



# **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**

**CHOICE BASED CREDIT SYSTEM**

## **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 with the technical knowledge on value addition, food nutrition, food quality and safety 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**

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
<b>THEORY &amp; PRACTICALS</b>								
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
<b>TOTAL</b>			<b>14</b>	<b>1</b>	<b>8</b>	<b>23</b>	<b>16</b>	

**SEMESTER – II**

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
<b>THEORY &amp; PRACTICALS</b>								
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 Biosciences	3	0	2	5	4	BS
5	GE23233	Problem Solving and Python Programming	1	0	4	5	3	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
<b>TOTAL</b>			<b>17</b>	<b>1</b>	<b>14</b>	<b>32</b>	<b>22</b>	

**SEMESTER –III**

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
<b>THEORY</b>								
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 & 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
<b>PRACTICALS</b>								
7	FT23311	Food Microbiology Laboratory	0	0	4	4	2	PC
8	FT23312	Biochemistry & Nutrition Laboratory	0	0	4	4	2	PC
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>8</b>	<b>27</b>	<b>23</b>	

**SEMESTER –IV**

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
<b>THEORY</b>								
1	MA23431	Probability, Statistics and Reliability	3	1	0	4	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	CS23433	Python Programming for Machine learning	0	0	4	4	2	ES
<b>PRACTICALS</b>								
7	FT23411	Unit operations in Food industries Laboratory	0	0	4	4	2	PC
8	FT23412	Food Processing and Preservation Laboratory	0	0	4	4	2	PC
9	GE23327	Soft Skills - I	0	0	2	2	1	EEC
<b>TOTAL</b>			<b>15</b>	<b>1</b>	<b>14</b>	<b>30</b>	<b>23</b>	

**SEMESTER V**

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
<b>THEORY</b>								
1	FT23501	Food Analysis	3	0	0	3	3	PC
2	FT23502	Food Product Technology	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	2	5	4	PE
5		Professional Elective II	3	0	2	5	4	PE
6		Open Elective I*	3	0	0	3	3	OE
<b>PRACTICALS</b>								
7	FT23511	Food Analysis Lab	0	0	4	4	2	PC
8	FT23512	Food Product Technology Laboratory	0	0	4	4	2	PC
9	GE23427	Soft Skills-II	0	0	2	2	1	EEC
<b>TOTAL</b>			<b>18</b>	<b>0</b>	<b>14</b>	<b>32</b>	<b>25</b>	

**SEMESTER VI**

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
<b>THEORY</b>								
1	FT23601	Professional Ethics	3	0	0	3	3	PC
2	GE23602	Fundamentals of Management for Engineers	3	0	0	3	3	HS
3		Professional Elective III	3	0	2	5	4	PE
4		Professional Elective IV	3	0	2	5	4	PE
5		Open Elective – II*	3	0	0	3	3	OE
<b>PRACTICALS</b>								
6	CR23P62	Microfluidics Laboratory	0	0	4	4	2	PC
7	GE23621	Problem Solving Techniques	0	0	2	2	1	EEC
8	FT23611	Innovation and Design thinking for Food Technologists	0	0	4	4	2	EEC
<b>TOTAL</b>			<b>15</b>	<b>0</b>	<b>14</b>	<b>29</b>	<b>22</b>	

**SEMESTER VII**

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
<b>THEORY</b>								
1	FT23701	Food Quality, Safety Standards and Certification	3	0	0	3	3	PC
2	FT23702	Comprehensive course for Food Technologists.	3	0	0	3	3	PC
3	FT23703	Functional Foods and Nutraceuticals	3	0	0	3	3	PC
4	FT23704	Sensory evaluation in foods	3	0	0	3	2	PC
5		Professional Elective V	3	0	0	3	3	PEC
6		Professional Elective VI	3	0	0	3	3	PEC
<b>PRACTICALS</b>								
7	FT23711	Problem solving using AI-ML for Food Technologists.	0	0	4	0	2	EEC
8	FT23712	Industrial Training/Internship	-	-	-	-	2	EEC
			<b>18</b>	<b>0</b>	<b>4</b>	<b>18</b>	<b>21</b>	

**SEMESTER VIII**

S. NO.	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Credits	Category
<b>PRACTICALS</b>								
1	FT23801	Internship/ Project Work	0	0	20	20	10	EEC
<b>TOTAL</b>			<b>0</b>	<b>0</b>	<b>20</b>	<b>20</b>	<b>10</b>	

**TOTAL CREDITS: 162**



## **Check-list based on for AICTE curriculum -- B. TECH FOOD TECHNOLOGY**

1. Total number of credits for a programme: 162
2. Credit distribution across semesters I to VIII
3. Contact hours' semester-wise: 16, 22, 23, 23, 25, 22, 21, 10
4. Category-wise credits for a programme
5. Number of Professional Electives: **6**
6. Number of Open Electives: **2**
7. Mandatory (Non-credit) courses: **2**
8. Courses to be taught by other departments: \_\_\_\_ (Open elective)
9. Courses to be taught for other departments: **2** (Open elective)
10. Common courses with other branch/discipline: \_\_\_\_

## 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	7	6	5					23
4.	PC		5	13	10	13	8	11		60
5.	PE					8	8	6		22
6.	OE					3	3			6
7.	EEC				1	1	3	4	10	19
8	MC	*	*							
<b>Total</b>		<b>16</b>	<b>22</b>	<b>23</b>	<b>23</b>	<b>25</b>	<b>22</b>	<b>21</b>	<b>10</b>	<b>162</b>

## PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI	Vertical VII
Dairy And Beverage Technology	Meat, Marine and Poultry Technology	Grain Science Technology and Plantation Crops	Fruit and Vegetable Technology	Food Packaging Technology	Baking and Confectionery Technology	Food Safety Management System
FT23A21	FT23B21	FT23C21	FT23D21	FT23E21	FT23F21	FT23G21
FT23A22	FT23B22	FT23C22	FT23D22	FT23E22	FT23F22	FT23G22
FT23A23	FT23B23	FT23C23	FT23D23	FT23E23	FT23F23	FT23G23
FT23A24	FT23B24	FT23C24	FT23D24	FT23E24	FT23F24	FT23G24
FT23A15	FT23B15	FT23C15	FT23D15	FT23E15	FT23F15	FT23G15
FT23A16	FT23B16	FT23C16	FT23D16	FT23E16	FT23F16	FT23G16

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 (Honours) 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 (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to Regulations 2021 Clause 4.10.

Course Code	Course Title (Theory course)	Category	L	T	P	C
HS 23111	Technical Communication I	Theory	2	0	0	2
Common to all branches of B.E/B. Tech programmes – First Semester						

<b>Objectives:</b>
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

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

Course Code	Course Title	Category	L	T	P	C
MA23112	ALGEBRA AND CALCULUS	BS	3	1	0	4
<b>Common to I sem. B.E. - AERO, AUTO, MECH, MCT, R&amp;A, CIVIL and B.Tech. - BT, FT &amp; CHEM</b>						

<b>Objectives:</b>
<ul style="list-style-type: none"> <li>To introduce the matrix techniques and to illustrate the nature of the matrix.</li> <li>To address data and synthesis of the information to provide valid conclusions.</li> <li>To explain techniques of calculus which are applied in the solutions of engineering problems.</li> <li>To analyse special types of integrals by analytical methods and numerical techniques.</li> <li>To practice the techniques of Integration in finding area and volumes.</li> </ul>

<b>UNIT-I</b>	<b>MATRICES</b>	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		
<b>UNIT-II</b>	<b>FUNCTIONS OF SEVERAL VARIABLES</b>	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.		
<b>UNIT-III</b>	<b>INTEGRAL CALCULUS</b>	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		
<b>UNIT-IV</b>	<b>MULTIPLE INTEGRALS</b>	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.		
<b>UNIT-V</b>	<b>REGRESSION</b>	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 $y = ax^2 + bx + c$ .		
<b>Total Contact Hours:60</b>		

<b>Course Outcomes:</b>
On completion of the course students will be able to
<ul style="list-style-type: none"> <li>Demonstrate the matrix techniques in solving the related problems in engineering and technology.</li> </ul>

<ul style="list-style-type: none"> <li>● Analyse and interpret data, and synthesize information to provide valid conclusions.</li> </ul>
<ul style="list-style-type: none"> <li>● Interpret the problems in Engineering and Technology using the principles of mathematical calculus.</li> </ul>
<ul style="list-style-type: none"> <li>● Apply the analytical methods and numerical techniques to solve the related engineering problems.</li> </ul>
<ul style="list-style-type: none"> <li>● Evaluate multiple integrals to conduct investigations of complex problems.</li> </ul>

#### **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 <sup>th</sup> 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.

Course Code	Course Title	Category	L	T	P	C
CY23312	CHEMISTRY FOR TECHNOLOGISTS	BS	3	0	2	4
Common to B.TECH. - CHEMICAL ENGG., FOOD TECH. & BIO TECH						

**Objectives:**

- 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.

<b>UNIT-I</b>	<b>SURFACE CHEMISTRY</b>	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.		
<b>UNIT-II</b>	<b>ELECTROCHEMISTRY</b>	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.		
<b>UNIT-III</b>	<b>NANO CHEMISTRY</b>	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.		
<b>UNIT-IV</b>	<b>POLYMERS AND HETEROCYC</b>	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.		
<b>UNIT-V</b>	<b>ANALYTICAL TECHNIQUES</b>	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.
- Pradeep T, "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](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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CY23312.1	2	1	1	-	-	-	1	1	-	-	-	-			
CY23312.2	2	2	1	-	-	-	-	-	-	-	-	1			
CY23312.3	3	2	2	-	-	-	-	-	-	-	-	-			
CY23312.4	2	2	1	-	-	-	1	1	-	-	-	-			
CY23312.5	2	1	1	-	-	-	-	-	-	-	-	-			
AVG.	2.2	1.6	1.2	-	-	-	1	1-	-	-	-	1			

Subject Code	Subject	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.

<b>UNIT-I</b>	<b>PLANE CURVES AND PROJECTION OF POINTS</b>	<b>11</b>
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.		
<b>UNIT-II</b>	<b>PROJECTION OF LINES AND PLANE SURFACE</b>	<b>12</b>
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.		
<b>UNIT-III</b>	<b>PROJECTION OF SOLIDS AND DEVELOPMENT OF SURFACE OF SECTIONED SOLIDS</b>	<b>12</b>
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		
<b>UNIT-IV</b>	<b>ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTIONS</b>	<b>12</b>
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		
<b>UNIT-V</b>	<b>PERSPECTIVE PROJECTIONS AND BUILDING DRAWING</b>	<b>12</b>
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			
	<b>Total</b>	<b>Contact</b>	<b>: 60</b>
	<b>Hours</b>		

<b>Course Outcomes:</b> 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

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

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

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

<b>Special Points Applicable to End Semester Examination on Engineering Graphics</b>	
<b>1</b>	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

Subject Code	Subject Name	Category	L	T	P	C
GE23121	ENGINEERING PRACTICES - ELECTRICAL AND ELECTRONICS	ES	0	0	2	1

**Objectives:**

- To provide hands-on experience on various basic engineering practices in Electrical Engineering.
- To impart hands-on experience on various basic engineering practices in Electronics Engineering.

**List of Experiments**

**A. ELECTRICAL ENGINEERING PRACTICE**

- Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- Fluorescent lamp wiring.
- Stair case wiring.
- Measurement of electrical quantities – voltage, current, power & power factor in RL circuit.
- Measurement of resistance to earth of electrical equipment.
- Study of Ceiling Fan and Iron Box

**B. ELECTRONICS ENGINEERING PRACTICE**

- Study of electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
- (a) Study of Multimeter  
(b) Testing of electronic components.
- Study of logic gates AND, OR, EXOR and NOT.
- Generation of Clock Signals.
- Soldering practice – Components Devices and Circuits – Using general purpose PCB.
- Measurement of ripple factor of HWR and FWR.

<b>Total Hours</b>	<b>Contact</b>	<b>:</b>	<b>30</b>
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**Course Outcomes:**

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

- fabricate the electrical circuits
- construct the house wiring circuits
- fabricate the electronic circuits
- verify the truth table of logic gates
- design the AC-DC converter using diodes and passive components

**SUGGESTED EVALUATION METHODS**

- Experiment based Viva

**REFERENCE**

- Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
- Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
- Jeyapooan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Publishing House Pvt.Ltd, 2006.
- Rajendra Prasad A. & Sarma P.M.M.S., "Workshop Practice", SreeSai Publication, 2002.

**Lab Equipment Required:**

S.	Name of the Equipment	Quantity Required
1	Residential house wiring using switches, fuse, indicator, lamp	3 Nos
2	Fluorescent lamp wiring.	3 Nos
3	Stair case wiring	3 Nos
4	Measurement of electrical quantities – voltage, current, power	2 Nos
5	Study purpose items: Iron box, Ceiling fan.	2 each
6	Megger (250V/500V)	2 Nos.
7	Soldering guns	10 Nos.
8	Assorted electronic components for making circuits	50 Nos.
9	Small PCBs	10 Nos.
10	Multimeters	10 Nos.
11	Digital trainer kit	5 Nos.
12	CRO	8 Nos.
13	Transformer	8 Nos.
14	Function Generator	8 Nos.

COs/POs&PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
<b>CO 1</b>	3	3	3	2	-	-	2	-	3	2	-	3			
<b>CO 2</b>	3	3	2	2	-	-	2	-	3	2	-	3			
<b>CO 3</b>	3	3	3	2	-	-	2	-	3	2	-	3			
<b>CO 4</b>	3	3	3	2	-	-		-	3	2	-	3			
<b>CO 5</b>	3	3	3	2	-	-		-	3	2	-	3			
<b>Average</b>	<b>3</b>	<b>3</b>	<b>2.67</b>	<b>2</b>	-	-	<b>2</b>	-	<b>3</b>	<b>2</b>	-	<b>3</b>			

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC23112	<b>ENVIRONMENTAL SCIENCE AND ENGINEERING</b> <b>Common to all branches of B.E./B.Tech. courses (Except B.Tech-CSBS)</b>	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

<b>UNIT-I</b>	<b>Air and Noise pollution</b>	9
<p>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.</p> <p>Noise pollution –sources - health effects - standards- measurement and control methods.</p>		
<b>UNIT-II</b>	<b>Water pollution and its management</b>	9
<p>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.</p>		
<b>UNIT-III</b>	<b>Solid waste and Hazardous waste management</b>	9
<p>Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation- sanitary landfill, recycling, composting, incineration, energy recovery options from waste - Hazardous waste – types, characteristics, and health impact - hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal.</p> <p>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.</p>		
<b>UNIT-IV</b>	<b>Sustainable Development</b>	9
<p>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.</p>		

<b>UNIT-V</b>	<b>Environmental Management and Legislation</b>	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**

<b>Course Outcomes:</b>	
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.

<b>Text Books:</b>	
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

<b>Reference Books</b>	
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.



Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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	PS0 1	PS O2	PS O3
MC2311 2.1	1	2	3	1	-	2	2	2	1	1	1	2			
MC2311 2.2	1	2	3	1	-	2	2	2	1	1	1	2			
MC2311 2.3	-	-	3	1	-	2	3	2	1	-	1	2			
MC2311 2.4	-	1	2	1	1	3	3	2	1	1	1	2			
MC2311 2.5	-	1	2	-	-	2	2	2	1	2	2	2			
AVG.	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2			

#### Web links:

1 | [https://onlinecourses.nptel.ac.in/noc19\\_ge22/](https://onlinecourses.nptel.ac.in/noc19_ge22/)

2 | [NPTEL](https://www.nptel.ac.in/)

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

Subject Code	Subject Name	Category	L	T	P	C
GE23117	தமிழர் மரபு	ES	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 - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

**அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை: 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, கையெழுத்துப்படிக்கல்கள் - தமிழ்ப் புத்தகங்களின் அச்ச 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 (Theory course)	Category	L	T	P	C
HS 23222	Technical Communication II	Theory	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
<b>Listening:</b> Telephonic Conversations and TV News <b>Reading:</b> Newspapers and Magazines <b>Speaking:</b> Conversational Practice: Speaking in a given situation, Asking permission and requesting etc., <b>Writing:</b> Job Application Letter and Resume <b>Grammar:</b> Reference words: pronouns and determiners <b>Vocabulary:</b> Guessing meanings of words in different contexts.		
UNIT-II	FUNCTIONAL LANGUAGE ASPECTS	6
<b>Listening:</b> Motivational listening – listening to real life challenges <b>Reading:</b> Articles and Technical reports <b>Speaking:</b> Using Polite Expressions, Indirect Questions <b>Writing:</b> Paraphrasing a Text, Poem <b>Grammar:</b> Purpose Statements, Cause and Effect Expressions <b>Vocabulary:</b> Neologisms.		
UNIT-III	TECHNICAL REPORTWRITING	6
<b>Listening:</b> Empathetic Listening – Giving Solutions to Problems <b>Reading:</b> Inferential Reading <b>Speaking:</b> Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc., <b>Writing:</b> Report Writing <b>Grammar:</b> Functional Usage of Expressions – used to, gone / been, etc., <b>Vocabulary:</b> Words Often Confused		
UNIT-IV	STRUCTURAL GRAMMAR	6
<b>Listening:</b> Comprehension (IELTS practice tests) <b>Reading:</b> Intensive Reading for specific information <b>Speaking:</b> Pick and Talk <b>Writing:</b> Proposals <b>Grammar:</b> Sentence Structures – Simple, Compound, Complex Sentences <b>Vocabulary:</b> Replacing dull words with vivid ones		
UNIT-V	PRESENTATION SKILLS	6
<b>Listening:</b> Discriminative listening – sarcasm, irony, pun, etc., <b>Reading:</b> Practice of chunking – breaking up reading materials <b>Speaking:</b> Mini presentation on some topic <b>Writing:</b> 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

- 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**

- Story Lines
- One truth and two lies
- Hang Man
- Pictionary
- Word Scramble
- Case study

**SUGGESTED EVALUATION METHODS**

- 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

Subject Code	Subject Name	Category	L	T	P	C
HS 23223	English for Professional Competence Common to all branches of B.E/B. Tech programmes – Second Semester		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
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**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
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**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
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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
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**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
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Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution

	<b>Total Contact Hours</b>	30
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**Course Outcomes:**

On completion of the course, students will be able to
<ul style="list-style-type: none"> <li>• interpret and respond appropriately in the listening and reading contexts.</li> </ul>
<ul style="list-style-type: none"> <li>• express themselves effectively in spoken and written communication</li> </ul>
<ul style="list-style-type: none"> <li>• apply their acquired language skills in writing the competitive examinations</li> </ul>
<ul style="list-style-type: none"> <li>• exhibit their professional skills in their work place</li> </ul>
<ul style="list-style-type: none"> <li>• identify the challenges in the work place and suggest strategies solutions</li> </ul>

### **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

### **Reference Books**

<b>1</b>	How to Read Better & Faster, Norman Lewis, Goyal Publishers
<b>2</b>	Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
<b>3</b>	The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
<b>4</b>	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.

Course Code	Course Title	Category	L	T	P	C
MA23212	DIFFERENTIAL EQUATIONS AND ANALYTIC FUNCTIONS	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.

<b>UNIT-I</b>	<b>ORDINARY DIFFERENTIAL EQUATIONS</b>	<b>12</b>
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.		
<b>UNIT-II</b>	<b>PARTIAL DIFFERENTIAL EQUATIONS</b>	<b>12</b>
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.		
<b>UNIT-III</b>	<b>LAPLACE TRANSFORM</b>	<b>12</b>
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		
<b>UNIT-IV</b>	<b>VECTOR CALCULUS</b>	<b>12</b>
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 parallelepipeds.		
<b>UNIT-V</b>	<b>COMPLEX VARIABLES</b>	<b>12</b>
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$ .		
<b>Total Contact Hours: 60</b>		

### Course Outcomes:

On completion of the course students will be able to

- 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"> <li>● Develop specific methodologies, techniques and resources in Partial differential equations to conduct research and produce innovative results in the area of specialisation.</li> </ul>
<ul style="list-style-type: none"> <li>● Use Laplace transform and inverse transform techniques to solve the complex problems in engineering and technology.</li> </ul>
<ul style="list-style-type: none"> <li>● 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.</li> </ul>
<ul style="list-style-type: none"> <li>● Demonstrate the concept of Analytic functions, conformal mapping and complex integration in solving Engineering problems.</li> </ul>

#### **SUGGESTED ACTIVITIES**

- Problem solving sessions
- Activity Based Learning

#### **SUGGESTED EVALUATION METHODS**

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

#### **Text Book(s):**

4.	Grewal B.S., “ Higher Engineering Mathematics ”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
5.	Veerarajan. T, Engineering Mathematics –II, Mc Graw Hill Education, 2018.
6.	Erwin Kreyszig, " Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
7.	Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th Edition, New Delhi, 2011.
8.	Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, 5th 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 <sup>th</sup> Edition 2006.
4.	Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

Course Code	Course title ( Lab oriented Theory Courses)	Category	L	T	P	C	
EE23133	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	ES	3	0	2	4	
<b>Objectives:</b>							
●	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.						
<b>UNIT-I</b>	<b>DC CIRCUITS</b>					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.							
<b>UNIT-II</b>	<b>AC CIRCUITS</b>					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							
<b>UNIT-III</b>	<b>ELECTRICAL MACHINES</b>					9	
Construction, Principles of operation of DC machines, Single phase Transformers, Synchronous machines, Single phase induction motors.							
<b>UNIT-IV</b>	<b>ELECTRONIC DEVICES &amp; CIRCUITS</b>					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.							
<b>UNIT-V</b>	<b>MEASUREMENTS &amp; INSTRUMENTATION</b>					9	
Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Piezoelectric, - Classification of instruments - PMMC and MI Ammeters and Voltmeters – Digital Storage Oscilloscope.							
					<b>Contact Hours</b>	<b>:</b>	<b>45</b>
<b>List of Experiments</b>							
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.						
					<b>Contact Hours</b>	<b>:</b>	<b>30</b>
					<b>Total Contact Hours</b>	<b>:</b>	<b>75</b>
<b>Course Outcomes:</b>							
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.
<b>Suggested Activities</b>	
●	Problem solving sessions
<b>Suggested Evaluation Methods</b>	
●	Quizzes
●	Class Presentation / Discussion
<b>Text Book(s):</b>	
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
<b>Reference Books(s) / Web links:</b>	
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	<a href="https://nptel.ac.in/courses/108108076">https://nptel.ac.in/courses/108108076</a>

### Lab Equipment Required:

Sl. No.	Name of the Equipment	Quantity Required (For a batch of 30 students)
1.	<b>Verification of ohms and Kirchhoff's Laws</b> 1. DC Regulated Power supply (0 - 30 V variable) 2. Bread Board 3. Resistors 4. Multimeter 5. Connecting wires	1 1  As per Circuit diagram1 As Required
2.	<b>Load test on DC Shunt Motor.</b> 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.	<b>Load Test on Induction Motor</b> 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 Required1

4.	<b>Load test on Single phase Transformer</b> 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.	<b>Characteristics of PN and Zener Diodes</b> 1. PN Diode (IN4007), Zener diode (6.8V, 1A) 2. Resistor 1 K $\Omega$ , 100 $\Omega$ 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.	<b>Characteristics of BJT</b> 1. Transistor (BC107) 2. Resistors- 1k $\Omega$ , 470K $\Omega$ , 1M $\Omega$ 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.	<b>Measurement of displacement of LVDT, RTD and Thermistor</b> 1. LVDT Kit 2. RTD 3. Thermistor 4. Multimeter	1 1 1 1 1

Subject Code	PHYSICS FOR BIOSCIENCE	Category	L	T	P	C
PH23231	Common to - B.E. – Biomedical Engineering and B.Tech – Bio Technology & Food Technology	BS	3	0	2	4
<b>Objectives:</b>						
●	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.					
<b>UNIT-I</b>	<b>WAVES AND ULTRASONICS</b>					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.						
<b>UNIT-II</b>	<b>PHYSICS OF SEMICONDUCTORS</b>					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.						
<b>UNIT-III</b>	<b>MATERIALS FOR MEDICAL APPLICATIONS</b>					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.						
<b>UNIT-IV</b>	<b>NUCLEAR AND PARTICLE PHYSICS</b>					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.						
<b>UNIT-V</b>	<b>ADVANCED ANALYTICAL TECHNIQUES</b>					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						
					<b>Contact Hours</b>	<b>: 45</b>
<b>List of Experiments</b>						
<b>1</b>	Determination of Velocity of ultrasound and compressibility of given liquid – Ultrasonic interferometer.					
<b>2</b>	Determination of wavelength of diode laser and angular divergence.					
<b>3</b>	Determination of Band gap of given semiconducting material.					
<b>4</b>	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.			
		<b>Contact Hours</b>	<b>:</b>	<b>30</b>
		<b>Total Contact Hours</b>	<b>:</b>	<b>75</b>
<b>Course Outcomes:</b>				
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.			
<b>Suggested Activities</b>				
●	Problem solving sessions			
<b>Suggested Evaluation Methods</b>				
●	Quizzes			
●	Class Presentation / Discussion			
<b>Text Book(s):</b>				
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.			
<b>Reference Books(s) / Web links:</b>				
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 <sup>th</sup> 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	6	13	-

	Travelling Microscope			
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	-

**CO - PO – PSO matrices of course 1:** Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation, put “-”

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	2	2	-	-	1	1	-	-	-	-	-	1	1	1
Average	2.4	1.6	1.4	-	-	1	1	-	-	-	-	-	1	1	1

Subject Code	Subject Name (Lab Oriented Theory Course)	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

<b>UNIT-I</b>	<b>ALGORITHMIC PROBLEM SOLVING</b>	<b>6</b>
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).		
<b>UNIT-II</b>	<b>DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW</b>	<b>6</b>
Python interpreter and interactive mode - values and types - data types – variables – keywords – expressions and statements- python I/O - operators- precedenceof operators– comments. Conditionals:conditional(if)-alternative(if-else)-chained conditional (if- elif- else)–nested conditional.		
<b>UNIT-III</b>	<b>CONTROL FLOW – II AND FUNCTIONS</b>	<b>7</b>
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.		
<b>UNIT-IV</b>	<b>STRINGS</b>	<b>5</b>
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.		
<b>UNIT-V</b>	<b>LISTS, TUPLES AND DICTIONARIES</b>	<b>6</b>
Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - listparameters. 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.		
<b>Contact Hours</b>		<b>: 30</b>

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.	
<b>Contact Hours</b>		<b>: 60</b>
<b>Total Contact Hours</b>		<b>: 90</b>



<b>Course Outcomes:</b>	
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.

<b>TextBooks:</b>	
1.	Allen B. Downey, Think Python:How to Think Like a Computer Scientist, Second edition,UpdatedforPython3, Shroff/ O'Reilly Publishers, 2016 ( <a href="http://greenteapress.com/wp/think-python/">http://greenteapress.com/wp/think-python/</a> )
2.	Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python3.2, Network Theory Ltd., 2011.
<b>ReferenceBooks:</b>	
1.	JohnVGuttag, 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.

### CO -PO-PSO matrices of course

PO/P SOCO	PO 1	PO2	PO 3	PO 4	PO5	PO6	PO 7	PO8	PO 9	P O 1 0	P O 1 1	P O 1 2	PS O1	PS O 2	PS O 3
GE19211.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
GE19211.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
GE19211.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
GE19211.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
GE19211.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
<b>Average</b>	<b>1.8</b>	<b>1.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1.8</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.2</b>	<b>0.2</b>	<b>1. 4</b>	<b>1</b>	<b>2. 4</b>	<b>2.4</b>	<b>2</b>



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

### Course Objectives:

- To develop the knowledge of students in the basic area of Food Chemistry
- To understand the composition and properties of food
- To understand the chemical changes of nutrients during handling, processing, and storage
- To understand underlying principles of food processing and preservation
- To appreciate the similarities and complexities of the chemical components in foods.

<b>UNIT-I</b>	<b>CARBOHYDRATES</b>	10
<p>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 &amp; gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Maltodextrins and dextrins; Structure of glycogen. Fiber- Cellulose &amp; hemicellulose Pectins: Gums &amp; seaweeds- gel formation &amp; viscosity.</p>		
<b>UNIT-II</b>	<b>PROTEINS</b>	9
<p>The principal proteins in the human diet. Review of protein structure &amp; conformation; Optical activity, solubility, hydration, swelling, foam formation &amp; stabilization, gel formation, emulsifying effect, thickening &amp; binding, amino acids in Maillard reaction, denaturation; Properties &amp; 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.</p>		
<b>UNIT-III</b>	<b>LIPIDS</b>	9
<p>Review of structure, composition and nomenclature of fats. Properties of fats &amp; 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 &amp; 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.</p>		
<b>UNIT-IV</b>	<b>FOOD COMPOSITION, WATER, MINERALS AND VITAMINS</b>	7
<p>Proximate composition of food, water activity in food, moisture content of food, water quality for</p>		

food processing. Mineral & vitamin content of foods- stability & degradation during food processing.		
<b>UNIT-V</b>	<b>AROMA &amp; IMPORTANT PHYTOCHEMICALS IN FOOD</b>	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.		
		<b>Total Contact Hours : 45</b>

<b>Course Outcomes:</b>
On completion of course, students will be able to
<ul style="list-style-type: none"> <li>• Analyze the relationships between nutritional health and food selection.</li> <li>• Explain the major chemical and biochemical (enzymatic) reactions that influence food quality</li> <li>• Understand the properties of different food components</li> <li>• Understand how the interactions between the components modulate the specific quality attributes of the food</li> <li>• Understand the importance of phytochemicals and aroma in food</li> </ul>

<b>Text Book (s):</b>	
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

<b>Reference Books(s) / Web links:</b>	
1	Meyer, Lillian Hoagland "Food Chemistry". CBS Publishers, 1987.
2	Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". 4th Edition, Kluwer-Academic, Springer, 2014.
3	Richard Owusu-Apenten "Introduction to Food Chemistry" CRC Press, 2005.
4	SrinivasanDamodaran, Kirk L. Parkin, "Fennema's Food Chemistry" 5th Edition, CRC Press, 2008.
5	Peter Chi Keung Cheung, Bhavbhuti M. Mehta, " Handbook of Food Chemistry" Springer, 2015

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC23111	<b>Indian Constitution and Freedom Movement</b>	Theory	3	0	0	0
Common to all branches of B.E/B. Tech Programmes – First / Second/third Semester						

**Objectives:**

- 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.

<b>UNIT-I</b>	<b>INDIAN FREEDOM MOVEMENT</b>	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India- <b>Indian Freedom Struggle under Mahatma Gandhi</b> - Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
<b>UNIT-II</b>	<b>CONSTITUTION OF INDIA</b>	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.		
<b>UNIT-III</b>	<b>STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT</b>	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
<b>UNIT-IV</b>	<b>STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY</b>	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.		
<b>UNIT-V</b>	<b>CONSTITUTIONAL FUNCTIONS AND BODIES</b>	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.		
		<b>Total Contact Hours: 45</b>

**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):**

8. M. Laxmikanth , “Indian Polity:, McGraw-Hill, New Delhi.
9. Durga Das Basu, “Introduction to the Constitution of India “, Lexis Nexis, New Delhi. 21<sup>st</sup>ed 2013.
10. P K Agarwal and K N Chaturvedi ,PrabhatPrakashan, New Delhi, 1<sup>st</sup>ed , 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.2<sup>nd</sup>ed, 2014.
5. Bipan Chandra, History of Modern India, Orient Black Swan, 2009.

<b>Course Code</b>	<b>Course title</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>GE23217</b>	<b>TAMILS AND TECHNOLOGY</b>	<b>ES</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>UNIT-I</b>	<b>WEAVING AND CERAMIC TECHNOLOGY</b>					<b>3</b>
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.						
<b>UNIT-II</b>	<b>DESIGN AND CONSTRUCTION TECHNOLOGY</b>					<b>3</b>
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.						
<b>UNIT-III</b>	<b>MANUFACTURING TECHNOLOGY</b>					<b>3</b>
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.						
<b>UNIT-IV</b>	<b>AGRICULTURE AND IRRIGATION TECHNOLOGY</b>					<b>3</b>
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoempu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society						
<b>UNIT-V</b>	<b>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</b>					<b>3</b>
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project						
						<b>Total Contact Hours : 15</b>

Course Code	Course title	Category	L	T	P	C
GE23217	<b>தமிழரும் தொழில்நுட்பமும்</b>	ES	1	0	0	1

<b>அலகு I</b>	<b>நெசவு மற்றும் பானைத் தொழில்நுட்பம்</b>	3
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சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்

<b>அலகு II</b>	<b>வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:</b>	3
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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.

<b>அலகு III</b>	<b>உற்பத்தித் தொழில் நுட்பம்</b>	3
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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

<b>அலகு IV</b>	<b>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</b>	3
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அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுழித் 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	
<p>அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.</p>			
		<b>Total Contact Hours</b>	<b>: 15</b>

#### 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) (Publishedby: 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

Course Code	Course Title (Laboratory Course)	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
<b>Total Contact Hours</b>	
<b>: 60</b>	

### 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:**

- |          |                                                                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | Weaver, C.M, and J.R. Daniel. "The Food Chemistry Laboratory – A Manual for Experimental Foods, Dietetics & Food Scientists." 2nd Edition, CRC Press, 2005. |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|

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

**Objectives:**

- 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.

**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. <a href="https://drspmaths.files.wordpress.com/2020/01/advanced-engineering-mathematics-peter-v.-o-neil.pdf">https://drspmaths.files.wordpress.com/2020/01/advanced-engineering-mathematics-peter-v.-o-neil.pdf</a>

COs/POs&PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS O2	PS O3
<b>CO1</b>	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
<b>CO2</b>	3	3	3	2	1	-	-	-	-	-	-	1	2	1	2
<b>CO3</b>	3	3	3	3	2	-	-	-	-	-	-	2	1	2	2
<b>CO4</b>	3	3	2	3	2	-	-	-	-	-	-	2	1	-	1
<b>CO5</b>	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.

<b>UNIT-I</b>	<b>MICROBES - STRUCTURE AND MULTIPLICATION</b>	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>		
<b>UNIT-II</b>	<b>ROLE OF MICROBES IN SPOILAGE OF FOODS AND THEIR CONTROL</b>	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>		
<b>UNIT-III</b>	<b>BENEFICIAL MICROBES IN FOODS</b>	9
<p>Microbes of importance in food fermentations, – Homo &amp; 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>		
<b>UNIT-IV</b>	<b>MICROBIAL AGENTS OF FOOD BORNE ILLNESS</b>	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>		
<b>UNIT-V</b>	<b>MICROBIAL EXAMINATION OF FOODS</b>	9
<p>Detection &amp; 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.
	Harrigan, W.F. "Laboratory Methods in Food Microbiology" 3rd Edition, Academic press, 1998

<b>PO/PS O CO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PS O1</b>	<b>PS O2</b>	<b>PS O3</b>	<b>PS O4</b>
<b>CO1</b>	3	2	2	2	3	3	3	3	2	-	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3	3
<b>CO3</b>	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	2	-	3	-	3	3	3	3	3	-
<b>Average</b>	3	2.6	2.6	2.8	3	3	2	2	2.8	-	3	3	3	3	2	2.4

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.

<b>UNIT-I</b>	<b>AN OVERVIEW OF NUTRITION</b>	<b>9</b>
<p>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.</p>		
<b>UNIT-II</b>	<b>CARBOHYDRATES</b>	<b>9</b>
<p>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.</p>		
<b>UNIT-III</b>	<b>PROTEINS &amp; LIPIDS</b>	<b>9</b>
<p>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.</p>		
<b>UNIT-IV</b>	<b>VITAMINS &amp; MINERALS</b>	<b>9</b>
<p>Water &amp; 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.</p>		
<b>UNIT-V</b>	<b>ENERGY METABOLISM</b>	<b>9</b>
<p>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</p>		

satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.			
	<b>Total Contact Hours</b>	<b>:</b>	<b>45</b>

<b>Course Outcomes:</b>	
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.

<b>Text Books:</b>	
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.

<b>Reference Books / Web links:</b>	
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3	PS O 4
<b>CO1</b>	3	2	2	2	3	3	3	3	2	-	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3	3
<b>CO3</b>	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3	3
<b>CO5</b>	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	2.4



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.

<b>UNIT-I</b>	<b>Thermodynamic Law and Properties of Fluids</b>	<b>9</b>
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.		
<b>UNIT-II</b>	<b>Thermodynamic Properties Of Solutions</b>	<b>9</b>
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.		
<b>UNIT-III</b>	<b>Phase equilibria</b>	<b>9</b>
Criteria for phase equilibria; VLE calculations for binary and multi component systems; Duhem's Theorem, Constant pressure equilibria and Constant temperature equilibria		
<b>UNIT-IV</b>	<b>Chemical Reaction Equilibria</b>	<b>9</b>
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.		
<b>UNIT-V</b>	<b>Thermodynamic Description for Microbial Growth and Product Formation</b>	<b>9</b>
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.		
		<b>Total Contact Hours : 45</b>

Course Outcomes:	
On completion of course students will be able to	
<input type="checkbox"/>	Apply various thermodynamic laws to the real system
<input type="checkbox"/>	Calculate the entropy changes in the system
<input type="checkbox"/>	Analyse basic thermodynamic cycles
<input type="checkbox"/>	Demonstrate the interrelationship between thermodynamic cycles
<input type="checkbox"/>	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	PSO4
CO1	3	2	2	2	2	3	3	-	-	-	3	3	3	-	3	3
CO2	3	3	2	2	2	2	2	-	-	-	-	3	3	-	-	-
CO3	3	3	3	2	3	2	2	-	-	-	3	3	3	-	3	3
CO4	3	3	2	2	3	2	2	-	-	-	3	3	3	-	3	3
CO5	3	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	2.4

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

Objectives:	
<input type="checkbox"/>	To understand the basic units in food processing.
<input type="checkbox"/>	To perform basic humidity calculations.
<input type="checkbox"/>	To perform material balance for process operations.
<input type="checkbox"/>	To make energy balance in food technology.
<input type="checkbox"/>	To understand the heat content and enthalpy in food processing.

<b>UNIT-I</b>	<b>UNITS AND DIMENSIONS</b>	<b>9</b>
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.		
<b>UNIT-II</b>	<b>HUMIDITY CALCULATIONS</b>	<b>9</b>
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.		
<b>UNIT-III</b>	<b>STOICHIOMETRY AND MATERIAL BALANCE</b>	<b>9</b>
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.		
<b>UNIT-IV</b>	<b>ENERGY BALANCE</b>	<b>9</b>
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.		

<b>UNIT-V</b>	<b>ENTHALPY</b>	<b>9</b>
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.		
<b>Total Contact Hours</b>		<b>: 45</b>

(Use of Psychometric chart is permitted in the examination)	
<b>Course Outcomes:</b>	
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.

<b>Reference Books / Web links:</b>	
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
<b>Text Books:</b>	
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	PS O1	PS O2	PS O3	PSO 4
<b>CO1</b>	2	3	3	3	3	-	-	2	1	-	-	2	2	3	2	2
<b>CO2</b>	2	3	3	3	3	-	-	2	1	-	1	2	3	3	2	2
<b>CO3</b>	2	2	1	2	1	1	2	1	-	2	-	2	3	3	2	2
<b>CO4</b>	3	3	2	3	2	-	-	-	2	-	-	2	2	3	2	2
<b>CO5</b>	3	3	2	2	3	-	2	-	2	-	-	2	2	3	2	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	2

Subject Code	Subject Name	Category	L	T	P	C
<b>FT23305</b>	<b>FOOD ADDITIVES</b>	<b>PC</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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.

<b>UNIT-I</b>	<b>ADDITIVES AND FOOD SAFETY</b>	<b>9</b>
<p>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.</p>		
<b>UNIT-II</b>	<b>PRESERVATIVES</b>	<b>9</b>
<p>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, water soluble and oil soluble antioxidants and their chemical structure, mechanism of action, permitted antioxidants permitted levels, and food application.</p>		
<b>UNIT-III</b>	<b>EMULSIFIERS, STABILISERS AND THICKENERS</b>	<b>9</b>

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

<b>UNIT-IV</b>	<b>COLOR, FLAVORS, FLAVOR ENHANCERS AND SWEETENERS</b>	<b>9</b>
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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.

<b>UNIT-V</b>	<b>OTHER FOOD ADDITIVES &amp; FOOD INGREDIENTS</b>	<b>9</b>
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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.

<b>Total Contact Hours: 45</b>	
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<b>Course Outcomes:</b>	
On completion of course students will be able to	
②	Comprehend laws related to food additives.
②	Assess the safety level of food additives.
②	Utilize the additives for novel product development.
②	Analyse the effect of food additives on food matrix.
②	Utilize the proteins and sugars as food additives.

<b>Text Books:</b>	
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:
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1	Thomas. E. Furia, “CRC Handbook of food additives” 2 <sup>nd</sup> edition, Volume 1, CRC press, 1978
2	Thomas. E. Furia, “CRC Handbook of food additives” 2 <sup>nd</sup> edition, Volume 2, CRC press, 1980
3	P. Michael Davidson, John N. Sofos, and A. L. Branen, “Antimicrobials in food”, 3 <sup>rd</sup> 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 <sup>nd</sup> edition, CRC Press, 2005

PO/PS O 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	PSO 4
<b>CO1</b>	3	3	3	3	3	3	-	3	3	-	2	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	-	2	3	-	2	3	3	3	3	3
<b>CO3</b>	3	2	3	3	3	2	-	2	3	-	2	3	3	3	3	3
<b>CO4</b>	3	3	2	3	3	2	-	3	3	-	2	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	2	-	2	3	-	2	3	3	3	3	3
Average	3	3	3	3	3	2.4	-	2.8	3	-	2	3	3	3	3	3

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
<b>FT23311</b>	<b>FOOD MICROBIOLOGY LABORATORY</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

#### 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

<b>1</b>	Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media-Types and Use; Preparation of Nutrient broth and agar.
<b>2</b>	Preparation of different culture media and microbial isolation using serial dilution technique
<b>3</b>	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
<b>Total Contact Hours : 60</b>	

**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
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**LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS**

<b>Equipment Required</b>		
<b>S.No.</b>	<b>Name of the equipment</b>	<b>Quantity</b>
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	PSO4
<b>CO1</b>	3	3	2	2	3	3	3	3	2	-	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3	3
<b>CO3</b>	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	2	-	3	-	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	2.4

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
<b>FT23312</b>	<b>BIOCHEMISTRY AND NUTRITION LABORATORY</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

### 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

<b>1</b>	Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
<b>2</b>	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
<b>Total Contact Hours : 60</b>	

**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**

<b>Equipment Required</b>		
<b>S.No.</b>	<b>Name of the equipment</b>	<b>Quantity</b>
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
<b>CO1</b>	3	3	2	2	3	3	3	3	2	-	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	-	2	3	-	3	3	3	3	3
<b>CO3</b>	3	2	3	3	3	3	3	2	3	-	3	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	2	3	3	-	3	3	3	3	3
<b>CO5</b>	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

Course Code	Course Title	Category	L	T	P	C
			<b>MA23431</b>	<b>PROBABILITY, STATISTICS AND RELIABILITY</b>	<b>BS</b>	<b>3</b>

**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.

<b>UNIT-I</b>	<b>PROBABILITY</b>	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.		
<b>UNIT-II</b>	<b>STATISTICAL TESTING</b>	9
Maximal Likelihood estimation – Parameters of Binomial and Poisson distribution - Tests of significance – Z test: Single mean, difference of means- Chi square - F test.		
<b>UNIT-III</b>	<b>ANOVA</b>	9
Design of Experiments - Completely randomized design – Randomized block design –Latin square design.		
<b>UNIT-IV</b>	<b>STATISTICAL QUALITY CONTROL</b>	9
Control charts for measurements ( $\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling		

<b>UNIT-V</b>	<b>RELIABILITY</b>	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.		
<b>Total Contact Hours: 45</b>		

<b>S.No</b>	<b>List of Experiment (using R Software)</b>	<b>Total Contact Hours: 30</b>
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	

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

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

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

<b>Text Book(s):</b>	
1.	Veerarajan T, 'Probability, Statistics and Random Processes with Queueing Theory and Queueing 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).

<b>Reference Books(s) / Web links:</b>	
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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
<b>CO1</b>	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	2	2	1	1	-	-	-	-	-	-	-	1	-	1	-	-
<b>CO3</b>	2	2	-	2	-	-	-	-	-	-	-	1	-	1	-	-
<b>CO4</b>	2	2	2	2	-	-	-	-	-	-	-	1	-	1	-	-
<b>CO5</b>	2	2	2	1	-	-	-	-	-	-	-	1	-	1	-	-
Average	2	2	1.6	1.5	-	-	-	-	-	-	-	1	-	1	-	-

Subject Code	Subject Name	Category	L	T	P	C
<b>FT23401</b>	<b>UNIT OPERATIONS IN FOOD INDUSTRIES</b>	<b>ES</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>Objectives:</b>	
<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.

<b>UNIT-I</b>	<b>EVAPORATION</b>	<b>9</b>
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		
<b>UNIT-II</b>	<b>MECHANICAL SEPARATION</b>	<b>9</b>
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.		
<b>UNIT-III</b>	<b>SIZE REDUCTION</b>	<b>9</b>
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.		
<b>UNIT-IV</b>	<b>CONTACT EQUILIBRIUM SEPARATION MIXING</b>	<b>9</b>
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		
<b>UNIT-V</b>	<b>EXTRACTION AND CRYSTALLIZATION</b>	<b>9</b>
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.		
<b>Total Contact Hours</b>		<b>: 45</b>

<b>Course Outcomes:</b>	
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

<b>Text Books:</b>	
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	PSO4
<b>CO1</b>	3	3	3	3	3	1	1	1	1	-	-	3	3	3	3	3
<b>CO2</b>	3	3	3	2	3	1	1	1	1	-	-	3	3	3	3	3
<b>CO3</b>	3	3	2	3	3	1	1	1	1	-	-	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	1	1	1	1	-	-	3	2	3	3	3
<b>CO5</b>	3	3	3	2	3	1	1	1	2	-	-	3	2	3	3	3
Average	3	3	2.8	2.6	3	1	1	1	1.2	-	-	3	2.6	2.8	3	3

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

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.

<b>UNIT-I</b>	<b>HIGH TEMPERATURE PROCESSING</b>	<b>9</b>
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		
<b>UNIT-II</b>	<b>PRESERVATION BY LOW TEMPERATURE STORAGE</b>	<b>9</b>
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.		
<b>UNIT-III</b>	<b>PRESERVATION BY CONTROL OF WATER ACTIVITY</b>	<b>9</b>
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.		
<b>UNIT-IV</b>	<b>NON THERMAL METHODS OF FOOD PROCESSING</b>	<b>9</b>
Non-thermal methods: Chemical Preservatives, Salting and Curing, Smoking, Pickling, Fermentation, Food Irradiation technology, Ultrasound technology, High pressure processing, Hurdle technology.		
<b>UNIT-V</b>	<b>NOVEL PROCESSING METHODS &amp; FOOD PACKAGING</b>	<b>9</b>
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.		
		<b>Total Contact Hours : 45</b>

<b>Course Outcomes:</b>	
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

<b>Text Books:</b>	
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 <sup>nd</sup> 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	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	PSO 4
<b>CO1</b>	3	3	3	2	3	2	2	3	1	1	2	3	3	2	3	3
<b>CO2</b>	3	2	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>Average</b>	3	2.8	3	2.8	3	2	2	1.8	1.8	1.8	2	3	3	3	3	3

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

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			
<b>UNIT-III</b>	<b>FLOW MEASUREMENTS</b>		<b>9</b>
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			
<b>UNIT-IV</b>	<b>OPEN CHANNEL FLOW AND FLUID FLOW THROUGH BEDS</b>		<b>9</b>
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			
<b>UNIT-V</b>	<b>DIMENSIONAL ANALYSIS &amp; PUMPS</b>		<b>9</b>
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.			
		<b>Total Contact Hours</b>	<b>: 45</b>

**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.

**Text Books:**

1	Modi, P.N. and Seth S.M. “Hydraulics and fluid mechanics”. Standard Publishers Distributors, New Delhi, 2010.
2	Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. 9th Edition. Tata McGraw-Hill, New Delhi, 1998

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	PSO 4
<b>CO1</b>	3	3	3	2	3	2	2	1	1	1	2	3	3	2	3	3
<b>CO2</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3	3
Average	3	3	3	2.8	3	2	2	1.8	1.8	1.8	2	3	3	3	3	3

Subject code	Subject Name	Category	L	T	P	C
<b>FT19404</b>	<b>REFRIGERATION AND COLD CHAIN MANAGEMENT</b>	<b>PC</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

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

<b>UNIT-I</b>	<b>REFRIGERATION PRINCIPLES</b>	<b>9</b>
Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - simple vapor compression cycle – T-S diagram – p-h chart - application of refrigeration		
<b>UNIT-II</b>	<b>VAPOR COMPRESSION REFRIGERATION AND COMPONENTS</b>	<b>9</b>
Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working.		

<b>UNIT-III</b>	<b>REFRIGERANTS AND VAPOR ABSORPTION CYCLE</b>	<b>9</b>
Refrigerants – properties – classification – comparison and advantages – chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants - vapour absorpctioncycle – theoretical - deviation in practice - Electrolux refrigerator – construction and principles.		
<b>UNIT-IV</b>	<b>SHELF-LIFE OF FOOD PRODUCTS</b>	<b>9</b>
Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deterioration- Kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf – life testing – the 11 steps procedure. 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, etc. floor heaters, vapor barriers.		
<b>UNIT-V</b>	<b>COLD CHAIN</b>	<b>9</b>
What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time deliveries; Temperature limits;-in various countries- Europe, US, Australia etc.; Chilling and freezing;- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc.; Thaw indicators.		
		<b>Total Contact Hours : 45</b>

<b>Course Outcomes:</b>	
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

<b>Text Books:</b>	
<b>1</b>	Anand, M.L. “Refrigeration& Air-Conditioning”. Asian Books Pvt., Ltd., 2002.
<b>2</b>	Sun, Da-Wen. “Advances in Food Refrigeration”. Leatherhead Publishing, 2001.

PO/PSO CO	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	P O 12	PS O1	PS O2	PS O3	PS O 4
CO 1	3	2	2	2	2	3	3	-	-	-	3	3	3	-	3	3
CO 2	3	3	2	2	2	2	2	-	-	-	-	3	3	-	-	-
CO 3	3	3	3	2	3	2	2	-	-	-	3	3	3	-	3	3
CO 4	3	3	2	2	3	2	2	-	-	-	3	3	3	-	3	3
CO 5	3	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	3

3	Kennedy, Christopher J. "Managing Frozen Foods". CRC / Wood head Publishing, 2000.
4	James, S.J. and C. James. "Meat Refrigeration". CRC / Wood head Publishing, 2002.
5	Stringer, Mike and C. Dennis. "Chilled Foods: A Comprehensive Guide". 2nd Edition, CRC/Wood head Publishing, 2002.
<b>Reference Books / Web links:</b>	
1	Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell, 2008.
2	Hui, Y.H. et al., "Handbook of Frozen Foods". Marcel Dekker, 2004.

Subject Code	Subject Name	Category	L	T	P	C
CS23433	Python Programming for Machine Learning (with effect from 2023 batch onwards)	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
<b>Contact Hours</b> : <b>60</b>	
<b>Course Outcomes:</b>	
On completion of the course, students will be able to:	
•	Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
•	Analyze and perform an evaluation of learning algorithms and model selection.
•	Compare the strengths and weaknesses of many popular machine learning approaches.
•	Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
•	Design and implement various machine learning algorithms in a range of real-world applications.
<b>Text Books:</b>	
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.
<b>Reference Books:</b>	
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
CO 1	2	2	2	2	1	0	0	0	1	2	0	1	3	3	3
CO 2	2	2	1	1	2	0	0	0	0	0	0	1	2	1	3
CO 3	2	3	2	1	2	0	0	0	1	1	0	1	2	3	2
CO 4	1	1	1	0	1	0	0	0	0	1	1	0	1	2	3
CO 5	3	3	2	3	3	0	0	0	2	1	0	1	2	3	3
Average	2	2	2	1	2	0	0	0	1	1	0	1	2	2	3

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
FT23411	UNIT OPERATIONS IN FOOD INDUSTRIES LABORATORY	ES	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
<b>Total Contact Hours : 60</b>	

**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

**LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS**

<b>Equipment Required</b>		
<b>S.No.</b>	<b>Name of the equipment</b>	<b>Quantity</b>
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	PSO 4
<b>CO1</b>	3	3	3	2	3	2	2	3	1	1	3	3	3	2	3	3
<b>CO2</b>	3	2	3	3	3	2	2	2	2	2	3	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	2	2	2	2	2	3	3	3	3	3	3
<b>Average</b>	3	2.8	3	2.8	3	2	2	1.8	1.8	1.8	3	3	3	3	3	3

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
<b>FT23412</b>	<b>FOOD PROCESSING AND PRESERVATION LABORATORY</b>	<b>PC</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

#### 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

<b>1</b>	Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
<b>2</b>	Refrigeration and Freezing of vegetables and fruits
<b>3</b>	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
<b>4</b>	Osmotic drying of foods with salt and sugar.
<b>5</b>	Canning & bottling of vegetable and fruit products
<b>6</b>	Filtration and concentration of fruit juices
<b>7</b>	Production of extruded products.
<b>8</b>	Spray drying of juices/milk
<b>9</b>	Pasteurization of milk
<b>10</b>	Retort processing of foods
<b>11</b>	Determination of Water vapor transmission rate of different packaging materials
<b>12</b>	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		
			<b>Total Contact Hours : 60</b>

**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**

<b>Equipment Required</b>		
<b>S.No.</b>	<b>Name of the equipment</b>	<b>Quantity</b>
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	PSO 4
<b>C01</b>	1	-	3	2	3	2	2	3	1	1	2	3	3	2	3	3
<b>C02</b>	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>C03</b>	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>C04</b>	1	2	3	3	3	2	2	2	2	2	2	3	3	3	3	3
<b>C05</b>	2	2	3	3	3	2	2	2	2	2	2	3	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	3

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