

**Course Curriculum of Fourth Semester as per the  
ICAR-Sixth Deans' Committee Report for Academic Programmes in  
FOOD TECHNOLOGY**

**Course Layout**

**B.Tech. (Food Technology)**

Semester: IV (New)

w.e.f. Academic Year: 2025-26

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	MDC-242	Entrepreneurship Development and Business Management	3(2+1)	--
2.	VAC-242	Agricultural Informatics and Artificial Intelligence	3(2+1)	--
3.	FT-MATH-243	Engineering Mathematics-II	2(2+0)	--
4.	FE-249	Fundamentals of Food Engineering	3(2+1)	--
5.	FQA-246	Food Plant Sanitation	3(2+1)	--
6.	FQA-247	Food Quality, Safety Standards and Certification	2(2+0)	--
7.	FPO-241	Food Plant Utilities and Services	3(2+1)	--
8.	SEC-246	Skill Enhancement Course-VI <sup>#</sup> (To be offered from the bouquet of SECs)	2(0+2)	--
9.	OC-1 / OC-2/ ...	Online Course(s) / MOOCs <sup>†</sup>	As opted by student	NG
<b>Total Credits Hrs. =</b>			<b>21(14+7)</b>	<b>G</b>
MDC: Multidisciplinary Course, VAC: Value Added Course; SEC: Skill Enhancement Course; OC: Online Course; G: Gradual; NG: Non-gradual				
<b>Post-IV Semester (Only for Exit option for award of UG-Diploma*)</b>				
10.	INT-242	Internship (10-week)	10(0+10)	NG
<p><sup>†</sup>Note: It is mandatory for each Student to complete <b>total 6 credits</b> (Non-gradual) of <b>Online Courses</b> from available resources across III to VIII semesters under the guidance of assigned Faculty/Advisor.</p> <p><b>Note: Students taking various SKILL ENHANCEMENT COURSES will be eligible to get a UG-Diploma with Nomenclature as follows, provided the student has to select courses as mentioned against the nomenclature of the UG-Diploma.</b></p>				
<b>*Nomenclature of Diploma</b>		<b>SEC to be selected from the respective disciplines</b>		
		<b>Semester-III</b>	<b>Semester-IV</b>	
UG-Diploma in Food Technology (Food Plant Operations)		Food Engineering	Food Plant Operations	
UG-Diploma in Food Technology (Food Manufacturing)		Food Technology	Food Plant Operations	
UG-Diploma in Food Technology (Food Quality Testing)		Food Quality Assurance	Food Plant Operations	

## B.Tech. (Food Technology): Fourth Semester

### Course-wise Syllabus with Teaching Schedules

<b>Semester</b> : IV	
<b>Course No.</b> : MDC-242	<b>Credit Hrs.</b> : 3(2+1)
<b>Course Title</b> : <b>Entrepreneurship Development and Business Management</b>	
Gradual Common Course among 4 UG degrees viz., B.Sc. (Hons.) Agriculture, B.Tech. (Agricultural Engineering), B.Tech. (Food Technology), B.Sc. (Hons.) Agri-Business Management (~with Course No. MDC-243)	

### SYLLABUS

#### Objectives:

- (i) To provide an insight into the concept and scope of entrepreneurship,
- (ii) To expose the student to various aspects of establishment and management of a small business unit,
- (iii) To enable the student to develop financially viable agribusiness proposal.

### **THEORY**

Development of entrepreneurship, Motivational factors, Social factors, Environmental factors, Characteristics of entrepreneurs, Entrepreneurial attributes/ Competencies. Concept, Need for and importance of entrepreneurial development. Evolution of entrepreneurship, Objectives of entrepreneurial activities, Types of entrepreneurs, Functions of entrepreneurs, Importance of entrepreneurial development and Process of entrepreneurship development. Environment scanning and opportunity identification need for scanning – spotting of opportunity-scanning of environment – identification of product/ service – starting a project; factors influencing sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection and formulation of project; project report preparation, Enterprise management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management / Accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement and taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

### **PRACTICAL**

Visit to small scale industries/ agro-industries, Interaction with successful entrepreneurs / agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

## TEACHING SCHEDULE

### THEORY [MDC-242]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Introduction to Entrepreneurship	Meaning and Definitions of an Entrepreneur, Entrepreneurship; Concept & Scope of Entrepreneurship	6
2	Importance of Entrepreneurship	Importance of Entrepreneurship in Agribusiness	
3	Entrepreneurship Development	Need for and objectives of Entrepreneurial development	4
4	Motivational Factors	Types of motivational factors, Role of social and environmental factors in entrepreneurship	4
5	Characteristics of Entrepreneurs	Characteristics, Entrepreneurial attributes and Competencies	4
6	Types of Entrepreneurs	Various types and their significance	4
7	Functions of Entrepreneurs	Key roles and Responsibilities	2
8	Evolution of Entrepreneurship	Historical perspective and Growth	3
9	Process of Entrepreneurship Development	Stages and Approaches in developing entrepreneurship	4
10	Environmental Scanning	Need for scanning, Techniques	2
11	Opportunity Identification	Spotting and Analysing opportunities	2
12	Infrastructure and Support Systems	Policies, Schemes and Role of financial and other agencies in entrepreneurship development	4
13	Enterprise Functioning Steps	Steps to establish an enterprise	4
14	Selection of Products/Services	Choosing products, Services and Business forms	3
15	Enterprise Location and Capital Sources	Registration, Site selection, Capital sources/Acquisition	3
16	Manufacturing and Distribution	Acquiring manufacturing know-how, Packaging and Distribution essentials	3
17	Planning of an Enterprise	Short term and Long-term planning of an enterprise	3
18 - 19	Project Formulation	Project identification, Selection, Steps in project formulation and Report preparation, etc.	8
20	Enterprise Management	Basics and Importance of managing an enterprise	3

*Continued....*

21	Production Management	Product types, Levels of products, Product mix, Quality control, Cost of production, Production control	4
22	Material Management	Raw material costing and Inventory control strategies	4
23	Personnel Management/Human Resource Management	Manpower planning, Labour turnover, Wages/Salaries	4
24	Financial Management	Funds, Fixed and Working capital, Costing, Pricing, Book-keeping basics	4
25 - 26	Accounting and Taxation	Journals, Ledgers, Subsidiary books, Annual financial statements, Taxation basics	4
27	Marketing Management	Market, Types of markets, Marketing assistance	4
28 - 29	Market Strategies and Pricing	Marketing strategies, Pricing strategies and Market penetration	4
30	Crisis Management	Crisis types, Strategies for managing raw material, etc.	2
31	Leadership in Crisis Situations	Role of leadership in handling crises	2
32	Financial Crises and Solutions	Strategies for financial crisis management	2
<b>Total=</b>			<b>100</b>

### TEACHING SCHEDULE

#### PRACTICAL [MDC-242]

Exercise No.	Exercise Topic/Title
1	Visit to Small-Scale Industries/Agro-Industries. (Objective: To understand setup and operations of small-scale units)
2	Interaction with Successful Entrepreneurs. (Objective: To gain insights from real-life entrepreneurial experiences)
3	Case Study on Agro-Entrepreneurs. (Objective: To analyse successful agribusiness ventures)
4	Visit to Financial Institutions. (Objective: To learn about funding options and financial support)
5	Identification of Agribusiness Ideas. (Objective: To identify viable agribusiness ideas based on demand)
6	Analysing Project Proposals. (Objective: To study structure and elements of project proposals)

*Continued...*

7	Preparing a Project Proposal. (Objective: To develop a basic proposal for an agribusiness venture)
8	Project Report Writing Techniques. (Objective: To practice format and structure for project reports)
9	Marketing Strategies Case Study. (Objective: To analyse effective marketing strategies in agribusiness)
10	Production and Cost Control Analysis (Objective: To study basic cost control measures in production)
11	Inventory Control Simulation (Objective: To apply inventory management methods in a hypothetical setup)
12	Basic Bookkeeping (Objective: To practice fundamental bookkeeping for small businesses)
13	Market Research Techniques (Objective: To use surveys and questionnaires for market insights)
14	Project Proposal Presentation (Objective: To present project ideas for feedback)
15	Review of Project Proposal (Objective: To refine project proposals based on feedback)
16	Final Evaluation of Proposals (Objective: To assess and finalize projects)

#### Suggested Readings [MDC-242]:

1. **Charantimath P.M. 2009.** Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. **Desai V. 2015.** Entrepreneurship: Development and Management, Himalaya Publ. House.
3. **Desai Vasant. 1997.** Small Scale Industries and Entrepreneurship. Himalaya Publ. House.
4. **Gupta C.B. 2001.** Management Theory and Practice. Sultan Chand and Sons.
5. **Indu Grover. 2008.** Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
6. **Khanka S.S. 1999.** Entrepreneurial Development. S. Chand and Co.
7. **Mehra P. 2016.** Business Communication for Managers. Pearson India, New Delhi.
8. **Pandey M. and Tewari D.2010.** The Agribusiness Book. IBDC Publishers, Lucknow.
9. **Singh D. 1995.** Effective Managerial Leadership. Deep and Deep Publ.
10. **Singhal R.K.2013.** Entrepreneurship Development and Management, Katson Books.
11. **Tripathi P.C and Reddy P.N.1991.** Principles of Management. Tata McGraw Hill.

<b>Semester</b> : IV	
<b>Course No.</b> : VAC-242	<b>Credit Hrs.</b> : 3(2+1)
<b>Course Title</b> : <b>Agricultural Informatics and Artificial Intelligence</b>	
Gradiual Common Course across 8 UG degrees viz., B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Horticulture, B.Tech. (Biotechnology), B.Tech. (Food Technology), B.Sc. (Hons.) Agri-Business Management, B.Sc. (Hons.) Forestry, B.F.Sc. (Hons.), B.Sc. (Hons.) Community Science	

### SYLLABUS

- Objectives :**
- (i) To acquaint students with the basics of computer applications in Agriculture, multimedia, database management, application of mobile app and decision-making processes etc.
  - (ii) To provide basic knowledge of computer with applications in Agriculture.
  - (iii) To make the students familiar with Agricultural-Informatics, its components and applications in Agriculture and Artificial Intelligence.

### THEORY

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office® for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database- concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to general programming concepts and standard input/output operations. e-Agriculture, concepts, design and development; Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, input-output files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in Agriculture for farm advice: Market price, post-harvest management etc. Geospatial technology: Techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture. Agriculture Expert System: Soil Information Systems etc. for supporting farm decisions.

Preparation of contingent crop planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India. Introduction to Artificial Intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A\*algorithm, IoT and Big Data; Use of AI in Agriculture for autonomous crop management and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce and other food processing applications; Concepts of Smart Agriculture, Use of AI in Food and Nutrition Science etc.

### **PRACTICAL**

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management. Use of MS-WORD and MS-PowerPoint for creating, editing and presenting a scientific document, MS-EXCEL - Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri-information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as-Visual Basic, Java, Fortran, C, C++, Hands-on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/Wofost, Preparation of inputs file for CSM and study of model outputs, Computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, AR/VR demonstration, India Digital Ecosystem of Agriculture (IDEA).

## TEACHING SCHEDULE

### THEORY [VAC-242]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 3	<b>Introduction to Computers, Anatomy of Computers</b>  <b>Memory Concepts:</b>  <b>Operating System:</b>	Definitions; Characteristics of Computer; Components of Computer; CPU: CU, ALU, MU; Input Devices; Output Devices; Units of Memory: bit to TB, Types: Primary, Secondary; Definitions and Types: Single user, Multi-user and features. OS Special Types (Brief Overview): Batch, Real-Time, Time Sharing, Distributed, Network OS. Functions of operating system	7
4 - 6	<b>Applications of MS Office®</b>	MS Word: Creating a New Document, Formatting option features; Insertion of Table; MS Excel: Creating worksheet and graph, Functions for Data Analysis: AVERAGE, COUNT, SUM, MIN, MAX, MEDIAN, MODE, STDEV, STDEVP, VAR, VARP, CORREL, PERCENTILE; Mathematical functions in MS-Excel: SUM, AVERAGE, AVERAGEIF, COUNT, COUNTIF, MOD, ROUND	7
7 - 9	<b>Database and DBMS</b>	Database: Definitions, Concepts and Types; Uses of DBMS in Agriculture; Characteristics of Database; Structure of Database Management System, Tables: Concept of view, Primary key, Foreign key; Creating Database: SQL query: Create, Insert, Select, Delete, Update. Form: Steps for Creating Forms, Entering Data in forms, Report using MS-ACCESS: Steps for Creating Reports, Printing reports.	7

*Continued...*

10	<b>Internet and World Wide Web (www)</b>	<p>Concepts and components;</p> <p>Internet: Introduction;</p> <p>Definition of LAN, WAN, MAN and Internet</p> <p>Internet Service Provider (ISP);</p> <p>World Wide Web; Hypertext;</p> <p>Web Browser;</p> <p>Web Page and Websites;</p> <p>E-Mail: Creating Email, Email Addresses, Using Email, Sending the message, CC and BCC; Search Engine</p>	7
11 - 12	<b>Introduction to Computer Programming</b>	<p>Computer Programming: Introduction, General concepts, Standard input/output operations.</p>	7
13 - 14	<b>e-Agriculture</b>	<p>Concepts, Application &amp; Importance of IT in e-Agriculture;</p> <p>AGRINET: Introduction, Objectives;</p> <p>Advantages and Challenges in Agriculture.</p>	7
15 - 16	<b>Computer Models in Agriculture</b>	<p>Statistical, Weather Analysis and Crop Simulation Models; Concepts, Input-output files, Limitation, Advantages and Application of models for understanding plant processes, Sensitivity, Verification, Calibration and Validation</p>	7
17 - 19	<b>IT and IOT Applications in Agriculture</b>	<p>IT Applications &amp; their role in Agriculture with emphasis on Computation of Water and Nutrient Requirement of Crop;</p> <p>IOT - Definition, Benefits/ Applications/ Uses in Agriculture: Precision Farming, Agricultural Drones, Smart Greenhouses, Drones; Challenges.</p>	7

Continued...

20 - 21	<b>Computer-controlled Devices; Smartphone Apps and Geospatial Technology</b>	Computer-controlled Devices (Automated systems) for Agri-input management- Examples of Automation Devices: Robotics Application in Planting, Drones for Irrigation, Harvest Automation Tools, Automated Tractors etc., AWS - Automatic Weather Station, AIS - Automatic Irrigation System. Smartphone Mobile Apps in Agriculture- Introduction- Irrigation Systems, Fertilizer Application, Pest and Disease Management; Seeding and Planting, Harvesting Systems; Weather Forecasting, Soil Testing and Analysis, Crop Management, Market Prices; Farm Management, Financial & Insurance Services. Geospatial Technology ( <i>in brief</i> ) – Introduction, Techniques, Components and Uses for generating valuable agri-information.	7
22 - 23	<b>Decision Support System (DSS)</b>	DSS: Introduction, Concepts, Components, Types and Applications in Agriculture.	7
24 - 25	<b>Agriculture Expert System (AES)</b>	AES: Introduction, Concepts, Components and Applications in Agriculture- Soil Information Systems for supporting farm decisions.	7
26 - 27	<b>Contingent Crop Planning using IT Tools</b>	Preparation of Contingent Crop Planning and Crop Calendars: Introduction, Definition, Benefits, Steps to prepare Contingent Crop Planning & Calendars using IT Tools.	7
28 - 30	<b>Digital India and Schemes to promote Digitalization of Agriculture in India</b>	Digital India and Schemes to promote Digitalization of Agriculture in India; Digital Agriculture in India: Status, Challenge, Digital India and Initiatives in Agriculture Sector. Digital Agriculture or NeGP-A 2.0	8
31 - 32	<b>Introduction to and Uses of Artificial Intelligence (Overview)</b>	Introduction to Artificial Intelligence, Background and Applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A*algorithm, IoT and Big Data; Use of AI in Agriculture for autonomous crop management and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce and other food processing applications; Concepts of Smart Agriculture, Use of AI in Food and Nutrition Science etc.	8
<b>Total =</b>			<b>100</b>

## TEACHING SCHEDULE

### PRACTICAL [VAC-242]

Exercise No.	Exercise Title
1 - 2	Study of computer components, accessories, practice of important DOS command Introduction to different Operating systems- such as Windows, Unix/ Linux; Creating files and folders, Files Management.
3 - 4	Use of ~ MS-WORD: Creating files and folders; Files management and MS-POWERPOINT: Presentation for creating, editing and presenting scientific documents. MS-EXCEL: Mathematical calculations; Preparation of Spread sheets; Use of statistical tools; Writing expressions; Creating graphs; Analysis of scientific data.
5	MS-ACCESS: Creating Database; Preparing queries and reports.
6	Demonstration of Agri-information system(s)
7 - 8	Introduction of Programming Languages & Program in C-Language: a) Program to enter name and print name b) Program to calculate sum and subtraction of numbers c) Program to calculate Area of Circle d) Program to calculate Area of Triangle e) Program to calculate Area of Rectangle
9	Introduction to Internet, World Wide Web (WWW) and its components.
10 - 11	Hands-on Practice on Crop Simulation Models (CSM): CROPWAT 8.0/ DSSAT/ Crop-Info/ CropSyst/ Wofost/ etc. Computation of water and nutrient requirements of crop using CSM and IT tools.
12	Use of Smartphone Apps (developed by SAUs) and other devices in agro-advisory and dissemination of market information
13	Introduction to Geospatial Technology (Use of Open-source GIS Tools)
14	Study/ Demonstration of general AR/VR tools (as available)
15	Hands-on Practice on Decision Support System (DSS)
16	Introduction to India Digital Ecosystem of Agriculture (IDEA)

#### **Suggested Readings [VAC-242]:**

1. Fundamentals of Computer by V. Rajaraman, PHI Learning.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C.J. Date, Pearson Education, N. Delhi.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K. *et al.*, Jain Brothers Publication.
6. Russell, Stuart, Artificial Intelligence: A Modern Approach, Pearson Edition 2013.
7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa Publ.
8. Agricultural Informatics and Artificial Intelligence for B.Tech.(Agril Technology) by Prashant Publ.

➤ **Online Resources: (VAC-242)**

- <https://en.wikipedia.org/wiki/Computer>
- <https://www.javatpoint.com/computer>
- <https://iasri.icar.gov.in/>
- [https://www.nrsc.gov.in/EO\\_Agr\\_Objective?language\\_content\\_entity=en](https://www.nrsc.gov.in/EO_Agr_Objective?language_content_entity=en)
- <https://www.agrimoon.com>
- <https://www.agriinfo.in>
- <https://eagri.org>
- <https://www.agriglance.com>
- <https://agritech.tnau.ac.in>
- [https://loksabhadocs.nic.in/Refinput/New\\_Reference\\_Notes/English/Agriculture\\_and\\_Digital\\_India.pdf](https://loksabhadocs.nic.in/Refinput/New_Reference_Notes/English/Agriculture_and_Digital_India.pdf)
- <https://www.investindia.gov.in/team-india-blogs/digitalisation-agriculture-india>
- <http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Session-11-Preparation-of-Contingent-Crop-Planning-and-Crop-Calendar-Using-IT-Tools.pdf>
- <https://optimizeias.com/indias-digital-ecosystem-for-agriculture/>
- <https://www.igi-global.com/chapter/introduction-to-agricultural-information-systems/266572#:~:text=Agricultural%20Information%20Systems%3A%20Information%20system.knowledge%20utilization%20by%20agricultural%20producers.>
- <https://cropcalendar.apps.fao.org/#/home>
- [http://www.irdindia.in/journal\\_ijrdmr/pdf/vol4\\_iss1/7.pdf](http://www.irdindia.in/journal_ijrdmr/pdf/vol4_iss1/7.pdf)
- <https://learn.microsoft.com/en-us/office365/servicedescriptions/office-applications-service-description/office-applications>
- <https://ebooks.inflibnet.ac.in/hsp16/chapter/application-of-software-in-statisticalanalysis-i-microsoft-excel/>
- <http://eagri.org/eagri50/STAM102/index.html>
- <https://edu.gcfglobal.org/en/internetbasics/using-a-web-browser/1/>
- <https://www.javatpoint.com/what-is-world-wide-web>
- [https://www.mdpi.com/journal/agriculture/special\\_issues/Decision\\_Support\\_Systems\\_Application](https://www.mdpi.com/journal/agriculture/special_issues/Decision_Support_Systems_Application)
- <https://apps.gov.in/ministry/ministry-agriculture>
- <http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Session-11-Preparation-of-Contingent-Crop-Planning-and-Crop-Calendar-Using-IT-Tools.pdf>
- [https://apps.mgov.gov.in/apps\\_by\\_category.jsessionid=8206D0DAE69F48FB50962462A8922C23?name=Agriculture](https://apps.mgov.gov.in/apps_by_category.jsessionid=8206D0DAE69F48FB50962462A8922C23?name=Agriculture)

➤ **Tools available for Student for Academic Purpose only: (VAC-242)**

1. DSSAT (Decision Support System for Agrotechnology Transfer)
  - Purpose: A comprehensive crop modeling tool.
  - Use: Simulates plant growth, development, and yield for various crops under different management and environmental conditions.
  - Download: <https://dssat.net/>
2. APSIM (Agricultural Production Systems Simulator)
  - Purpose: A powerful plant simulation tool.
  - Use: Models the effects of environmental variables like soil, climate, and management strategies on plant growth and crop yield.
  - Download: <https://www.apsim.info/>
3. Open Sim Root
  - Purpose: A root growth modeling software.
  - Use: Helps understand plant root growth processes, interactions with soil, and how they respond to environmental conditions.
  - Download: Available as open-source software via research platforms like Git Hub. <https://gitlab.com/rootmodels/OpenSimRoot>
4. Virtual Plant
  - Purpose: A tool for visualizing and modeling plant metabolic and regulatory networks.
  - Use: Helps in understanding complex plant processes such as gene regulation, metabolic pathways, and how they respond to environmental conditions.
  - Download: <https://sourceforge.net/projects/virtualplant/>
5. R Studio (with Bioconductor and Plant Modeling Libraries)
  - Purpose: A programming environment for statistical computing.
  - Use: Using plant modeling libraries like plant and photosynthesis, researchers can model plant growth, carbon assimilation, and nutrient cycling.
  - Download: <https://posit.co/downloads/>
6. WOFOST (World Food Studies)
  - Purpose: A plant process and crop growth simulation model developed by the FAO.
  - Use: Helps in understanding crop development, photosynthesis, and biomass accumulation under different environmental and management conditions.
  - Download: <https://www.wur.nl/en/research-results/research-institutes/environmental-research/facilities-tools/software-models-and-databases/wofost/downloads-wofost.htm>
7. Green Lab
  - Purpose: A plant growth model focused on plant architecture and functional growth processes.
  - Use: Simulates plant organ development and growth processes, integrating functional and structural aspects of plant behavior.
  - Download: [https://greenlab.cirad.fr/GLUVED/html/P3\\_Tools/Tool\\_simul\\_003.html](https://greenlab.cirad.fr/GLUVED/html/P3_Tools/Tool_simul_003.html)

<b>Semester</b> :	<b>IV</b>	
<b>Course No.</b> :	<b>FT-MATH-243</b>	<b>Credit Hrs.</b> : <b>2(2+0)</b>
<b>Course Title</b> :	<b>Engineering Mathematics-II</b>	

### **SYLLABUS**

- Objectives** :
- (i) To familiarize the students with basic concept of Mathematics.
  - (ii) To gain knowledge about matrix and their transformation.
  - (iii) To develop partial differential equations and their applications.

### **THEORY**

**Matrix:**

Elementary transformation and rank of a matrix, Reduction to normal form, Gauss-Jordan method to find inverse of a matrix; Consistency and solution of linear equations; Eigen value and vectors, Cayley-Hamilton theorem; Linear and Orthogonal transformations

**Derivative of function of complex variable:**

Limit, Continuity, Derivative of function of complex variable; Analytical function, C-R equations, Conjugate function, Harmonic functions

**Infinite series:** Infinite series and its convergence,

**Fourier series:** Periodic function, Euler's formulae for calculating Fourier coefficients, Dirichlet's conditions; Fourier series of functions with arbitrary period; Fourier series of odd and even functions; Half range sine and cosine series

**Partial Differential Equations:**

Formation of partial differential equations; Lagrange's linear equation; Solution of non-linear partial differential equation

## TEACHING SCHEDULE

### THEORY [FT-MATH-243]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 11	Matrix	Elementary transformation and Rank of a matrix	35
		Gauss-Jordan method to find inverse of a matrix	
		Reduction to normal form	
		Consistency and Solution of linear equations by Rouché's Theorem	
		Eigen value and Vectors (For non-repeated Eigen values)	
		Introduction to Linear and Orthogonal transformations	
		Cayley-Hamilton theorem (without proof and to find inverse of Matrix)	
12 - 16	Derivative of Function of Complex Variable	Limit, Continuity, Derivative of function of complex variable	15
		Analytical function, C-R equations (Cartesian Form)	
		Conjugate function, Harmonic functions	
17 - 19	Infinite Series	Definition of Infinite series and its convergence, Divergence and Oscillation.	10
		Geometric Series,	
		Tests of convergence: D'Alembert's Ratio Test	
20 - 27	Fourier Series	Periodic function (Definition)	25
		Euler's formulae for calculating Fourier coefficients	
		Dirichlet's conditions (Statement)	
		Fourier series of functions with arbitrary period $(-c, c)$ , $(0, 2c)$	
		Fourier series of odd and even functions	
Half range sine and cosine series			
28 - 32	Partial Differential Equations	Formation of partial differential equations	15
		Lagrange's linear equation	
		Solution of non-linear partial differential equation of the First Order	
<b>Total=</b>			<b>100</b>

#### Suggested Readings [FT-MATH-243]:

1. Grewal B. S., 2015; Higher Engineering Mathematics. Khanna Publishers Delhi. (43<sup>rd</sup> Edition)
2. Narayan, S. 2016. A Text Book of Vector. S. Chand and Co. Ltd., New Delhi.
3. Narayan, S. 2016. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
4. Narayan, S. 2016. Integral Calculus. S. Chand and Co. Ltd., New Delhi.

<b>Semester</b>	: IV	
<b>Course No.</b>	: FE-249	<b>Credit Hrs.</b> : 3(2+1)
<b>Course Title</b>	: <b>Fundamentals of Food Engineering</b>	

### SYLLABUS

- Objectives** :
- (i) To understand basic concepts of Engineering principles applied to food.
  - (ii) To differentiate between drying and dehydration and different types of dryers.
  - (iii) To gain knowledge about basic operations like size reduction, mixing, separation etc.

### THEORY

Drying and dehydration: Basic drying theory, Heat and Mass transfer in drying, Drying rate curves, Calculation of drying times, Dryer efficiencies; Classification and Selection of dryers; Tray, Vacuum, Osmotic, Fluidized bed, Pneumatic, Rotary, Tunnel, Trough, Bin, Belt, Microwave, IR, Heat pump and Freeze dryers; Dryers for liquid: Drum or roller dryer, Spray dryer and Foam-mat dryers. Size reduction: Benefits, Classification, Determination and Designation of the fineness of ground material, Sieve/screen analysis, Principle and Mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, Work index, Energy utilization; Size reduction equipment: Principal types, Crushers (Jaw crushers, Gyratory, Smooth roll), Hammer mills and Impactors, Attrition mills, Buhr mill, Tumbling mills, Ultra fine grinders, Fluid jet pulverizer, Colloid mill, Cutting machines (Slicing, Dicing, Shredding, Pulping). Mixing: Theory of solids mixing, Criteria of mixer effectiveness and Mixing indices, Rate of mixing, Theory of liquid mixing, Power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (Paddle agitators, Impeller agitators, Powder-liquid contacting devices, other mixers), Mixers for high viscosity liquids and pastes, Mixers for dry powders and particulate solids. Mechanical Separations: Theory, Centrifugation, Liquid-liquid centrifugation, Liquid-solid centrifugation, Clarifiers, Desludging and Decanting machine. Filtration: Theory of filtration, Rate of filtration, Pressure drop during filtration, Applications, Constant-rate filtration and Constant-pressure filtration, Derivation of equation; Filtration equipment; Plate and frame filter press, Rotary filters, Centrifugal filters and Air filters, Filter aids. Membrane separation: General considerations, Materials for membrane construction, Ultra-filtration, Microfiltration, Concentration, Polarization, Processing variables, Membrane fouling, Applications of ultra-filtration in food processing, Reverse osmosis, Mode of operation and Applications; Membrane separation methods, Demineralization by electro-dialysis, Gel filtration, Ion exchange, Per-evaporation and Osmotic dehydration.

### PRACTICAL

Determination of fineness modulus and uniformity index; Determination of mixing index of a feed mixer; Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law. Performance evaluation of hammer mill; Performance evaluation of attrition mill; Study of centrifugal separator; Study of freeze dryer and freeze-drying process; Study on osmosis in fruits; Determination of solid gain and moisture loss during osmosis; Study of reverse osmosis process; Study of microfiltration and ultra-filtration/membrane separation process.

## TEACHING SCHEDULE

### THEORY [FE-249]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 2	<b>Drying and Dehydration</b>	Basic drying theory, Heat and Mass transfer in drying, Drying rate curves, Calculation of drying times, Dryer efficiencies.	5
3 - 6	<b>Classification and Selection of Dryers</b>	Tray, Vacuum, Osmotic, Fluidized bed, Pneumatic, Rotary, Tunnel, Trough, Bin, Belt, Microwave, IR, Heat pump and Freeze dryers and Osmotic dehydration.	5
7 - 10	<b>Dryers for liquid</b>	Drum or roller dryer, Spray dryer and Foam-mat dryers.	5
11 - 12	<b>Size reduction</b>	Benefits, Classification, Determination and Designation of the fineness of ground material, Sieve/screen analysis, Principle and Mechanisms of Comminution of food, Rittinger's, Kick's and Bond's equations, Work index, Energy utilization.	5
13 - 14	<b>Size reduction equipment</b>	Principal types, Crushers (jaw crushers, Gyratory, smooth roll), Hammer mills and impactors, Attrition mills, Buhrmill, Tumbling mills, Tumbling mills, Ultra fine grinders, Fluid jet pulverizer, Colloid mill, Cutting machines (Slicing, Dicing, Shredding, Pulping).	10
15 - 18	<b>Mixing</b>	Theory of Solids mixing, Criteria of mixer effectiveness and mixing indices, Rate of mixing, Theory of liquid mixing, Power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (Paddle agitators, Impeller agitators, Powder-liquid contacting devices, Other mixers), Mixers for high viscosity liquids and pastes, Mixers for dry powders and particulate solids.	15
19 - 22	<b>Mechanical Separations</b>	Theory, Centrifugation, Liquid-liquid centrifugation, Liquid-solid centrifugation, clarifiers, Desludging and decanting machine.	15

*Continued...*

23 - 26	<b>Filtration</b>	Theory of filtration, Rate of filtration, Pressure drop during filtration, Applications, Constant-rate filtration and Constant-pressure filtration, Derivation of equation; Filtration equipment; Plate and Frame filter press, Rotary filters, Centrifugal filters and Air filters, Filter aids.	15
27 - 30	<b>Membrane Separation</b>	General considerations, Materials for membrane construction, Ultra-filtration, Microfiltration, Concentration, Polarization, Processing variables, Membrane fouling, Applications of ultra-filtration in food processing, Reverse osmosis, Mode of operation and applications	15
31 - 32	<b>Membrane Separation Methods</b>	Membrane separation methods, Demineralization by electro-dialysis, Gel filtration, Ion exchange, Per-evaporation	10
<b>Total =</b>			<b>100</b>

### TEACHING SCHEDULE

#### PRACTICAL [FE-249]

Exercise No.	Exercise Title
1	Determination of fineness modulus and uniformity index
2	Determination of mixing index of a feed mixer (Numerical)
3	Determination of power requirement in size reduction of grain using Rittinger's law (Numerical)
4	Determination of power requirement in size reduction of grain using Kick's law and Bond's law (Numerical)
5	Study the performance evaluation of hammer mill
6	Study the performance evaluation of attrition mill
7	Study of centrifugal separator
8	Study of freeze dryer and freeze-drying process
9	Study on osmosis in fruits (Aonla)
10	Study on osmosis in fruits (Papaya)
11	Determination of solid gain and moisture loss during osmosis
12	Study of reverse osmosis process
13	Study of micro-filtration/membrane separation process
14	Study of ultra-filtration/membrane separation process
15	Study the drying characteristics for fruit drying
16	Determination of separation efficiency of the centrifugal separator (Numerical)

**Suggested Readings [FE-249]:**

1. **Earle, R.L.** 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.
2. **Geankoplis, C.J.** 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th edn. Prentice-Hall, NY, USA.
3. **McCabe, W.L., Julian Smith, Peter Harriott.** 2004. **Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.**
4. **Mohsenin, N.N.** 1986. Physical Properties of Plant and Animal Materials: Structure, Physical Characteristics and Mechanical properties, 2nd edn. Gordon and Breach Science Publishers, New York.
5. **Mohsenin, N.N.** 1984. Electromagnetic Radiation Properties of Foods and Agricultural Products. Gordon and Breach Science Publishers, New York.
6. **Mohsenin, N.N.** 1980. Thermal Properties of Foods and Agricultural Materials. Gordon and Breach Science Publishers, New York.
7. **Pandey, H., Sharma, H.K., Chauhan, R.C., Sarkar, B.C. and Bera, M.B.** 2010. Experiments in food process engineering. New Delhi: CBS Publisher and Distributors Pvt Ltd
8. **Richardson, J F., Harker, J.H. and Backhurst, J.R.** 2002. Coulson and Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th edn. Butterworth-Heinemann, Oxford, UK.
9. **Saravacos, G.D. and Kostaropoulos, A.E.** 2002. Handbook of Food Processing Equipment. Springer Science and Business Media, New York, USA.

<b>Semester</b>	: IV	
<b>Course No.</b>	: FQA-246	<b>Credit Hrs.</b> : 3(2+1)
<b>Course Title</b>	: Food Plant Sanitation	

### SYLLABUS

- Objectives** :
- (i) To gain importance of sanitation and hygiene and its application to food.
  - (ii) To gain knowledge of Hazard Analysis and Critical Control Point
  - (iii) To learn good manufacturing practices.

#### THEORY

Sanitation and food industry: Sanitation, Sanitation laws, Regulations, and Guidelines, Establishment of sanitary Practices. Food borne bioterrorism: Potential risks and protection measures for bioterrorism. The Relationship of microorganisms to sanitation: Microbial growth in relation to spoilage and food borne out breaks and its control measures. The Relationship of allergens to sanitation: Food allergens and its control measures. Food contamination sources: Sources of contamination, Contamination of foods, Protection against contamination. Personal hygiene and sanitary food handling: Personal hygiene, Employee hygiene, Sanitary food handling, Role of employee supervision, Employee responsibility. Cleaning compounds and sanitizers: Classification, Selection of cleaning compounds and sanitizers, CIP and COP, Handling and Storage, Precautions. Pest and Rodent Control: Insect infestation, Cockroaches, Insect destruction, Rodents, birds, Use of pesticides, Integrated Pest Management. Sanitary design and Construction for food processing: Site selection, site preparation, Building construction considerations, Processing and Design considerations, Pest control design. Waste product handling: Solid waste and Liquid waste management. Role of HACCP in sanitation: Good manufacturing practices, Current good manufacturing practices; Standard operating procedures, Good laboratory practices.

#### PRACTICAL

Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand); Determination of hardness of water; Good Manufacturing Practices (GMPs) and Personal hygiene; Sewage treatment: Primary, Secondary, Tertiary and Quaternary; Aerobic and Anaerobic sludge treatment; Lab demonstration on state of water; Study of CIP plant; Isolation and Identification of Actinomycetes; Enrichment and Isolation of cellulose degrading bacteria; Biodegradation of phenol compounds; Bacteriological examination of water: Coli form MPN test; Sampling of airborne microorganisms; Sampling of surfaces-equipment and physical plant; Aerosol sampling and Measurement guidelines

## TEACHING SCHEDULE

### THEORY [FQA-246]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1 - 3	<b>Sanitation and Food Industry</b>	Sanitation, Sanitation laws, Regulations and Guidelines, Establishment of Sanitary Practices.	10
4 - 6	<b>Food-borne Bioterrorism</b>	Potential risks and Protection measures for Bioterrorism.	5
7 - 9	<b>Relationship of Microorganisms to Sanitation</b>	Microbial growth in relation to spoilage and food borne out breaks and its control measures.	10
10 -11	<b>Relationship of Allergens to Sanitation</b>	Food allergens and its control measures	5
12 - 14	<b>Food Contamination Sources</b>	Sources of contamination, Contamination of foods, Protection against contamination.	10
15 - 17	<b>Personal Hygiene and Sanitary Food Handling</b>	Personal hygiene, Employee hygiene, Sanitary food handling, Role of employee supervision, Employee responsibility.	10
18 - 20	<b>Cleaning Compounds and Sanitizers</b>	Classification, Selection of cleaning compounds and sanitizers, CIP and COP, Handling and storage, Precautions.	10
21 - 23	<b>Pest and Rodent Control</b>	Insect infestation, Cockroaches, Insect destruction, Rodents, Birds, Use of pesticides, Integrated Pest Management.	10
24 - 26	<b>Sanitary Design and Construction for Food Processing</b>	Site selection, Site preparation, Building construction considerations, Processing and Design considerations, Pest control design.	10
27 - 29	<b>Waste Product Handling</b>	Solid waste and Liquid waste management.	10
30 - 32	<b>Role of HACCP in Sanitation</b>	Good manufacturing practices, Current good manufacturing practices; Standard operating procedures, Good laboratory practices (GLPs).	10
<b>Total =</b>			<b>100</b>

## TEACHING SCHEDULE

### PRACTICAL [FQA-246]

Exercise No.	Exercise Title
1	Estimation of BOD (Biological Oxygen Demand)
2	Estimation of COD (Chemical Oxygen Demand)
3	Determination of hardness of water
4	Good Manufacturing Practices (GMPs) and personal hygiene
5	Sewage treatment: Primary, secondary, tertiary and quaternary
6	Aerobic and Anaerobic sludge treatment
7	Lab demonstration on state of water
8	Study of CIP plant
9	Isolation and Identification of Actinomycetes
10	Enrichment and Isolation of cellulose degrading bacteria
11	Biodegradation of phenol compounds
12	Bacteriological examination of water
13	Coli form MPN test
14	Sampling of airborne microorganisms
15	Sampling of surfaces - equipment and physical plant
16	Aerosol sampling and measurement guidelines

#### **Suggested Readings [FQA-246]:**

1. **Cramer, M.M.** 2013. Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press, Boca Raton, FL, USA.
2. **Hui, Y.H., Bruinsma, B.L., Gorham, J.R., Nip, W.-K., Tong, P.S., and Ventresca, P.** 2003. Food Plant Sanitation. Marcel Dekker, Inc., NY, USA.
3. **Mitchell, R. and Gu, J. D.** 2010. Environmental Microbiology, 2<sup>nd</sup> edn. John Wiley and Sons, Inc., Hoboken, New Jersey, USA.
4. **Marriott, N.G. and Gravani, R.B.** 2006. Principles of Food Sanitation, 5<sup>th</sup> edn. Springer Science and Business Media, Inc., NY, USA.
5. **Pepper, I.L. and Gerba, C.P.** 2005. Environmental Microbiology: Laboratory Manual, 2<sup>nd</sup> edn. Elsevier Academic Press, Amsterdam.

<b>Semester</b> : IV	
<b>Course No.</b> : FQA-247	<b>Credit Hrs.</b> : 2(2+0)
<b>Course Title</b> : Food Quality, Safety Standards and Certification	

### **SYLLABUS**

- Objectives** :
- (i) To familiarize the students with quality and safety of food and the standards and certification available,
  - (ii) To understand quality and its assessment,
  - (iii) To learn different Food Laws and FSMS 22000.

### **THEORY**

Introduction: Definition, its role in food industry, Quality attributes; Quality Defects: Classification, Genetic-physiological defects: Structural, Off color, character; Entomological defects: Holes, Scars, Lesions, Off coloring, Curled ayes, Pathological defects; Mechanical defects, Extraneous or foreign material defects. Measurement of defects by different techniques; Quality Assessment: Quality assessment of food materials on the basis of sensory evaluation, Physical, Chemical microbiological methods; Quality of products during processing and after processing: Factors influencing the food qualities: Soil, Field practices, Harvesting practices, Procedures, Packaging, Transportation, Storage, Conditions, Processing conditions, Packaging and Storage conditions of finished products. Role of QC and QA Quality: Quality Control, Quality Assurance, Concepts of quality control and quality assurance functions in food industries. Quality Improvement, Total Quality Management: Quality evolution, Quality gurus, Defining TQM, Principals of TQM, Stages in implementation, TQM road map. Quality improvement tools, Customer focus, Cost of quality Food Laws and Standards: National and International food laws Mandatory and Voluntary food laws. FSSAI Indian Food Regulations and Certifications: Food Safety and Standards Act FSSAI Rules, Food adulteration, Misbranding, Common adulterants in foods, Duties and Responsibilities of Food Safety Authorities AGMARK, BIS, FPO, Weights and Measures Act, CODEX: Agricultural Marketing and Grading Standards (AGMARK), Bureau of Indian Standards (BIS) and their certification, FPO–standards and certification process, Weights and Measures Act and Packaged commodity rules Role of CODEX in food safety and standards, Food safety issues and risk analysis FSMS 22000 Food Safety Management Systems, ISO22000–2005 and other Global Food safety management systems. Principles, implementation; Documentation, Types of records; Auditing, Certification procedures, Certifying bodies, Accrediting bodies.

## TEACHING SCHEDULE

### THEORY [FQA-247]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	<b>Introduction</b>	Introduction: Definition, its Role in Food industry, Quality attributes	5
2 - 4	<b>Quality Defects</b>	Classification, Genetic-physiological defects: Structural, Off colour, Character; Entomological defects: Holes, Scars, Lesions, Off coloring, Curled aves, Pathological defects; Mechanical defects; Extraneous or foreign material defects; Measurement of defects by different techniques	10
5 - 7	<b>Quality Assessment</b>	Quality assessment of food materials on the basis of Sensory evaluation; Physical, Chemical microbiological methods; Quality of products during processing and after processing.	10
8 - 10	<b>Factors influencing the Food Qualities</b>	Soil, Field practices, Harvesting practices, Procedures, Packaging, Transportation, Storage, Conditions.	5
11 - 13	<b>Factors influencing the Food Qualities</b>	Processing conditions, Packaging and Storage conditions of finished products.	5
14 - 16	<b>Role of QC and QA Quality</b>	Quality Control, Quality Assurance, Concepts of quality control and Quality assurance functions in food industries.	10
17 - 19	<b>Quality Improvement; Total Quality Management</b>	Quality evolution, Quality gurus, Defining TQM, Principals of TQM, Stages in implementation.	5
20 - 22	<b>Quality Improvement; Total Quality Management</b>	TQM Road map, Quality improvement tools, Customer focus, Cost of quality.	5

*Continued...*

23 - 25	<b>Food Laws and Standards</b>	National and International Food Laws, Mandatory and Voluntary Food Laws.	5
26 - 28	<b>Indian Food Regulations and Certifications</b>	Food Safety and Standards Act FSSAI Rules, Food adulteration, Misbranding, Common adulterants in foods, Duties and Responsibilities of Food Safety Authorities	10
29 - 30	<b>AGMARK, BIS, FPO, Weights and Measures Act, CODEX</b>	Agricultural Marketing and Grading Standards (AGMARK), Bureau of Indian Standards (BIS) and their Certification, FPO–Standards and Certification process Weights and Measures; Act and Packaged Commodity Rules, Role of CODEX in Food safety and standards, Food safety issues and risk analysis.	15
31 - 32	<b>FSMS 22000</b>	Food Safety Management Systems- ISO 22000–2005 and other Global Food Safety Management Systems. Principles; Implementation; Documentation; Types of records; Auditing, Certification procedures, Certifying bodies, Accrediting bodies.	15
<b>Total =</b>			<b>100</b>

**Suggested Readings [FQA-247]:**

1. **Alli, I.** 2004. Food Quality Assurance: Principles and Practices. CRC Press, Boca Raton, FL, USA.
2. **Hester, R.E. and Harrison, R.M.** 2001. Food Safety and Food Quality. Royal Society of Chemistry, Cambridge, UK.
3. **Schmidt, R.H. and Rodrick, G.E.** 2003. Food Safety Handbook. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.

<b>Semester</b> :	<b>IV</b>	
<b>Course No.</b> :	<b>FPO-241</b>	<b>Credit Hrs. : 3(2+1)</b>
<b>Course Title</b> :	<b>Food Plant Utilities and Services</b>	

### SYLLABUS

- Objectives** :
- (i) To gain knowledge of various utilities and services required in a food processing plant,
  - (ii) To understand working of different services,
  - (iii) To acquire knowledge of cleaning, maintenance and trouble shooting.

### THEORY

Classification of Various Utilities and Services in food Plant/ industry. Commercial energy Pricing; Electrical System- Introduction to electric power supply systems, Electrical billing, Electrical load management and maximum demand control, Power factor improvement and Benefits, Transformers, System distribution losses, Harmonics, Trouble shooting of electrical power system. Electrical motors- Types, Losses in Introduction motor, Motor efficiency, Factors affecting motor performers, Performance, Rewinding and Motor replacement issues, Energy saving opportunities with energy efficient motors. Compressed air system- Requirement, Types, Compressor efficiency, Efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test, Factors affecting the performance and efficiency. Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration system- Requirement, Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, Factor affecting refrigeration and air conditioning system performance and saving opportunities. Vapor absorption refrigeration system: Working principle, Types and comparison with VCR system, Saving potential; Fans and blowers- Requirement, Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities, Pumps and Pumping systems- Requirement, types, Performance evaluation, Efficient system operation, Flow control strategies and Energy conservation opportunities. DG set system- Requirement, Introduction, Factors affecting selection; Fuels and Combustion - Introduction to fuels; Properties of fuel oil, Coal and Gas; Storage; Handling and preparation of fuels; Principles of combustion, Combustion of oil, Coal and Gas; Draft system. Boilers- Boiler specification, Indian boiler regulation, system components, Types, Combustion in boilers, Performance terms, Analysis of losses, Feed water treatment, Blow down, Energy conservation opportunities; Steam system - Properties of steam, Assessment of steam distribution losses, Steam leakage, Steam trapping, Condensate and flash steam recovery system, Opportunities for energy savings; Waste heat recovery - Classification, Advantages and application, Commercially viable waste heat recovery devices, Saving potential; Other utilities and services- Lighting, Cleaning In Place (CIP) system, Waste water/drainage, Water treatment, Dust removal, Fire protection and maintenance system.

## PRACTICAL

Study on energy basic, Types, Forms, Terms and Measuring instruments used in food plant utilities; Electrical power supply system, Billing and Load estimation; Motors and Variable speed drives specification, Selection, Performance terms and definitions; Compressed air system components and Performance terms and Definitions; Refrigeration and HVAC system components, Performance terms and Definitions and load estimation of a plant; Fans and Blowers, Types, Specification, Performance terms and Definitions. Pumps types, Specification, Selection, Performance terms and Definitions; Plant lighting system and their components; DG system their specification and selection; Combustion of oil, Gas and Coal; Boiler performance terms and assessment. Study on cost of steam; Waste heat recovery devices. Recuperates, Regenerators, Heat wheel, Heat pipes, Economizers, Heat exchanger (Shell and Tube, PHE, Run around coil exchanger, Direct contact HX), Waste heat recovery boilers, Heat pumps and Thermo compressor; Water treatment plant; Effluent treatment plant; Fire control operations and use of fire extinguishers.

## TEACHING SCHEDULE

### THEORY [FPO-241]

Lecture No.	Topic	Sub-topics/Key Points	Weightage (%)
1 - 2	<b>Introduction</b>	Classification of various Utilities and Services in Food Plant/ Industry. Commercial Energy Pricing	5
3 - 5	<b>Electrical System</b>	Introduction to electric power supply systems, Electrical billing, Electrical load management and Maximum demand control, Power factor improvement and Benefits, Transformers, System distribution losses, Harmonics, Trouble shooting of electrical power system	10
6 - 8	<b>Electrical Motors</b>	Types, Losses in Introduction motor, Motor efficiency, Factors affecting motor performers, Performance, Rewinding and Motor replacement issues, Energy saving opportunities with energy efficient motors.	10
9 - 11	<b>Compressed Air System</b>	Requirement, Types, Compressor efficiency, Efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test, Factors affecting the performance and efficiency.	10
12 - 14	<b>HVAC and Refrigeration System</b>	Requirement, Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, factors affecting refrigeration and air conditioning system performance and saving opportunities.	10
15	<b>Vapor Absorption Refrigeration System</b>	Working principle, Types and Comparison with VCR system, Saving potential	5
16 - 17	<b>Fans and Blowers</b>	Requirement, Types, Performance evaluation, Efficient system operation, Flow control strategies and Energy conservation opportunities.	5

*Continued...*

18 - 19	<b>Pumps and Pumping Systems</b>	Requirement, Types, Performance evaluation, Efficient system operation, Flow control strategies and Energy conservation opportunities.	5
20	<b>DG Set system</b>	Requirement, Introduction, Factors affecting selection	5
21 - 23	<b>Fuels and Combustion</b>	Introduction to fuels; Properties of fuel oil, Coal and Gas; Storage; Handling and Preparation of fuels; Principles of combustion, Combustion of oil, Coal and Gas; Draft system.	10
24 - 26	<b>Boilers</b>	Boiler specification, Indian boiler regulation, System components, Types, Combustion in boilers, Performance terms, Analysis of losses, Feed water treatment, Blow down, Energy conservation opportunities.	10
27 - 28	<b>Steam System</b>	Properties of steam, Assessment of steam distribution losses, Steam leakage, Steam trapping, Condensate and Flash steam recovery system, Opportunities for energy savings;	5
29 - 30	<b>Waste Heat Recovery</b>	Classification, Advantages and Application, Commercially viable waste heat recovery devices, Saving potential	5
31 - 32	<b>Other Utilities and Services</b>	Lighting, CIP system, Waste water/drainage, Water treatment, Dust removal, Fire protection and Maintenance system.	5
<b>Total =</b>			<b>100</b>

## TEACHING SCHEDULE

### PRACTICAL [FPO-241]

Exercise No.	Exercise Title
1	Study on energy basic, types, forms, terms and measuring instruments used in food plant utilities.
2	Electrical power supply system, billing and load estimation
3	Motors and variable speed drives specification, selection, performance terms and definitions
4	Compressed air system components and performance terms and definitions
5	Refrigeration and HVAC system components, performance terms and definitions and load estimation of a plant
6	Fans and Blowers, types, specification, performance terms and definitions.
7	Pumps types, specification, selection, performance terms and definitions
8	Plant lighting system and their components
9	DG system their specification and selection
10	Combustion of oil, gas and coal
11	Boiler performance terms and assessment
12	Study on cost of steam waste heat recovery devices
13	Studies on waste heat recovery boilers,
14	Heat pumps and Thermo compressor.
15	Visit to water treatment plant and effluent treatment plant.
16	Visit to food industry for demonstration of fire control operations and use of fire extinguishers.

#### **Suggested Readings [FPO-241] :**

1. **Lijun Wang.** 2008. Energy Efficiency and Management in Food Processing Facilities, Published by CRC Press.
2. **Casper M.E.** 1977. Energy-saving Techniques for the Food Industry, Published by Noyes Data Corp.
3. Chilton's Food Engineering. Published by Chilton Co., 1979.
4. **Whitman, W.E. and Holdsworth, S.D.** A Survey of Water Use in the Food Industry, Published by British Food Manufacturing Industries Research Association.

## B.Tech. (Food Technology)

### #List/ Bouquet of Skill Enhancement Courses (SECs)

[in continuation of the SECs' Syllabi prescribed under I, II & III semesters]

Sr. No.	Course No.	Course Title	Credit Hrs.
<b>Department of Food Technology</b>			
1.	SEC-xxx	Introduction to Drying Technology and Dryers	2(0+2)
2.	SEC-xxx	Introduction to Processing of Extruded Foods	2(0+2)
3.	SEC-xxx	Introduction to Milling (Rice, Dal, Spices, etc.)	2(0+2)
<b>Department of Food Quality Assurance</b>			
4.	SEC-xxx	Introduction to Food Safety and Sanitation	2(0+2)
5.	SEC-xxx	Introduction to Good Laboratory Practices	2(0+2)
6.	SEC-xxx	Basic Food Analysis Laboratory Techniques	2(0+2)
<b>Department of Food Engineering</b>			
7.	SEC-xxx	Introduction to Electrical and Control Systems in Food Industry	2(0+2)
8.	SEC-xxx	Introduction to Mechanical Systems in Food Industry	2(0+2)
9.	SEC-xxx	Introduction to AutoCAD	2(0+2)
<b>Department of Food Plant Operations</b>			
10.	SEC-xxx	Maintenance of Food Processing Equipments	2(0+2)
11.	SEC-xxx	Introduction to Bottling and Canning Line	2(0+2)
12.	SEC-xxx	Introduction to Manufacturing of Bakery Products	2(0+2)

- Note:** (i) Skill Enhancement Courses can be added/ offered as per the facilities and resources available at the respective universities/colleges based on the relevance to the region and the UG degree subject. **\*However, students with exit option have to select/ get offered the SECs as mentioned against the Nomenclature of UG-Diploma and such course(s) is/are to be selected from respective dept./disciplines.**
- (ii) Above list/ bouquet of SEC courses is an indicative list and subject to modification as applicable therein.
- (iii) In case of unavailability of the detailed course-wise syllabus/ teaching schedules of any of above SEC courses, the same can be primarily developed and followed at College/ University level in the current academic year. However, the same can be obtained from the respective UG Degree Coordinator/ Discipline Coordinators and can be followed w.e.f. AY, 2025-26.

**Skill Enhancement Courses (SECs): Detailed Syllabi**  
*[in continuation of the SECs' Syllabi prescribed under I, II & III Semesters]*

**Discipline: Food Technology: Department of Food Technology**

<b>Course No. : SEC-xxx</b>	<b>Credit Hrs. : 2(0+2)</b>
<b>Course Title : Introduction to Drying Technology &amp; Dryers</b>	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

<b>Exercise No.</b>	<b>Exercise Title</b>
1	Introduction to drying process and its mechanism
2	Understanding of different methods for moisture estimation
3	Determination of moisture content with oven method
4	Determination of drying characteristics and study of kinetics
5	Prediction of moisture sorption isotherms
6	Determination of equilibrium moisture content of grain
7	Introduction to different dryings theories and its importance
8	Introduction to different methods of drying (contact, convective and radiation).
9	Principle and operational mechanism involved in cabinet and tunnel drying
10	Principle and operational mechanism involved in spray drying
11	Principle and operational mechanism involved in roller/ drum drying
12	Principle and operational mechanism involved in fluidized bed drying
13	Principle and operational mechanism involved in foam-mat drying
14	Principle and operational mechanism involved in microwave drying
15	Principle and operational mechanism involved in vacuum oven drying
16	Principle and operational mechanism involved in solar drying
17	Principle and operational mechanism involved in refractance window drying of foods
18	Study of pretreatment methods for drying and dehydration
19	Study of operational principle and working of freeze dryer
20	Study of Rehydration/ Reconstitution properties of dehydrated foods
21	Drying of fruit slices in cabinet drier
22	Drying of green leafy vegetables
23	Drying of mango/ other pulp by foam-mat drying
24	Drying of foods using roller dryer and spray dryer

*Continued...*

### Introduction to Drying Technology & Dryers....

25	Drying of foods using freeze drying process
26	Preparation of mango leather
27	Preparation of Osmo-dehydrated food products (candied fruits, glazed fruits)
28	Preparation of dehydrated raisins
29	Study of packaging, labeling and FSSAI Regulations of Dehydrated products
30 - 31	Industrial Visit to different dehydration Units.
32	Case study on fruits and vegetable drying

Course No. : SEC-xxx	Credit Hrs. : 2(0+2)
Course Title : Introduction to Processing of Extruded Foods	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

Exercise No.	Exercise Title
1	Introduction and market survey of extruded products
2	Introduction of food extruders components and their functions
3-4	Principle and operational mechanism involved in cold and hot extruder (Single and Twin-Screw Extruder)
5	Preparation of spaghetti pasta
6	Preparation of penne pasta
7	Preparation of noodles
8	Preparation of vermicelli
9	Preparation of instant noodles
10	Quality evaluation of pasta products
11-12	Demonstration of extrusion products (extruded snacks/ breakfast cereal/ texturized vegetable protein)
13	Preparation of traditional extruded products (sev/ chakli)
14	Evaluation of physical properties of expanded snacks
15	Evaluation of water and milk hydration properties of breakfast cereal
16	Evaluation of functional properties of expanded snacks
17	Evaluation of functional properties of texturized vegetable protein.
18	Preparation of plant-based meat analogue by using extruder
19	Preparation of cereal, pulses based ready-to-eat snack food by extrusion cooking
20	Preparation of extruded confectionary product
21	Effect of feed moisture content on extrudate food product characteristic
22	Studies on development of weaning food by extrusion technology
23	Texture profile analysis of extruded product
24	Preparation of dietary fiber rich extruded product
25	Quality evaluation of commercially available extruded food products
26	Packaging of extruded products
27	Quality evaluation of different extruded products
28	Determination of techno-economic feasibility of prepared extruded product
29	Sensory evaluation of prepared extruded products
30	Labeling and FSSAI regulations of different extruded products.
31 - 32	Visit to commercial extrusion unit.

Course No. : SEC-xxx	Credit Hrs. : 2(0+2)
Course Title : Introduction to Milling (Rice, Dal, Spices etc.,)	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

Exercise No.	Exercise Title
1	Introduction and market survey of milled rice, dal and spices,
2	Determination of physical properties of rice grain, dal and spices
3	To study the defects in grains and milled rice, dal and spices by physical observation
4	Determination of moisture content in different milled product
5	Studies on traditional methods of milling of dal and rice grains
6	Cleaning of rice, dal and spices for milling
7	Studies on different dehusking and deshelling equipment's involved in the milling of paddy grains
8	Principles and operational mechanism of rice mills
9	Determination of Head Rice Yield (HRY), Milled Rice Yield (MRY) and % broken.
10	Determination of polishing quality of paddy
11	Studies on different byproducts of paddy milling
12	Studies on different methods and pretreatments involved in pulse milling
13	Studies on dry milling and wet milling of pulses for production of dal
14	Principles and operational mechanism of dal mills
15	Cleaning and inspection for effective grading and sieving of grains based on size and grade.
16	Demonstration of the procedure of cleaning of unprocessed whole spices
17	Principles and operational mechanism spice mills
18	Manufacture of dalia from cereal and legumes
19	Production process of rice from paddy
20	Study on mini dal mill
21	Studies on utilization of byproduct from dal milling industry
22	Preparation of turmeric powder
23	Preparation of curry powder
24	Recipe formulation and preparation of different spice mix powder (Turmeric, Chilli, Onion, Ginger etc.)
25	Sieve analysis of milled products for particle size distribution

*Continued...*

26	Milling yield calculation for different grains
27	Packaging and storage techniques for milled products
28	Techno-economic feasibility of prepared spice powder and milled dal
29	Case study on spice powder processing industries
30	To study milling quality of rice, dal and spices
31	Study of packaging, labelling and FSSAI regulations of dehydrated products
32	Visit to commercial rice mill, dal mill and spice industry

**Discipline: Food Technology: Department of Food Quality Assurance**

<b>Course No. : SEC-xxx</b>	<b>Credit Hrs. : 2(0+2)</b>
<b>Course Title : Introduction to Food Safety and Sanitation</b>	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

<b>Exercise No.</b>	<b>Exercise Title</b>
1 - 2	Understanding food safety and sanitation: concept, terms and importance
3 - 4	Developing the process flow for the food establishment including all the inputs, outputs and interim loops
5 - 6	Data collection for identification of biological, chemical and physical hazards
7	Hazard Analysis using FMEA technique for risk assessment
8	Demonstration of correct method of washing hands
9 - 10	Assessment of personal hygiene
11 - 12	Identifying the key focus areas for GHP and GMP
13 - 14	Identifying gaps in its implementation; closure plans for identified gaps
15 - 16	Importance of temperature control and demonstrating proper cooking, cooling and reheating temperatures using thermometers
17	Introduction to HACCP
18 - 19	Development of OPRP (Operational Pre-requisite Programme) and Development of HACCP Plan (Critical Limits including Rationale for Limits)
20 - 21	Monitoring procedure, correction and corrective measures
22 - 23	Introduction to cleaning agents and techniques for sanitizing surfaces
24 - 25	Hands-on Demonstration of using chemical sanitizers correctly
26 - 27	To recognize signs of pest infestations and methods of control
28 - 29	Demonstration of segregation of waste
30 - 31	To study proper disposal methods for different types of waste
32	Practice identifying common food allergens and labeling

<b>Course No.</b> : SEC-xxx	<b>Credit Hrs.</b> : 2(0+2)
<b>Course Title</b> : Introduction to Good Laboratory Practices	

### TEACHING SCHEDULE

#### PRACTICAL [SEC-xxx]

<b>Exercise No.</b>	<b>Exercise Title</b>
1 - 2	Introduction and importance of good laboratory practices
3 - 4	Practical session on identifying hazards and using appropriate personal protective equipment
5 - 6	Hands-on practice with common lab equipment (e.g. microscopes, pipettes, balances, centrifuges etc.)
7 - 8	Equipment calibration techniques and how to properly maintain instruments
9 - 10	Techniques for cleaning, drying and sterilizing lab glassware to prevent contamination
11 - 12	Autoclave operation for sterilization, calibration of balances, pH meters and spectrophotometers
13 - 14	Sample collection techniques for biological, chemical or environmental samples
15 - 16	Correct labeling and storage procedures to maintain integrity
17 - 18	Proper segregation and disposal of hazardous and non-hazardous lab waste
19 - 20	Understanding chemical compatibility and safe disposal practices
21 - 22	Performing basic quality control tests like titration, pH measurement and UV-Vis Spectrophotometry to assess the purity and quality of samples
23 - 25	Aseptic techniques for handling microbial cultures, preparing agar plates and transferring cultures
26 - 28	Detecting, recording and reporting errors or deviations in experimental work
29 - 30	Writing and following SOPs for basic lab techniques like, solution preparation or instrument usage

Course No. : SEC-xxx	Credit Hrs. : 2(0+2)
Course Title : Basic Food Analysis Laboratory Techniques	

### TEACHING SCHEDULE

#### PRACTICAL [SEC-xxx]

Exercise No.	Exercise Title
1 - 2	Sampling plan; Sample collection and preparation for analysis
3 - 4	Sensory evaluation techniques of food products
5 - 6	Quality evaluation of food products for color and taste of marketed products
7 - 8	Determination of moisture content in food samples
9 - 10	Water analysis
11 - 12	Determination of ash content in food samples
12 - 13	Determination of crude fat in food samples
14	Determination of crude protein in food samples by Kjeldahl method
15 - 16	Determination of crude fibre in food samples
17	Qualitative tests for sugars
18 - 19	Qualitative tests for proteins, Colorimetric estimation of protein concentration
20 - 21	Estimation of total and reducing sugars
22 - 23	Measuring the pH of various food samples like fruits, dairy, and beverages
24 - 25	Determining the acidity in food samples by titrating with a base
26 - 27	Determination of Total Soluble Solids and Vitamin C in food samples
28	Determination of Salt Content in food samples
29 - 30	Estimation of chlorophyll and carotenoids in food samples
31	Estimation of Macro and Micro minerals
32	Visit to NABL-Accredited Food Laboratory

**Discipline: Food Technology: Department of Food Engineering**

<b>Course No. : SEC-xxx</b>	<b>Credit Hrs. : 2(0+2)</b>
<b>Course Title : Introduction to Electrical and Control Systems in Food Industry</b>	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

<b>Exercise No.</b>	<b>Exercise Title</b>
1 - 2	Build simple electrical circuits using resistors, capacitors and inductors
3	Measurement of voltage, current and resistance using a multimeter
4 - 5	Explore different types of sensors used in food processing
6 - 7	Performing calibration exercises with EC/pH meter. Study of different types of motors (AC, DC, Stepper) and their applications
8 - 9	Developing a motor control circuit for a conveyor system
10 - 11	Programming simple control sequences using PLC software
12	Creating a basic ladder logic diagram for a conveyor belt system
13	Simulating PID control for a temperature control system
14 - 15	Designing a simple HMI using software tools (like Factory Talk or WinCC)
16 - 17	Integrating the HMI with PLC for monitoring and control
18 - 19	Setting-up a small SCADA system for monitoring a food processing operation
20 - 21	Understanding data logging and visualization techniques
22	Learning about industrial communication protocols (Modbus, Ethernet/IP)
23 - 24	Creating a simple network setup to connect PLCs and HMIs
25	Building and analyze a control loop for a food processing scenario (e.g. Pasteurization)
26	Understanding feedback mechanisms and their importance in control systems
27	To diagnose and troubleshoot faulty electrical circuits
28	To develop systematic approaches to identify common issues
29	To measure and analyze energy consumption in a small-scale food processing set-up
30	To explore energy-saving practices and technologies in the industry
31	Safety protocols in electrical systems
32	Visit to Food Industry for practical exposure of electrical and control system

<b>Course No. : SEC-xxx</b>	<b>Credit Hrs. : 2(0+2)</b>
<b>Course Title : Introduction to Mechanical Systems in Food Industry</b>	

### TEACHING SCHEDULE

#### PRACTICAL [SEC-xxx]

Exercise No.	Exercise Title
1 - 2	Introduction to mechanical system and its application in food industry
3 - 4	To identify and understand the function of basic mechanical components (gears, belts, pulleys, bearings) used in food machinery
5 - 6	To study different materials used in food machinery and their properties
7 - 8	To practice the assembly and disassembly of simple food processing machines (e.g., mixers, blenders)
9 - 10	To measure and analyze vibration in food processing equipment
11 - 12	To learn how to identify issues such as misalignment or imbalance
13 - 14	To perform routine maintenance tasks on mechanical systems (lubrication, belt tensioning)
15 - 16	To conduct troubleshooting exercises to identify and fix common mechanical failures
17	Study of principles, construction and working of cleaning equipments
18	Study of principles, construction and working of sorting/grading equipments
19	Study of principles, construction and working of washing equipments
20	Study of principles, construction and working of handling equipments
21	Study of principles, construction and working of food packaging machines
22 - 23	To conduct tests to evaluate corrosion resistance and suitability for food contact
24 - 25	To explore the use of robotic systems for tasks such as packing or palletizing
26 - 27	To implement quality control measures in a mechanical process (e.g. measuring dimensions of food products)
28 - 29	To create basic mechanical drawings using CAD software
30 - 31	Project work to enlist various mechanical parts and its functionality in different food processing industries
32	Visit of food industry to identify mechanical systems in food processing

<b>Course No.</b> : SEC-xxx	<b>Credit Hrs.</b> : 2(0+2)
<b>Course Title</b> : Introduction to AutoCAD	

### TEACHING SCHEDULE

#### PRACTICAL [SEC-xxx]

Exercise No.	Exercise Title
1 - 2	Introduction to AutoCAD and its application in the food processing industry
3 - 4	Familiarization with the AutoCAD interface: toolbars, menus and command line
5	Practice using drawing tools to create geometric shapes
6 - 7	Experiment with drawing precision using grid and snap features
8	Learning to modify objects using commands such as move, copy, rotate, scale and mirror
9	To perform exercises on editing shapes and lines in an existing drawing
10	To create and manage layers in a drawing
11	To assign different colours and line types to layers for better organization
12	To add linear, radial and angular dimensions to drawings
13 - 14	To practice dimensioning techniques and understand best practices for clarity
15	To insert text and annotations into a drawing
16	To explore styles and formatting options for clarity and presentation
17 - 18	To draw a complete 2D engineering drawing of an equipment
19	Introduction to 3D modeling: create basic 3D shapes (cubes, cylinders)
20 - 21	To practice using 3D viewing tools and rendering techniques
22 - 23	Setting-up a layout for printing: scaling, title blocks and viewports
24 - 25	Understanding the file types and compatibility issues (DWG, DXF) to save the AutoCAD files
26	To attach and manage external references in a drawing
27 - 28	To develop a detailed plan (floor plan, mechanical part) incorporating multiple elements
29 - 30	To create isometric drawings to represent three-dimensional objects in two dimensions
31 - 32	To practice isometric dimensioning and labeling

**Discipline: Food Technology: Department of Food Plant Operations**

<b>Course No. : SEC-xxx</b>	<b>Credit Hrs. : 2(0+2)</b>
<b>Course Title : Maintenance of Food Processing Equipments</b>	

**TEACHING SCHEDULE**

**PRACTICAL [SEC-xxx]**

<b>Exercise No.</b>	<b>Exercise Title</b>
1 - 2	Hands on identification of various types of food processing equipment
3 - 4	Creation of customized preventive maintenance check lists for different equipment
5 - 6	Simulated execution of a preventive maintenance routine
7	Understanding the types of lubricants used in food processing
8	Practicing proper lubrication techniques on machinery
9 - 10	Learning about different cleaning agents and their appropriate use
11 - 12	Conducting cleaning protocols on equipment in compliance with food safety standards
13 - 14	Practical exercises in electrical trouble shooting, including circuit testing and voltage measurement
15 - 16	Dismantling and reassembling parts of common food processing equipment
17 - 18	Simulated troubleshooting of common equipment functions
19 - 20	Simulating the documentation of maintenance activities and creating maintenance logs
21	Study of maintenance of cleaning equipment
22 - 23	Study of care and maintenance of sorting/ grading equipment
24 - 25	Study of care and maintenance of milling equipment
26 - 27	Study of care and maintenance of drying equipment
28 - 29	Study of care and maintenance of material handling equipment
30 - 31	Study of care and maintenance of packaging equipment
32	Study of care and maintenance of storage units

<b>Course No. :</b> SEC-xxx	<b>Credit Hrs. :</b> 2(0+2)
<b>Course Title :</b> Introduction to Bottling and Canning Line	

**TEACHING SCHEDULE**

**PRACTICAL**

<b>Exercise No.</b>	<b>Exercise Title</b>
1 - 2	Introduction to bottling and canning process
3	Study of sorting and grading equipments
4	Study of washing equipments
5	Study of peeling methods and equipments
6	Study of cutting equipments
7	To perform the blanching of fruits and vegetables
8	To check the adequacy of blanching process
9 - 10	Study of different types of bottles and cans, including materials and sizes
11	Study of different filling techniques (gravity, pressure, vacuum)
12	Practical session on filling bottles/cans accurately
13	Cut out analysis of cans
14	Hands-on practice on in-bottle sterilization
15	Hands-on practice with various sea ling methods(screw caps, corks, can lids)
16	Testing seal integrity using various methods
17	Practical session on labeling machinery operation
18	Coding and printing best practices for product information
19	Conduct quality checks on filled and sealed products
20	Discuss common quality issues and troubleshooting techniques
21	Study of domestic carbonator and carbonation process
22	Learn proper cleaning and sanitation protocols for equipment
23 - 24	Hands-on cleaning sessions for different parts of the line
25	Basic maintenance tasks for key equipments
26	Troubleshooting common problems in bottling and canning lines
27	Workshop on regulations affecting bottling and canning
28	Product handling and storage
29	Practical session on proper storage techniques
30 - 31	Study of packaging, labeling and FSSAI regulations of beverages and canned products
32	Visit to beverage and canning industry

<b>Course No. :</b> SEC-xxx	<b>Credit Hrs. :</b> 2(0+2)
<b>Course Title :</b> Introduction to Manufacturing of Bakery Products	

### TEACHING SCHEDULE

#### PRACTICAL [SEC-xxx]

Exercise No.	Exercise Title
1 - 2	Introduction and market survey of bakery products
3 - 4	Study of different methods of preparation of bakery product (bread, biscuit, cake and cookies etc.)
5 - 6	Determination of gluten content in Wheat flour
7 - 8	Determination of sedimentation value of Wheat flour
9 - 10	Determination of Pelshenke value of Wheat flour
11 - 12	Determination of water and oil absorption of flour
13 - 14	Determination of emulsion capacity and stability of flour
15 - 16	Determination of foaming capacity and stability of flour
17 - 18	Determination of alkaline water retention capacity of flour
19 - 20	Preparation and quality evaluation of composite formulation of Wheat-based cookies
21 - 22	Preparation and quality evaluation of Millet-based cookie formulations
23 - 24	Preparation and quality evaluation of crackers
25 - 26	Preparation and quality evaluation of unleavened flat breads
27 - 28	Preparation and quality evaluation of leavened breads (White bread, Brown bread)
29	Preparation and quality evaluation of cake/muffin
30	Preparation and quality evaluation of baked cereal bar
31	Study of packaging, labeling and FSSAI regulations of bakery products
32	Visit to Commercial Bakery Unit