas, settling under combined forces -centrifugal separations – rate of separations – liquid separation – centrifuge equipment.		
UNIT-III	SIZE REDUCTION	9
Size reduction – grinding and cutting – principles of comminuting – sieving and particle size distribution in comminuted products-energy and power requirements in comminuting — Rittinger’s, Bond’s and Kick’s laws - New surface formed by grinding - size reduction equipment’s – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.		
UNIT-IV	MIXING	9
Introduction, Characteristics of mixtures, Measurement of mixing - sample size, sample composition, Particle mixing and Liquid Mixing - mixing index. Mixing of different quantities. Rate of Mixing and Energy Input in Mixing. Mixing equipment’s - Liquid Mixers, Powder and Particle Mixers, Dough and Paste Mixers		
UNIT-V	EXTRACTION AND CRYSTALLIZATION	9

Extraction – rate of extraction – Single and multistage extraction operation-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers. Crystallization– equilibrium -solubility and equilibrium diagram – rate of crystal growth – equilibrium crystallization-crystallization equipment – classification – construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers.

Total Contact Hours

: 45

Course Outcomes:

On completion of course students will be able to

<input type="checkbox"/>	Analyse the principle and operation of different types of evaporators
<input type="checkbox"/>	Assess the various mechanical separation operations in food processing
<input type="checkbox"/>	Select the appropriate size reduction equipment for different types of food materials
<input type="checkbox"/>	Examine the characteristics of the mixtures and select appropriate mixing equipment
<input type="checkbox"/>	Interpret the extraction and crystallization techniques to convert raw materials into value added products

Text Books:

1	Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K
3	Geankoplis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.
4	McCabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, 7th Edition, McGraw – Hill Int., 2001,

Reference Books / Web links:

1	Richardson, J.E. et al., “Coulson & Richardson’s Chemical Engineering” Vol.2 (Particle Technology & Separation Processes”) 5th Edition, Butterworth – Heinemann / Elsevier, 2003.
2	Coulson, J.M and J.F. Richardson, “Chemical Engineering”. Volume I to V. The Pergamon Press. New York, 1999
3	McCabe, W.L., J.C. Smith and P. Harriot, “Unit Operations of Chemical Engineering”. McGraw-Hill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
4	Sahay, K. M. and K.K. Singh, “Unit operation of Agricultural Processing”, Vikas Publishing House Pvt. Ltd., New Delhi, 2004

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23401.1	3	3	3	3	3	1	1	1	1	-	-	3	3	3	3
FT23401.2	3	3	3	2	3	1	1	1	1	-	-	3	3	3	3
FT23401.3	3	3	2	3	3	1	1	1	1	-	-	3	3	3	3
FT23401.4	3	3	3	3	3	1	1	1	1	-	-	3	2	3	3
FT23401.5	3	3	3	2	3	1	1	1	2	-	-	3	2	3	3
Average	3	3	2.8	2.6	3	1	1	1	1.2	-	-	3	2.6	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23402	FOOD PROCESSING AND PRESERVATION TECHNOLOGY	PC	3	0	0	3

Objectives:

<input type="checkbox"/>	Provide information about the scope and importance of food preservation
<input type="checkbox"/>	Educate the different types of food processing and preservation
<input type="checkbox"/>	Understand the principles of technology in processing of food

<input type="checkbox"/>	Understand the applications of technology in processing of food
<input type="checkbox"/>	Gain knowledge in the area of novel food processing techniques and packaging.

UNIT-I	HIGH TEMPERATURE PROCESSING	9
Introduction, classification of Thermal Processes; Blanching, Pasteurization, Sterilization, commercial sterilization, Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data, Thermal process Calculations Commercial heat preservation methods: Canning; Types and classification of foods used for canning; spoilage of canned and bottled foods, storage of canned foods; Influence of canning on the quality of food, Retort pouch processing.		
UNIT-II	PRESERVATION BY LOW TEMPERATURE STORAGE	9
Refrigeration: Definition, objectives, Refrigerants used in food industry, Effect on enzymes, Microbes; Response of microbes at low temperature, Microbe inactivation mechanism and Food system, Freezing: Freezing curve for Homogenous and Non-homogenous food system, Freezing point depression, Freezing rate, Effect of freezing: Physical and chemical changes in Foods, Enzyme activity, Microbe inactivation and Food quality: sensory quality, nutritional aspects.		
UNIT-III	PRESERVATION BY CONTROL OF WATER ACTIVITY	9
Dehydration: Theory of Drying, Factors influencing drying rate, traditional and modern methods of drying, types of driers, Effect of drying on Foods, pigments and enzymes. Hybrid Drying techniques-Osmotic dehydration: Concept of Osmotic dehydration, Factors influencing osmosis, and Preservative effects on foods. Food Concentration: Evaporation and membrane technology- Intermediate moisture food concepts.		
UNIT-IV	NON THERMAL METHODS OF FOOD PROCESSING	9
Non-thermal methods: Chemical Preservatives, Salting and Curing, Smoking, Pickling, Fermentation, Food Irradiation technology, Ultrasound technology, High pressure processing, Hurdle technology.		
UNIT-V	NOVEL PROCESSING METHODS & FOOD PACKAGING	9
Novel processing: Ohmic heating, Microwave, Radio frequency heating and Infra-red heating, Ozone processing, Dense phase carbon dioxide processing of fluid foods Pulsed electric field, and Pulsed X-Ray. Packaging: Definition, Significance, functions, basic packaging materials, and role of different packaging methods in food preservation.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Understand the principles of food processing and preservation.
<input type="checkbox"/>	Interpret the role of different methods of processing various foods.
<input type="checkbox"/>	Comprehend the impact of various preservation methods on the shelf life, quality physical and sensory characteristics of foods.
<input type="checkbox"/>	Select the recent methods pertaining to minimal processing of foods
<input type="checkbox"/>	Understand the novel methods of food processing and packaging

Text Books:

1	Khetarpaul, Neelam. "Food Processing and Preservation." Daya Publications, 2005
2	Singh, M.K. "Food Preservation" Discovery Publishing, 2007.
3	Fellows, P.J. "Food Processing Technology: Principles and Practice". 2 nd Edition, CRC/Wood Head Publishing, 2000.
4	Gopala Rao, Chandra. "Essentials of Food Process Engineering". B.S. Publications, 2006.

Reference Books / Web links:

1	Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.
2	Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3	Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.
4	P. J. Cullen, "Novel Thermal and Non-Thermal Technologies for Fluid Foods". Academic Press, 2012

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	P O 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23402.1	3	3	3	2	3	2	2	3	1	1	2	3	3	2	3
FT23402.2	3	2	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23402.3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23402.4	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23402.5	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
Average	3	2.8	3	2.8	3	2	2	1.8	1.8	1.8	2	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23403	FLUID MECHANICS IN FOOD PROCESSES	ES	3	0	0	3

Objectives:

<input type="checkbox"/>	Provide information about the mechanics of fluids through the properties of the fluids, behaviour of fluids.
<input type="checkbox"/>	Educate the dynamics of fluids.
<input type="checkbox"/>	Understand the applications of the conservation laws and flow measurement.
<input type="checkbox"/>	Gain knowledge in the area of flow through open channel flow (both laminar and turbulent)
<input type="checkbox"/>	Analyse the dimensions and application of pumps in the field of food technology

UNIT-I	PROPERTIES OF FLUIDS	9
Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity, equation of state – perfect gas - Viscosity – vapor pressure– compressibility, elasticity & surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gauges –calibration. Hydrostatic forces on surfaces – Total pressure and Centre of pressure -Horizontal- vertical		

and inclined plane surface. Archimedes principles – buoyancy, applications - fluid food - case studies			
UNIT-II	FLUID FLOW ANALYSIS	9	
Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational –circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube – path line– steak line – flow net – velocity potential – stream function. Principles of conservation of mass– energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion, applications - fluid food - case studies			
UNIT-III	FLOW MEASUREMENTS	9	
Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter & rota meter –pitot tube. Orifice – sharp edged orifice – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula –Major and minor losses in pipes. Valves, valve types and characteristics of valves, applications - fluid food- viscosity - case studies			
UNIT-IV	OPEN CHANNEL FLOW AND FLUID FLOW THROUGH BEDS	9	
Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific force - critical flow. Flow measurement in channels – notches rectangular triangular. Float method. Fluid flow through fixed and fluidized beds			
UNIT-V	DIMENSIONAL ANALYSIS & PUMPS	9	
Dimensional analysis – concept of geometric, kinematic and dynamic similarity. Important non-dimensional numbers – Reynolds, Froude, Euler, Mach and Weber. Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers – Priming–cavitation. Turbine and submersible pumps - Jet pump – Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump-Hydraulic ram, applications- fluid food - case studies.			
		Total Contact Hours	: 45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Understand the properties of fluids.
<input type="checkbox"/>	Apply the physical laws in addressing problems in hydraulics.
<input type="checkbox"/>	Interpret the flow measurements and transportation of fluids.
<input type="checkbox"/>	Analyse the fluid kinematics
<input type="checkbox"/>	Comprehend the types of dimension and pumps.

Reference Books / Web links:	
1	Bansal, R.K., “A text book of fluid mechanics and hydraulic machinery”, Laxmipublications (P) Ltd., New Delhi, 2002.
2	Grade, R.J., “Fluid mechanics through problems”. Wiley eastern Ltd., Madras,2002
3	Jain A. K. “Fluid Mechanics”. Khanna Publishers 2004.
4	JagadishLal, “Hydraulic machines”. Metropolitan book house, New Delhi, 2000

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23403.1	3	3	3	2	3	2	2	1	1	1	2	3	3	2	3
FT23403.2	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23403.3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23403.4	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23403.5	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
Average	3	3	3	2.8	3	2	2	1.8	1.8	1.8	2	3	3	3	3

Subject code	Subject Name	Category	L	T	P	C
FT23404	REFRIGERATION AND COLD CHAIN MANAGEMENT	PC	3	0	0	3

Objectives:

<input type="checkbox"/>	To learn the fundamental principles and methods of refrigeration
<input type="checkbox"/>	To study various refrigeration cycles and evaluate its performance
<input type="checkbox"/>	To study the different refrigerants with respect to properties, applications and environmental issues.
<input type="checkbox"/>	To highlight the use of predictive modelling as a tool in shelf life assessment
<input type="checkbox"/>	To understand the key aspects of food supply chains from a management and social perspective

UNIT-I	REFRIGERATION PRINCIPLES	9
Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - theoretical- deviation in practice- simple vapor compression cycle – T-S diagram – p-h chart - application of refrigeration		
UNIT-II	VAPOR COMPRESSION REFRIGERATION AND COMPONENTS	9
Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working.		
UNIT-III	REFRIGERANTS AND VAPOR ABSORPTION CYCLE	9
Refrigerants – properties – classification – comparison and advantages – chlorofluoro carbon (CFC)refrigerants - effect on environmental pollution - alternate refrigerants - vapour absorption cycle – - Electrolux refrigerator – construction and principles.		
UNIT-IV	STORAGE AND SHELF-LIFE OF FOOD PRODUCTS	9
Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Storage of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size, Insulation, entry –exit position, palletization, proper disk-space for air-circulation, automatic door – closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, floor heaters, vapor barriers.		

UNIT-V	COLD CHAIN MANAGEMENT	9
<p>Introduction to cold chain – Cold chain management for chilled / frozen food item, importance of shelf- life; just-in-time deliveries; Temperature limit in various countries- India, Europe, US, Australia; Chilling injury, cook-chilling systems; cold – shortening; Block Chain Management ; Temperature –time indicators (TTI); Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc.; Thaw indicators</p>		

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Illustrate the fundamental principles and applications of refrigeration system.
<input type="checkbox"/>	Obtain cooling capacity and coefficient of performance by conducting test on vapour compression system
<input type="checkbox"/>	Present the properties, applications and environmental issues of different refrigerants
<input type="checkbox"/>	Demonstrate the predictive modelling for shelf life assessment of foods
<input type="checkbox"/>	Identify challenges to the future of food retailing as well as challenges in international food supply chains

Text Books:	
1	Anand, M.L. “Refrigeration& Air-Conditioning”. Asian Books Pvt., Ltd., 2002.
2	Sun, Da-Wen. “Advances in Food Refrigeration”. Leatherhead Publishing, 2001.
2	Kennedy, Christopher J. “Managing Frozen Foods”. CRC / Wood head Publishing, 2000.
3	James, S.J. and C. James. “Meat Refrigeration”. CRC / Wood head Publishing, 2002.
4	Stringer, Mike and C. Dennis. “Chilled Foods: A Comprehensive Guide”. 2nd Edition, CRC/Wood head Publishing, 2002.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23404.1	3	2	2	2	2	3	3	-	-	-	3	3	3	-	3
FT23404.2	3	3	2	2	2	2	2	-	-	-	-	3	3	-	-
FT23404.3	3	3	3	2	3	2	2	-	-	-	3	3	3	-	3
FT23404.4	3	3	2	2	3	2	2	-	-	-	3	3	3	-	3
FT23404.5	3	3	3	3	3	3	3	-	-	-	3	3	3	-	3
Average	3	2.8	2.4	2.2	2.6	2.4	2.4	0	0	0	3	3	3	-	3

Subject Code	Subject Name	Category	L	T	P	C
FT23411	UNIT OPERATIONS IN FOOD INDUSTRIES LABORATORY	PC	0	0	4	2

Objectives:	
<input type="checkbox"/>	To learn basic flow measurement in food processing.
<input type="checkbox"/>	To learn to calculate the efficiencies of evaporator.
<input type="checkbox"/>	To understand basic operations of filters.
<input type="checkbox"/>	To gain knowledge in sieve analysis of foods.
<input type="checkbox"/>	To understand the different energy requirements.

List of Experiments	
1.	Solving problems on single and multiple effect evaporator
2.	Determination of bulk density, true density and porosity of grains
3.	Determination of coefficient of friction and angle of repose of grains.
4.	Flow measurement using Orifice meter
5.	Flow measurement using Venturimeter,
6.	Flow measurement using Rotameter
7.	Determination of particle size of granular foods by sieve analysis.
8.	Determination of energy requirement in size reduction using roll crusher
9.	Determination of particle size distribution using ball mill
10.	Determination of particle size distribution using hammer mill
11.	Determination of collection efficiency in cyclone separator.
12.	Determination of efficiency of liquid solid separation by filtration.
13.	Determination of separation efficiency of centrifugal separator.
14.	Visit to food processing industry
Total Contact Hours : 60	

Course Outcomes:	
The students will be able to	
<input type="checkbox"/>	Assess basic flow measurement in food processing.
<input type="checkbox"/>	Calculate the efficiencies of evaporator.
<input type="checkbox"/>	Understand basic operations of filters.
<input type="checkbox"/>	Perform the sieve analysis of foods.
<input type="checkbox"/>	Understand the different energy requirements

References:	
1.	Warren Lee McCabe. "Unit Operations of Chemical Engineering", McGraw-Hill, 1967

2.	Maria Margarida Cortez Vieira. "Experiments in Unit Operations and Processing of Foods", Springer, 2008
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LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required		
S.No.	Name of the equipment	Quantity
1.	Orificemeter	1
2.	Venturimeter	1
3.	Rotameter	1
4.	Packed column	1
5.	Centrifugal separator	1
6.	Steam distillation unit	1
7.	Fluidized bed column	1
8.	Rotary flash evaporator	1
9.	Cyclone separator	1
10.	Ball mill	1
11.	Hammer mill	1
12.	Burr mill	1
13.	Pin mill	1
14.	Sieve Shaker	1

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23411.1	3	3	3	2	3	2	2	3	1	1	3	3	3	2	3
FT23411.2	3	2	3	3	3	2	2	2	2	2	3	3	3	3	3
FT23411.3	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3
FT23411.4	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3
FT23411.5	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3
Average	3	2.8	3	2.8	3	2	2	1.8	1.8	1.8	3	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23412	FOOD PROCESSING AND PRESERVATION LABORATORY - I	PC	0	0	4	2

Objectives:	
<input type="checkbox"/>	Develop knowledge in basic area of food preservation and processing.
<input type="checkbox"/>	Acquire knowledge on different types of food processing and preservation
<input type="checkbox"/>	Understand the principles of technology in processing of foods.
<input type="checkbox"/>	Understand the applications of technology in processing of food
<input type="checkbox"/>	Gain knowledge in the area of novel food processing techniques and packaging.

List of Experiments	
1	Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
2	Refrigeration and Freezing of vegetables and fruits

3	Drying of vegetables and fruits with and without additives - Drying rate studies including, constant rate and falling rate periods and the effects of various factors on them
4	Osmotic drying of foods with salt and sugar.
5	Canning & bottling of vegetable and fruit products
6	Filtration and concentration of fruit juices
7	Production of extruded products.
8	Spray drying of juices/milk
9	Pasteurization of milk
10	Retort processing of foods
11	Determination of Water vapor transmission rate of different packaging materials
12	Determination of migration characteristics of packaging materials
13	Determination of tensile and burst strength of given packaging material
14	Visit to any Food processing industry
Total Contact Hours : 60	

Course Outcomes:

The students will be able to

<input type="checkbox"/>	Demonstrate food processing in terms of unit operations, both conceptually and in the pilot scale
<input type="checkbox"/>	Apply the mass and energy balances for food processing
<input type="checkbox"/>	Operate the food processing equipment's at the pilot plant scale
<input type="checkbox"/>	Analyze the effect of processing conditions on safety and quality of resulting food products.
<input type="checkbox"/>	Evaluate the properties of food packaging materials

References:

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

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required		
S.No.	Name of the equipment	Quantity
1.	Plate heat exchanger	1
2.	Refrigerator	2
3.	Deep freezer	1
4.	Tray dryer	1
5.	Hot air oven	5
6.	Refractometer	5
7.	Pilot scale Extruder	1
8.	Ultra Filtration unit	1
9.	Double seamer machine	1
10.	Canning and bottling unit	1

11.	Pilot Scale Pasteurizer	1
12.	Spray dryer	1
13.	Retort unit	1
14.	Thermometer	3
15.	Water vapour permeability tester	1
16.	Oxygen permeability tester	1
17.	Tensiometer	1
18.	Viscometer	1
19.	Desiccator	5
20.	Weighing balance	2
21.	Vegetable chopper	1

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23412.1	1	1	3	2	3	2	2	3	1	1	2	3	3	2	3
FT23412.2	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23412.3	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23412.4	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3
FT23412.5	2	2	3	3	3	2	2	2	2	2	2	3	3	3	3
Average	1.4	1.6	3	2.8	3	2	2	1.8	1.8	1.8	2	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
CS23422	PYTHON PROGRAMMING FOR MACHINE LEARNING	ES	0	0	4	2

Course Objectives:

This course is aimed at enabling the students to :

- Understand the relationship of the data collected for decision making.
- Know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected.
- Lay the foundation of machine learning and its practical applications and prepare students for real-time problem-solving in data science.
- Develop self-learning algorithms using training data to classify or predict the outcome of future datasets.
- Distinguish overtraining and techniques to avoid it such as cross-validation.

List of Experiments

1. NumPy Basics: Arrays and Vectorized Computation
2. Getting Started with pandas
3. Data Loading, Storage, and File Formats
4. Data Cleaning and Preparation
5. Data Wrangling: Join, Combine, and Reshape
6. Plotting and Visualization
7. Data Aggregation and Group Operations

8.	Time Series
9.	Supervised Learning
10.	Unsupervised Learning and Pre-processing
11.	Representing Data and Engineering Features
12.	Model Evaluation and Improvement
Contact Hours	
	60
Course Outcomes:	
On completion of the course, students will be able to:	
<input type="checkbox"/>	Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
<input type="checkbox"/>	Analyze and perform an evaluation of learning algorithms and model selection.
<input type="checkbox"/>	Compare the strengths and weaknesses of many popular machine learning approaches.
<input type="checkbox"/>	Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
<input type="checkbox"/>	Design and implement various machine learning algorithms in a range of real-world applications.
Text Books:	
1.	Wes McKinney, Python for Data Analysis - Data wrangling with Pandas, Numpy, and IPython, Second Edition, O'Reilly Media Inc, 2017.
2.	Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python - A Guide for Data Scientists, First Edition, O'Reilly Media Inc, 2016.
Reference Books:	
1.	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media Inc, 2019.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23422.1	2	2	2	2	1	-	-	-	1	2	-	1	3	3	3
CS23422.2	2	2	1	1	2	-	-	-	-	-	-	1	2	1	3
CS23422.3	2	3	2	1	2	-	-	-	1	1	-	1	2	3	2
CS23422.4	1	1	1	-	1	-	-	-	-	1	1	-	1	2	3
CS23422.5	3	3	2	3	3	-	-	-	2	1	-	1	2	3	3
Average	2	2	2	1	2	-	-	-	1	1	-	1	2	2	3

Subject Code	Subject Name	Category	L	T	P	C
GE23421	SOFT SKILLS-I	EEC	0	0	2	1
Objectives:						
<input type="checkbox"/>	To help the students break out of shyness.					
<input type="checkbox"/>	To build confidence					
<input type="checkbox"/>	To enhance English communication skills.					
<input type="checkbox"/>	To encourage students' creative thinking to help them frame their own opinions.					
Learning and Teaching Strategy:						
The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.						
Week	Activity Name	Description	Objective			
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program			
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.			
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.			
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.			
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box			
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to stand up in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.			
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate			
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify	The aim of the lesson is to provide an opportunity for the participants to learn about body			

		the various methods of being diplomatic and how do deal with misinformation.	language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question “Should students be required to wear uniforms at school?” might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people’s perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn’t Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn’t disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.
Total Contact Hours:30			
Course Outcomes: At the end of the course the student will be able to			
<input type="checkbox"/>	Be more confident		
<input type="checkbox"/>	Speak in front of a large audience		
<input type="checkbox"/>	Be better creative thinkers		
<input type="checkbox"/>	Be spontaneous		
<input type="checkbox"/>	Know the importance of communicating in English.		

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE23421.1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
GE23421.2	1	-	-	-	-	-	1	-	1	3	1	1	-	-	-
GE23421.3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
GE23421.4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
GE23421.5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Average	1	-	-	-	-	-	1	-	1	3	1	1	-	-	-

Subject Code	Subject Name	Category	L	T	P	C
FT23501	FOOD ANALYSIS	PC	3	0	0	3

Course Objectives:
<ul style="list-style-type: none"> To learn basic sampling methods for food analysis
<ul style="list-style-type: none"> To understand the techniques for analysis of lipids & proteins
<ul style="list-style-type: none"> To study the techniques for analysis of carbohydrates
<ul style="list-style-type: none"> To gain knowledge on spectroscopic & chromatographic techniques
<ul style="list-style-type: none"> To Explore the Sensory and Organoleptic Properties of Food

UNIT-I	SAMPLING METHODS FOR FOOD ANALYSIS	9
Introduction, Food Regulations and Standards - Sampling methods - Sample preparation and preservation; Statistical evaluation of analytical data - Official Methods of Food Analysis. Proximate analysis of Foods-Moisture in foods, Ash content of foods - determination by different methods; Titratable Acidity in foods, Rapid methods of microbial analysis		
UNIT-II	LIPIDS AND PROTEINS ANALYSIS	9
Determination of Total fat in foods by different methods; Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants. Determination of Proteins Concentration-Colorimetric methods, Spectrophotometric methods; Protein Characterization; Analysis of Protein quality; Protein Digestibility; Measurement of Functional properties of proteins- Protein hydration properties, Surface properties of protein, Protein gel properties.		
UNIT-III	CARBOHYDRATE ANALYSIS, REFRACTOMETRY AND POLARIMETRY	9
Carbohydrate analysis- Colorimetric methods, HPLC methods using refractive index detection; Starch-Enzymatic quantification and Determination of total amylose content; Cell wall Polysaccharides, Degree of Methylation and Acetylation of pectin. Refractometry- Basic Principles and Instrumentation. Polarimetry- Basic principles, Instrumentation and Applications-Determination of specific rotations of sugars; Estimation of simple sugars and disaccharides. Determination of dietary fibre and crude fibre		
UNIT-IV	SPECTROSCOPIC TECHNIQUES & CHROMATOGRAPHIC TECHNIQUES	9
Spectrophotometry: Basic Principles, Spectrophotometric analysis of food additives and food Components - Ultra violet spectroscopy – Theory, instrumentation - Single and Double beam, applications, IR Spectroscopy in online determination of components in foods; AAS and ICP-AES in mineral elements and toxic metals analysis; Fluorimeter and Tintometer analysis. Chromatography: Basic Principles, Types and applications in food analysis: Paper, Thin layer, Column, High Pressure Liquid Chromatography, Gas chromatography, HPTLC; Significance of MS detector in HPLC and GC, Ion Exchange Chromatography, Affinity chromatography, Size Exclusion Chromatography-Supercritical chromatography.		
UNIT-V	SENSORY EVALUATION TECHNIQUES	9
Introduction to quality attributes of food: Appearance, flavour, textural factors, Mechanism of taste perception, Taste measurement-Electronic Tongue; Olfaction: definition, Mechanism of odour perception, Odour measurement technique- e- nose; Colour: Perception of colour, Colour Measurement; Texture:, Texture perception, Texture measurement and recent advances in texture evaluation. Sensory Evaluation: Type of food panels, Characteristics of panel member, Layout of sensory evaluation laboratory, Paired comparison test, Duo trio test, Triangle test, Hedonic scale		
		Total Contact Hours
		45

Course Outcomes:

On completion of course students will be able to

<input type="checkbox"/>	Adapt the appropriate sampling methods for food analysis
<input type="checkbox"/>	Demonstrate lipids & proteins analysis for its quality & characteristics
<input type="checkbox"/>	Evaluate the quality and characteristics of carbohydrates.
<input type="checkbox"/>	Apply spectroscopic & chromatographic techniques for analysis of food components
<input type="checkbox"/>	Utilize sensory evaluation methods to assess the quality of food.

Text Books:

1	Pomeranz, Yeshajahu, "Food Analysis: Theory and Practice", 3 rd Edition, Aspen Publishers / Springer, 2000.
2	Kirk, R.S. and R. Sawyer, "Pearson's Composition and Analysis of Food". 9th Edition, Longman, New York, 1991.
3	Nielsen, S. Suzanne, "Food Analysis". 4 th Edition. Springer, 2010.
4	Meilgard, "Sensory Evaluation Techniques", 3 rd Edition., CRC Press LLC, 1999.

Reference Books / Web links:

1	Ronald E. Wrolstad, "Handbook of Food Analytical Chemistry" Vol I, John Wiley & sons, 2005.
2	Magdi M. Mossoba, "Spectral Methods in Food analysis" Marcel & Dekker, 1998.
3	Otles, Semih, "Methods of Analysis of Food Components and Additives". CRC Press, 2005.
4	Amerine, Pangborn & Roessler, "Principles of Sensory Evaluation of food", Academic Press, 1965.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23501.1	3	2	1	3	3	1	2	1	1	1	1	3	3	3	2
FT23501.2	2	2	1	3	3	1	2	1	1	1	1	3	3	3	3
FT23501.3	2	2	1	3	3	1	2	1	1	1	1	3	3	3	3
FT23501.4	2	2	1	3	3	1	2	1	1	1	1	3	3	3	3
FT23501.5	2	2	1	3	3	1	2	1	1	1	1	3	3	3	2
Average	2.2	2	1	3	3	1	2	1	1	1	1	3	3	3	2.6

Subject Code	Subject Name	Category	L	T	P	C
FT23502	FOOD PROCESS ENGINEERING	PC	3	0	0	3

Objectives:	
<input type="checkbox"/>	To understand the physical properties of foods
<input type="checkbox"/>	To understand the concept of thermal processing
<input type="checkbox"/>	To understand the importance of mixing in food processing
<input type="checkbox"/>	To highlight the role of encapsulation in food processing
<input type="checkbox"/>	To understand the key aspects of extrusion cooking

UNIT-I	PROPERTIES OF FOOD	9
Engineering properties of food materials - Rheological and textural Properties, Thermal Properties, Thermodynamic Properties, surface and gas exchange properties, electric and dielectric properties Water activity and states: a thermodynamic quantity, water sorption isotherms, hysteresis, theories of sorption hysteresis, water activity measurement methods, water binding, control of water activity and moisture, principles of IMF and their application		
UNIT-II	THERMAL PROCESSING	12
Thermal Processing - Concept of thermo bacteriology, Thermal Process Evaluation- Basic considerations, General method, Mathematical method, Conversion of Heat penetration data, Process Determination Problems. Drying- Three States of Water phase diagram for water, Heat Requirements for Vaporization, Thermodynamics of moist air (psychrometry) - Measurement of Humidity, Air Drying, Conduction drying, drying under varying external condition, calculation of drying time. Freezing – Freezing time calculations, Glass transitions in frozen foods.		
UNIT-III	MIXING- EMULSIONS	9
Mixing Equipment–Mixing Mechanisms, Laminar Mixing, Turbulent Mixing Liquid Mixers, Powder and Particle Mixers, Standard Geometry Stirred Tanks, Dough and Paste Mixers, Double Spiral Mixer, Blending Tank for Cream Mixing, Double-Arm Kneading Mixers. Emulsions- Introduction to Emulsions, Methods to Form an Emulsion, Emulsion Characteristics- Micro- and Nano-Emulsions, Properties of Emulsions- Emulsion Stability, Disperse Phase Volume Fraction, Droplet Size, Interfacial Properties, Droplet Charge, Rheology, Particle Sizing Characterization of Emulsions.		
UNIT-IV	ENCAPSULATION OF FOOD INGREDIENTS	9
Basic Principles of Encapsulation, Benefits of Encapsulation in Food Industry, Encapsulation process & design & Evaluation-Purpose of an encapsulation Process; Encapsulated Product's Yield; Microencapsulation Yield; Microencapsulating Efficiency; Percentage Retention, Encapsulating Agents, Encapsulation Methods- Spray Drying, Freeze Drying, Spray Cooling/Chilling, Fluidized-Bed Coating, Cocrystallization, Coacervation, Liposome entrapment.		
UNIT-V	EXTRUSION	6
Introduction, Single screw & Twin screw extruder- Structure, Operation, Flow models, Extruder throughput, Advantages and shortcomings; Effect of extrusion cooking on foods, Applications in Food industries.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Apply the knowledge properties of foods during the processing
<input type="checkbox"/>	Design parameters for thermal processing of food.
<input type="checkbox"/>	Explain the principles and current practices of mixing and the effects of processing parameters on product quality.
<input type="checkbox"/>	Demonstrate the encapsulation technology available in the field of processing
<input type="checkbox"/>	Develop novel products using extrusion cooking.

Text Books:	
1	Toledo, Romeo T. "Fundamentals of Food Process Engineering" II Edition. CBS Publishers, 2000.
2	Fellows P. J "Food Processing Technology" Wood head Publishing, 1998
3	Smith P. G "Introduction to Food Process Engineering". Springer, 2005
4	Earle, R.L, "Unit Operations in Food Processing". Pergamon Press. Oxford. U.K, 2003

Reference Books / Web links:	
1	TheodorosVarzakas and ConstantinaTzia. "Food Engineering Handbook: Food Process Engineering", CRC Press, 2015.
2	Berk, Zeki. "Food Process Engineering and Technology". Elsevier, 2009.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23502.1	2	1	2	1	1	1	2	3	3	2	1	2	3	3	3
FT23502.2	1	2	1	1	1	1	1	2	1	2	2	1	1	2	2
FT23502.3	1	2	1	1	1	1	1	1	3	3	1	2	3	2	3
FT23502.4	2	3	2	2	2	2	3	2	3	2	1	1	3	3	3
FT23502.5	3	2	1	1	2	1	1	1	2	3	2	1	3	3	3
Average	1.8	2	1.4	1.2	1.4	1.2	1.6	1.8	2.4	2.4	1.4	1.4	2.6	2.6	2.8

Subject Code	Subject Name	Category	L	T	P	C
FT23503	HEAT AND MASS TRANSFER IN FOOD PROCESSING	PC	3	0	0	3

Objectives:	
<input type="checkbox"/>	To understand the fundamental concepts of heat conduction.
<input type="checkbox"/>	To understand the convective heat transfer.
<input type="checkbox"/>	To understand the concept of radiation and to differentiate the heat exchangers
<input type="checkbox"/>	To gain insights into diffusion in gas, liquid, and solids
<input type="checkbox"/>	To gain knowledge the various distillation processes

UNIT-I	HEAT TRANSFER – CONDUCTION	9
Basic heat transfer processes - conductors and insulators - conduction – Fourier’s law of heat conduction – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – solving problems in heat transfer by conduction.		
UNIT-II	HEAT TRANSFER - CONVECTION	9
Heat transfer - convection – free and forced convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in foods.		
UNIT-III	HEAT TRANSFER – RADIATION AND HEAT EXCHANGER	9
Radiation heat transfer – concept of black and grey body - monochromatic total emissive power– Kirchoff’s law – Planck’s law - Stefan-Boltzmann’s law –Heat exchangers – parallel, counter and cross flow- Logarithmic Mean Temperature Difference – overall coefficient of heat transfer in shell and tube heat exchanger for food products.		
UNIT-IV	MASS TRANSFER –DIFFUSION	9
Mass transfer in foods – introduction – Fick’s law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of A through non-diffusing B, diffusion coefficients for gases - molecular diffusion in liquids, solids, biological solutions and gels.		
UNIT-V	MASS TRANSFER - DISTILLATION	9
Vapor liquid equilibria - Raoult’s law- Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by McCabe -Thiele method.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

<input type="checkbox"/>	Infer the fundamental concepts of heat conduction.
<input type="checkbox"/>	Assess the convective heat transfer.
<input type="checkbox"/>	Demonstrate the concept of radiation and to differentiate the heat exchangers
<input type="checkbox"/>	Understand the diffusion in gas, liquid, and solids.
<input type="checkbox"/>	Analyse the various distillation processes

Text Books:

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

Reference Books / Web links:

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

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
FT23503.1	2	1	1	3	1	2	2	2	1	2	1	1	3	2	2
FT23503.2	2	2	1	1	3	1	1	2	1	1	1	1	3	2	2
FT23503.3	1	1	1	1	1	1	2	1	2	2	2	2	3	2	3
FT23503.4	2	1	1	2	2	1	1	3	2	1	2	1	3	3	3
FT23503.5	3	1	1	1	1	1	1	1	2	1	1	2	3	2	3
Average	2	1.2	1	1.6	1.6	1.2	1.4	1.8	1.6	1.4	1.4	1.4	3	2.2	2.6

Subject Code	Subject Name	Category	L	T	P	C
GE23311	FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS	HS	3	0	0	3

OBJECTIVES	
1	To expose the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.

UNIT-I	INTRODUCTION TO MANAGEMENT	9
Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of management thought. Organization: Types and environmental factors.		
UNIT-II	PLANNING AND DECISION MAKING	9
General Framework for Planning – Planning Process, Types of Plans, Management by Objectives; Decision making and Problem Solving - Steps in Problem Solving and Decision Making.		
UNIT-III	ORGANIZATION AND HRM	9
Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization. Human Resource Management & Business Strategy: Talent Management and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.		
UNIT-IV	LEADING AND MOTIVATION	9
Leadership, Power and Authority, Leadership Styles, Leadership Skills, Leader as Mentor and Coach, Team Leadership. Motivation – Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories – Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.		
UNIT-V	CONTROLLING	9
Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems. Managing productivity- Cost control- Purchase control- Maintenance control- Quality control- Planning operations. Managing globally- Strategies for International business.		
Total Contact Hours		: 45
Course Outcomes: After completing the course, the Learners should be able to:		
1	Understand and apply the basic principles of management.	
2	Understand and apply the planning, organizing and control processes	
3	Will be able to understand and design organization as well as manage and develop human	
4	Understand various theories related to the development of leadership skills, motivation techniques and team work	
5	Will be able to understand and apply controlling practices in all applications.	

Text Books:	
1	Principles of Management, Prakash Chandra Tripathi, Tata McGraw-Hill Education, 2008

2	Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.
Reference Books / Web links:	
1	Essentials of Management, Koontz Kleihrich, Tata Mc – Graw Hill.
2	Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

Subject Code	Subject Name	Category	L	T	P	C
FT23511	FOOD ANALYSIS LABORATORY	PC	0	0	4	2

Course Objectives:	
	To learn and apply various analytical techniques
□	To gain practical experience in performing nutrient analysis of food products
□	To interpret the methods for analysis of additives and antioxidants in food products
□	To understand the methods for analysis of adulterants in food products
□	To explore the methodology for sensory evaluation of food products

List of Experiments	
1	Determination of moisture in spices powder by distillation method and Hot air oven method.
2	Determination of total fat, protein in milk and milk products.
3	Rancidity test for fried foods to assess primary and secondary oxidative products.
4	Determination of Vitamin C in fruit juices. a. Titrimetric method using dichlorophenolindophenol dye b. Spectrophotometric method using dinitro phenyl hydrazine
5	Extraction and identification of synthetic Food colour in sweets, confectioneries and beverages.
6	Determination of Iron content in foods.
7	Determination of Iodine content in iodized salt.
8	Detection and estimation of Annatto, lead, MSG, sulphur-di-oxide, Emulsifiers and stabilizers in food products.
9	Estimation of antioxidant activity in foods by DPPH assay
10	Determination of soluble and insoluble fibre in foods.
11	Detection of adulterants in edible oil and ghee.
12	Chromatographic separation of carotenoids
13	Identification of colours in fruit juice using TLC.
14	Sensory Evaluation of food products - Difference Test- triangle Test-Preference Test- Paired Preference Test.
Total Contact Hours : 60	

Course Outcomes:	
The students will be able to	
☐	Able to perform various food analysis techniques
☐	Analyze & interpret the nutrient content of food products
☐	Detect the presence of additives and antioxidants in food products
☐	Demonstrate the method for analysis of adulterants in food products
☐	Acquire practical experience in performing sensory evaluations of food products.

Text Books:	
1.	Shalini Sehgal, "A laboratory manual of food analysis", I.K. International publishing, 2016.

References:	
1.	Ceirwyn S. James, "Analytical chemistry of foods", Springer, 1995
2.	S. Suzanne Nielsen, "Food analysis laboratory manual", 3 rd edition, Springer, 2017
3.	Ronald E. Wrolstad, "Handbook of food analytical chemistry- Water, Proteins, Enzymes, Lipids and Carbohydrates", John Wiley & sons, inc., 2005

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required		
S.No.	Name of the equipment	Quantity
1.	Soxhlet apparatus	5
2.	Kjeldahl apparatus	2
3.	UV spectrophotometer	1
4.	Colour comparator	1
5.	pH meter	3
6.	Water bath	2
7.	Fume hood	1
8.	Dean and stark apparatus	1
9.	Weighing balance	1
10.	Hot air oven	1
11.	Simple distillation unit	2
12.	High Pressure Liquid Chromatography equipment	1
13.	Muffle furnace	1
14.	Chromatography Columns	10
15.	TLC paper strips As required	
16.	Whatman Cellulose Paper for chromatography	100 Nos.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23511.1	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-
FT23511.2	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-
FT23511.3	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-
FT23511.4	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-
FT23511.5	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-
Average	3	-	3	3	3	-	-	-	3	-	3	3	3	3	-

Subject Code	Subject Name	Category	L	T	P	C
FT23512	FOOD PROCESSING AND PRESERVATION LABORATORY-II	PC	0	0	4	2

Objectives:

<input type="checkbox"/>	Analyze the hurdle technology in food processing.
<input type="checkbox"/>	Understand the fortification in fruit juices.
<input type="checkbox"/>	Study the production and quality of fermented vegetables.
<input type="checkbox"/>	Explore the viscosity and rheological properties of food products
<input type="checkbox"/>	Investigate the process involved during baking

List of Experiments

1.	Sonication- assisted dehydration in fruits
2.	Preparation of fortified fruit juices
3.	Preparation and quality assessment of fermented vegetables
4.	Assessment of viscosity and rheological properties of fluids like milk, yogurt, and juices.
5.	Platform test on milk
6.	Blanching of vegetables
7.	Assessment of homogenization process on fat distribution in milk
8.	Identifying sugar cooking stages for confectionery preparation
9.	Standardization of milk by Pearson's square method
10.	Understanding material balance in juice extraction process
11.	Investigating the effect of ingredient proportions on texture of bread and cake
12.	Effect of baking time on bread crust and texture
13.	Reconstitution test for dried fruits and vegetable products
14.	Visit to food processing industry
Total Contact Hours : 60	

Course Outcomes:

The students will be able to

<input type="checkbox"/>	Perform hurdle technology in food processing.
<input type="checkbox"/>	Analyze the effect of fortification in food products
<input type="checkbox"/>	Produce and assess the quality of fermented vegetables.
<input type="checkbox"/>	Analyze viscosity and rheological properties of food liquids.
<input type="checkbox"/>	Understand the process involved during baking

References:

1.	Theodoros Varzakas, Constantina Tzia. (2015). Handbook of Food Processing: Food Safety, Quality, and Manufacturing Processes, CRC Press, UK.
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2.	Fuller, G.W. (2011). New Food Product Development: From Concept to Marketplace, 3rd ed, CRC Press, UK.
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PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23512.1	3	3	3	3	3	3	2	3	3	2	2	3	3	3	2
FT23512.2	3	3	3	3	3	3	2	3	3	2	2	3	3	3	2
FT23512.3	3	3	3	3	2	3	2	3	3	2	2	3	3	3	2
FT23512.4	3	3	3	3	2	3	2	3	3	2	2	3	3	3	2
FT23512.5	3	3	3	3	2	3	2	3	3	2	2	3	3	3	2
Average	3	3	3	3	2.4	3	2	3	3	2	2	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23601	FOOD PRODUCT TECHNOLOGY	PC	3	0	0	3

Objectives:	
<input type="checkbox"/>	To comprehend the basic aspects of food product technology
<input type="checkbox"/>	To understand processing and preservation techniques for fruits and vegetables
<input type="checkbox"/>	To explore the manufacturing process of various dairy products
<input type="checkbox"/>	To learn the methods for producing bakery and confectionery products
<input type="checkbox"/>	To comprehend with processing, preservation, and quality control of meat, fish, and poultry products

UNIT-I	INTRODUCTION TO FOOD PRODUCTS	9
Importance and Scope of food products – Types of Food Products - Major players in Indian and global food product industries - Basic Principles in Food Product Technology - Constituents of foods - Food Product Development Process - Food Processing Techniques – Quality control - Sensory attributes - Determination of shelf life – Regulatory aspects - Current trends		
UNIT-II	FRUITS AND VEGETABLE PRODUCTS	9
Commercially important fruits and vegetables in India - Canning- Fruit Juice & pulp – Squashes, cordials, nectar, drinks, concentrates – RTS beverage - Preserves - Vegetable Purees & pastes – Jams and Marmalades – Ketchup and sauces – Pickles – Chutneys - Fruit Bar – Fermented vegetables – soup powders – Standards and regulations for fruits and vegetable products.		
UNIT-III	DAIRY PRODUCTS	9
Manufacturing of Butter, Ghee – Channa and paneer: Preparation and preservation - Fermented milk products – Yogurt, Cheese - Ice-cream -evaporated milk - Flavoured milk – Processing of milk powder - Traditional Indian dairy products - Standards and regulations for Dairy products.		
UNIT-IV	BAKERY AND CONFECTIONERY PRODUCTS	9
Bakery ingredients - Classification of bakery products - Bread making methods - Production of cakes, cookies, biscuits - Production process for wafers – Puff Pastry – Confectionery ingredients - Types of confectionery products - Processing method for Caramel, Toffee and Fudge - Standards and regulations for Baking and Confectionery products.		
UNIT-V	MEAT AND MARINE PRODUCTS	9
Types and structure of meat - Meat processing – Slaughtering of animals, mechanical deboning, inspection and grading of meat. Meat Products - Dried and Cured meat, canned meat, frozen meat, cooked and refrigerated meat, Restructured meat, Enrobed meat, Emulsion meat - Processing and preservation techniques for fishes,		

fish meal and oil – Poultry and Egg products - Standards and regulations of meat products.			
			Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Infer fundamental aspects of food product technology, including food composition, processing, and quality control.
<input type="checkbox"/>	Explain various fruit and vegetable products processing and preservation techniques
<input type="checkbox"/>	Illustrate dairy product manufacturing and preservation techniques, ensuring regulatory compliance.
<input type="checkbox"/>	Analyse bakery and confectionery production methods, ensuring adherence to quality standards.
<input type="checkbox"/>	Interpret processing methods for meat, fish, and poultry, focusing on preservation and quality control.

Text Books:	
1	N. Shakuntala O. Manay, “Food Facts and Principles”. 4 th Edition, New Age International Publishers., New Delhi, 2020
3	Ananthkrishnan, C.P., and Sinha, N.N., “Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1984.
4	Matz, Samuel A., "Bakery Technology and Engineering", III Edition, Chapman & Hall London.

Reference Books / Web links:	
1	Hosahalli S. Ramaswamy. “Post-harvest Technologies of Fruits & Vegetables” DES tech publications, 2015.
2	Lawrie, R.A. "Meat Science", Second Edition. Pergamon Press, Oxford, UK. 1975.
3	Matz, Samuel A. “ The Chemistry and Technology of Cereals as Food and Feed” 2nd Edition, CBS, 1996.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23601.1	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3
FT23601.2	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3
FT23601.3	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3
FT23601.4	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3
FT23601.5	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3
Average	3	3	2	2	1	1	1	1	1	1	2	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23602	FOOD PACKAGING TECHNOLOGY	PC	3	0	0	3
Objectives:						
●	To learn basics of food packaging & testing its performance.					
●	To gain knowledge on different food grade packaging materials.					
●	To understand the functions of novel packaging system.					
●	To develop suitable packaging system for different food matrix.					

●	To understand the Regulatory aspects of packaging.
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UNIT-I	BASICS OF PACKAGING	9
Introduction of Food Packaging-Need of food packaging, Role of packaging, Designing of package materials, Testing of package materials & its performance- WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test, puncture test, impact test etc., Principles in the development of safe and protective packing, Safety assessment of food packaging materials: Studies on migratory chemicals from food packages and its toxic effects.		
UNIT-II	PACKAGING MEDIA & MATERIALS	9
Introduction of packaging materials, Types of packaging materials their characteristics and uses; Use of paper as a packaging material-Pulping, Fibrillation, Beating, Types of papers ,Testing methods; Use of glass as a packaging material-Composition, Properties, Types, Methods of bottle making; Use of metals as a packaging material- Tinplate containers, Tinning process, Components of tinplate, Tin free steel (TFS), Types of cans, Aluminium containers, Lacquers; Use of plastics as a packaging material-Types of plastics, Plastic films, laminated plastic materials, Co-extrusion.		
UNIT-III	PACKAGING SYSTEMS AND METHODS	9
Vacuum packaging, Gas flush packaging - CAP & MAP, Aseptic packaging, Retort packaging, box in box, Packages for microwave ovens, Biodegradable plastics, Edible packaging & Coatings- Coating on paper & films, types of coatings. Need of coating, methods of coatings; Active packaging systems and their food applications, Intelligent packaging system: Time-Temperature indicators, Radio Frequency Identification Tags (RFID), Sensors.		
UNIT-IV	PACKAGING REQUIREMENTS OF DIFFERENT COMMODITIES	9
Food packaging systems, Product characteristics and package requirements, Different forms of packaging- Rigid, semi-rigid, flexible forms of packaging. Different packaging system for-Dehydrated foods, Frozen foods, Dairy products, Fresh fruits, Vegetables, Meat, Poultry, Sea foods, Eggs, Breakfast cereals & baked food products, Beverages, Snacks.		
UNIT-V	REGULATORY ASPECTS OF PACKAGING	9
Food Packaging Laws and Regulations, Food Labelling, coding and marking including bar coding. Packaging requirements under FSSAI regulations- Declaration and Labelling, Specification of Display panels, Statutory Requirements on Packages.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Demonstrate the packaging functions and evaluate its performance in food preservation.
●	Utilize the various food grade materials for packaging of food.
●	Comprehend the functions of advanced packaging methods.
●	Design the packaging system for different food matrix
●	Apply the packaging and labelling regulations while designing the packaging system.

Text Books:	
1	Robertson, G.L. “Food Packaging: Principles and Practice”. 3 rd Edition. Taylor & Francis, 2013.
2	Robertson, G.L. “Food Packaging and Shelf-life: A Practical Guide, CRC Press, 2009.
3	Food Safety and Standards (Packaging and Labelling) Regulation, 2011
4	Food Safety and Standards (Packaging) Regulation, 2018

Reference Books / Web links:	
1	Ahvenainen, Raija. “Novel Food Packaging Techniques”. Wood Head Publishing, 2003.
2	Han, Jung H. “Innovations in Food Packaging”. Elsevier, 2005.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23602.1	3	1	1	3	3	2	2	1	3	1	1	3	3	2	2
FT23602.2	3	1	1	1	1	1	1	2	1	1	2	3	3	3	2
FT23602.3	3	3	3	2	3	3	3	2	3	1	3	3	3	3	2
FT23602.4	3	3	3	3	3	3	3	3	3	1	3	3	3	3	2
FT23602.5	3	1	1	1	1	3	3	3	3	1	2	3	3	3	2
Average	3	1.8	1.8	2	2.2	2.4	2.4	2.2	2.6	1	2.4	3	3	2.8	2

Subject Code	Subject Name	Category	L	T	P	C
FT23603	START-UP ECOSYSTEMS FOR FOOD TECHNOLOGISTS	PC	3	0	0	3
Objectives:						
●	To give food scientists an awareness of the entrepreneurial environment					
●	To gain knowledge on tools and tactics required to create, maintain, and grow food industry firms.					
●	To acquire knowledge about fundraising, business development, innovation, and negotiating regulatory systems.					
●	To develop suitable knowledge for entrepreneurial management					
●	To understand the Regulatory aspects of start up in Food Technology					

UNIT-I	INTRODUCTION TO THE STARTUP ECOSYSTEM	9
Start-up -Definition, characteristics, types: technology, product-based, service-based, etc. The Start-up Ecosystem -Key players: entrepreneurs, investors, incubators, accelerators, government, etc. Role of food technologists in startup ecosystems, the impact of digital technologies on the food industry		
UNIT-II	ENTREPRENEURIAL MINDSET AND BUSINESS PLANNING STRATEGY	9
Entrepreneurial Mindset and Skills, Developing a business plan: vision, mission, and goals, Market research: identifying gaps, consumer behavior, and trends, Business models for food startups: D2C, B2B, subscription models, etc. Case studies of successful food startups.		
UNIT-III	PRODUCT DEVELOPMENT AND INNOVATION	9
Product ideation to commercialization: phases & methods, Incorporating AI, IoT, and block chain in food start-ups, R&D in Food Innovation: Formulating and Testing New Products, Food product development		

based on ideas of sustainability and circular economy, Packaging advances: eco-friendly solutions and functional designs.			
UNIT-IV	FUNDING AND ACCELERATION PROGRAMS	9	
Sources of Funding: Bootstrapping, Angel investors, Venture capital, Crowdfunding, Government grants and subsidies. Incubation Programs: Benefits, Selection Process. Acceleration Programs: Focus on rapid growth and scaling, Investment opportunities, Expert mentorship and coaching.			
UNIT-V	REGULATORY FRAMEWORK AND QUALITY COMPLIANCE	9	
Regulatory landscape for food businesses: FSSAI, FDA, and global standards, Licensing, certifications, and intellectual property for food start-ups, Quality assurance frameworks: HACCP, ISO, and GMP, Addressing ethical concerns: labelling, advertising, and environmental impacts, Crisis management: food safety risks and product recalls			
		Total Contact Hours	: 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand the dynamics of the start-up ecosystem and its relevance to food technologists.
●	Be equipped to create business plans and develop innovative food products.
●	Learn strategies for product development and innovation in food-based ventures
●	Understand the various funding opportunities and acceleration programs
●	Navigate regulatory frameworks and implement quality standards in food start-ups.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23603.1	3	1	1	3	3	2	2	1	3	1	1	3	3	2	2
FT23603.2	3	1	1	1	1	1	1	2	1	1	2	3	3	3	2
FT23603.3	3	3	3	2	3	3	3	2	3	1	3	3	3	3	2
FT23603.4	3	3	3	3	3	3	3	3	3	1	3	3	3	3	2
FT23603.5	3	1	1	1	1	3	3	3	3	1	2	3	3	3	2
Average	3	1.8	1.8	2	2.2	2.4	2.4	2.2	2.6	1	2.4	3	3	2.8	2

Subject Code	Subject Name	Category	L	T	P	C
FT23611	FOOD PACKAGING TECHNOLOGY LABORATORY	PC	0	0	4	2

Objectives:	
●	To describe testing methods for packaging material
●	To get familiar with detect the type of plastic packaging material
●	To gain experience with universal testing machine for analysis of different parameters of packaging material.
●	To learn the operation of WVTR & OTR testing machines.

●	To learn the testing methods for migration of chemicals from packaging material.
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List of Experiments	
1	Identification of different types of packaging and packaging materials
2	Measurement of thickness of packaging films, papers and boards
3	Measurement of water absorption rate of paper, paper boards
4	Measurement of bursting strength of paper of paper boards
5	Determination of tensile/compression strength of given material
6	Destructive and non-destructive test on glass container, drop test
7	Determination of wax weights, tensile strength of papers, bursting strength
8	Determination of WVTR of various packaging materials
9	Determination of Oxygen Transmission Rate of various packaging materials
10	Determination of coating on package materials
11	Evaluation of residue migration from package to food
12	Tests for identification of plastic films.
Total Contact Hours : 60	

Course Outcomes:	
The students will be able to	
●	Demonstrate the testing methods for packaging materials.
●	Identify the type of packaging material
●	Operate the food package testing equipment.
●	Analyse the WVTR and OTR of different packaging films.
●	Evaluate the properties of food packaging materials

References:	
1.	Robertson, G. L. Food Packaging Principles and Practices, (Marcel Decker, 2006)
2.	Han, J.H. Innovation in Food Packaging, (Elsevier Publications, 2005)

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Equipment Required		
S.No.	Name of the equipment	Quantity
1.	Caliper Thickness Gauge	2
2.	Universal Testing machine for packaging material	2
3.	Pouch Burst Tester	1
4.	Drop Tester	1
5.	COBB Tester	1
6.	Water Vapour Transmission Rate testing equipment	2

7.	Oxygen Transmission Rate testing equipment	5
8.	Densimeter for packaging material	1

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23611.1	3	1	1	3	3	2	2	1	3	1	1	3	3	2	2
FT23611.2	3	1	1	1	1	1	1	2	1	1	2	3	3	3	2
FT23611.3	3	3	3	2	3	3	3	2	3	1	3	3	3	3	2
FT23611.4	3	3	3	3	3	3	3	3	3	1	3	3	3	3	2
FT23611.5	3	1	1	1	1	3	3	3	3	1	2	3	3	3	2
Average	3	1.8	1.8	2	2.2	2.4	2.4	2.2	2.6	1	2.4	3	3	2.8	2

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
FT23612	FOOD PRODUCT TECHNOLOGY LABORATORY	PC	0	0	4	2

Objectives:	
<input type="checkbox"/>	To learn the basic techniques involved in the formulation and processing of food products.
<input type="checkbox"/>	To explore the principles and role of ingredient functionality.
<input type="checkbox"/>	To gain practical knowledge in the production of bakery, confectionery, dairy, and meat-based products.
<input type="checkbox"/>	To develop skills for evaluating quality attributes of processed foods.
<input type="checkbox"/>	To foster innovation in food product development

List of Experiments	
1.	Preparation and Quality Analysis of Ready-to-Serve (RTS) Beverages
2.	Formulation and Production of Fruit Jam
3.	Development and Sensory Evaluation of Tomato Ketchup
4.	Processing and Preservation of Fruit Squash
5.	Production of Bread
6.	Cake Formulation and Evaluation of Quality Attributes
7.	Preparation and Analysis of Biscuits and Cookies
8.	Preparation for Sugar-Boiled Confectionery
9.	Production of Fermented Dairy Products
10.	Development of Coagulated Milk Products
11.	Preparation of Traditional Dairy Products
12.	Development of Emulsion-Based Meat Products: Chicken Nuggets
13.	Production of Enrobed Meat Products
14.	Visit to Food Processing Industry
Total Contact Hours : 60	

Course Outcomes:	
The students will be able to	
<input type="checkbox"/>	Apply fundamental techniques for the formulation and processing of various food products.
<input type="checkbox"/>	Interpret ingredient functionality and its impact on food product characteristics.
<input type="checkbox"/>	Exhibit practical skills in the production of bakery, confectionery, dairy, and meat-based products
<input type="checkbox"/>	Evaluate the quality attributes of processed foods
<input type="checkbox"/>	Design and develop innovative food products

References:	
1.	Theodoros Varzakas, Constantina Tzia. (2015). Handbook of Food Processing: Food Safety, Quality, and Manufacturing Processes, CRC Press, UK.
2.	Fuller, G.W. (2011). New Food Product Development: From Concept to Marketplace, 3rd ed, CRC Press, UK.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23612.1	2	2	3	1	2	2	1	1	3	3	2	3	3	2	2
FT23612.2	2	2	3	3	1	2	1	1	3	3	2	3	3	2	2
FT23612.3	3	2	3	3	2	2	1	2	3	3	3	3	3	3	3
FT23612.4	3	3	2	2	3	2	1	2	3	3	3	3	3	3	3
FT23612.5	3	3	3	3	3	2	1	2	3	3	3	3	3	3	3
Average	2.6	2.4	2.8	2.4	2.2	2	1	1.6	3	3	2.6	3	3	2.6	2.6

Subject Code	Subject Name	Category	L	T	P	C
GE23627	DESIGN THINKING AND INNOVATION (Type - Project based learning)	EEC	0	0	4	2

Objectives:						
•	To understand the design thinking concepts and deep understanding of user needs and experiences.					
•	To find the problem statement and To develop innovative design solutions that address identified user challenges					
•	To master the process of prototyping and iterating on designs.					
•	To conduct thorough market analysis and financial planning					
•	To effectively communicate design concepts and findings.					
UNIT-I	INTRODUCTION TO DESIGN THINKING					9
The design thinking concepts - Different design thinking models - Details of Stanford Design thinking process: Empathize, Define, Ideate, Prototype, Test						
Activities:						
<ul style="list-style-type: none"> Case studies of successful domain based Design Thinking and Innovative projects Group discussions on design thinking 						
UNIT-II	EMPATHIZE AND DEFINE					9
User research methods (interviews, surveys, observation, contextual inquiry) - Persona development- Journey mapping – Brainstorming Defining the design problem statement						
Activities:						
<ul style="list-style-type: none"> Conducting user interviews and surveys Creating user personas and journey maps Identifying key user needs and pain points Analyze the user needs and Brainstorming to define problem statement 						

UNIT-III	IDEATE AND CREATE	9
Brainstorming techniques (e.g., mind mapping, SCAMPER) - Ideation tools (e.g., design thinking tools, concept sketching) - Concept generation and evaluation (e.g. Brainstorming)		
Activities:		
<ul style="list-style-type: none"> • Group brainstorming sessions to select the best idea • Creating concept sketches and prototypes • Evaluating ideas based on user needs and feasibility 		
UNIT-IV	PROTOTYPE AND TEST	9
Low, Medium and high level fidelity for prototyping-Usability testing -Iterative design		
Activities:		
<ul style="list-style-type: none"> • Building low-fidelity prototypes (e.g., paper prototypes) • Conducting usability tests with users • Iterating on designs based on feedback 		
UNIT-V	MARKET ANALYSIS AND IMPLEMENTATION	9
Market research and analysis - Business model development- Financial planning-Implementation strategies		
Activities:		
<ul style="list-style-type: none"> • Conducting market research • Developing a business model canvas • Creating a financial projection • Developing an implementation plan 		
		Total Contact Hours : 45

Course Outcomes:	
On completion of the course, the students will be able to	
CO1	Construct design challenge and reframe the design challenge into design opportunity.
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.
CO3	Develop ideas and prototypes by brainstorming.
CO4	Organize the user walkthrough experience to test prototype
CO5	Develop smart strategies and implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.

Assessment:

- Encourage students to work on real-world design challenges based on the user needs
- Group presentations
- Quizzes and exams
- Final Project report and evaluation and also encourage for filing patent/ copyright / presenting in conference / publishing in journal

Text Book(s):	
1	Handbook of Design Thinking by Christian Müller-Roterberg, Kindle Direct Publishing, 2018.
2	Design Thinking – A Beginner’s Perspective, by E Balagurusamy, Bindu Vijakumar, MC Graw Hill, 2024

Reference Books:	
1	Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work – by Beverly Rudkin Ingle, Apress; 1st ed. Edition, 2013
2	Design Thinking: Understanding How Designers Think and Work by Nigel Cross, Bloomsbury Visual Arts; 2 edition 2023

Web links	
1	Design thinking Guide https://www.rcsc.gov.bt/wp-content/uploads/2017/07/dt-guide-book-master-copy.pdf

2	NPTEL Course on Design Thinking and Innovation By Ravi Poovaiah ; https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
3	IITB Design course tools and Resources https://www.dsource.in/resource

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GE23627.1	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2
GE23627.2	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2
GE23627.3	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2
GE23627.4	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2
GE23627.5	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2
Average	3	2	3	3	3	2	2	3	3	3	3	3	3	2	2

Subject Code	Subject Name	Category	L	T	P	C
FT23613	MICROFLUIDICS LABORATORY FOR FOOD TECHNOLOGY	PC	0	0	2	1
Objectives:						
●	To introduce and strengthen the concept of microfluidic technology					
●	To gain clear understanding of fabrication techniques in microfluidics					
●	To familiarize the ways to analyse various applications of microfluidics					
●	To impart knowledge on the CAD design of micro-mixers					
●	To empower the students to design and fabricate novel microfluidic devices					
List of Experiments						
1	Microfluidic Technology - Introduction, definitions and applications					
2	Materials for microfluidic device fabrication					
3	Fabrication Techniques for Microfluidics, Soft Lithography Technique in detail					
4	CAD design of microchannels – Y -structure and T-structure – 2D and 3D models					
5	Simulation of micro-mixers					
6	Demonstration of Prime mould fabrication					
7	Demonstration of Replica fabrication by casting					
8	Demonstration of sealing of microchannels with a cover glass with plasma bonding technique					
9	Demonstration of leak testing of microfluidic channels					
10	Applications of microfluidics – recent reports					
					Total contact hours	30
Course Outcomes:						
On completion of the course, students will be able to						
●	Understand the fundamentals of microfluidic technology.					
●	Familiar with various fabrication techniques for microfluidics.					
●	Design microfluidic devices using CAD software.					
●	simulate the micro-mixers with FEA					
●	Fabricate a microfluidic device using soft-lithography technique					
References:						
1	Albert Folch, “Introduction to BioMEMS”, CRC press, Taylor and Francis group, 2013.					
2	Yujun Song, Daojian Cheng, Liang Zhao, “Microfluidics: Fundamentals, Devices, and Applications”, Wiley VCH publications, 2018.					
3	Patrick Tabeling, Suelin Chen,” Introduction to Microfluidics”, Oxford University press,first edition 2005, reprint 2011.					

Subject Code	Subject Name	Category	L	T	P	C
GE23621	PROBLEM-SOLVING TECHNIQUES	EEC	0	0	2	1

Course objectives:	
This course will enable the students to	
•	To improve the numerical ability
•	To improve problem-solving skills.

List of Experiments	
1	Numbers system
2	Reading comprehension
3	Data arrangements and Blood relations
4	Time and Work
5	Sentence correction
6	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning
7	Percentages, Simple interest and Compound interest
8	Sentence completion and Para-jumbles
9	Profit and Loss, Partnerships and Averages
10	Permutation, Combination and Probability
11	Data interpretation and Data sufficiency
12	Logarithms, Progressions, Geometry and Quadratic equations.
13	Time, Speed and Distance

Course outcomes:	
This course will enable the students to	
•	Have mental alertness
•	Have numerical ability
•	Solve quantitative aptitude problems with more confident

Subject Code	Subject Name	Category	L	T	P	C
FT23701	FOOD QUALITY, SAFETY STANDARDS AND CERTIFICATION	PC	3	0	0	3

Objectives:	
●	To explain the functional role and safety issues of food contaminants, food adulteration
●	To explain the various quality attributes of food and emphasizing on microbial quality control in food and water quality
●	To conduct a food safety-based risk assessment at different stages of production of food and thereby designing the HACCP and ISO system
●	To explain the role, standard and law set by Indian and global regulatory authorities with respect to food quality control.
●	To familiarize with CODEX commission and its regulation

UNIT-I	INTRODUCTION TO FOOD QUALITY	9
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities, Organic Foods: Certification from National Programme for Organic Production (NPOP) and Participatory Guarantee System for India (PGS-India)		
UNIT-II	FOOD SAFETY	9
Definition of food safety and concept of safe food; characterization of food hazards- physical, chemical and biological; Hygienic design of food plants and equipment's, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Fortification. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials, Traceability, Sustainability, Control of rodents, birds, insects and microbes. Cleaning and Disinfection.		
UNIT-III	HAZARDS AND QUALITY CONTROL	9
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication. ISO 22000 – Importance and Implementation.		
UNIT-IV	RECENT TRENDS IN FOOD SAFETY REGULATIONS& STANDARDS	9
Food Safety and Standards Authority of India- Regulation on Licensing and Registration of Food Businesses, Regulation on Import of foods, Regulation on Food Recall Procedure, Regulation on Prohibition and Restriction of Sales.		
UNIT-V	GLOBAL FOOD SAFETY REGULATIONS & STANDARDS	9
FAO, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection, Convention (IPPC), Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Describe the functional role and safety issues of food contaminants, food adulteration and food additives
●	Analyse the various quality attributes of food and especially on microbial quality control of food and water in Food Processing Industry
●	Identify and analyze the critical quality control point in different stages of production of food and thereby designing the HACCP system.
●	Explain the role, standard and law set by Indian and global regulatory authorities with respect to food quality control
●	Gain knowledge on CODEX commission.

Text Books:

1	The food safety information handbook by Cynthia A. Robert, 2009
2	Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003.

Reference Books / Web links:

1	Handbook of food toxicology by S. S. Deshpande, 2002
2	Nutritional and safety aspects of food processing by Tannenbaum S. R, Marcel Dekker Inc., New York 1979.
3	Microbiological safety of Food by Hobbs BC, 1973

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23701.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23701.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23701.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23701.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23701.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23702	COMPREHENSION IN FOOD TECHNOLOGISTS	PC	3	0	0	3

Objectives:	
●	To assimilate the role of preservation techniques in extending the shelf-life of foods.
●	To understand the food engineering principles
●	To assimilate the technology for processing of fruit and vegetable products.
●	To comprehend the technology for processing of milk
●	To understand the rheology and technology in bakery & confectionary products

UNIT-I	FOOD PRESERVATION TECHNIQUES	9
Principles of Food Preservation, Thermal preservation techniques: Drying and dehydration, evaporation and concentration, Pasteurization and Sterilization, Freezing & thawing Non-thermal preservation techniques- Fermentation; High Pressure Processing; Irradiation Technology; Ultrasound Technology; Hurdle Technology, Novel preservation techniques: Ohmic heating, Ozone Processing, Pulse Electric field processing, Pulsed light Technology		
UNIT-II	PRINCIPLES OF FOOD ENGINEERING	9
Engineering Properties of Food-physical, thermal, aerodynamic and dielectric properties Introduction to food engineering principles – classification of transport processes –conservation of mass and energy balance. Heat transfer: heat transfer by conduction, convection, radiation, heat exchangers. Mass transfer: molecular diffusion and Fick’s law, conduction and convective mass transfer- diffusion in porous solids. Food rheology and flow behaviour of fluids.		
UNIT-III	FRUIT & VEGETABLE TECHNOLOGY	9
Harvesting and washing of fruits and vegetables– cleaning and grading – peeling - equipments – pre-cooling – importance, methods, pretreatments and advantages Maturity Indices and Determination methods, Principles of Storage of Fruits and Vegetables– MAP, CAS, Hypobaric storage.		
UNIT-IV	MILK PROCESSING TECHNOLOGY	9
Sources and Composition of Milk - Milk reception- Platform test - Cooling and storage of raw milk – principles and methods transfer of milk -transport and storage tanks - Standardization-cleaning and sanitization of Dairy equipment- CIP systems - Processing of Milk- Pasteurization, sterilization, Homogenization, Filtering and Clarification of Milk.		
UNIT-V	BAKING AND CONFECTIONERY TECHNOLOGY	9
Introduction to Bakery Ingredients – Types, Chemical Constituents; Principles of Baking, Baking Equipments, Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph – Composition and manufacturing process of confectionary products – Faults, Defects and Spoilage of Bakery and Confectionery products.		
		Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- On completion of course, students will be able to: understand and apply the food preservation techniques.
- Analyse the engineering properties of food and apply to processing techniques.
- Comprehend the processing of fruit and vegetable technology.
- Apply basic properties of milk for product manufacturing.
- Assess the rheology and its impact on bakery and confectionery products

Text Books:

- 1 The food safety information handbook by Cynthia A. Robert, 2009
- 2 Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003.

Reference Books / Web links:

- 1 Handbook of food toxicology by S. S. Deshpande, 2002
- 2 Nutritional and safety aspects of food processing by Tannenbaum S. R, Marcel Dekker Inc., New York 1979.
- 3 Microbiological safety of Food by Hobbs BC, 1973

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23702.1	3	3	3	2	3	3	2	2	2	2	3	3	3	3	2
FT23702.2	3	3	3	2	3	3	2	2	2	2	3	3	3	3	1
FT23702.3	3	3	3	2	2	3	2	2	2	2	3	3	3	3	2
FT23702.4	3	3	3	2	2	3	2	2	2	2	3	3	3	3	2
FT23702.5	3	3	3	2	2	3	2	2	2	2	3	3	3	3	1
Average	3	3	3	2	2.4	3	2	2	2	2	3	3	3	3	1.6

Subject Code	Subject Name	Category	L	T	P	C
FT23703	FUNCTIONAL FOODS AND NUTRACEUTICALS	PC	3	0	0	3

Objectives:

- To introduce nutraceuticals, functional foods, and their role in health and disease prevention.
- To impart knowledge on methods for analyzing phytochemicals and understanding their bioavailability.
- To explore techniques for assessing antioxidant activity and optimizing phytochemical release.
- To explain the role of nutraceuticals in managing diseases like cancer, diabetes, and obesity.
- To provide knowledge of regulations, health claims, and safety issues for functional foods.

UNIT-I INTRODUCTION AND SIGNIFICANCE 9

Definition, history, and scope. Differences between functional foods, nutraceuticals, and dietary supplements. Categories and characteristics of functional foods. Role of functional foods in health promotion and disease prevention. Global market trends and future prospects of functional foods and

nutraceuticals.			
UNIT-II	BIOACTIVE COMPOUNDS IN FUNCTIONAL FOODS		10
Overview of bioactive compounds: Definitions and categories. Natural sources: Plants, animals, and microbial origins. Key functional components: Polyphenols, flavonoids, carotenoids, phytosterols, omega-3 fatty acids, and others. Biological mechanisms: Antioxidant activity, anti-inflammatory effects, and more. Techniques for extraction, identification, and quantification of bioactive components.			
UNIT-III	NUTRACEUTICALS AND CHRONIC DISEASE MANAGEMENT		9
Role of nutraceuticals in managing chronic conditions: Cardiovascular health, Diabetes control, Cancer prevention, Obesity management, Neuroprotection. Mechanisms influencing bioavailability and therapeutic potential. Safety profiles, interactions, and efficacy in combination with traditional medicines.			
UNIT-IV	REGULATORY AND SAFETY ASPECTS		9
Global regulatory standards and definitions (FDA, FSSAI, EFSA, etc.). Labeling and health claims for functional foods and nutraceuticals. Structure/function claims and disease risk reduction claims. Quality assurance, clinical testing, and safety evaluations. Ethical concerns in production, labeling, and marketing practices.			
UNIT-V	INNOVATION AND COMMERCIALIZATION OF FUNCTIONAL FOODS		9
Selection of ingredients and development of functional food formulations. Modern processing techniques to preserve bioactivity. Strategies for stability, shelf life, and packaging solutions. Consumer acceptance studies and sensory evaluation methods. Case studies of innovative functional food products in the market.			
			Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- Understand the relevance and applications of functional foods and nutraceuticals in improving public health.
- Identify bioactive compounds and evaluate their health-promoting properties.
- Assess the potential of nutraceuticals in managing chronic diseases and maintaining wellness.
- Interpret and apply international regulatory standards for functional foods.
- Gain practical knowledge of developing and marketing functional food products.

Text Books:

- | | |
|---|-------------------------------------------------------------------------------------|
| 1 | Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, II |
| 2 | Edition, CRC, 2001 |
| 3 | Wildman, Robert “Handbook of Nutraceuticals and Functional F-oods”. CRC, 2006 |
| 4 | Webb, P P. “Dietary Supplements and Functional Foods”. Blackwell, 2006 |
| 5 | Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / |

Reference Books / Web links:

- | | |
|---|----------------------------------------------------------------------------------|
| 1 | Shi, John, FereidoonShahidi and Chi-Tang Ho “Asian Functional Foods”. CRC/Taylor |
|---|----------------------------------------------------------------------------------|

2	&Francis, 2007.
3	Watson, Robald Ross “Functional Foods and Nutraceuticals in Cancer Prevention”.
4	Blackwell Publishing, 2007.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23703.1	3	2	2	2	2	3	3	3	3	3	3	2	3	2	3
FT23703.2	3	3	3	2	2	3	3	3	3	3	3	2	3	3	3
FT23703.3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
FT23703.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23703.5	3	2	2	2	2	3	3	3	3	3	3	2	3	3	3
Average	3	2.6	2.4	2.4	2	3	3	3	3	3	3	2.2	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23711	PROBLEM SOLVING USING AI-ML FOR FOOD TECHNOLOGISTS	EEC	0	0	4	2

Objectives:

- To identify the overall characteristics of Food Products
- To understand the present marketing trends in Food supply chain management
- To solve the problems related to Food Technology using modern software tools
- To develop software programmes related to Food Technology applications
- To describe the process of artificial intelligence and Machine learning in Food Processing

List of Problem oriented Projects

Identification of internal and external characteristics of grains, cereals, Fruits & Vegetable, Spices, live stocks & Poultry, Oilseeds etc using Software tools

Design and fabrication of 3D Food products

Development of Sensors – Biosensors, Nano sensors applications in Food Processing

Distinguish the Fresh and Spoiled food products using Software – AI, ML, IOT etc

Understand the Customer choice-based Food products in current market trends

Total Contact Hours	:	45
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Course Outcomes:

On completion of course students will be able to

- Solve the problems associated with Food Process and Product development
- Analyse the consumer preference in food supply chain management
- Identify the problems and Create solutions in Food processing using modern software tools
- Design and develop programmes using software techniques
- Apply the knowledge of artificial intelligence and machine learning in Food Technology

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23711.1	3	2	2	2	2	3	3	3	3	3	3	2	3	2	3
FT23711.2	3	3	3	2	2	3	3	3	3	3	3	2	3	3	3
FT23711.3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
FT23711.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23711.5	3	2	2	2	2	3	3	3	3	3	3	2	3	3	3
Average	3	2.6	2.4	2.4	2	3	3	3	3	3	3	2.2	3	2.8	3

VERTICAL I - DAIRY TECHNOLOGY

Subject Code	Subject Name	Category	L	T	P	C
FT23A01	BASIC PRINCIPLES OF DAIRY PROCESSING	PE	3	0	0	3

Objectives:	
●	To understand the market milk industry, focusing on tropical dairying and milk collection systems.
●	To learn milk grading methods and pre-processing techniques like chilling, homogenization, and clarification.
●	To study thermal processing principles, methods, and their effects on microbial and physical milk properties.
●	To explore the production of special milks, UHT processing, aseptic packaging, and operational controls in dairy plants.
●	To emphasize quality, safety, plant hygiene, and operational efficiency in dairy processing.

UNIT-I	MARKET MILK INDUSTRY AND MILK COLLECTION SYSTEMS	9
Overview of the market milk industry in India and abroad. Distinctive features of tropical dairying compared to developed countries. Collection and transportation of milk: Organization of milk collection routes, Practices for milk collection, preservation at the farm, and refrigeration, Natural microbial inhibitors: Lactoperoxidase system. Microbial quality of farm-produced milk: Effect of pooling and storing on microbial quality of refrigerated milk. Role of psychrotrophs and tropical climate on milk spoilage		
UNIT-II	MILK GRADING AND PRE-PROCESSING STEPS	9
Chemical tests for grading raw milk. Microbiological tests for grading raw milk. Reception and pre-processing of milk at the dairy plant: Reception, chilling, clarification, and storage practices. Homogenization: Definition, pre-treatments, and theories, Synchronization of homogenizer with pasteurizer (HTST), Effect of homogenization on milk's physical properties. Bactofugation: Theory and microbiology.		
UNIT-III	THERMAL PROCESSING OF MILK	9
Principles of thermal processing: Kinetics of microbial destruction, Thermal death curve, Arrhenius equation, D value, Z value, F ₀ value, Q ₁₀ value. Factors affecting microbial thermal destruction. Thermal processing methods: Pasteurization, thermization, sterilization, UHT processing, Microbiology of pasteurized, thermized, sterilized, and UHT milk. Defects in market milk. Product control in market milk plants.		
UNIT-IV	SPECIAL MILKS, UHT PROCESSING, AND PACKAGING SYSTEMS	9
Manufacture of special milks: Toned, double toned, reconstituted, recombined, flavored, homogenized, vitaminized, and sweet acidophilus milk, Manufacture of sterilized milk. UHT Processing: Relevance in tropical climates, UHT plants: Direct, indirect, upstream/downstream homogenization, third-generation UHT plants, technical control in UHT plants. Aseptic packaging: Types and systems of packaging, Sterilization of packages, filling systems.		
UNIT-V	QUALITY, SAFETY, AND HYGIENE IN MILK PROCESSING	9
Quality and safety aspects in the dairy food chain. Good Manufacturing Practices (GMP) in dairy processing. Plant hygiene, personnel training, and HACCP principles. Effect of heat processing on the nutritive value of milk. Shelf life of UHT milk and tests for its assessment. Efficiency of plant operations: Product accounting and monitoring operational and processing losses (quantity, fat, SNF), Cleaning and sanitation in the plant: Manual cleaning and CIP (Cleaning-In-Place), Strength of detergents and sanitizers.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Understand tropical dairying and efficiently organize milk collection systems.
- Acquire skills to test and grade milk based on chemical and microbial quality.
- Apply thermal processing principles to ensure safe and high-quality milk products.
- Demonstrate proficiency in UHT processing, special milk production, and packaging systems.
- Implement GMP, HACCP, and hygiene practices for quality and safety in dairy operations.

Text Books:

- 1 De, S. (1981). Outlines of dairy technology. Oxford University Press.
- 2 Park, Y. W., Haenlein, G. F., & Ag, D. S. Milk and Dairy Products in Human Nutrition.
- 3 Zadow, J. G., & ROBINSON, R. (1997). Modern dairy technology: advances in milk processing.

Reference Books / Web links:

- 1 Robinson, R. K. (Ed.). (2005). Dairy microbiology handbook: the microbiology of milk and milk products. John Wiley & Sons.
- 2 Kilara, A. (2013). Principles of dairy processing. Manufacturing Yogurt and Fermented Milks, 95-113.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PSO3
FT23A01.1	3	2	1	2	1	3	3	1	3	1	3	1	3	2	3
FT23A01.2	1	3	1	3	2	3	3	1	3	1	3	2	3	3	1
FT23A01.3	3	3	2	3	2	1	3	3	1	3	3	1	3	1	3
FT23A01.4	3	1	3	2	3	1	3	3	3	1	3	3	3	1	3
FT23A01.5	1	1	1	1	1	3	3	3	3	3	3	3	1	3	3
Average	2.2	2	1.6	2.2	1.8	2.2	3	2.2	2.6	1.8	3	2	2.6	2	2.6

Subject Code	Subject Name	Category	L	T	P	C
FT23A02	TECHNOLOGY OF MILK PRODUCTS	PE	3	0	0	3

Objectives:

- To introduce students to the classification, properties, and nutritional significance of various dairy products.
- To provide an in-depth understanding of the principles and technologies involved in the production of fermented, concentrated, and dried dairy products.
- To explore the methods of manufacturing cream, butter, ghee, cheese, and frozen dairy products with a focus on quality and safety.
- To familiarize students with cream, butter and ghee processing.
- To equip students with the knowledge for processing of cheese and frozen dairy products.

UNIT-I	OVERVIEW OF DAIRY PRODUCTS	9
Introduction to the dairy industry and its importance. Classification of dairy products: fluid milk, concentrated milk, fermented products, cream, butter, cheese, frozen products, and by-products. Nutritional		

and functional properties of dairy products. Role of milk products in the food industry. Trends and innovations in the dairy product market.			
UNIT-II	FERMENTED AND CULTURED MILK PRODUCTS	9	
Principles of fermentation and microbiology of starter cultures. Types of fermented milks - dahi, yoghurt, acidophilus milk; different types of dahi and yoghurt; preparation; defects and their control. Kefir and koumiss: origin and characteristics; microbiology of kefir grains; other fermented milks such as Bulgarian milk, cultured buttermilk, Leben, Villi and Yakult;			
UNIT-III	CONCENTRATED AND DRIED MILK PRODUCTS	9	
Evaporation and concentration processes: condensed milk and evaporated milk. Spray drying and roller drying: milk powders and infant formula. Factors affecting product quality and shelf life. Applications of concentrated and dried milk products.			
UNIT-IV	CREAM, BUTTER, AND GHEE TECHNOLOGY	9	
Principles of cream separation and standardization. Technology of butter manufacturing: composition and types. Clarified butter (ghee) production methods and quality aspects. By-products utilization in cream and butter production.			
UNIT-V	CHEESE AND FROZEN DAIRY PRODUCTS	9	
Classification and types of cheese. Technology of cheese production: steps and variants (e.g., processed cheese, mozzarella). Technology of frozen products: ice cream and frozen desserts. Additives and stabilizers used in frozen dairy products.			
			Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze the classification and significance of dairy products, including their functional and nutritional roles in the food industry.
●	Apply knowledge of microbiology and fermentation to produce and control the quality of fermented milk products.
●	Evaluate and implement effective methods for the production of concentrated and dried milk product.
●	Demonstrate a thorough understanding of the manufacturing processes for cream, butter, and ghee.
●	Design and implement technologies for the production of diverse cheese types and frozen dairy products.

Text Books:	
1	Robertson, G.L. "Food Packaging: Principles and Practice". 3 rd Edition. Taylor & Francis, 2013.
2	Robertson, G.L. "Food Packaging and Shelf-life: A Practical Guide, CRC Press, 2009.

Reference Books / Web links:	
1	Chandan, R.C., & Kilara, A. <i>Dairy Ingredients for Food Processing</i> . Wiley-Blackwell.
2	Fox, P.F., & McSweeney, P.L.H. <i>Advanced Dairy Chemistry</i> . Springer.
3	Tamime, A.Y., & Robinson, R.K. <i>Yoghurt: Science and Technology</i> . CRC Press.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PSO 3
FT23A02.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23A02.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23A02.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A02.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A02.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23A03	FROZEN AND FERMENTED DAIRY PRODUCTS	PE	3	0	0	3

Objectives:	
●	To provide in-depth knowledge of the technological processes involved in producing frozen and fermented dairy products.
●	To understand the role of microbial cultures and freezing technologies in enhancing the quality and shelf-life of these products.
●	To develop technical skills for producing various frozen and fermented dairy products while maintaining quality and safety.
●	To familiarize students with modern advancements, equipment, and quality standards in dairy product technology.
●	To explore sustainability and innovation in the production of frozen and fermented dairy products.

UNIT-I	INTRODUCTION TO FROZEN AND FERMENTED DAIRY PRODUCTS	9
Overview of frozen and fermented dairy products: Definition, classification, and importance. Composition and nutritional value. Market trends and scope of frozen and fermented products. Quality standards and regulatory aspects.		
UNIT-II	FROZEN DAIRY PRODUCTS	9
Ice cream and frozen dessert technology: Ingredients and formulation. Manufacturing processes: Standardization, freezing, and hardening. Emulsifiers, stabilizers, and their role in product quality. Defects in frozen dairy products and their prevention.		
UNIT-III	FERMENTED DAIRY PRODUCTS	9
Role of starter cultures in fermentation. Technology of yoghurt, curd, and probiotic products. Principles and processes for cultured dairy products like kefir, sour cream, and buttermilk. Quality control and troubleshooting defects in fermented products.		
UNIT-IV	EQUIPMENT AND MODERN TECHNOLOGIES	9
Overview of equipment used in fermentation and freezing. Membrane technology applications in frozen and fermented dairy products. Refrigeration and freezing systems: Advances in freezing technology. Automation in dairy production and quality assurance.		
UNIT-V	SUSTAINABILITY AND INNOVATIONS	9
Bio-preservation techniques for enhancing product shelf-life. Incorporating functional and bioactive ingredients. Sustainability in frozen and fermented dairy production. Case studies on recent innovations and product development.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze the scientific principles behind the production of frozen and fermented dairy products.
●	Develop proficiency in using starter cultures and understanding fermentation dynamics.
●	Gain skills in producing high-quality ice creams, yoghurts, and other dairy products using modern equipment.
●	Evaluate the quality standards and troubleshoot defects in frozen and fermented dairy products.
●	Apply innovative techniques for sustainable production and improved shelf-life of dairy products.

Text Books:	
1	Walstra, P., Wouters, J.T.M., & Geurts, T.J. Dairy Science and Technology. CRC Press.
2	Chandan, R.C., & Kilara, A. Dairy Ingredients for Food Processing. Wiley-Blackwell.

Reference Books / Web links:	
1	Tamime, A.Y., & Robinson, R.K. Yoghurt: Science and Technology. CRC Press.
2	Arbuckle, W.S. Ice Cream. Springer.
3	Fox, P.F., & McSweeney, P.L.H. Advanced Dairy Chemistry. Springer.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23A03.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23A03.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23A03.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A03.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A03.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23A04	TRADITIONAL DAIRY PRODUCTS	PE	3	0	0	3

Objectives:	
●	To understand the significance and cultural importance of traditional dairy products in India.
●	To acquire knowledge of the manufacturing processes, preservation, and packaging of traditional dairy products.
●	To study the physico-chemical changes and factors influencing the quality of traditional dairy products.
●	To explore modern technological interventions and innovations in traditional dairy product processing.
●	To develop practical skills in the preparation and quality assessment of traditional dairy products.

UNIT-I	SIGNIFICANCE AND OVERVIEW OF TRADITIONAL DAIRY PRODUCTS	9
Status and importance of traditional dairy products in India. Cultural and nutritional value of traditional products. Overview of different types: khoa, chhana, paneer, and other indigenous products. Economic significance and market trends.		
UNIT-II	KHOA AND KHOA-BASED SWEET	9
Classification and types of khoa: standards and methods of preparation. Factors influencing the yield and quality of khoa. Preparation of khoa-based sweets: burfi, peda, kalakhand, and milk cake. Mechanization and preservation of khoa and khoa-based products.		
UNIT-III	CHHANA AND CHHANA-BASED SWEETS	9
Standards and methods of manufacturing chhana. Preparation of chhana-based sweets: rasogolla, sandesh, rasmalai. Mechanization of the chhana manufacturing process. Advances in packaging and preservation.		
UNIT-IV	PANEER, SHRIKHAND, AND OTHER FERMENTED PRODUCTS	9
Standards and preparation of paneer: traditional and mechanized methods. Preparation of shrikhand, misti dahi, and lassi. Fermentation processes, physico-chemical changes, and quality control. Bio-preservation techniques and innovations in fermented dairy products.		
UNIT-V	INNOVATIONS AND QUALITY CONTROL IN TRADITIONAL DAIRY	9

PRODUCTS			
Innovations in manufacturing processes and equipment. Role of bio-preservatives and active packaging. Quality control measures for traditional dairy products. Case studies on sustainability and modernization of traditional dairy production.			
Total Contact Hours			: 45

Course Outcomes:

On completion of course students will be able to

- Comprehend the importance of traditional dairy products in the Indian food sector.
- Demonstrate knowledge of manufacturing and preserving traditional dairy products.
- Analyze factors influencing the quality and shelf life of traditional dairy products.
- Apply modern technological methods to traditional product processing.
- Develop hands-on skills in preparing and assessing traditional dairy products.

Text Books:

- 1 Aneja, R.P., Mathur, B.N., Chandan, R.C., & Banerjee, A.K. Technology of Indian Milk Products. Dairy India Yearbook.
- 2 De, Sukumar. Outlines of Dairy Technology. Oxford University Press.

Reference Books / Web links:

- 1 Gupta, P.R. Dairy India Yearbook. Dairy India Publications.
- 2 Tamime, A.Y., & Robinson, R.K. Yoghurt: Science and Technology. CRC Press.
- 3 Rao, K.L.R. Dairy Engineering. Oxford & IBH Publishing Co.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23A04.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23A04.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23A04.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A04.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A04.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23A05	DAIRY BY-PRODUCTS TECHNOLOGY	PE	3	0	0	3

Objectives:	
●	To provide an understanding of the value addition and utilization of dairy by-products.
●	To learn the technological processes involved in converting by-products into useful products.
●	To understand the principles of quality control, storage, and preservation for dairy by-products.
●	To explore innovative approaches for by-product utilization to enhance sustainability.
●	To develop practical skills in the processing and evaluation of dairy by-products.

UNIT-I	INTRODUCTION TO DAIRY BY-PRODUCTS	9
Definition and classification of dairy by-products. Composition and characteristics of whey, skim milk, and buttermilk. Importance of dairy by-product utilization in the industry. Economic and environmental implications of by-product management.		
UNIT-II	PROCESSING AND UTILIZATION OF WHEY	9
Composition of whey and its types (sweet and acid whey). Processing technologies: Ultrafiltration, reverse osmosis, and membrane concentration. Manufacture of whey-based beverages, powders, and protein concentrates. Functional properties and applications of whey proteins in food products.		
UNIT-III	SKIM MILK AND BUTTERMILK UTILIZATION	9
Processing and properties of skim milk and buttermilk. Manufacture of skim milk powders, casein, and caseinates. Production of cultured buttermilk, protein concentrates, and nutritional beverages. Applications of skim milk and buttermilk in various food formulations		
UNIT-IV	CONVERSION OF BY-PRODUCTS INTO VALUE-ADDED PRODUCTS	9
Manufacture of lactose and its derivatives. Production of bioactive peptides and nutraceuticals. Development of enriched animal feeds and bio fertilizers. Case studies on innovative value-added dairy by-products.		
UNIT-V	QUALITY ASSURANCE AND SUSTAINABILITY IN BY-PRODUCT UTILIZATION	9
Quality control and assurance in by-product processing. Preservation techniques and packaging of dairy by-products. Waste management strategies in the dairy industry. Sustainability practices and their impact on by-product utilization.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze the significance of dairy by-products and their potential in the food industry.
●	Apply knowledge of technological processes for the efficient utilization of dairy by-products.
●	Demonstrate skills in quality control and preservation of dairy by-products.
●	Evaluate the economic and sustainability benefits of by-product utilization.
●	Develop innovative solutions for value addition to dairy by-products.

Text Books:	
1	Aneja, R.P., Mathur, B.N., Chandan, R.C., & Banerjee, A.K. Technology of Indian Milk Products. Dairy India Yearbook.
2	De, Sukumar. Outlines of Dairy Technology. Oxford University Press.

Reference Books / Web links:	
1	Chandan, R.C., & Kilara, A. Dairy Ingredients for Food Processing. Wiley-Blackwell.
2	Gupta, P.R. Dairy India Yearbook. Dairy India Publications.
3	Fox, P.F., & McSweeney, P.L.H. Advanced Dairy Chemistry. Springer.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23A05.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23A05.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23A05.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A05.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A05.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

Subject Code	Subject Name	Category	L	T	P	C
FT23A06	DAIRY PLANT DESIGN AND LAYOUT	PE	3	0	0	3

Objectives:	
●	To provide knowledge about the principles and fundamentals of dairy plant design and layout.
●	To understand the perishable nature of milk and its implications for processing plant flexibility.
●	To explore classification, location, and hygienic design considerations for dairy plants.
●	To develop skills in planning, designing, and arranging equipment and sections within a dairy plant.
●	To introduce computer-aided design (CAD) for dairy plant layout and its applications.

UNIT-I	INTRODUCTION TO DAIRY PLANT DESIGN AND LAYOUT	9
Types of dairies: Fluid milk plants, product-focused plants, and multiproduct dairies. Perishable nature of milk and its influence on plant reception and flexibility. Classification of dairy plants. Location selection: Problems and considerations for site selection. Hygienic design considerations for dairy processing plants.		
UNIT-II	DAIRY PLANT PLANNING AND LAYOUT	9
Principles of dairy plant layout: Importance and planning process. Space requirements and estimation of service needs, including peak load considerations. Types of layouts: Process layout, product layout, and hybrid layouts. Arrangement of process sections, utility sections, and offices. Development of dairy layouts and use of planning tables.		
UNIT-III	DESIGN ASPECTS AND MATERIAL HANDLING	9
General design considerations: Floor plans, single or multilevel designs. Service accommodations and arrangement of equipment. Milk piping and material handling techniques in dairies. Office layout flexibility and common layout problems. Model planning and detailed plot layout development.		
UNIT-IV	BUILDING CONSTRUCTION MATERIALS AND DRAINAGE	9
Floors: Requirements and finishes for different sections. Foundations, walls, doors, and windows for dairy plants. Drainage systems: Layouts for small and large dairies. Ventilation, fly control, mold prevention, and illumination in dairy plants.		
UNIT-V	INTRODUCTION TO COMPUTER-AIDED DESIGN (CAD)	9
Basics of CAD and its importance in dairy plant design. Application of CAD in developing layouts and optimizing plant efficiency. Case studies: CAD software for dairy plant layout and design. Challenges and innovations in computer-aided design for dairy plants.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand the principles of dairy plant design and layout, considering the perishable nature of milk.
●	Evaluate and classify dairy plants based on location, size, and purpose.
●	Develop dairy plant layouts using hygienic design considerations and space requirements.
●	Apply knowledge of building materials, construction techniques, and drainage systems in dairy plant design.
●	Utilize CAD software for developing dairy plant layouts and optimizing operational efficiency.

Text Books:	
1	Rao, K.L.R. Dairy Engineering. Oxford & IBH Publishing.
2	Tetra Pak. Dairy Handbook.

Reference Books / Web links:	
1	Chandan, R.C., & Kilara, A. Dairy Ingredients for Food Processing. Wiley-Blackwell.
2	Gupta, P.R. Dairy India Yearbook. Dairy India Publications.
3	Fox, P.F., & McSweeney, P.L.H. Advanced Dairy Chemistry. Springer.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23A06.1	3	2	1	2	1	3	3	3	3	3	3	1	3	2	3
FT23A06.2	3	3	2	2	2	3	3	3	3	3	3	2	3	3	3
FT23A06.3	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A06.4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	3
FT23A06.5	3	2	1	2	1	3	3	3	3	3	3	1	3	3	3
Average	3	2.6	1.6	2.4	1.6	3	3	3	3	3	3	1.6	3	2.8	3

VERTICAL II - MEAT, MARINE AND POULTRY TECHNOLOGY

Subject Code	Subject Name	Category	L	T	P	C
FT23B01	MEAT AND POULTRY PROCESSING	PE	3	0	0	3

Objectives:	
●	To explore different varieties of meats and their handling.
●	To introduce the concept of meat processing.
●	To provide insights into the basics of marine food processing.
●	To outline the fundamentals of poultry processing.
●	To examine egg processing and its related aspects.

UNIT-I	INTRODUCTION TO MEAT PRODUCTS	9
Scope of meat & meat products industry in India, Sources of meat and meat products in India, its importance in national economy; Effect of feed, breed and management on meat production and quality		
UNIT-II	INTRODUCTION TO POULTRY	9
Definition of Poultry, Importance of Poultry Farming, and Poultry development in India. Present status and future prospectus of poultry Industry. Origin of the chicken and Classification of Poultry based on Genetics utility. Classification of chicken as per international standards. Commonly Occurring Anti-Nutrients, and Antibiotics in Poultry Feed Ingredients and its Effect on Egg and Meat Nutrition.		
UNIT-III	INTRODUCTION TO SEA FOODS	9
Introduction, Marine species, Aquaculture, Seafood spoilage, Seafood hazards, Pre-mortem handling, post-mortem handling.		
UNIT-IV	SLAUGHTERING OF ANIMALS AND POULTRY	9
Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Factors affecting post-mortem changes, properties and shelf-life of meat; Meat quality evaluation; Mechanical deboning, meat tenderization.		
UNIT-V	RECENT TRENDS IN MEAT PROCESSING	9
Precision Meat Processing: Technologies for customized product creation. Smart Sensors and IoT: Real-time monitoring and control improvements. Advanced Packaging: Innovations in extending shelf life and reducing spoilage. Integration of AI: Role of artificial intelligence in processing and quality control. Color, flavors, microbiology and spoilage factors of meat and meat products.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand different variety of meats and its handling.
●	Familiarize with the concept of meat processing.
●	Get insights into basics of marine food processing.
●	Understand the basics of poultry processing.
●	Discuss egg processing and its related aspects.

Text Books:	
1	Govindan. T.K, —Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2	Lawrie, R.A. —Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3	Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology, Second Edition, AVI, Westport, 1977

Reference Books / Web links:	
1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B01. 1	2	2	2	2	2	2	1	1	2	2	1	2	2	1	2
FT23B01. 2	3	1	2	1	1	3	2	2	2	1	1	3	2	1	2
FT23B01. 3	1	1	2	1	1	3	1	1	2	1	2	3	1	2	3
FT23B01. 4	1	2	2	2	2	2	2	1	1	2	1	2	2	1	2
FT23B01. 5	2	2	3	2	2	2	2	2	2	1	1	2	2	1	2
Average	1.8	1.6	2.2	1.6	1.6	2.4	1.6	1.4	1.8	1.4	1.2	2.4	1.8	1.2	2.2

Subject Code	Subject Name	Category	L	T	P	C
FT23B02	BY-PRODUCTS IN MEAT AND POULTRY PROCESSING	PE	3	0	0	3

Objectives:	
●	To learn about the production and use of meat products.
●	To study fish byproducts and their applications.
●	To understand egg products and their functions.
●	To explore ingredients used in processed meat.
●	To learn about meat alternatives and their importance.

UNIT-I	MEAT PRODUCTS	9
Flavours and Flavour Generation of Meat Products, Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Meat Fermentation, Developments in Meat Bacterial Starters. By product utilization in meat industries		
UNIT-II	INTRODUCTION TO POULTRY	9
Definition of Poultry, Importance of Poultry Farming, and Poultry development in India. Present status and future prospectus of poultry Industry. Origin of the chicken and Classification of Poultry based on Genetics utility. Classification of chicken as per international standards. Commonly Occurring Anti-Nutrients, and Antibiotics in Poultry Feed Ingredients and its Effect on Egg and Meat Nutrition.		
UNIT-III	INTRODUCTION TO SEA FOODS	9
Introduction, Marine species, Aquaculture, Seafood spoilage, Seafood hazards, Pre-mortem handling, post-mortem handling.		
UNIT-IV	SLAUGHTERING OF ANIMALS AND POULTRY	9
Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Factors affecting post-mortem changes, properties and shelf-life of meat; Meat quality evaluation; Mechanical deboning, meat tenderization.		
UNIT-V	RECENT TRENDS IN MEAT PROCESSING	9
Precision Meat Processing: Technologies for customized product creation. Smart Sensors and IoT: Real-time monitoring and control improvements. Advanced Packaging: Innovations in extending shelf life and reducing spoilage. Integration of AI: Role of artificial intelligence in processing and quality control. Color, flavors, microbiology and spoilage factors of meat and meat products.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand different variety of meats and its handling.
●	Familiarize with the concept of meat processing.
●	Get insights into basics of marine food processing.
●	Understand the basics of poultry processing.
●	Discuss egg processing and its related aspects.

Text Books:	
1	Govindan. T.K, —Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2	Lawrie, R.A. —Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3	Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology, Second Edition, AVI, Westport, 1977

Reference Books / Web links:	
1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B02. 1	2	2	2	2	2	2	1	1	2	2	1	2	2	1	2
FT23B02. 2	3	1	2	1	1	3	2	2	2	1	1	3	2	1	2
FT23B02. 3	1	1	2	1	1	3	1	1	2	1	2	3	1	2	3
FT23B02. 4	1	2	2	2	2	2	2	1	1	2	1	2	2	1	2
FT23B02. 5	2	2	3	2	2	2	2	2	2	1	1	2	2	1	2
Average	1.8	1.6	2.2	1.6	1.6	2.4	1.6	1.4	1.8	1.4	1.2	2.4	1.8	1.2	2.2

Subject Code	Subject Name	Category	L	T	P	C
FT23B03	PRESERVATION TECHNOLOGY OF EGGS, MEAT AND POULTRY	PE	3	0	0	3

Objectives:

- To understand various techniques for preserving meat.
- To learn the methods of canning and curing fish.
- To explore techniques and new technologies for preserving seafood.
- To understand how to preserve poultry meat and manage its quality.
- To gain knowledge of techniques used for preserving eggs.

UNIT-I	MEAT	9
The storage and preservation of meat: Preservation of meat- chilling, freezing, curing, smoking, canning, dehydration, irradiation, freeze drying, antibiotics, microwave, chemicals. Moisture control, Direct microbial inhibition.		
UNIT-II	POULTRY	9
Biochemical Changes During Onset and Resolution of Rigor Mortis Under Ambient Temperature, Physicochemical Changes During Freezing and Thawing of Poultry Meat, Low-Temperature Storage of Poultry, Engineering Principles of Freezing, Quality of Frozen Poultry, Quality of Refrigerated Poultry, Refrigeration Equipment and Operations, Freezing Equipment and Operations, Refrigeration and Freezing in Industrial Food Facilities (Hospitals, Restaurants, Factories). Heating, Drying, and Chemicals, Irradiation		
UNIT-III	EGG	9
Preservation of eggs, refrigeration and freezing, thermal processing, dehydration, coating		
UNIT-IV	FISH	9
Canning - Principles of canning, classification based on pH groupings, effect of heat processing on fish, storage of canned fish, pre-process operations, and post process operations, canning operations for specific canned products (Tuna, Mackerel and Sardine). Curing- Salting, Marinating and Smoking (smoke production, smoke components, quality, safety and nutritive value of smoked fish, processing and equipment, pre-smoking processes, smoking process control) operations.		
UNIT-V	OTHER SEAFOODS	9
Preservation of shrimp and lobsters, methods and regulations critical to maintaining quality and safety. Freezing techniques (blast freezing and cryogenic methods), canning processes (thermal processing and packaging), drying and dehydration (air and freeze drying), salting and brining (concentration and effects), and smoking (cold and hot techniques). Novel technologies - High-Pressure Processing (HPP) and Pulsed Electric Fields (PEF), quality control measures like HACCP and GMP.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Comprehensive Understanding of Meat Preservation Techniques
- Expertise in Canning and Curing of Fish.
- Knowledge of Seafood Preservation Techniques and Emerging Technologies.
- Understanding of Poultry Meat Preservation and Quality Management.
- Proficiency in Egg Preservation Techniques.

Text Books:	
1	Govindan. T.K, —Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2	Lawrie, R.A. —Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3	Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology, Second Edition, AVI, Westport, 1977

Reference Books / Web links:	
1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B03. 1	2	1	1	2	2	2	1	1	2	1	1	2	2	2	2
FT23B03. 2	3	3	2	3	3	3	2	1	2	2	1	3	2	1	2
FT23B03. 3	3	2	2	2	3	3	1	2	2	2	1	3	1	2	2
FT23B03. 4	3	3	2	3	3	2	2	1	3	1	1	2	3	2	1
FT23B03. 5	3	2	1	2	2	1	2	1	1	2	2	2	1	1	3
Average	2.8	2.2	1.6	2.4	2.6	2.2	1.6	1.2	2	1.6	1.2	2.4	1.8	1.6	2

Subject Code	Subject Name	Category	L	T	P	C
FT23B04	MARINE FOOD PROCESSING	PE	3	0	0	3

Objectives:

●	To understand the seafood industry and its nutritional value.
●	To learn techniques for fish processing.
●	To explore fish fermentation and future trends.
●	To study methods of fish waste management.
●	To learn about seaweeds and their use in fermentation.

UNIT-I	INTRODUCTION	9
History of seafood industry; Types of fish – major cultured species, underutilized fishery species; Composition, Major and minor nutrients present in sea food, nutrient intake recommendations, nutrition labelling for sea food, structure and spoilage factors of fish. Techniques for harvesting fish; Post harvest quality changes, post-harvest losses, methods for assessing and preventing losses.		
UNIT-II	FISH PROCESSING	9
Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Shellfish Handling and primary processing; Chilling of fish, Freezing and Individual quick freezing, Heat processing of Fish; Radiation processing of fish and fish products. Drying - Traditional chimney kiln, modern mechanical fish smoking kiln of fish. Overview on – Crabs, Lobsters, Prawns, Shrimps.		
UNIT-III	FISH FERMENTATION	9
Introduction to fermentation in Food Technology;; Lactic Acid Fermentation; Traditional salt/fish fermentation; Classification of fermented fish; Future trends in fish fermentation technology.		
UNIT-IV	FISH WASTE MANAGEMENT	9
Introduction, Treatment methods – Hydrolysis, Bioremediation, Anaerobic treatment, Filtration/Screening. Uses of fish waste – Animal feed, Biogas, Natural pigments, Inputs and outputs in fisheries.		
UNIT-V	SEAWEEDS AND ITS APPLICATION	9
Introduction to seaweeds, Chemical composition; Saccharification of seaweeds; Lactic Acid fermentation of sea weeds; Applications of fermented products in food; Future prospects of seaweed fermentation.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Understand the significance and nutritional value of seafood.
●	Apply basic fish processing and preservation techniques.
●	Describe methods and trends in fish fermentation.
●	Identify sustainable fish waste management practices.
●	Recognize the role of seaweeds in fermentation.

Text Books:

1	T.K. Bose, V.A. Parthasarathy, and P. Das, “A Textbook of Plantation Crops”, 2 nd edition, Naya Udyog, 2002
2	Shanmugavelu KG , Kumar N, Production Technology of Spices and Plantation Crops, 1st Edition, Peter Page 194 of 215 KV Publisher : Agrobios (India), 2018

Reference Books / Web links:

1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
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2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B04. 1	2	1	2	2	2	2	1	2	1	1	1	2	2	2	2
FT23B04. 2	3	2	2	3	3	3	2	1	2	1	1	3	2	2	1
FT23B04. 3	3	3	2	2	3	3	1	1	1	1	1	3	1	2	2
FT23B04. 4	3	2	2	3	2	2	2	2	1	1	1	2	2	2	2
FT23B04. 5	1	2	1	1	3	1	2	2	1	1	3	2	1	1	1
Average	2.4	2	1.8	2.2	2.6	2.2	1.6	1.6	1.2	1	1.4	2.4	1.6	1.8	1.6

Subject Code	Subject Name	Category	L	T	P	C
FT23B05	TECHNOLOGY OF PACKAGING MEAT, POULTRY AND MARINE PRODUCTS	PE	3	0	0	3

Objectives:

●	To understand packaging materials and their functions.
●	To learn techniques for packaging cooked meats and muscle-based processed foods.
●	To apply Modified Atmosphere Packaging (MAP) principles to meat and fish products.
●	To study packaging methods for poultry products and eggs.
●	To explore trends in packaging materials for meat, fish, and poultry.

UNIT-I	INTRODUCTION	9
Introduction, Packaging materials and its functions – Metal containers, Ethylenic and Non – ethylenic Thermoplastic, Package design and packaging equipment's, Packaging safety		
UNIT-II	PACKAGING OF COOKED MEATS AND MUSCLE BASED PROCESSED FOODS	9
Cooked meats, Packaging requirements for muscle-based cooked food products, Consumer trends in food packaging, choosing packaging materials for cooked meat products, Packaging materials and forms used on cooked meat and muscle-based, convenience-style food products – Wrapping, Film packing, Tray packing, Vacuum packaging, MAP.		
UNIT-III	PACKAGING OF FISH AND FISHERY PRODUCTS	9
MAP principles and importance for packaging fresh fish, non-microbial effects of MAP, Effects of MAP on - fish spoilage, and microbial safety of fish products, Application of MAP on fish and fishery products.		
UNIT-IV	PACKAGING OF POULTRY PRODUCTS	9
Packaging of Egg and Egg Products, Over-wraps, Tray with over-wraps, Shrink film with over-wraps. Vacuum packaging, MAP.		
UNIT-V	TRENDS IN PACKAGING MATERIALS FOR MEAT, FISH AND POULTRY	9
Over-wrapping / stretch-wrapping, Vacuum packaging, MAP, Boil and steam cooking packaging, Retort sterilized packaging, Smart packaging, Packaging with enclosed free-oxygen scavenging agent – Future trends.		
		Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

●	Understanding of Packaging Materials and Functions
●	Proficiency in Packaging Cooked Meats and Muscle-Based Processed Foods.
●	Application of MAP Principles in Packaging Fresh Fish and Fishery Products
●	Knowledge of Packaging Poultry Products and Eggs.
●	Awareness of Trends in Packaging Materials for Meat, Fish, and Poultry

Text Books:

1	NIIR Board of Consultants & Engineers, The Complete Book on Meat Processing and Preservation with Packaging Technology
2	Gordon. L Robertson, Food Packaging, Practice and Principles, 3 rd edition, 2012

Reference Books / Web links:

1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B05. 1	2	1	2	2	2	2	1	2	1	1	1	2	2	2	2
FT23B05. 2	3	2	2	3	3	3	2	1	2	1	1	3	2	2	1
FT23B05. 3	3	3	2	2	3	3	1	1	1	1	1	3	1	2	2
FT23B05. 4	3	2	2	3	2	2	2	2	1	1	1	2	2	2	2
FT23B05. 5	1	2	1	1	3	1	2	2	1	1	3	2	1	1	1
Average	2.4	2	1.8	2.2	2.6	2.2	1.6	1.6	1.2	1	1.4	2.4	1.6	1.8	1.6

Subject Code	Subject Name	Category	L	T	P	C
FT23B06	QUALITY, LAWS AND REGULATIONS IN MEAT, POULTRY AND SEAFOOD INDUSTRIES	PE	3	0	0	3

Objectives:

●	To gain proficiency in quality control techniques for meat products.
●	To understand regulations and quality control for fish products.
●	To assess and manage the quality of shrimp and lobster.
●	To study chemical residues and HACCP in poultry.
●	To learn egg quality assessment and sanitation practices.

UNIT-I	MEAT	9
Physical Sensors for Quality Control during Processing, Sensory Evaluation of Meat Products, Detection of Chemical Hazards, and Microbial Hazards in Foods: Food-Borne Infections and Intoxications, Assessment of Genetically Modified Organisms (GMO) in Meat Products by PCR, HACCP: Hazard Analysis Critical Control Point, Quality Assurance. Effects of feed, breed and environment on production of meat animals and their quality Meat Quality-color, flavor, texture, Water-Holding Capacity (WHC), Emulsification capacity of meat.		
UNIT-II	FISH	9
National and International Regulations, Standards, Quality Control and Marketing of Fish and Fish Products; Grading Standards of Fish; Quality assessment by Chemical, Physical and sensory methods. Risk characterization		
UNIT-III	SHRIMP AND LOBSTER	9
Overview of shrimp and lobster and aquaculture, Quality assessment methods for shrimp and lobster, Physical, chemical, and sensory evaluation, grading systems and standards, factors affecting quality harvesting, handling, and storage methods, processing techniques, Microbiological contaminants in shrimp and lobster, pathogens (e.g., Vibrio, Salmonella), testing and control measures		
UNIT-IV	POULTRY	9
Chemical Residues: Pesticides and Drugs (β -Agonists and Antibiotics), Factors Affecting Microbial Growth in Fresh Poultry, Basic Principles of the HACCP System in the Poultry Industry, HACCP in Poultry Slaughterhouses, Online Inspection Poultry-Related Foodborne Disease, Overview of Poultry Processing and Workers' Safety, Poultry-Processing Industry and eTool. Grading of poultry meat - Grade I, Grade II		
UNIT-V	EGGS	9
Preservation of shrimp and lobsters, methods and regulations critical to maintaining quality and safety. The Nutritive value of Eggs after cooking; Quality identification of shell eggs; Factors affecting egg quality and measures of egg quality. Selection of types of Detergents and Sanitizers for controlling Egg Quality and Poultry Products		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Proficiency in Quality Control Techniques for Meat Products.
●	Understanding of Regulations and Quality Control in Fish Products.
●	Quality Assessment and Management in Shrimp and Lobster.
●	Knowledge of Chemical Residues and HACCP in Poultry.
●	Egg Quality Assessment and Sanitation Practices.

Text Books:	
1	Govindan. T.K, —Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2	Lawrie, R.A. —Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3	Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology, Second Edition, AVI, Westport, 1977

Reference Books / Web links:	
1	Joseph Kerry, John Kerry and David Ledwood. —Meat Processing, Woodhead Publishing Limited, England (CRC Press), 2002.
2	Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3	Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

PO/PSO CO	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23B06.1	2	1	1	2	1	2	1	2	2	1	2	2	2	2	2
FT23B06.2	3	3	2	3	2	3	2	1	2	1	2	2	2	2	2
FT23B06.3	2	2	3	2	1	3	1	2	1	2	1	3	3	2	3
FT23B06.4	3	3	2	3	2	2	2	2	1	2	2	2	2	2	2
FT23B06.5	2	1	2	2	1	1	1	2	2	3	1	1	2	1	1
Average	2.4	2	2	2.4	1.4	2.2	1.4	1.8	1.6	1.8	1.6	2	2.2	1.8	2

VERTICAL III - GRAIN SCIENCE TECHNOLOGY AND PLANTATION CROPS

Subject Code	Subject Name	Category	L	T	P	C
FT23C01	PROCESSING OF CEREALS, OIL SEEDS AND PULSES	PE	3	0	0	3

Objectives:	
●	To learn the fundamental principles involved in the processing of cereals, oilseeds, and pulses
●	To equip students with comprehensive knowledge and skills in the processing of oilseeds
●	To provide an in-depth understanding of the processing technologies for wheat and rice
●	To develop a thorough understanding of the principles and technologies involved in the processing of cereals
●	To impart knowledge on the processing techniques for maize

UNIT-I	CEREALS, OIL SEED AND PULSES	9
Chemical composition and characters of cereals, oil seed and pulses. Anti-nutritional factors, removal of anti-nutritional factors. Post-harvest technology of oils seeds. Handling, drying, storage, grading, pre-treatments, cleaning, dehulling, solving problems in size reduction and flaking.		
UNIT-II	OIL SEED PROCESSING	9
Oil seeds processing, Sesame, Coconut, Groundnut, Mustard, Soybean, Sunflower, Safflower. Oil seeds extraction traditional methods, New Technologies in oil seed processing, Calculation of extraction efficiency, new technologies in oilseed processing, Modification of oil seed process- Hydrogenation, chemical process- interesterification, dry fractionation, utilizations of oil seed meals of different food use. Desolventization and refining of oils; degumming, neutralization bleaching, filtration, deodorization.		
UNIT-III	PROCESSING OF WHEAT AND RICE	9
Wheat-types, milling, flour grade, flour treatments-bleaching, maturing, types of flour for baking technology of dough development, Marconi products. Oil extraction- mechanical expression of oil-Ghani, power, Ghani, rotary, hydraulic press, screw press expellers, filter press.; solvent extraction process. Other source of edible oil like rice bran, corn germ oil.		
UNIT-IV	PROCESSING OF CEREALS	9
Corn-milling (wet and dry), cornflakes. Barely-Milling, Malting, Processing of beer. Oats- Milling (oatmeal, oat flour & oat flakes). Sorghum, Pearl Millet, finger millet-Milling.		
UNIT-V	PROCESSING OF MAIZE	9
Structure-composition of maize-milling methods-Pre-cleaning-cleaning equipment -degermination and dehusking -Dry milling of maize-wet milling -flow chart-Products of milling-Flour-Semolina-Brewer' grits and their applications.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand the structure and composition of cereals, pulses, and oilseeds.
●	Gain knowledge of oil extraction methods from oilseeds.
●	Understand Wheat and Rice Processing Technologies
●	Identify suitable equipment for processing of cereals.
●	Understand and master Maize Processing Techniques

Text Books:	
1	Colin Wrigley, Harold Corke, Koushik Seetharaman, and Jon Faubion, "Cereal Grains: Assessing and Managing Quality", 2nd Edition. Woodhead Publishing, 2016.
2	A. Chakraverty, Arun S. Mujumdar, G.S.V. Raghavan, and H.S. Ramaswamy, "Post-Harvest Technology of Cereals, Pulses and oilseeds", 3rd edition., CRC Press, 2014.
3	Karel Kulp and Joseph G. Ponte, "Handbook of Cereal Science and Technology", 2nd Edition., CRC Press, 2000.
4	Brijesh K. Tiwari, Narpinder Singh, and Alice A. Y. Hamid, "Pulses Chemistry, Technology, and Processing" 1st edition, CRC press, 2011

Reference Books / Web links:	
1	Gavin Owens," Cereal Processing Technology",2nd edition, Woodhead Publishing, 2001
2	D.K. Salunkhe, J.K. Chavan, R.N. Adsule, and S.S. Kadam," Oilseeds: Chemistry, Technology, and Utilization", 3rd edition, CRC Press, 1992.
3	Y. Pomeranz," Modern Cereal Science and Technology",1st edition, VCH Publishers, 1987.
4	Gopal Krishna and D.M. Sirohi," Technology of Oilseeds Processing", Oxford & IBH Publishing Co., 1990.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C01.1	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1
FT23C01.2	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1
FT23C01.3	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1
FT23C01.4	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1
FT23C01.5	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1
Average	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1

Subject Code	Subject Name	Category	L	T	P	C
FT23C02	INFESTATION AND PEST CONTROL IN GRAIN STORAGE	PE	3	0	0	3

Objectives:	
●	Learn the principles of grain storage and factors affecting grain quality.
●	Understand the biology and behavior of common storage pests.
●	Explore infestation prevention and control measures.
●	Apply modern technologies and regulatory frameworks in pest control.
●	Analyze integrated pest management (IPM) strategies.

UNIT-I	INTRODUCTION TO GRAIN STORAGE	9
Grain storage – principles, moisture movement during bulk storage of grains, pressure distribution in storage bins, methods of aeration, various theories, Physical, chemical, microbiological and sensory changes occurring during storage, Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations.		
UNIT-II	BIOLOGY OF STORAGE PESTS	9
Insects and pests – types, extent of losses during storage, causes and control measures, Insecticides-principles, scope of application in warehouses; requirements, group of active ingredients, choice, toxicity, resistance, application techniques, Fumigants - chemicals, areas of application, choice, toxicity, application rates, exposure time and resistance. Rodenticides - types and effectiveness and limitations, important moulds and bacteria involved in spoilage of grains; effect on physico- chemical and sensory quality of grains; Mycotoxins.		
UNIT-III	INFESTATION MANAGEMENT	9
Types of damages caused by pests - Monitoring and surveillance techniques - Preventive measures: Cleaning, hygiene, and facility design. Role of moisture content and temperature control. Air tight, controlled atmosphere and modified atmospheric storage; differences, principles, optimization of storage gas composition, rate of supply, control systems for oxygen and carbon dioxide- their effect on microbes and limitations.		
UNIT-IV	PEST CONTROL METHODS	9
Physical Methods: Temperature treatment, aeration, and mechanical barriers. Chemical Methods: Fumigants, insecticides, and rodenticides. Biological Control: Predators, parasitoids, and microbial agents. Cultural Practices: Crop rotation, resistant varieties, and timely harvest. Modern technologies in pest detection and control: Sensors, AI, and IoT. Use of drones in pest management. Regulatory guidelines and safety standards in pest control. Environmental impacts and sustainable practices.		
UNIT-V	INTEGRATED PEST MANAGEMENT	9
Economic Threshold Level – Economic Injury Level – Principles and methods of IPM–physical – mechanical – cultural – host plant resistance – chemical–biological control – predators – parasitoids – microbial control – use of attractants and repellents –Male sterility techniques – Pheromones – Insecticide Formulations – Application methods – plant protection appliances		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Evaluate the factors affecting grain quality and storage efficiency.
●	Identify common storage pests, and analyze the environmental factors contributing to infestations.
●	Develop and apply practical strategies to prevent pest infestations
●	Evaluate and implement various pest control methods with a focus on safety and efficacy.
●	Integrate multiple pest management strategies for sustainable and cost-effective solutions.

Text Books:	
1	David W. Hagstrum, Thomas W. Phillips, and Gerrit Cuperus, "Stored Product Protection, 1st edition, Kansas State University, 2012.
2	Bhadriraju Subramanyam and David W. Hagstrum," Integrated Management of Insects in Stored Products", 1st edition, CRC Press, 1995.
3	R. B. H. Wills, B. McGlasson, D. Graham, and T. Joyce, "Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals", 5th edition, CAB International, 2007.
4	Bhadriraju Subramanyam and Ramesh N. Bhargava,"Principles of Stored Product Entomology", 1st edition, CBS Publishers & Distributors, 2002.

Reference Books / Web links:	
1	Food and Agriculture Organization (FAO)," Manual on the Prevention of Post-Harvest Grain Losses", Revised Edition, 2013.
2	John R. Gorham,"Ecology and Management of Food-Industry Pests", 1st edition, Food and Drug Administration (FDA) & AOAC International, 1991.
3	David W. Hagstrum, Steve W. Flinn, and Bhadriraju Subramanyam,"Pest Management in Stored Grain Ecosystems", Springer Science Business Media" 1st edition, 1999.
4	Peter Golob, Graham Farrell, and John E. Orchard," Post-Harvest Grain Losses Assessment Methods", Natural Resources Institute (NRI), 1st edition, 2002.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C02.1	3	2	2	2	2	1	3	1	1	1	2	2	2	3	3
FT23C02.2	2	2	2	2	2	1	3	1	1	1	2	2	2	3	3
FT23C02.3	2	2	3	2	2	3	3	1	1	1	2	2	2	3	3
FT23C02.4	3	2	3	2	3	3	3	1	1	1	2	2	2	3	3
FT23C02.5	3	2	3	2	3	3	3	1	1	1	2	2	2	3	3
Average	2.6	2	2.6	2	2.4	2.2	3	1	1	1	2	2	2	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23C03	OILS AND FATS PROCESSING TECHNOLOGY	PE	3	0	0	3

Objectives:	
●	To provide a comprehensive understanding of the physical and chemical properties of oils
●	To equip students with knowledge of various oil and bioactive compound extraction methods
●	To provide an in-depth understanding of the refining processes for oils
●	To familiarize students with the production, processing, and applications of various fat and oil products
●	To impart knowledge on the principles and techniques of edible oil packaging

UNIT-I	PHYSICAL AND CHEMICAL PROPERTIES OF OIL	9
Sources; chemical composition; physical and chemical characteristics; functional and Nutritional importance of dietary oils and fats. Post-harvest and ling storage and processing of Oilseeds for directs use and consumption, importance of oil seeds processing in India.		
UNIT-II	EXTRACTION METHODS	9
Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes Suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ.		
UNIT-III	REFINING OF OILS	9
Degumming, refining, bleaching, hydrogenation, fractional crystallization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining), bleaching, deodorization techniques/processes. Blending of oils. Chemical adjuncts- lecithin, monoglycerides and derivatives, propylene glycol esters, polyglycoesters, Hydrogenation, fractionation, winterization, inter-esterification for obtaining tailor-made fats and oils.		
UNIT-IV	FAT AND OIL PRODUCTS	9
Production of butter oil lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low Fat spreads, peanut butter etc. Specialty fats and designer lipids for nutrition and dietetics, especially by biotechnology. Mayonnaise and salad dressings. Confectionery coatings. Imitation dairy products- peanut butter and vegetable ghee.		
UNIT-V	PACKAGING OF EDIBLE OILS	9
Packing and storage of fats and oils, cocoa butter, fat substitutes. Changes during storage of oil – rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – Colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Assess the physical and chemical properties of fats and oils
●	Infer different methods of oil extraction for edible purpose
●	Analyze the principle and methodology of solvent extraction and refining of oils
●	Interpret the techniques involved in manufacturing of edible oil, fat products and modified oil
●	Demonstrate an appropriate process in package and storage for oils

Text Books:	
1	Bailey, "Industrial Oil and Fat Products", John Wiley and Sons.6th edition, 2005
2	Ernesto M. Hernandez and Afaf Kamal-Eldin, ""Processing and Nutrition of Fats and Oils", Wiley-

	Blackwell, 1st Edition, 2013.
3	George M. Gray and Peter M. Williams,” The Chemistry and Technology of Edible Oils and Fats”, Pergamon Press, 1st edition, 1998.
4	Frank D. Gunstone, John L. Harwood, and Albert J. Dijkstra, “Handbook of Lipid Technology”, Wiley-Blackwell, 2nd edition, 2007
5	Wolf Hamm and Richard J. Hamilton,” Edible Oil Processing”, Wiley-Blackwell, 2nd edition, 2013.

Reference Books / Web links:

1	M.M. Chakrabarty, Chemistry and Technology of Oils & Fats, Applied Publisher, 2003.
2	Wolf Hamm, Richard J. Hamilton, Gijs Calliauw, Edible Oil Processing, 2nd Edition Wiley-Blackwell, 2013
3	Casimir C. Akoh and David B. Min, “Food Lipids: Chemistry, Nutrition, and Biotechnology”, CRC Press, 4 th edition, 2017.
	Casimir C. Akoh, “Handbook of Functional Lipids”, CRC Press, 1 st edition, 2005.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C03.1	3	1	3	3	1	2	2	1	1	1	1	1	3	1	1
FT23C03.2	3	3	3	2	1	1	2	1	1	1	2	2	3	3	1
FT23C03.3	3	3	2	2	2	2	3	3	1	1	1	2	3	3	1
FT23C03.4	3	3	3	3	3	3	3	3	1	1	1	1	2	2	1
FT23C03.5	3	2	3	3	3	3	3	3	1	1	1	1	2	2	1
Average	3	2.4	2.8	2.6	2	2.2	2.6	2.2	1	1	1.2	1.4	2.6	2.2	1

Subject Code	Subject Name	Category	L	T	P	C
FT23C04	SPICE PROCESSING TECHNOLOGY	PE	3	0	0	3

Objectives:	
●	To understand the basics about spices and condiments.
●	To equip students with knowledge of the chemical composition, functional properties, and processing technologies of major and minor spices,
●	To impart knowledge of the various equipment used in spice processing
●	To impart knowledge on the principles and techniques of drying and storage for major and minor spices,
●	To deliver knowledge on the principles and techniques of different forms of spices.

UNIT-I	OVERVIEW OF SPICES AND CONDIMENTS	9
Spices and Condiments - Description of various types of spices and condiments, their composition, functional properties, flavoring agents. Nutritive value of spices and their health benefits. Intermediate Moisture Products viz., ginger paste, ginger garlic paste, tamarind paste, tamarind concentrate, processing of spices like chili, turmeric pepper, ginger.		
UNIT-II	CHEMISTRY AND TECHNOLOGY OF MAJOR MINOR SPICES	9
Pepper, Cardamom, ginger, turmeric, Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove, Vanilla and essential oils - Method of manufacture, Chemistry of the volatiles, Enzymatic synthesis of flavor identical – Quality control.		
UNIT-III	EQUIPMENT IN SPICE PROCESSING	9
Spice cleaning - Magnets, sifters, air tables, destoners, sir separators, indent separators, spiral separators. Spice reconditioning. Spice grinding - Different mills sifting operations, ambient condition grinding, and cryogenic grinding. Post processing treatments - Ethylene oxide, propylene oxide, irradiation, steam sterilization.		
UNIT-IV	DRYING AND STORAGE OF MAJOR AND MINOR SPICES	9
Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of major and minor spice crops, viz., Pepper, Cardamom, onion, ginger, turmeric, Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove, Vanilla, Extraction of oleoresin and essential oils.		
UNIT-V	FORMS, FUNCTIONS, AND APPLICATION OF SPICES	9
Spice forms and composition – fresh whole spices, dried spices. Spice extractives – essential oils, oleoresins, other spice extractives. Functions of spices – primary function of spices, secondary function – preservatives, antimicrobials, antioxidants. Emerging functions of spices – spices as medicines, traditional medicine, and modern medicine.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze the roles of Spices and Condiments in Industrial applications.
●	Analyze the chemical composition and functional properties of major and minor spices.
●	Identify and evaluate different types of equipment used in spice processing
●	Apply appropriate drying techniques and storage methods for both major and minor spices
●	Comprehend the functional roles of spices in enhancing flavor, aroma, and nutritional value across different industries.

Text Books:	
1	Minor spices and condiments: crop management and post-harvest technology. J.S.Purthi, ICAR Publication, 1st edition 2001
2	R. K. P. G. V. S. M. Rao, "Spices and Their Applications", Springer, 2017.
3	J.S.Purthi, 1st edition, Major spices of india crop management and post-harvest technology. ICAR Publication.2003
4	K. S. S. N. Murthy and T. P. A. K. Reddy, "Spices and Condiments: Processing and Technology", CRC Press, 2020.
5	K. V. Peter, "Technology of Spices and Seasonings", CRC Press, 2009

Reference Books / Web links:	
1	Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004.
2	K. V. Peter, "Spices: Volume 1: Production, Technology, Chemistry", 1st Edition, CRC Press, 2001.
3	Kenji hirasa and mitsuo takemasam., Spice science and technology, CRC Press, 1998
4	K. V. Peter, "Handbook of Herbs and Spices: Volume 2", 1st Edition, Woodhead Publishing, 2004.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C04.1	2	2	2	3	2	3	3	3	1	1	1	1	2	2	1
FT23C04.2	2	3	3	3	2	3	3	3	1	1	1	1	3	2	1
FT23C04.3	3	3	2	3	2	3	3	3	1	1	1	1	3	3	1
FT23C04.4	3	3	2	3	3	3	3	3	1	1	1	1	2	2	1
FT23C04.5	3	3	3	3	2	3	3	3	1	1	1	1	2	2	1
Average	2.6	2.8	2.4	3	2.2	3	3	3	1	1	1	1	2.4	2.2	1

Subject Code	Subject Name	Category	L	T	P	C
FT23C05	PLANTATION CROPS	PE	3	0	0	3

Objectives:	
●	To understand the basics of plantation crops.
●	To Examine the primary chemical constituents of coffee.
●	To comprehend knowledge on tea processing techniques.
●	To Explore the biochemical changes and flavor profiles of coco beans.
●	To familiarize students with various drying methods for different plantation crops

UNIT-I	OVERVIEW OF PLANATATION CROPS	9
Plantation crops-description of various types of plantations crops viz. coconut, areca nut coffee, tea, cocoa etc. processing and preservation methods. Value added and shelf stable products viz., bottled coconut water, desiccated coconut powder, coffee concentrate.		
UNIT-II	CHEMISTRY AND TECHNOLOGY OF COFFEE	9
Coffee – Occurrence - chemical constituents- harvesting - fermentation of coffee beans - changes taking place during fermentation - drying – roasting - decaffeination - Process flow sheet for the manufacture of coffee powder - Instant coffee, technology - Chicory chemistry – Quality grading of coffee		
UNIT-III	TEA - CHEMISTRY AND TECHNOLOGY	9
Occurrence - chemistry of constituents- harvesting - types of tea - green, oolong and ctc - Chemistry and technology of CTC tea- Manufacturing process - Green tea manufacture - Black tea – semi fermented tea - Instant tea manufacture - Grading of tea		
UNIT-IV	CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS	9
Occurrence - Chemistry of the cocoa bean- changes taking place during fermentation of cocoa Bean - Processing of cocoa bean - cocoa powder - cocoa liquor manufacture. Chocolates - Types - Chemistry and technology of chocolate manufacture - Quality control of chocolates		
UNIT-V	DRYING AND STORAGE OF PLANTATION CROPS	9
Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of plantation crops, viz., coconut, arecanut, cashewnut, oil palm, palmyrah, cocoa, tea and coffee.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand the basics about plantation and its processing.
●	List the appropriate techniques for processing of coffee and its products
●	Analyze the chemical components of tea and its processing techniques
●	Identify the quality aspects of cocoa processing and chocolate manufacturing technology
●	Apply techniques that maintain crop quality, flavor, and nutritional value during storage.

Text Books:	
1	T.K. Bose, V.A. Parthasarathy, and P. Das, “A Textbook of Plantation Crops”, 2 nd edition, Naya Udyog, 2002.
2	Shanmugavelu KG, Kumar N, Production Technology of Spices and Plantation Crops, 1st Edition, Peter Page 194 of 215 KV Publisher: Agrobios (India), 2018
3	Clarke.R.J & Macrae.R – Coffee, Volume 2: Technology 1st edition.

4	Wilson.K.C – Tea-cultivation to consumption, Springer, 2012
5	Emmanuel., - Chocolate science and technology, Wiley, 2010

Reference Books / Web links:

1	Shanmugavelu KG, Kumar N, Production Technology of Spices and Plantation Crops, 1st Edition, Peter KV Publisher: Agrobios (India), 2018
2	P. N. Ravindran, “Spices, Plantation Crops, Medicinal and Aromatic Plants”, 1st edition, Oxford & IBH Publishing Co. Pvt. Ltd., 2004.
3	Minifie Bernard W.,Chocolate, Cocoa and Confectionery Technology, III Edition, Aspen Publication, 1999

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C05.1	1	1	2	1	2	1	3	2	1	1	1	1	2	2	1
FT23C05.2	2	2	2	1	1	2	3	2	1	1	1	1	3	2	1
FT23C05.3	1	2	3	1	2	1	3	2	1	1	1	2	3	3	1
FT23C05.4	1	1	2	2	2	1	3	2	1	1	1	2	2	2	1
FT23C05.5	2	2	1	2	2	1	3	2	1	1	1	2	2	2	1
Average	1.4	1.6	2	1.4	1.8	1.2	3	2	1	1	1	1.6	2.4	2.2	1

Subject Code	Subject Name	Category	L	T	P	C
FT23C06	QUALITY STANDARDS AND REGULATORY COMPLIANCE IN GRAIN AND CROP PROCESSING INDUSTRIES	PE	3	0	0	3

Objectives:	
●	To understand the principles of quality control and safety standards in grain marketing
●	To gain knowledge of the processes involved in analysis of spices and plantation products.
●	To learn the methods for packaging and grading of grain and crop products.
●	To equip students with the theoretical and practical knowledge necessary for assessing and managing the quality of grains
●	To comprehensive understanding of regulations associated with product labeling specifications in food industries.

UNIT-I	QUALITY CONTROL AND SAFETY IN GRAIN AND CROP MARKETING	9
Objectives, importance and functions of quality control, Importance of safety in marketing of grain and crop products - domestic and export markets. International organizations: ISO, CAC, WTO, USFDA, Codex, EIC. National organizations: FSSAI, BIS, CCFS, Agmark and APEDA, Good Laboratory Practices.		
UNIT-II	ANALYSIS OF SPICES AND PLANTATION PRODUCTS	9
Spices- Sample preparation, Determination of moisture, Acid insoluble ash, Determination of Cold-Water Extract, Determination of Alcohol Soluble Extract, Calcium Oxide, Non-Volatile Ether Extract, Volatile Oil, Crude Fiber Tea & Coffee- Preparation of sample, Moisture content, Total ash, Water soluble ash, Determination of Caffeine content by different methods, microscopic examination, Determination of solubility in boiling water, Determination of Iron filings and size of the particles, Test for presence of added coloring matter		
UNIT-III	PACKAGING, GRADING AND QUALITY ANALYSIS	9
Cleaning and grading - packaging and storage of grain and crop – grading specifications – AGMARK, ASTA, ESA specifications - processes involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives		
UNIT-IV	ASSESSING AND MANAGING GRAIN QUALITY	9
Assessing Grain Quality - Physical Aspects, Variety, Growth and Storage Conditions, Chemical Composition. Managing Grain Quality, Sampling Devices - Human Visual Analysis, Bulk Density (Test Weight), Moisture Content, Sieves and Dockage Tester, Protein Content, Wheat Hardness, ELISA Test Kits for Mycotoxins. Falling Number, NIR Spectroscopy, Digital Imaging, Hyper spectral Imaging, ELISA Test Kits for Insect Activity, Electronic Noses, X-ray Imaging for Internal Insects.		
UNIT-V	LABELING, STANDARDS, REGULATION AND QUALITY SPECIFICATION	9
Definition and labeling regulations, authenticity and quality concerns, quality specifications, maintaining quality.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Understand the importance of quality control of grain
●	Analyze the factors influencing grain quality during production, storage, and processing stages.
●	Demonstrate the ability to analyze and interpret mandatory labeling requirements for grain and crop products.
●	Develop and implement effective strategies for maintaining and improving grain quality at all stages of the value chain.
●	Apply knowledge of legal frameworks to ensure compliance with national and international regulations.

Text Books:	
1	Inteaz. A, Food Quality Assurance: Principles and Practices, Taylor and Francis, 2014
2	Andres V J, Quality Assurance for the Food Industry: A Practical Approach, CRC Press, 2004
3	Manoranjan K, Food analysis and Quality control, Kalyani Publishers, 2002
4	David K, Sensory Analysis for Food and Beverage Quality Control: A Practical Guide, Woodhead Publishing Ltd, 2010

Reference Books / Web links:	
1	ASTA, Official analytical methods of the American Spice Trade Association, IV Edition, 1997.
2	Pruthi, J.S. Spices and Condiments Chemistry, Microbiology and Technology. 1st Edition. Academic Press Inc., New York, USA. 2011.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23C06.1	2	2	1	2	1	2	1	2	1	1	1	2	1	1	2
FT23C06.2	1	3	2	2	2	1	1	1	2	3	2	3	2	2	1
FT23C06.3	2	1	1	1	3	2	1	2	2	1	1	2	3	2	2
FT23C06.4	1	2	2	2	2	3	2	2	2	2	1	1	1	2	1
FT23C06.5	1	2	1	1	1	2	1	1	3	2	3	2	2	1	1
Average	1.4	2	1.4	1.6	1.8	2	1.2	1.6	2	1.8	1.6	2	1.8	1.6	1.4

VERTICAL IV - TECHNOLOGY FOR FRUIT, VEGETABLE AND BEVERAGES

Subject Code	Subject Name	Category	L	T	P	C
FT23D01	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	PE	3	0	0	3

Objectives:

●	To understand the significance of fruits and vegetables
●	To learn the fundamentals of harvesting, maturity and ripening
●	To gain knowledge in postharvest handling techniques
●	To appreciate the packaging and storage techniques of fruits and vegetables
●	To recognize postharvest physiological disorders in fresh produce

UNIT-I	BASIC AGRICULTURAL ASPECTS	9
Importance of fruits and vegetables - Morphology, structure, classification and nutritional composition of fruit and vegetable - Postharvest losses: causes and its impact – Pre harvest factors on postharvest quality - Production and processing scenario of fruits and vegetable: India and World.		
UNIT-II	HARVESTING, MATURITY AND RIPENING	9
Harvesting of Fruits and Vegetables – Harvesting tools, Hand harvesting, Mechanical harvesting and its types, factors affecting harvesting. Maturity – Types, maturity index determination and factors affecting maturity – Effects of maturity on physico-chemical changes and ripening -Maturity index for selected fruits and vegetables - Fruit ripening- changes during fruit ripening, methods and its regulations		
UNIT-III	POST HARVEST HANDLING	9
Precooling – Importance and Methods - Room cooling, Forced-air cooling, Hydro-cooling, Ice cooling, Vacuum cooling, Cryogenic cooling, Evaporative cooling – Commodity pre-treatments - Washing, Cleaning and Trimming – Sorting, Grading and Sizing – Curing – Waxing		
UNIT-IV	PACKAGING AND STORAGE	9
Importance of packaging – Packaging materials for fruits and vegetables – Packaging Techniques – Storage Principles – Storage types – cold storage – controlled atmospheric storage – modified atmospheric storage – hypobaric storage – on farm storage		
UNIT-V	POST HARVEST PHYSIOLOGICAL DISORDERS	9
Introduction - Physiological Disorder of Tropical and Sub-tropical Produce: Causes - Low Temperature Disorders – Chilling Injury – Symptoms, Mechanisms - High Temperature Disorders – Storage atmosphere related disorders - Mineral Deficiency Disorders – Physiological disorders in selected fruits and vegetables		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Infer the importance, composition and post-harvest losses of fruits and vegetables
●	Identify suitable harvesting technique, determine maturity and ripening changes
●	Apply techniques such as precooling, cleaning, and grading to maintain postharvest quality
●	Select appropriate packaging materials and storage systems for preserving fruits and vegetables
●	Examine physiological disorders in selected produce and propose management strategies

Text Books:	
1	Hosahalli S. Ramaswamy. "Post-harvest Technologies of Fruits & Vegetables" DES tech publications, 2015.
2	L.R. Verma & V.K. Joshi. "Post-harvest Technology of fruits and vegetables: General concepts and Principles." Indus publishing, 2000.

Reference Books / Web links:	
1	Thompson, A.K. 1996. Post-harvest technology of fruits and vegetables. Blackwell Science Ltd., London
2	A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.

PO/PSO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3
FT23D01.1	3	1	2	2	1	3	2	1	1	1	1	3	3	2	3
FT23D01.2	3	2	2	2	1	3	2	1	1	1	1	3	3	3	3
FT23D01.3	3	2	3	2	2	2	2	1	1	1	2	3	3	3	3
FT23D01.4	3	2	3	2	2	2	2	1	1	1	2	3	3	3	3
FT23D01.5	3	2	2	2	2	2	2	1	1	1	1	3	3	2	3
Average	3	1.8	2.4	2	1.6	2.4	2	1	1	1	1.4	3	3	2.6	3

Subject Code	Subject Name	Category	L	T	P	C
FT23D02	VALUE ADDED FRUIT AND VEGETABLE PRODUCTS	PE	3	0	0	3

Objectives:	
●	To learn the freezing and drying technique for value addition of fruit and vegetable
●	To gain knowledge on various steps in canning of fruit and vegetable
●	To appraise the various fruit-based products
●	To understand the preservation techniques of vegetable products
●	To explore waste valorisation by utilizing peels, seeds, and pulp of fruit and vegetable

UNIT-I	VALUE ADDITION BY FREEZING, DRYING	9
General pre-processing, different freezing methods and equipment's, problems associated with specific fruits and vegetables; Dehydration – General pre-processing, different methods of drying, osmotic dehydration; Indian Food Regulation and Quality assurance.		
UNIT-II	VALUE ADDITION BY CANNING	9
Introduction – Types of can – Packaging materials, can making process – Steps in canning of fruit and vegetables – selection of raw materials, cleaning, blanching – Types, factors affecting, Filling – Methods, Exhausting - sealing – sterilization - Role of time and temperature in achieving adequate sterilization – Microbial safety and quality control – Labeling		
UNIT-III	FRUIT BASED VALUE-ADDED PRODUCTS	9
Overview – Importance, and Market Potential - Fruit Juices and Beverages – Types, processing techniques - Fruit Jams, Jellies, and Marmalades – Process, quality control - Dried Fruits and Fruit Powders - Fruit-based Confectioneries - Fruit Bars, Fruit Candies, and Gummies - Fruit-based Fermented Products – Wines, Cider, Vinegar - Fortified Fruit Products		
UNIT-IV	VEGETABLE BASED VALUE-ADDED PRODUCTS	9
Overview - Introduction and Economic Significance - Vegetable Juices – Extraction methods – Vegetable soups – Pickles – Preparation, fermentation – Vegetable snacks – Dehydrated chips, RTE products – Sauces and Pastes – Fermented products - Sauerkraut, Kimchi – Meat substitutes - Vegetable-Based Functional Foods		
UNIT-V	FRUIT AND VEGETABLE WASTE VALORIZATION	9
Scope of fruit and vegetable waste management - Sources and types of fruit and vegetable waste - Fruit and Vegetable Peels – nutritional value and application – Seeds – oil extraction, seed based snack, health supplement - Vegetable Pulp and Fibrous By-Product – application in bakery product – Bioactive compounds – functional foods from fruit and vegetable.		
		Total Contact Hours : 45

Course Outcomes:	
On completion of course students will be able to	
●	Apply the freezing and drying technique to process and preserve the fruit and vegetable produce
●	Infer the application of canning techniques
●	Select the appropriate methods to process various fruit-based products
●	Apply the suitable techniques to produce value added vegetable products
●	Develop value added products from fruit and vegetable wastes

Text Books:	
1	Hosahalli S. Ramaswamy. "Post-harvest Technologies of Fruits & Vegetables" DES tech publications, 2015.
2	N. P. Singh. "Fruit and Vegetable Preservation" Oxford Book Company, 2007

Reference Books / Web links:	
1	A.K.Anal. "Food Processing By-Products and Their Utilization" Wiley, Germany, 2017
2	A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23D02.1	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2
FT23D02.2	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2
FT23D02.3	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2
FT23D02.4	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2
FT23D02.5	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2
Average	3	3	3	3	2	2	2	1	1	1	2	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23D03	PACKAGING AND STORAGE TECHNIQUES IN FRUIT AND VEGETABLE	PE	3	0	0	3

Objectives:	
●	To understand packaging materials and their functions
●	To learn various packaging technologies and its applications
●	To explore active, intelligent, and smart packaging systems
●	To appraise traditional and modern storage techniques
●	To comprehend controlled, hypobaric, and hyperbaric storage methods

UNIT-I	INTRODUCTION TO PACKAGING OF FRUITS AND VEGETABLES	9
Introduction to Packaging of Fruits and Vegetables - Types of packaging materials, Basic functions – Types of packaging materials and packages – Barrier properties- Factors Influencing the Selection of Packaging material – Effect on quality of fruits and vegetables		
UNIT-II	PACKAGING TECHNOLOGIES	9
Modified Atmosphere Packaging – Principles, Effect on shelf life of fruits and vegetables Shrink packaging of fruits and vegetables – Concept, benefits & application, non-migratory bioactive polymers (NMBPs), Antimicrobial packaging – basic concepts and applications in fresh and fresh-cut fruits and vegetables - Edible coating and their effect on their effect on post-harvest quality of fruits and vegetables		
UNIT-III	ACTIVE, INTELLIGENT AND SAMRT PACKAGING SYSTEMS	9
Active packaging of fresh and fresh-cut fruits and vegetables, Intelligent packaging applications of fruits and vegetables, Smart packaging technologies for fruit and vegetable beverage products – gas release, flavour release, nutrient release, enzyme release, thermos chromic labelling, smart branding, odour removal packaging, anti-counterfeit beverage packaging, tamper-proof packaging.		
UNIT-IV	INTRODUCTION TO STORAGE OF FRUITS AND VEGETABLES	9
Introduction – storage operation, harvest and pre-harvest factors, traditional and modern storage methods, changes during storage, factors influencing storage, genetic effects on storage, humidity and temperature – measurement and control technology, Cold store design and methods, pre-storage treatments – mode of action, effect on fruits and vegetables, case studies on raw horticultural commodities and processed products		
UNIT-V	CONTROLLED ATMOSPHERE, HYPOBARIC AND HYPERBARIC STORAGE	9
Controlled atmosphere (CA) – changes during storage, gas exchange mechanism, equipment for producing and regulation CA - Design, construction and operation - Effect of gas atmosphere and interactions. Hypobaric storage – mode of action, transport, effect on fruits and vegetables, case studies on fruits and vegetables, Hyperbaric storage – mode of action, effect on fruits and vegetables, case studies on fruit and vegetables		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Identify suitable packaging materials for quality preservation
●	Apply advanced packaging technologies for shelf-life extension
●	Make use of smart packaging solutions for fresh produce
●	Interpret effective storage strategies for fruit and vegetable
●	Examine various storage systems for storing fruit and vegetable

Text Books:	
1	Thompson, A.K. "post-harvest technology of fruits and vegetables". Blackwell Science Ltd., London, 1996
2	Thompson, A. K., Thompson, A. K. "Fruit and Vegetable Storage: Hypobaric, Hyperbaric and Controlled Atmosphere". Springer International Publishing, Germany, 2015

Reference Books / Web links:	
1	M. W. Siddiqui, M.S. Rahman, A.A.Wani. "Innovative Packaging of Fruits and Vegetables: Strategies for Safety and Quality Maintenance". Apple Academic Press, Canada, 2018
2	T.Alam, "Packaging and Storage of Fruits and Vegetables: Emerging Trends". Apple Academic Press, 2021

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23D03.1	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D03.2	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D03.3	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D03.4	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D03.5	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
Average	3	2.6	2.6	2.6	2	2	2	1	1	1	1	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23D04	CARBONATED BEVERAGES	PE	3	0	0	3

Objectives:	
●	To provide students with foundational knowledge of carbonated beverages
●	To comprehend students with an understanding of the various ingredients and additives used in beverage production
●	To understand the various manufacturing processes involved in the production of beverages
●	To equip students with the knowledge and skills necessary to implement quality control
●	To explore the latest trends and technological innovations in the carbonated beverage industry

UNIT-I	INTRODUCTION TO CARBONATED BEVERAGES	9
General pre-processing, different freezing methods and equipment's, problems associated with specific fruits and vegetables; Dehydration – General pre-processing, different methods of drying, osmotic dehydration; Indian Food Regulation and Quality assurance.		
UNIT-II	INGREDIENTS AND ADDITIVES	9
Water: Quality and treatment; Sweeteners: Natural; Artificial; Acids and pH modifiers; Flavors and fragrances; Stabilizers and emulsifiers; Colorants		
UNIT-III	MANUFACTURING PROCESSES	9
Carbonated beverage Production; Formulation and Ingredient Mixing; Carbonation; Syrup preparation; Filtration, Pasteurization, Bottling and packaging of carbonated beverages		
UNIT-IV	QUALITY CONTROL AND TESTING	9
Quality Testing and Standards; Measuring carbonation level; Hazard Analysis and Critical Control Points (HACCP); Sensory Evaluation; Troubleshooting Common Defects		
UNIT-V	EMERGING TRENDS AND INNOVATIONS IN CARBONATED BEVERAGES	9
Fruit based carbonated beverages, carbonated water. Equipment's used in the manufacture of carbonated beverages. Health-Conscious and Functional Beverages; Sustainability and Environmental Impact; innovative Technologies in Carbonated Beverage Production; Future of the Carbonated Beverage Industry.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Explore the key principles involved in the carbonation process
●	Identify and describe the function of key ingredients and additives in beverages
●	Apply knowledge of different manufacturing processes to optimize beverage production
●	Design and conduct quality control tests on beverages, analyzing key parameters
●	Evaluate emerging trends and innovations in the carbonated beverage market

Text Books:	
1	P. K. Dey, Carbonated Beverages: Technological Advances in Processing and Packaging, Wiley-Blackwell, 1 st edition, 012.
2	M. S. K. K. and M. G. W., Handbook of Carbonated Beverages: Science and Technology, Wiley-Blackwell, 1 st edition, 2019

Reference Books / Web links:	
1	R. W. B. (Robert W. Bowers), Technology of Carbonated Soft Drinks, Elsevier, 2 nd edition,

	2007.
2	H. J. S. and A. P., The Science and Technology of Soft Drinks and Fruit Juices, Woodhead Publishing, 2nd edition, 2003.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23D04.1	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D04.2	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D04.3	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D04.4	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D04.5	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
Average	3	2.6	2.6	2.6	2	2	2	1	1	1	1	3	3	3	2

SUBJECT CODE	SUBJECT NAME	CATEGORY	L	T	P	C
FT23D05	NON-ALCOHOLIC BEVERAGES	PE	3	0	0	3

Objectives:

●	To comprehensive understanding of the production, types, and market trends of non-alcoholic beverages
●	To provide students with an in-depth understanding of the production, processing, and preparation methods of tea, coffee, and cocoa beverages
●	To introduce students to the production, uses, and health benefits of spices, herbs, and dairy-based beverages
●	To understand the production, processing, and formulation of fruit-based beverages
●	To explore the different types of bottled waters, their sources, regulatory standards,

UNIT-I	OVERVIEW ON NON-ALCOHOLIC BEVERAGES	9
Definition and Scope; Classification of beverages; Types of non-carbonated beverages; Consumer demand for low-sugar, organic, and sustainable beverages. Market Trends and Consumer Preferences.		
UNIT-II	TEA, COFFEE, AND COCOA BEVERAGES	9
Tea-Based Beverages: Black, green, white, oolong, and herbal teas; ready-to-drink (RTD) tea beverages; Coffee-Based Beverages: Coffee bean varieties and their impact on beverage flavour, Brewing techniques, Espresso, cold brew, drip coffee, instant coffee, coffee-based RTD beverages; Cocoa-Based Beverages: Types of cocoa and their processing into cocoa powder and chocolate beverages; Hot chocolate and cocoa-based RTD beverages.		
UNIT-III	SPICES, HERBS, AND DAIRY-BASED BEVERAGES	9
Spices and herbs used in beverages; Herbal tea and spiced drinks; Developing functional herbal beverages for digestion, immunity, and relaxation; Dairy-Based Beverages: Types of dairy-based beverages: Milkshakes, lassis, buttermilk, and flavored milk; Fermented dairy beverages: Yogurt-based drinks, probiotic beverages; Techniques in flavoring and fortification of dairy beverages, Beverages based on coconut, sugarcane.		
UNIT-IV	FRUIT-BASED BEVERAGES	9
Ready-to-Serve (RTS) Beverages; Squash, Nectar, and Cordial Beverages; Fruit Concentrates and Juices; Flash Pasteurization; Canning of Beverages; Aseptic Packaging.		
UNIT-V	BOTTLED WATER, MINERAL WATER, SPRING WATER, FLAVOURED WATER	9
Overview of Water-Based Beverages; Water Sources and Their Characteristics; Water Treatment; Bottled Water; Mineral and Spring Water; Flavored Water; Water resource management.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Analyze the production processes, ingredients, and health considerations associated with various non-alcoholic beverages
●	Identify the key stages in the production and processing of tea, coffee, and cocoa,
●	Formulate and produce a variety of beverages using spices, herbs, and dairy
●	Design and produce a variety of fruit-based beverages, applying knowledge of fruit types
●	Apply knowledge of water sources to produce high-quality, marketable water-based beverages.

Text Books:

1	Hosahalli S. Ramaswamy. "Post-harvest Technologies of Fruits & Vegetables" DES tech publications, 2015.
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2	N. P. Singh. “ Fruit and Vegetable Preservation ” Oxford Book Company, 2007
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Reference Books / Web links:	
1	A.K.Anal. “Food Processing By-Products and Their Utilization” Wiley, Germany, 2017
2	A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23D05.1	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D05.2	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D05.3	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D05.4	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D05.5	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
Average	3	2.6	2.6	2.6	2	2	2	1	1	1	1	3	3	3	2

Subject Code	Subject Name	Category	L	T	P	C
FT23D06	FERMENTED BEVERAGES	PE	3	0	0	3

Objectives:	
●	To introduce the fundamental principles of fermentation
●	To provide a deep understanding of the steps involved in winemaking
●	To demonstrate an understanding of the different stages of beer production,
●	To comprehensive understanding of the production, history, and diversity of distilled alcoholic beverages
●	To ensure quality control and maintain safety standards in the production of fermented beverages

UNIT-I	FERMENTATION OF BEVERAGES	9
Alcoholic beverages- Classification; Introduction to Fermentation; Types of Fermentation; Microbiology of Fermentation; Factors Affecting Fermentation; Technological Innovations in Fermentation		
UNIT-II	WINE PRODUCTION AND TYPES OF WINE	9
Overview of wine consumption and market trends. Global wine-producing regions and varieties Classification of Wines; Raw Materials for Winemaking; Harvesting and sorting. Crushing and destemming; Juice extraction and must preparation. Fermentation Process; Role of yeast in alcoholic fermentation; Clarification; Stabilization; Aging and Maturation; Bottling and Storage		
UNIT-III	BEER BREWING PROCESS	9
History and classification of Beer: ale, lager, stout; Ingredients in Beer Production; Malted barley, Hops, Yeast: ale yeast vs. lager yeast; Malting and Mashing Processes; By-products of Malting and Mashing; Brewing and Fermentation: Types of fermentation: top fermentation (ale), bottom fermentation (lager). By-products of fermentation; Conditioning and Maturation; Packaging, Storage.		
UNIT-IV	DISTILLED BEVERAGES	9
Introduction to Distilled Beverages; Definition and difference between distilled and fermented beverages; Principles of Distillation; Classification: grain-based (whiskey, vodka), fruit-based (brandy), sugar-based (rum), and agave-based (tequila); Quality Control, Safety, and Trends in Distilled Beverages		
UNIT-V	QUALITY CONTROL AND SAFETY IN FERMENTED BEVERAGES	9
Quality Control Parameters: Sensory evaluation, physicochemical testing, and microbiological standards; Common defects and troubleshooting in fermentation: Safety and Regulations, Contaminants and hazards in fermented beverages; Regulatory standards: FSSAI, FDA, and international guidelines; Packaging and Shelf life		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Apply quality control methods to monitor the fermentation process
●	Develop skills to evaluate the sensory attributes of wine
●	Evaluate how the quality and mineral content of water affect beer flavor
●	Apply the principles of fermentation and distillation to produce a variety of distilled beverages
●	Implement quality control techniques and safety protocols in the production of fermented beverages

Text Books:	
1	"Fermented Beverage Production" by Y. H. Hui, Springer, 004
2	N. P. Singh. "Fruit and Vegetable Preservation" Oxford Book Company, 2007

Reference Books / Web links:	
1	"The Oxford Handbook of Food Fermentations" edited by Charles W. Bamforth and Robert E. Martin, oxford university press, 2014
2	A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23D06.1	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D06.2	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D06.3	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
FT23D06.4	3	2	2	2	2	2	2	1	1	1	1	3	3	3	2
FT23D06.5	3	3	3	3	2	2	2	1	1	1	1	3	3	3	2
Average	3	2.6	2.6	2.6	2	2	2	1	1	1	1	3	3	3	2

VERTICAL V - FOOD BIOTECHNOLOGY

Subject Code	Subject Name	Category	L	T	P	C
FT23E01	MICROBIAL TECHNOLOGY	PE	3	0	0	3

Objectives:

- Understand and identify the important microorganisms in fermented foods
- Identify the microorganism's growth characteristics in foods and the conditions under which they will grow
- Understand the importance of microbes in producing pro and prebiotic food products
- Understand and identify the important pathogens and spoilage microorganisms in foods.
- To impart knowledge of food processing using modern preservation techniques.

UNIT-I	INTRODUCTION AND SCOPE OF FOOD MICROBIOLOGY	9
Introduction of microbiology - General characteristics of microbiomes including bacteria, fungi, virus, protozoa and algae. - Importance of microorganisms in food - Food as a substrate for microorganism - Classification of nomenclature of microorganism - Factors affecting the growth of microorganisms in food, feed and fodder - Normal micro flora of some common foods.		
UNIT-II	MICROBIAL GROWTH RESPONSE IN THE FOOD ENVIRONMENT	9
Microbial growth characteristics - Factors influencing microbial growth in food – Microbial metabolism of food components - Microbial sporulation and germination - Microbial stress response in the food environment.		
UNIT-III	BENEFICIAL USES OF MICROORGANISMS IN FOOD	9
Basic of food fermentation process and role of microorganisms, Microorganisms used in food fermentation - Microbiology of fermented food production - Intestinal beneficial bacteria - Food bio preservatives of microbial origin - Food ingredients and enzymes of microbial origin		
UNIT-IV	MICROBIAL FOODBORNE DISEASES	9
Important factors in microbial food spoilage - Food spoilage by microbial enzymes- Indicators of microbial food spoilage - Microbial foodborne diseases - Foodborne intoxications – Foodborne infections - Foodborne toxic infections - Opportunistic pathogens, parasites, and algal toxins -Indicators of bacterial pathogens.		
UNIT-V	CONTROL OF MICROORGANISMS IN FOODS	9
Control of access (Cleaning and Sanitation) - Physical removal – heat - low temperature -low pH and organic acids - modified atmosphere (or reducing O-R potential) – Antimicrobial preservatives - Novel processing technologies - Hurdle concept - Detection of microorganisms in food and food environment.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Apply the functions of food microbes for manufacturing fermented foods.
- Find the importance of microbial growth in foods
- Outline the importance of microbes in producing pro and prebiotic food products.
- Analyze the new innovation in developing new preservative techniques.
- Evaluate the response to the changes in processing foods by modern preservation techniques.

Text Books:	
1	Adams, M. R. and M. O. Moss. 2008. Food Microbiology, 3rd Edition. Cambridge: The Royal Society of Chemistry (RSC Publishing).
2	Benwart, G. J. 1987. Basic Food Microbiology. New Delhi: CBS Publishers & Distributors
3	Blackburn, Clive de W. 2006. Food Spoilage Microorganisms. Cambridge: Woodhead Publishing.

Reference Books / Web links:	
1	Deak, T. and L. R. Beuchat. 1996. Handbook of Food Spoilage Yeasts. US: CRC Press.
2	Frazier, William C. and Dennis C. Westhoff. 1988. Food Microbiology. New York: McGrawHill.
3	Garbutt, John. 1997. Essentials of Food Microbiology. London: Arnold – International Students Edition.
4	Jay, J. M. 2000. Modern Food Microbiology, 6th Edition. New York: Chapman & Hall.
5	Prescott, L. M., J. P. Harley and D. A. Klein. 2014. Microbiology, 9th Edition. New York: McGraw Hill
6	Ray, Bibek and Arun Bhunia. 2013. Fundamental Food Microbiology, 5th Edition. . New York: CRC Press
7	Robinson, Richard K. 2002. Dairy Microbiology Handbook: The Microbiology of Milk and Milk Products, 3rd Edition. New York: Wiley Interscience

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E01.1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	2
FT23E01.2	1	1	2	2	2	1	1	2	1	1	1	1	1	1	1
FT23E01.3	1	1	1	2	3	2	1	1	1	1	1	1	1	1	1
FT23E01.4	2	1	2	2	2	1	1	1	1	1	1	1	1	1	2
FT23E01.5	1	1	1	2	2	2	1	2	1	1	1	1	1	1	1
Average	1.4	1	1.6	1.8	2.2	1.5	1	1.4	1	1	1	1	1	1	2

Subject Code	Subject Name	Category	L	T	P	C
FT23E02	BIOPROCESS TECHNOLOGY	PE	3	0	0	3

Objectives:

- To understand the fundamentals of bioprocess and sterilization kinetics
- To gain knowledge about stoichiometric calculations to predict bioprocess efficacy
- To plan a research career or to work in the food industry with a strong foundation in bioreactor design and scale-up.
- To learn about the structured models and metabolic pathways in product formation.
- To apply modeling and simulation of bioprocesses to reduce costs and to enhance the quality of products and systems.

UNIT-I	MEDIA DESIGN AND STERILIZATION	9
Basic configuration of bioreactor and ancillaries, medium requirements for bioprocesses, Medium formulation of optimal growth and product formation, Medium optimization methods, Thermal death kinetics of microorganisms, Heat and filter sterilization of liquid media, Air sterilization, Design of sterilization equipment.		
UNIT-II	METABOLIC STOICHIOMETRY AND ENERGETICS	9
Stoichiometry of cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass, Available electron balances, Yield coefficients of biomass and product formation, energetic analysis of microbial growth and product formation, Thermodynamic efficiency of growth.		
UNIT-III	BIOREACTOR DESIGN AND SCALE UP	9
Batch, fed batch and continuous cultivation. Feeding Strategies and Microbial Kinetics, Rheology of fermentation fluids, Transport phenomena in bioprocess systems, Oxygen mass transfer rate determination methods, stirred tank reactor, Plug flow reactor, Fluidized bed reactor, Bubble column, Air lift reactor, Photo bioreactor, Bioreactors on a chip, Scale up criteria for bioreactors.		
UNIT-IV	MODELLING OF BIOPROCESSES	9
Monod model, Multiple substrate models, Models of growth associated product formation kinetics, Compartmental models, Models of cellular energetics and metabolism, Single cell models, Models of gene expression and regulation, Models of plasmid expression and replication.		
UNIT-V	BIOPROCESS SIMULATION	9
Major subsystems of a process simulator, General architecture of on-line simulation system, Dynamic simulation of batch, Fed batch, Steady and transient culture metabolism, Model simulation using MATLAB - SIMULINK and ISIM software packages.		
		Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

- Find the bioprocess and sterilization kinetics.
- Apply stoichiometric calculations to predict bioprocess efficacy.
- Analyze the productivity in a bioreactor for the given metabolite.
- Evaluate the structured models and metabolic pathways in product formation.
- Evaluate simulated bioprocesses for automatic control with reduced costs and enhanced product quality

Text Books:

- 1 Michael L. Shuler and Fikret Kargi, Bioprocess Engineering - Basic Concepts, Pearson New International Edition, 2014.
- 2 Pauline M. Doran, Bioprocess Engineering Principles, Academic Press Limited, 2013.
- 3 Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of Fermentation Technology, Butterworth Heinemann publications, 1995.

Reference Books / Web links:

1	Harvey W. Blanch, S. Douglas and Clark, Biochemical Engineering, New York: Marcel Dekker Inc.,1997.
2	Shijie Liu, Bioprocess Engineering - Kinetics, Sustainability, and Reactor Design, Elsevier Science,2013.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E02.1	2	1	3	1	2	1	1	1	1	2	1	1	1	1	2
FT23E02.2	2	1	3	2	2	1	1	1	1	2	1	2	1	1	2
FT23E02.3	2	2	3	2	3	1	1	2	1	2	1	1	1	1	2
FT23E02.4	1	2	3	2	2	1	1	2	1	2	1	2	1	1	1
FT23E02.5	1	1	3	2	2	1	1	1	1	1	1	1	1	1	1
Average	1.6	1.4	3	1.8	2.2	1	1	1.4	1	1.8	1	1.4	1	1	1.6

Subject Code	Subject Name	Category	L	T	P	C
FT23E03	FOOD ALLERGENS AND TOXICOLOGY	PE	3	0	0	3

Objectives:

- Familiarize with hazards, and toxicity associated with food and their implications for health.
- Know the various kinds of allergens and basis of allergic reactions.
- To understand the protocols of sampling techniques in food toxicology measurements.
- To gain the knowledge on level of processing of food to destroy allergens / toxins.
- Creates an awareness to choose food with highly safe.

UNIT-I	INTRODUCTION OF FOOD TOXICOLOGY AND ALLERGENS	9
Definition and need for understanding food toxicology; Hazards Microbiological, nutritional and environmental. Basics of immune resources - Humoral and cell media resources. Allergen and mechanism of allergic resources.		
UNIT-II	FOOD ALLERGY AND SENSITIVITY	9
Chemistry of food allergens, celiac disease, food disorders associated with metabolism, Lactose intolerance, and asthma. Natural toxins in food: Natural toxins of importance in food - Toxins of plant and animal origin; Microbial toxins (e.g., bacterial toxins, fungal toxins and algal toxins), Natural occurrence, Toxicity and significance, Determination of toxicants in foods and their management.		
UNIT-III	PRINCIPLES OF TOXICOLOGY	9
Natural food toxicants - Toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, Toxin absorption in the gastrointestinal track, Industrial micro flora, blood, brain barrier, storage and excretion of toxins.		
UNIT-IV	DETERMINATION OF TOXICANTS IN FOOD SAMPLING	9
Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immune toxicity.		
UNIT-V	TOXICANTS FORMED DURING FOOD PROCESSING	9
Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavor enhancers, food colors, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Find the different types of allergens and Natural toxins associated with food.
- Assess the food toxicology and its hazards.
- Outline about food sensitivity and allergy.
- Analyze food toxin in food samples.
- Evaluate toxin formed during processing and controlling.

Text Books:

1 | Helferich, W., and Winter, C.K “Food Toxicology”,. CRC Press, LLC. Boca Raton, FL. 2007.

2	Shibamoto, T., and Bjeldanes, L. "Introduction to Food Toxicology", 2009, 2 nd Edition. Elsevier Inc., Burlington, MA.
3	Watson, D.H. "Natural Toxicants in Food", CRC Press, LLC. Boca Raton, FL1998.

Reference Books / Web links:

1	Duffus, J.H., and Worth, H.G. J. "Fundamental Toxicology", The Royal Society of Chemistry.2006.
2	Stine, K.E., and Brown, T.M. "Principles of Toxicology", 2ndEdition. CRC Press. 2006.
3	Tönu, P. "Principles of Food Toxicology". CRC Press, LLC. Boca Raton, FL. 2007.
4	Alluwalia, Vikas "Food Hygiene and Toxicology" Paragon International Publishers, 2007
5	Maleki, Soheila J. A. Wesley Burks, and Ricki M. Helm "Food Allergy" ASM Press, 2006
6	Labbe, Ronald G. and Santos Garcia "Guide to Food Borne Pathogens" John Wiley & Sons,2001.
7	Clover, Dean O. and Hans P. Riemann "Food Borne Diseases" 2 nd Edition., Academic Press/Elsevier.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E03.1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	2
FT23E03.2	1	1	2	2	2	1	1	2	1	1	1	1	1	1	1
FT23E03.3	1	1	1	2	3	2	1	1	1	1	1	1	1	1	1
FT23E03.4	2	1	2	2	2	1	1	1	1	1	1	1	1	1	2
FT23E03.5	1	1	1	2	2	2	1	2	1	2	1	1	1	1	1
Average	1.4	1	1.6	1.8	2.2	1.4	1	1.4	1	1.2	1	1	1	1	1.8

Subject Code	Subject Name	Category	L	T	P	C
FT23E04	ENZYME TECHNOLOGY	PE	3	0	0	3

Objectives:

●	To provide students with a basic understanding of classification, nomenclature, mechanism and purification and characterization of enzymes.
●	To understand enzyme immobilization methods, kinetics of free, immobilized and allosteric enzymes
●	To learn the inhibition study of enzyme and also its application in Food Industry
●	To learn the theoretical and practical aspects of enzyme kinetics to promote research.
●	Creates the knowledge about role of enzymes in Food Processing and Preservation.

UNIT-I	INTRODUCTION TO ENZYMES	9
Nomenclature and classification of enzymes. Mechanism and specificity of enzyme action - Units for enzyme activity - Coenzymes-Classification, Coenzymes in metabolic pathways, metal-activated enzyme and metallo enzyme.		
UNIT-II	ENZYMES: EXTRACTION, PURIFICATION AND IMMOBILIZATION	9
Production and purification of crude enzyme extracts from plant, animal, and microbial sources; methods of characterization of enzymes; development of enzymatic assays. Physical and chemical techniques for enzyme immobilization adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding.		
UNIT-III	ENZYME INHIBITION	9
Reversible inhibition - Competitive, non-competitive, uncompetitive, mixed, Substrate, allosteric and product inhibition. Irreversible Inhibition - Suicide inhibition. Examples and mechanism of various inhibitions like Penicillin, Iodoacetamide and Di-isopropyl fluorophosphates (DIPF).		
UNIT-IV	ENZYME KINETICS	9
Factors affecting the enzyme activity - Concentration, pH and temperature. Kinetics of a single - Substrate enzyme catalyzed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes.		
UNIT-V	APPLICATION OF ENZYME IN FOOD INDUSTRY	9
Application of enzymes in food processing and production - Enzymes in baking, brewing, dairy and meat industries. Enzymes used in various fermentation processes, cellulose degrading enzymes, Applications of enzymes in flavor enhancement and modification.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Apply and gain knowledge on enzyme, coenzyme and their classification.
●	Find the different methods of Production and Purification of enzymes from various sources.
●	Analyze the different methods of enzyme inhibition and kinetics.
●	Outline the theoretical and practical aspects of enzyme kinetics to promote research.
●	Evaluate the role of enzymes in Food Processing and Preservation.

Text Books:

1	Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.
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2	Chaplin and Bucke, Enzyme Technology, Cambridge University Press, 1990.
3	Price and Stevens, Fundamentals of Enzymology, Oxford University Press.

Reference Books / Web links:

1	Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997.
2	Branden C. and Tooze J., Introduction to Protein Structured Garland Publishing, 1999.
3	Creighton T.E. Proteins, 2ndEdition. W.H. Freeman, 1993.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E04.1	2	3	1	1	2	1	1	1	1	1	1	1	1	2	2
FT23E04.2	1	2	3	2	2	1	1	1	1	2	1	1	1	1	1
FT23E04.3	3	3	1	1	3	1	1	1	1	2	1	1	1	2	3
FT23E04.4	2	3	1	1	2	1	1	1	1	1	2	1	1	1	2
FT23E04.5	2	3	3	1	2	1	1	1	1	2	2	1	1	1	2
Average	2	2.8	1.8	1.2	2.2	1	1	1	1	1.6	1.4	1	1	1.4	2

Subject Code	Subject Name	Category	L	T	P	C
FT23E05	FOOD FERMENTATION TECHNOLOGY	PE	3	0	0	3

Objectives:

- To understand the different methods of fermentation technique for food product formation.
- Gain insights into developing fermented dairy food products with desirable sensory attributes
- Creates the knowledge of different types of fermented fruit, and vegetable products.
- To learn the process of wine processing and preservation by fermentation.
- To understand the concept of producing fermented fish and meat products.

UNIT-I	INTRODUCTION	9
History of food fermentations; Types of fermented foods and substrates/raw materials used, Traditional fermented foods, Major biotransformation of raw materials during fermentation, Modern fermented foods industry, Properties of fermented foods, Fermented foods in the twenty-first century, Health benefits of fermented foods and beverages.		
UNIT-II	FERMENTED DAIRY PRODUCTS	9
Fermented Dairy products Introduction, Consumption of cultured dairy products, Cultured dairy products - Yogurt, Cultured buttermilk, Sour cream, Kefir, Other cultured dairy products. Cheese Introduction, Manufacturing principles, General steps in cheese making, Types of cheese, Cheese ripening, Microbial defects, Recent technological advances in cultured dairy products technology.		
UNIT-III	FERMENTED FRUITS AND VEGETABLE PRODUCTS	9
Fermented Vegetable products - Introduction, Production principles, Manufacture of Sauerkraut, Principles of pickle production, fermented olives, Kimchi. Fermented Fruit Products - Manufacture of Canned fruits - Fruit vinegar production- Fermented Fruit juices.		
UNIT-IV	ENOLOGY (STUDY OF WINE)	9
Wine manufacture principles - Harvesting and preparation of grapes, Crushing and maceration, Sulphur dioxide treatment, Separation and pressing, Fermentation, Yeast metabolism, Factors affecting yeast metabolism, Sulphur and nitrogen metabolism, stuck fermentations, Adjustments, blending, and clarification, Aging, Malolactic fermentation, Types of wine, Wine spoilage and defects.		
UNIT-V	FERMENTED MEAT AND FISH PRODUCTS	9
Fermented Meat product Sausages - History and evolution of the fermented meats industry, Meat composition, Fermentation principles, Meat starter cultures, Principles of fermented sausage manufacture, Manufacture of fermented sausage - Cutting and mixing, Stuffing, Casing materials, Fermentation, Cooking, drying, and smoking, Mold-ripening, Flavor of fermented meats, Defects and spoilage of fermented meats. Fermented fish products Fish sauces, Fish paste - Manufacturing steps, Biochemical changes, Storage and Shelf-life of products.		
Total Contact Hours		45

Course Outcomes:

On completion of course students will be able to

- Apply the different methods of fermentation technique for the food product formation.
- Assess the history and properties of fermented dairy foods.
- Analyze the production of different types of fermented fruit and vegetable products.
- Outline the process of wine processing and preservation by fermentation.
- Evaluate the concept of producing fermented fish and meat products.

Text Books:	
1	Joshi, V. K. “Biotechnology Food Fermentation” Volume 1. Educational Publishers Distributors, 2004
2	Robert W. Hutkins. “Microbiology and Technology of Fermented Foods”, 2nd Edition, Blackwell, 2006
3	Hui Y. H “Handbook of Food and Beverage Fermentation Technology”. Marcel Dekker, 2004.

Reference Books / Web links:	
1	Wood, Brian J. B. “Microbiology of Fermented Foods” Volume 1 and 2. II Edition. Blackie Academic and Professional, 1998.
2	Farnworth, Edward R. “Handbook of Fermented Functional Foods” II Edition. CRC Press, 2008.
3	Ramesh C. Ray and Didier Montet, “Fermented Foods, Part- II Technological Interventions”, CRC Press, 2017.
4	N.R. Reddy, “Legume based Fermented foods”, CRC Press, 2018.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E05.1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1
FT23E05.2	1	1	2	2	2	1	1	2	1	1	1	1	1	1	1
FT23E05.3	1	1	1	2	3	2	1	1	1	1	1	1	1	1	1
FT23E05.4	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1
FT23E05.5	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1
Average	1.4	1	1.6	1.6	2	1.2	1	1.4	1	1.2	1	1	1	1	1

Subject Code	Subject Name	Category	L	T	P	C
FT23E06	GENETIC ENGINEERING AND GENETICALLY MODIFIED FOODS	PE	3	0	0	3

Objectives:

- To study genetically modified plants which are commercially available
- To study transgenic animals and their engineering method
- To understand genetically modified microorganisms and their applications in foods
- To know about pharmaceutical applications of genetically engineered plants
- To understand Risk and safety assessment of the GM foods and their labeling

UNIT-I	BASICS OF RECOMBINANT DNA TECHNOLOGY	9
Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.		
UNIT-II	DNA LIBRARIES	9
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera.		
UNIT-III	SEQUENCING AND AMPLIFICATION OF DNA	9
Maxam Gilbert’s and Sanger’s methods of DNA sequencing. Inverse PCR, Nested PCR, AFLPPCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.		
UNIT-IV	TRANSGENIC TECHNOLOGY	9
DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid.		
UNIT-V	APPLICATIONS OF RDNA TECHNOLOGY IN FOODS	9
Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr™ tomato, Monsanto Round-Up™ Ready, Ciba GeigyBasta™ resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Better understanding of genetically modified plants, animals and modified microorganisms
- Familiarize in Pharmaceutical applications of genetically engineered plants
- Obtain knowledge in Risk and safety assessment of the GM foods and their label.
- Apply the genetically modified microorganisms and their applications in foods
- Apply the Risk and safety assessment of the GM foods and their labeling

Text Books:

- 1 Rees, Andy “Genetically Modifies Food: A Short Guide for the Confused”. Pluto Press, 2006.
- 2 Ahmed, Farid E. “Testing of Genetically Modified Organisms in Food”. Food Products Press, 2004.

Reference Books / Web links:

1 | Halford, Nigel G. "Genetically Modified Crops". Imperial College Press, 2003.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23E06.1	1	2	1	2	2	1	2	1	1	1	1	1	2	1	2
FT23E06.2	2	3	1	3	3	1	3	2	1	1	1	1	3	2	1
FT23E06.3	3	1	2	1	3	1	3	1	1	1	1	1	3	2	2
FT23E06.4	3	3	2	2	3	1	2	2	1	1	1	1	2	2	2
FT23E06.5	3	3	2	2	3	1	2	2	1	1	1	1	2	2	2
Average	2.4	2.4	1.6	2	2.8	1	2.4	1.6	1	1	1	1	2.4	1.8	1.8

VERTICAL VI - BAKING AND CONFECTIONERY TECHNOLOGY

Subject Code	Subject Name	Category	L	T	P	C
FT23F01	BAKERY INGREDIENTS AND FLOUR REHOLOGY	PE	3	0	0	3

Objectives:

- To understand classification, types, and treatments of flour.
- To analyze physicochemical properties and functionality of flour
- To examine rheological techniques and dough measurement methods.
- To analyze functionality of sweeteners and leavening agents.
- To understand dairy, fats, and functional bakery ingredients

UNIT-I	FLOUR TYPES AND CLASSIFICATION	9
Grains; Milling; Grades of flour; Types of flour- Chorleywood bread flour, Patent flour, Soft flour, Whole meal flour, Brown flour and Low moisture flour, Flour treatment.		
UNIT-II	FUNCTIONAL AND PHYSICOCHEMICAL EVALUATION OF FLOUR	9
Flour Analysis- Moisture, Ash, Minerals, Fat, Protein, Starch damage, Diastatic activity of flour, Maltose value, Particle size distribution, Colour. Gluten content estimation, SDS- sedimentation volume, Falling number, Dough raising capacity, Alkaline water retention test. Importance of above tests with respect to bread, Biscuits and Cakes.		
UNIT-III	RHEOLOGICAL MEASUREMENT OF DOUGH	9
Fundamental methods – Dynamic oscillation, Concentric cylinder, Parallel plates; Tube viscometers - Capillary, Pressure, Extrusion, Pipe flow, Transient flow; Extension- Uniaxial, Biaxial TAXT 2 dough inflation system, Lubricated compression. Empirical methods- Brabender Farinograph, Extensograph, Amylograph, Mixograph, Reomixer, Consistometer, Flow viscometers and Penetrometers.		
UNIT-IV	SWEETNERS AND LEAVENING AGENTS IN BAKERY	9
Sucrose: source and functionality; Alternative sweeteners- Traditional natural sweeteners, Starch sugars, Syrups, Glucose, Maltose, Fructose, Honey, Bulk sweeteners and High Intensity sweeteners. Leavening agents: Air, Water or steam, Yeast types and functionality, Chemical leavening agents.		
UNIT-V	DIARY INGREDIENTS, SHORTENING AND OTHER INGREDIENTS	9
Dairy ingredients: Milk, Milk concentrates, Powdered milk, Cream, Cheese, Whey, Protein concentrates. Role and functionality. Fats and shortening- Role and Functionality in bakery products.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Analyse various flour types and uses
- Evaluate flour characteristics using standard methods.
- Apply empirical and fundamental rheological methods.
- Assess the role of leavening in bakery processes.
- Analyze functionality of dairy and fat components.

Text Books:

1	WP Edwards, The Science of Bakery Products, Published by Royal Society of Chemistry, 2007
2	Weibiao Zhou, Bakery Products Science and Technology-Second Edition, Wiley Blackwell,2014

Reference Books / Web links:

1	Wayne Gisslen , Professional baking- Sixth edition, Published by John Willey & sons, 2013
2	Samuel A. Matz, Ph. D., Bakery Technology and Engineering, The AVI Publishing Company Inc,1960

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23F01.1	3	2	2	2	2	1	2	1	2	2	1	2	3	2	2
FT23F01.2	3	3	2	3	2	1	2	1	2	2	1	3	3	3	2
FT23F01.3	3	3	3	3	3	1	2	1	3	2	2	3	3	3	3
FT23F01.4	2	3	2	3	2	1	2	1	2	3	2	3	3	2	2
FT23F01.5	3	2	2	2	2	1	2	1	2	2	1	2	3	2	2
Average	2.8	2.6	2.2	2.6	2.2	1	2	1	2.2	2.2	1.4	2.8	3	2.4	2.8

Subject Code	Subject Name	Category	L	T	P	C
FT23F02	TECHNOLOGY OF BREAD, BUN, CAKES AND PASTRIES	PE	3	0	0	3

Objectives:	
●	To understand bread-making processes, methods, and quality controls effectively.
●	To learn roles of ingredients and machinery in bread making.
●	To understand cake ingredients, methods, and techniques to ensure quality.
●	To learn diverse mixing methods for cake production processes.
●	To pastry machines and their role in product innovation.

UNIT-I	BREAD MAKING PROCESS	9
Status of bakery industry. Bread formulation, basic bread making procedure - mixing. Fermentation, proofing and baking. Raw material receiving – quality check- batch making (addition of ingredients with respective proposition) – kneading – molding – panning - Proofing – baking – cooling – slicing – packing. Functions of mixing, types of mixers, functions of moulding and dividing, functions of proving, changes during mixing, fermentation and baking unit operations. Straight dough method, normal straight dough, 70% sponge and dough, 100% sponge and dough, soaker and dough method, ferment method, frozen dough process, micro-wave process. Advantages and limitations of various bread processes		
UNIT-II	INGREDIENTS & BREAD MAKING MACHINES	9
Role of ingredients, additives and improvers in bread making. Chemical leavening agents- baking powder, sodium bicarbonate, ammonium bicarbonate cream of tartar. Different types of bread - methods of bread preparation - quality aspects of bread and standards. Dividers – Construction, dividing principle and operation. Rounders - Construction, rounding principle and operation.		
UNIT-III	BAKING OF CAKES	9
Role of ingredients - flours, oils and fats, eggs, sugar, dried fruits and nuts- types of cakes - methods of mixing - preparation of fancy cakes and techniques - quality - cake faults and remedies. Heat transfer in the oven, mixing and delivery of batter – batch & continuous mixers, depositing the batter, baking ovens- band, tunnel & reel ovens		
UNIT-IV	MIXING METHODS AND PROCESSING TECHNOLOGY OF CAKES	9
Shortening style cakes, creaming method, flour batter method, single stage, emulsion, continuous batter mixing, foam style cakes – angel food, sponge, chiffon, genoise cake. Types of cakes, formula balance in cake, production of cakes and pastry - mixing, baking, cooling and packaging. Cakes faults - shape, structure, texture, crust and colour faults. Remedies of cake faults.		
UNIT-V	CAKE MAKING MACHINES AND PASTRY	9
Encrusting machines – Introduction, Construction – General structure, Feed system; Moulding – extrusion nozzle moulding, flourless encrusting moulding, encrusting disk moulding, Transmission system, Operation – Filling control, casing thickness control, product size adjustment, flour dusting regulation, stability disk adjustment. Basic formulation - different types - flaky, puff and danish pastry- bakery products that combines flour and fat. Pie - types and methods. Preparation methods of danish pasties and the role of ingredients used. Cold and hot pastries		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze bread production stages for quality improvement and efficiency.
●	Evaluate bread ingredients and equipment to ensure optimal performance.
●	Develop innovative cake recipes by understanding ingredient functionalities.
●	Apply efficient cake processing techniques balancing formula requirements.
●	Evaluate pastry equipment to produce consistent, high-quality products.

Text Books:

1	Hui.Y.H. - Bakery products, Science and Technology, Blackwell, 2006.
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Reference Books / Web links:

1	Zhou - Bakery products, Science and Technology, Second edition, 2014
2	Edwards W.P. — Science of bakery products, RSC, UK, 2007

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23F02.1	3	3	2	3	3	2	2	3	2	3	2	3	3	3	2
FT23F02.2	3	3	2	2	3	2	2	3	2	2	2	2	3	3	3
FT23F02.3	3	2	3	2	3	3	2	2	3	3	2	3	3	2	3
FT23F02.4	3	3	3	3	2	3	3	2	3	2	3	3	3	3	3
FT23F02.5	3	3	3	2	3	2	3	3	3	3	2	3	3	3	3
Average	3	2.8	2.6	2.4	2.8	2.4	2.4	2.6	2.6	2.6	2.2	2.8	3	2.8	2.8

Subject Code	Subject Name	Category	L	T	P	C
FT23F03	TECHNOLOGY OF BISCUIT, CRACKERS AND COOKIES	PE	3	0	0	3

Objectives:

- To understand biscuit types, ingredients, and manufacturing processes.
- To learn about biscuit processing equipment and operations.
- To understand cookie classifications, ingredients, and production methods.
- To learn the principles and operation of cookie equipment.
- To understand the processing of crackers, wafers, and pretzels.

UNIT-I	BISCUITS- CLASSIFICATION AND PROCESSING	9
Introduction, Classification: Hard dough and soft dough biscuits – ingredients, functionality and formulation. Processing: Dough mixing, forming, flavors addition, baking, cooling and packaging. Factors influencing dough spread during baking.		
UNIT-II	BISCUIT PROCESSING EQUIPMENTS	9
Sheeting process, principle and parameters. Sheeters, Gauge rolls, Multiple roller gauging. Lamination process and Laminators. Rotary and reciprocating cutters: Construction, shaping, principle and transmission.		
UNIT-III	COOKIES- CLASSIFICATION AND PROCESSING	9
Introduction. Classification of Cookies. Cookie ingredients: functionality and impact on product characteristics. Characteristics of cookie dough. General method of cookie manufacture: Mixing, sheeting, baking, cooling and packaging.		
UNIT-IV	COOKIE PROCESSING EQUIPMENTS	9
Moulding: Rotary moulder-Description, instrumentation, principle and operation. Extruder and Depositor: Description, working principle and operation. Dough feed assembly and Die assembly: Description, working principle and operation.		
UNIT-V	CRACKERS AND MISCELLANEOUS PRODUCTS	9
Crackers- classification: cream, soda and snack crackers- ingredients and processing technology. Wafers: Types, ingredients and processing, Pretzels: Types, Ingredients and processing. Recent global trends in biscuits product category.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Classify biscuits and analyze processing steps affecting dough behaviour.
- Evaluate the operation and functionality of biscuit processing equipment.
- Classify cookies and apply appropriate manufacturing techniques effectively.
- Describe the working principles of cookie processing equipment.
- Analyze cracker, wafer, and pretzel processing techniques accurately.

Text Books:

- 1 WP Edwards, The Science of Bakery Products, Published by Royal Society of Chemistry, 2007
- 2 Weibiao Zhou, Bakery Products Science and Technology-Second Edition, Wiley Blackwell,2014

Reference Books / Web links:

1	Wayne Gisslen , Professional baking- Sixth edition, Published by John Willey & sons, 2013
2	Samuel A. Matz, Ph. D., Bakery Technology and Engineering, The AVI Publishing Company Inc,1960

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23F03.1	3	3	2	3	2	2	3	2	2	2	3	2	3	2	2
FT23F03.2	3	3	2	3	3	2	3	2	2	2	2	2	2	3	2
FT23F03.3	3	2	2	3	2	2	3	2	2	2	3	2	3	2	2
FT23F03.4	3	2	2	3	2	2	3	3	2	2	2	2	2	3	2
FT23F03.5	2	2	3	2	2	3	2	2	3	2	2	2	3	2	3
Average	2.8	2.4	2.2	2.8	2.2	2.2	2.8	2.2	2.2	2	2.4	2	2.6	2.4	2.4

Subject Code	Subject Name	Category	L	T	P	C
FT23F04	SUGAR AND GUM BASED CONFECTIONERY TECHNOLOGY	PE	3	0	0	3

Objectives:

- To understand the components, production, and sensory properties.
- To understand the formulation, processing, and texture development.
- Ingredients, gel formation, and texture.
- To analyze the composition, processing, and production challenges.
- To understand the science and processing methods

UNIT-I	HARD BOILED CANDIES	9
Introduction- Definition and classification of hard-boiled candies; Formulation and Ingredients – Sweeteners, Flavours, Colors, Organic Acids, Fats, Fruits, Dairy Ingredients; Processing Steps; Product Characteristics, Stability and Quality aspects.		
UNIT-II	CARAMEL, TOFFEE AND FUDGE	9
Introduction – Difference between caramel, toffee, fudge, traditional recipes; Formulation and Ingredients- Sweeteners, Dairy compounds, Fats and Oils, Emulsifiers, Flavors and Colors. Processing – Mixing and Emulsification, Cooking and Browning, Cooling and Forming; Color and Flavor generation; Stability and Quality aspects.		
UNIT-III	JELLIES AND GUMMIES	9
Introduction. Classification of Cookies. Cookie ingredients: functionality and impact on product characteristics. Characteristics of cookie dough. General method of cookie manufacture: Mixing, sheeting, baking, cooling and packaging.		
UNIT-IV	CHEWING AND BUBBLE GUMS	9
Definition and distinction, importance in confectionery; Science for gum base; Formulation and Ingredients – Gum Base, Sweeteners, Acid, Humectants, Flavors, Colors, High intensity sweeteners, Active ingredients; Gum manufacture; Characteristics; Quality aspects; Challenges in gum production		
UNIT-V	COMPRESSED TABLETS AND AERATED CONFECTIONERY	9
Definition, Signification, Classification and role in confectionary industry; Science behind compressed tablet and aerated confectionery; Ingredients of compressed tablets and aerated confectionery; Processing of Compressed tablets and aerated confectionery; Product characteristics, Quality aspects.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Analyze the production techniques and sensory characteristics.
- Apply formulation and processing techniques to texture development.
- Evaluate the role of ingredients in gel formation and texture.
- Analyze composition, processing, and production challenges.
- Understand the science and methods for production.

Text Books:

- 1 W.P. EDWARDS, Bardfield Consultants, Essex, UK; The Science of Sugar Confectionery, 2000

Reference Books / Web links:

1 Richard W. Hartel • Joachim H. von Elbe, Randy Hofberger; Confectionery Science and Technology; Springer International Publishing AG, 2018

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23F04.1	3	3	2	2	2	1	1	1	2	3	2	3	3	3	2
FT23F04.2	3	3	3	3	2	1	1	1	2	3	2	3	3	3	3
FT23F04.3	3	3	2	2	2	1	1	1	3	3	2	3	3	3	2
FT23F04.4	3	3	2	2	2	1	1	1	3	3	3	3	3	3	3
FT23F04.5	3	3	3	3	3	1	2	1	3	3	3	3	3	3	3
Average	3	3	2.4	2.4	2.2	1	1.2	1	2.6	3	2.4	3	3	3	2.6

Subject Code	Subject Name	Category	L	T	P	C
FT23F05	COCOA AND CHOCOLATE BASED CONFECTIONERY TECHNOLOGY	PE	3	0	0	3

Objectives:

- To understand cocoa beans, sugar, milk, and their properties.
- To examine cocoa bean varieties and processing techniques.
- To understand chocolate milling, conching, and tempering processes.
- To analyze hazards and ensure chocolate quality management.
- To examine chocolate coating processes and modern innovations.

UNIT-I	CHOCOLATE INGREDIENTS	9
Cocoa Beans-Cocoa trees, Commercial cocoa producing countries, Cocoa pods, Fermentation, Drying, Storage and transport; Sugar and Sugar Substitutes - Sugar and its production, Crystalline and amorphous sugar, Lactose, Glucose and Fructose, Sugar alcohols, Polydextrose; Milk- Milk fat, Milk proteins		
UNIT-II	COCOA BEAN PROCESSING	9
Introduction – Cocoa -Varieties- Climatic and environment requirement – Harvesting- Chemistry of the cocoa bean - Changes taking place during fermentation of cocoa bean - Processing of cocoa bean - cocoa powder, cocoa butter.		
UNIT-III	CHOCOLATE MANUFACTURING PROCESS	9
Chocolate milling - Separate grinding mills, Combined milling; Chocolate conching- Chemical changes, Conching machines, the three stages of conching; Tempering - Liquid chocolate storage, Tempering machines, Temper measurement; Moulding- Solid tablets, Chocolate shells; Enrobers - Maintaining tempered chocolate; Solidifying.		
UNIT-IV	CHOCOLATE QUALITY AND RHEOLOGY	9
The importance of food safety management in chocolate processing- Physical hazards, Chemical hazards, Microbiological hazards, Allergen hazards; Quality of cocoa mass – Cocoa Powder, Cocoa Butter, Chocolate industry; Analytical techniques for quality analysis; Factors affecting the properties of chocolate.		
UNIT-V	COATED CHOCOLATE PRODUCTS AND RECENT TRENDS	9
Introduction; Panning methods – Chocolate panning, Soft coatings, Hard coating, Film and suspension coating; Process – Center selection, Center preparation, Selection of chocolate and compound coatings, Chocolate and compound engrossing, Polishing and sealing; Packaging, Storage		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Identify chocolate ingredients and their functionalities.
- Explain cocoa fermentation and product preparation.
- Analyze chocolate-making stages and techniques.
- Evaluate safety and quality using analytical methods.
- Apply coating methods and packaging knowledge effectively.

Text Books:

- | | |
|---|------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Stephen T. Beckett; Industrial Chocolate Manufacture and Use Fourth Edition; Wiley- Blackwell, John Wiley & Sons Ltd., Publication, 2009 |
|---|------------------------------------------------------------------------------------------------------------------------------------------|

Reference Books / Web links:

1	Bernard W. Minifie, Ph.D.; Chocolate, Cocoa, And Confectionery: Science and Technology Third Edition; AnaVIBook Published by Van Nostrand Reinhold New York, 1989
2	STEPHEN T. BECKETT; THE SCIENCE OF CHOCOLATE; The Royal Society of Chemistry-2000

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23F05.1	3	2	2	2	2	1	2	1	2	2	1	2	3	2	2
FT23F05.2	3	3	2	3	2	1	2	1	2	2	1	3	3	3	2
FT23F05.3	3	3	3	3	3	1	2	1	3	2	2	3	3	3	3
FT23F05.4	3	3	3	3	3	1	3	1	3	3	2	3	3	3	3
FT23F05.5	3	2	2	2	2	1	2	1	2	2	1	2	3	2	2
Average	3	2.6	2.4	2.6	2.4	1	2.2	1	2.4	2.2	1.4	2.6	3	2.6	2.4

Subject Code	Subject Name	Category	L	T	P	C
FT23F06	SHELF LIFE AND REGULATORY ASPECTS OF BAKERY AND CONFECTIONERY PRODUCTS	PE	3	0	0	3

Objectives:	
●	To understand BIS standards for bakery ingredients and contaminants limits.
●	To learn food safety regulations, certifications, and FSSAI procedures.
●	To understand cleaning, sanitation methods, and food soil removal techniques.
●	To learn safety rules, sanitation equipment duties, and hygiene codes.
●	To sensory attributes and factors influencing product assessment.

UNIT-I	SPECIFICATIONS FOR BAKERY INGREDIENTS AND PRODUCTS	9
BIS standards for whole wheat flour (atta), protein rich flour, maida, fortified maids, protein rich maids, suji (semolina), BIS standards for wheat flour used in bread/biscuit industry, limits for heavy metal contaminants in food grains, limits of pesticides/insecticides residues in food grains/milled food grains.		
UNIT-II	FOOD SAFETY REGULATIONS & CERTIFICATION	9
Need for testing of food, notified NABL labs, referral labs and reference labs in India. GMP, GHP, GLP practices, HACCP implementation program. Regulations and standards for maintaining food safety and quality – BIS, FSSAI and International standards – FSSAI packaging and labeling requirements. FSSAI registration and licensing procedure		
UNIT-III	BAKERY HYGIENE	9
Cleaning and Sanitation in bakery, General cleaning and sanitizing program cleaning methods: Clean-out-of-Place Manual cleaning, Properties of food soils Cleaning agents, Sanitizers: Physical and chemical Factors affecting effectiveness of sanitizer		
UNIT-IV	SAFETY AND SANITATION	9
Health and safety – safety rules- safe practices in the work places – sanitation – duties of the sanitation equipment – Code for hygiene condition in bakery and biscuit manufacturing unit.		
UNIT-V	SENSORY ATTRIBUTES OF BAKERY PRODUCTS	9
Introduction to basic principles in sensory assessment – sensory attributes and senses, general requirements for sensory assessment. Sensory attributes of bakery products. Factors affecting sensory attributes of bakery products.		
		Total Contact Hours: 45

Course Outcomes:	
On completion of course students will be able to	
●	Analyze BIS standards and evaluate ingredient safety regulations.
●	Apply safety standards and implement HACCP for food quality.
●	Evaluate sanitation practices ensuring hygiene in bakery production.
●	Apply safety measures ensuring hygienic practices in bakeries.
●	Evaluate sensory characteristics of bakery products for quality control.

Text Books:

1	Hui.Y.H. - Bakery products, Science and Technology, Blackwell, 2006
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Reference Books / Web links:

1	Zhou - Bakery products, Science and Technology, Second edition, 2014
2	Edwards W.P. — Science of bakery products, RSC, UK, 2007

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FT23F06.1	3	3	2	3	3	3	2	3	2	2	3	2	3	3	2
FT23F06.2	3	3	2	3	2	3	2	3	2	2	3	3	3	3	3
FT23F06.3	3	2	3	3	2	2	3	3	2	2	2	2	3	2	3
FT23F06.4	2	2	3	2	2	3	2	3	3	2	2	2	3	2	2
FT23F06.5	3	3	2	3	3	2	3	2	3	3	2	3	3	3	3
Average	2.8	2.6	2.4	2.4	2.4	2.6	2.4	2.8	2.2	2.2	2.4	2.4	3	2.6	2.6

VERTICAL VII - ADVANCED FOOD PROCESSING TECHNOLOGY

Subject Code	Subject Name	Category	L	T	P	C
FT23G01	RADIATION IN PRESERVATION AND PROCESSING OF FOOD PRODUCTS	PE	3	0	0	3

Objectives:

- Identify the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
- Understand the effect of radiation as a processing and preservation method
- Learn the importance and safety issues of the irradiated foods.
- Explore the effects of infrared radiation on food.
- Evaluate the impact of radio frequency on foods

UNIT-I	BASICS OF RADIATION CHEMISTRY	9
Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.		
UNIT-II	RADIATION CHEMISTRY OF FOOD COMPONENTS	9
Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foodsmeat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.		
UNIT-III	MICROWAVES IN FOOD PROCESSING	9
Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.		
UNIT-IV	INFRA-RED RADIATION	9
Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.		
UNIT-V	RADIO FREQUENCY HEATING PRINCIPLES	9
RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Apply the concept of radiation chemistry on food preservation.
- Predict the effect of dosage of radiation on plant and animal foods.
- Exemplify and analyze the effect of microwave in food processing.
- Outline the effect of Infra-red radiation in food processing.
- Evaluate the effect of radio frequency on foods.

Text Books:	
1	Welter M. Urbain: Food Irradiation Academic Press, New York, 1986
2	Ohlsson and Bengtson, Microwave Processing Technologies Woodhead Publishing, Cambridge, UK, 2002.
3	Gould G.W., New Methods of Food Preservation, Aspen Publishers Inc., Maryland, 1999.

Reference Books / Web links:	
1	S.G.Llyasor and V.V. Krasnikov, Physical Principles of Infra-Red Irradiation of Food Stuffs: Hemisphere Publishing Corporation, London, 1991.
2	Philip Richardson, Thermal Technologies for Food Processing, Wood head Publishing Limited, CRC Press, 2001.
3	Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

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FT23G01.1	2	2	1	1	2	2	1	1	1	1	1	1	1	1	1
FT23G01.2	2	1	2	1	1	2	1	1	1	1	1	1	1	1	2
FT23G01.3	2	3	1	2	1	3	1	1	1	1	1	1	1	1	1
FT23G01.4	3	2	2	1	1	2	1	1	1	1	1	1	1	3	3
FT23G01.5	3	2	3	2	2	2	1	1	1	1	1	1	1	2	2
Average	2.4	2	1.8	1.4	1.4	2.2	1	1	1	1	1	1	1	1.6	1.8

Subject Code	Subject Name	Category	L	T	P	C
FT23G02	NON- THERMAL PROCESSING TECHNIQUES		3	0	0	3

Objectives:	
●	To understand principles and applications of high-pressure processing
●	To explore pulsed electric fields in food processing
●	To learn ultrasound applications in food preservation
●	To recognize alternative non-thermal processing techniques
●	To comprehend electromagnetic energy-based food processing methods

UNIT-I	HIGH PRESSURE PROCESSING	9
Principles - Mechanism and applications of high-pressure processing to food systems - High pressure processing of salads, meats and seafoods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high-pressure processing - High Pressure Freezing: principles and equipment, types of high-pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.		
UNIT-II	PULSED ELECTRIC FIELDS PROCESSING	9
Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology - Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.		
UNIT-III	ULTRASOUND PROCESSING	9
Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultrasound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing.		
UNIT-IV	ALTERNATIVE NON-THERMAL PROCESSING TECHNIQUES	9
High Intensity pulsed light technology: - principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ohmic Heating: Fundamentals of Ohmic Heating, Electrical Conductivity, Generic Configuration, Treatment of Products. Infrared Heating - Fundamentals, Basic laws for blackbody radiation; IR Heater, IR Emitters - Types and Selection Criteria, Applications and Effect on Foods		
UNIT-V	PROCESSING TECHNIQUES BY ELECTROMAGNETIC ENERGY	9
Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave vacuum drying, microwave freeze-drying - applications. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms.		
Total Contact Hours		: 45

Course Outcomes:	
On completion of course students will be able to	
●	Outline the high-pressure processing principles and its effects on foods
●	Infer the mechanism of pulsed electric field systems in food processing
●	Apply ultrasound techniques for food preservation
●	Examine the concepts non-thermal processing impacts on food quality
●	Assess microwave and radio frequency heating methods

Text Books:	
1	P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head Publishing limited, Cambridge, 2009.
2	Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1 Edition, 2005.

Reference Books / Web links:	
1	Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. Barbosa Canovas, CRC Press, 1st Edition, 2004.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23G02.1	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3
FT23G02.2	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3
FT23G02.3	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3
FT23G02.4	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3
FT23G02.5	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3
Average	3	3	3	3	2	1	1	1	1	1	1	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23G03	FOOD PROCESS EQUIPMENT DESIGN AND PLANT LAYOUT	PE	3	0	0	3

Objectives:

- Apply different methods for production planning
- Design layout for various types of food processing industries.
- Design water storage systems and prepare electrical layout.
- Demonstrate the repair and maintenance of equipment.
- Evaluate and construct a project profile analysis and prepare a project report.

UNIT-I	PLANT LOCATION AND LAYOUTS	9
Introduction to food plant design - special features of food and agricultural process industry - plant location - location factors, site selection, location theory and models - layout - objectives, classical and practical layout - preparation of process chart and machinery layout - product layout and process layout - plant layout for size reduction machinery, evaporation plant, drying plant, heat exchanger plant, refrigeration and packaging plant.		
UNIT-II	PROJECT PROFILE ANALYSIS	9
Project profile, key aspects to consider in preparing a project profile and DPR (Detailed Project Report), Describing Project Operations, Categorizing Costs, Environmental Sustainability, completing and interpreting the profile, Project Profile Formats, Preparing model project report on fruit and vegetable processing unit.		
UNIT-III	ELECTRICAL AND WATER SUPPLY	9
Estimation of services - peak and critical load - preparation of electrical layout - selection of fittings and accessories for electrical and water supply - provision of water supply - design of water storage system - selection of pipe, valves and safety devices - drainage -systems, pipeline, traps, safety devices - illumination and ventilation - materials, mounting, operation and maintenance - layout for effluent treatment plant - safe disposal of effluent		
UNIT-IV	PRODUCTION PLANNING AND CONTROL	9
Production planning and control - continuous and intermittent production - scheduling - routing and dispatching - activity chart and Gantt chart - network planning methods - PERT and CPM - applications - method study - work study - methods - man-machine chart - time study - standard time of a job - inventory control - economic ordering quantity - inventory models		
UNIT-V	REPAIR AND MAINTENANCE OF EQUIPMENT	9
Repair and maintenance of equipment - preventive maintenance and breakdown maintenance - replacement of equipment - alternative methods and analysis - method of annual equivalence, present worth method and internal rate of returns.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Apply different methods for production planning.
- Design layout for various types of food processing industries.
- Design water storage systems and prepare electrical layout.
- Demonstrate the repair and maintenance of equipment.
- Evaluate and construct a project profile analysis and prepare a project report

Text Books:	
1	O.P.Kanna, Industrial Engineering and Management, Dhanpat Rai Publication (P) Ltd., New Delhi, 2003
2	S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014
3	Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A., 2003.
	Antonio Lopez-Gomez and Gustavo V. Barbosa-Canovas, Food Plant Design, CRC, London, 2005.

Reference Books / Web links:	
1	C.S.Rao, Environmental Pollution Control Engineering, New age International (P) Ltd., New Delhi, 1999.
2	G.K. Agarwal, Plant layout and materials handling, Jain brothers, New Delhi, 2008.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23G03.1	1	2	1	1	2	2	1	2	1	1	1	1	1	2	1
FT23G03.2	1	1	2	3	3	1	1	1	1	1	3	1	2	2	1
FT23G03.3	3	3	2	2	3	3	1	1	1	1	3	1	1	2	1
FT23G03.4	1	2	1	2	1	2	2	1	1	1	3	1	1	2	1
FT23G03.5	1	3	2	1	2	2	1	1	1	1	1	1	2	2	1
Average	2	1	2	2	1	1	3	1	1	1	2	1	3	2	1

Subject Code	Subject Name	Category	L	T	P	C
FT23G04	FOOD SENSORS	PE	3	0	0	3

Objectives:

- To understand the basics and attributes of sensors.
- To understand the physical concepts related to sensing mechanism.
- To examine the role of interphase electronic circuits in sensing process.
- To analyze the principle of different food biosensors.
- To understand the application of food biosensors in food science and food safety.

UNIT-I	SENSORS BASICS AND ATTRIBUTES	9
Introduction- Sensors: Sensing principles - Sensor Classification, terminologies- Units of Measurements - Measured- Characteristics of sensors: Static and Dynamic.		
UNIT-II	SENSING FUNDAMENTALS AND PHYSICAL PRINCIPLES	9
Electric Charges, Fields, and Potentials; Capacitance; Principles of Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Thermal Properties of Material; Heat Transfer concept; Light; Dynamic Models of Sensor Elements.		
UNIT-III	ELECTRONIC CIRCUITS TOOLS AND CONCEPTS	9
Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.		
UNIT-IV	FOOD BIOSENSORS TYPES AND CLASSIFICATION	9
Introduction: Food Biosensors: Types and Principles- Mechanical (Resonant) Biosensors, Optical detection Biosensors, Electrochemical Biosensors, Impedimetric/Conductometric Biosensors, Amperometric Biosensors, Potentiometric Biosensors, Cell based Biosensors, DNA detection Sensors.		
UNIT-V	APPLICATION OF FOOD BIOSENSORS	9
Food Science and Manufacturing: Sensors for food pathogen detection, monitoring food packaging and shelf life, Biosensors for food quality/additive control, Biosensors for sensory evaluation of foods. Role of Biosensors in Food Safety Management system: Biosensors and Biosecurity, Biosensors and HACCP.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

- Understand static and dynamic characteristics of different sensors
- Apply the working principles of different sensors
- Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor.
- Understand the principle of food biosensors.
- Apply food biosensors in suitable food science and food safety.

Text Books:

- 1 J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer, 2016
- 2 D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, New Delhi, 2009.
- 3 Mehrnetmutlu,(2010)“Biosensors in food processing, safety, and quality control”-CRC Press

Reference Books / Web links:

- | | |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Erika Kress-Rogers (2001). Instrumentation and sensors for the food industry, CRC Press Publishers. |
| 2 | I.E. Tothill (Editor) (2000.) Rapid and On-Line Instrumentation for Food Quality Assurance (Woodhead Publishing in Food Science and Technology). Woodhead Publishing, England. |

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23G04.1	3	3	2	3	3	1	1	2	3	2	2	3	3	3	3
FT23G04.2	3	3	3	3	3	1	1	2	3	2	2	3	3	3	3
FT23G04.3	3	3	3	3	3	1	1	2	3	2	2	3	3	3	3
FT23G04.4	3	3	3	3	3	1	1	2	3	2	2	3	3	3	3
FT23G04.5	3	2	2	3	3	1	1	2	3	2	2	3	3	3	3
Average	3	2.8	2.6	3	3	1	1	2	3	2	2	3	3	3	3

Subject Code	Subject Name	Category	L	T	P	C
FT23G05	3D PRINTING OF FOODS	PE	3	0	0	3

Objectives:

●	To understand history, applications, benefits, and challenges of 3D food printing.
●	To examine hardware, software, and food materials in 3D printing.
●	To analyze workflows and optimize design principles for food models..
●	To design innovative, personalized food products meeting dietary preferences.
●	To emerging trends, scalability, and safety challenges in 3D printing

UNIT-I	INTRODUCTION TO 3D FOOD PRINTING	9
Overview of 3D food printing technology. History and evolution of 3D food printing. Applications of 3D food printing in the food industry, healthcare, and other sectors. Benefits and challenges of 3D food printing		
UNIT-II	3D FOOD PRINTING HARDWARE AND SOFTWARE	9
Types of 3D food printers and their working principles. Key components of a 3D food printer, including extruder, build platform, and print head. Different food materials used in 3D printing and their properties. 3D food printing software for designing and slicing food models.		
UNIT-III	3D FOOD PRINTING PROCESS AND DESIGN PRINCIPLES	9
Workflow of the 3D food printing process, from design to printing. Factors affecting the printability of food materials. Design principles for creating 3D printable food models. Techniques for optimizing food models for printability		
UNIT-IV	CULINARY APPLICATIONS OF 3D FOOD PRINTING	9
Creating visually appealing and personalized food presentations. Customizing food textures and shapes for dietary needs and preferences. Enhancing nutritional value and incorporating functional ingredients. Exploring culinary creativity and developing innovative 3D-printed food products..		
UNIT-V	FUTURE DIRECTIONS AND CHALLENGES IN 3D FOOD PRINTING	9
Advancements in 3D food printing technology and materials. Emerging applications of 3D food printing in personalized nutrition and healthcare. Regulatory and safety considerations for 3D-printed food products. Addressing challenges in scalability, cost-effectiveness, and consumer acceptance.		
Total Contact Hours		: 45

Course Outcomes:

On completion of course students will be able to

●	Analyze advancements in food technology through historical and practical contexts.
●	Evaluate hardware-software integration for precise 3D food printing operations.
●	Develop efficient food models ensuring printability and design effectiveness.
●	Create visually appealing food prototypes with enhanced nutritional attributes.
●	Evaluate future opportunities balancing cost, safety, and consumer acceptability

Text Books:

1	C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika, 3D Printing of Foods, John Wiley & Sons Ltd., 2022. 2. Kamalpreet Sandhu, Sunpreet Singh, Food Printing: 3D Printing in Food Industry, Springer, 2022.
2	C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika, 3D Printing of Foods, John Wiley & Sons Ltd., 2022. 2. Kamalpreet Sandhu, Sunpreet Singh, Food Printing: 3D Printing in Food Industry, Springer, 2022.

Reference Books / Web links:

1	C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika, 3D Printing of Foods, John Wiley & Sons Ltd., 2022. 2. Kamalpreet Sandhu, Sunpreet Singh, Food Printing: 3D Printing in Food Industry, Springer, 2022.
2	C. Anandharamakrishnan, Jeyan A. Moses, T. Anukiruthika, 3D Printing of Foods, John Wiley & Sons Ltd., 2022. 2. Kamalpreet Sandhu, Sunpreet Singh, Food Printing: 3D Printing in Food Industry, Springer, 2022.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23G05.1	3	3	2	2	3	2	2	3	2	3	2	3	3	2	3
FT23G05.2	3	3	3	3	3	2	2	2	3	2	3	3	3	3	2
FT23G05.3	3	2	3	2	2	2	3	3	3	2	2	3	3	3	3
FT23G05.4	3	3	3	3	2	3	3	2	2	3	3	3	3	2	3
FT23G05.5	3	3	2	3	3	3	2	3	2	3	2	2	3	3	3
Average	3	2.8	2.6	2.6	2.6	2.4	2.4	2.6	2.4	2.6	2.4	2.8	3	2.6	2.8

Subject Code	Subject Name	Category	L	T	P	C
FT23G06	APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING	PE	3	0	0	3

Objectives:

●	To understand the techniques associated with nanoparticle preparation.
●	To familiarize with characterization techniques.
●	To learn the applications of nanotechnology in food processing
●	To learn the applications of nanotechnology in food packaging
●	To learn the applications of nanotechnology in development of sensors

UNIT-I	NANOPARTICLES- INTRODUCTION AND PREPARATION	9
Classifications of nanostructured materials- Nanoparticles and nanofibers- quantum dots, nanowires, Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic, Biological and Thermal properties. General methods of preparation- Bottom-up Synthesis-Top-down Approach: Co- Precipitation, Ultra sonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.		
UNIT-II	CHARACTERIZATION TECHNIQUES	9
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.		
UNIT-III	NANOTECHNOLOGY IN FOOD PROCESSING	9
Nano encapsulation & microencapsulation- flavour & aroma encapsulation- Nano formulations for the delivery of bioactive compounds- Nano carriers- Lipid Nano carriers for Phytochemical Delivery in Foods- Nano-emulsions- Nano-dispersions Characterization & stability- Bioavailability studies- limitations- Electrospinning and Electro spraying Technologies- Applications in the food Industry, Nano-filtration, Nanoclusters, Nano chelates.		
UNIT-IV	NANOPACKAGING	9
Nano packaging for enhanced shelf life- Potential of nanomaterials in food packaging- Nano polymers, Nanocomposites, Nano laminates and Nanostructured Coatings in Food Packaging- Smart/Intelligent packaging- Nano antimicrobials in enhancement of shelf-life of foods.		
UNIT-V	NANO SENSORS	9
Nanotechnology in Microbial Food Safety & bio-security- Electrochemical sensors for food analysis and contaminant detection- Monitoring and separation of food-borne pathogens using nanoparticles- Safety Assessment for Use of Nanomaterials in Food and Food Production- Efficacy Evaluation and Risk Assessment- Regulatory Framework for Food Nanotechnology		
		Total Contact Hours : 45

Course Outcomes:

On completion of course students will be able to

●	Prepare the nanomaterials using different techniques
●	Characterize the synthesized nanomaterials
●	Apply the nanotechnology in food processing techniques
●	Apply the nanotechnology in food packaging
●	Develop Nano based sensors for food applications

Text Books:	
1	V. Ravishankar Rai, Jamuna A Bai, "Nanotechnology applications in the food industry", CRC Press, 2018
2	Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).
3	Lynn J. Frewer, WillehmNorde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011).
4	Alexandra Elena Oprea&AlexandruMihaiGrumezescu," Nanotechnology applications in food: Flavour, stability, Nutrition & Safety", Academic Press, 2017.

Reference Books / Web links:	
1	Michael Wilson, KamaliKannangara, Geoff smith, "Nanotechnology: Basic Science & emerging technologies", CRC press, 2014.
2	W. Goddard, "Handbook of Nanoscience Engineering & Technology", CRC Press, 2007.
3	Erika – Rogers and Christopher J B, 2001, "Instrumentation and Sensors for Food Industry", CRC press.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
FT23G03.1	3	3	3	3	3	2	3	3	3	1	2	2	2	2	2
FT23G03.2	2	3	3	3	3	2	3	3	3	1	2	2	2	2	2
FT23G03.3	2	1	1	1	1	2	3	3	3	1	2	2	2	2	2
FT23G03.4	2	1	1	1	1	2	3	3	3	1	2	2	2	2	2
FT23G03.5	2	3	3	3	3	2	3	3	3	1	2	2	2	2	2
Average	2.2	2.2	2.2	2.2	2.2	2	3	3	3	1	2	2	2	2	2