

# **SEMESTER WISE COURSE STRUCTURE & DETAILED SYLLABUS**

**B.TECH. CHEMICAL TECHNOLOGY-FOOD TECHNOLOGY**

**(Effective from the session 2019-20 for new entrants)**



**HARCOURT BUTLER TECHNICAL UNIVERSITY  
KANPUR-208002 (UP) – INDIA**

**HARCOURT BUTLER TECHNICAL UNIVERSITY**  
**SCHOOL OF CHEMICAL TECHNOLOGY**  
**DEPARTMENT FOOD TECHNOLOGY**

**THE UNIVERSITY**

**VISION**

*“To achieve excellence in technical education, research and innovation”*

**MISSION**

- 1. Imparting Knowledge to develop analytical ability in science and technology to serve the industry and society at large.*
- 2. Equip and enable students with conceptual, technical and managerial skills to transform the organization and society.*
- 3. Inculcating entrepreneurial philosophy and innovative thinking to promote research, consultancy and institutional social responsibility.*
- 4. Serving people, society and nation with utmost professionalism, values and ethics to make development sustainable and quality of life.*

**THE DEPARTMENT**

**VISION**

*“To develop technically sound food technocrats, to cater the needs of food processing industries, Research & Development organizations and society”*

**MISSION**

The missions of the Department of Food Technology are:

- M1 : Imparting technical knowledge to develop human resources for food processing sectors.*
- M2 : Imparting knowledge & technical skills for better processing and value addition of Food & Agro-products through R&D.*
- M3 : Inculcating innovative thinking with the aim to support entrepreneurship and to develop state-of-art technologies for testing and consultancy to fulfill the needs of industry and society.*
- M4 : Cultivating strong ethical values for sustainable modern and safe food to society.*

**I. Program Educational objectives (PEOs) for B. Tech. Chemical Technology-Food Technology**

The educational objectives of B. Tech. Chemical Technology - Food Technology program are:

<b>PEO1:</b>	Graduates of the program will contribute to the development of sustainable growth of food processing sector for the betterment of society
<b>PEO2:</b>	Graduates of the program will accept and create innovations in providing solution for sustainable technological development
<b>PEO3:</b>	Graduates of the program will meet challenges in terms of quality assurance and standardization to withstand the global competitiveness
<b>PEO4:</b>	Graduates of the program will exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning for betterment of society

*Consistency of PEOs with Mission of the Department*

PEO Statements		M1	M2	M3	M4
<b>PEO1:</b>	Graduates of the program will contribute to the development of sustainable growth of food processing sector for the betterment of society	3	3	2	1
<b>PEO2:</b>	Graduates of the program will accept and create innovations in providing solution for sustainable technological development	3	2	2	1
<b>PEO3:</b>	Graduates of the program will meet challenges in terms of quality assurance and standardization to withstand the global competitiveness	3	2	2	1
<b>PEO4:</b>	Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning for betterment of society	2	2	2	3

**Program Outcomes (POs) of B. Tech. Chemical Technology - Food Technology**

Graduating Students of B. Tech. Chemical Technology - Food Technology program will be able to:

Program Outcomes (POs)		Graduate Attributes (GAs)
<b>PO1</b>	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Engineering Knowledge

<b>PO2</b>	Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Problem Analysis
<b>PO3</b>	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	Design/Development of solutions
<b>PO4</b>	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Conduct Investigations of complex problems
<b>PO5</b>	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	Modern Tool Usage
<b>PO6</b>	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	The Engineer & Society
<b>PO7</b>	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	Environment and sustainability
<b>PO8</b>	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	Ethics
<b>PO9</b>	Function effectively as an individual, and as a	Individual and team work

	member or leader in diverse teams, and in multidisciplinary settings.	
<b>PO10</b>	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	Communication
<b>PO11</b>	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Project management and finance
<b>PO12</b>	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	Life-long learning

**Program Specific Outcomes (PSOs) for B. Tech. Chemical Technology - Food Technology program are:**

Graduating students of B. Tech. Chemical Technology - Food Technology program will be able:

<b>PSO1</b>	to apply practical skills, technical knowledge in major streams such as chemistry, manufacturing, processing, and to application areas of engineering & technology in food industries
<b>PSO2</b>	to take-up career in research organizations and to pursue higher studies in food technology and interdisciplinary programs with high regard for ethical values, environmental and social issues.

**HARCOURT BULTER TECHNICAL UNIVERSITY KANPUR**  
**SCHOOL OF CHEMICAL TECHNOLOGY**  
**DEPARTMENT OF FOOD TECHNOLOGY**  
**Semester wise Course Structure**  
**B. Tech. Chemical Technology - Food Technology**  
**(Applicable from Session 2019-2020 for new entrants)**  
**Year I, Semester-I**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	BSC	Engineering Chemistry	BCY 151	4	3	0	2	15	20	15	50	50	100
2	BSC	Mathematics I	BMA 151	4	3	1	0	30	20	-	50	50	100
3	ESC	Electronics & Instrumentation Engineering	EET 151	3	3	0	0	30	20	-	50	50	100
4	ESC	Engineering Graphics	ECE 151	3	2	4	0	30	20	-	50	50	100
5	ESC	Computer Concepts & Programming	ECS 151	4	3	0	2	15	20	15	50	50	100
6	ESC	Workshop Practice	EWS 151	2	0	0	4	00	20	30	50	50	100
7	MC (Non-Credit)	Environment & Ecology	ECE 153	0	2	0	0	30	20	-	50	50	100*
<b>Total Credits: 20</b>												<b>600</b>	

\* 100 marks will not be added as the course is non-credit.

(Applicable from Session 2019-2020 for new entrants)

**Year I, Semester-II**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	BSC	Physics	BPH 152	4	3	0	2	15	20	15	50	50	100
2	BSC	Mathematics II	BMA 152	4	3	1	0	30	20	-	50	50	100
3	ESC	Electrical Engineering	EEE 152	4	3	0	2	15	20	15	50	50	100
4	ESC	Engineering Mechanics	EME 152	3	3	0	0	30	20	-	50	50	100
5	HSMC	English Language & Composition	HHS 152	2	2	0	0	30	20	-	50	50	100
6	HSMC	Professional Communication	HHS 154	3	2	0	2	15	20	15	50	50	100
<b>Total Credits: 20</b>												<b>600</b>	

**(Applicable from Session 2020-2021)**  
**Year II, Semester-III**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	BSC	Mathematics III	BMA 251	4	3	1	0	30	20	-	50	50	100
2	PCC	Materials & Energy Balance	TFT 251	4	3	1	0	30	20	-	50	50	100
3	ESC	Fluid Mechanics and Mechanical Operation	TFT 253	5	3	1	2	15	20	15	50	50	100
4	PCC	Introduction to Food Technology	TFT 255	4	3	1	0	30	20	-	50	50	100
5	PCC	Analysis of Food Constituents Lab	TFT 257	2	0	0	4	-	20	30	50	50	100
6	HSMC	Organizational Behaviour	HHS 253	3	3	0	0	30	20	-	50	50	100
7	MC (Non-Credit)	Cyber Security	ECS 255	0	2	0	0	30	20		50	50	100*
<b>Total Credits: 22</b>												<b>600</b>	

\* 100 marks will not be added as the course is non-credit.

**(Applicable from Session 2020-2021)**  
**Year II, Semester-IV**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	BSC	Modern Analytical Techniques	BCY 252	4	3	0	2	15	20	15	50	50	100
2	ESC	Computer Oriented Numerical Methods	BMA 252	4	2	1	2	15	20	15	50	50	100
3	PCC	Heat Transfer Operations	TFT 252	3	3	0	0	30	20	-	50	50	100
4	PCC	Chemical Engineering Thermodynamics	TFT 254	3	3	0	0	30	20	-	50	50	100
5	PCC	Food Microbiology	TFT 256	5	3	1	2	15	20	15	50	50	100
6	HSMC	Engg Economics & Management	HHS 252	3	3	0	0	30	20	-	50	50	100
7	MC (Non-Credit)	Indian Constitution (Audit course)	HHS 256	0	2	0	0	30	20		50	50	100*
<b>Total Credits: 22</b>												<b>600</b>	

\* 100 marks will not be added as the course is non-credit.

**(Applicable from Session 2021-2022)**  
**Year III, Semester-V**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	PCC	Mass Transfer Operations	TFT 351	4	3	1	0	30	20	-	50	50	100
2	PCC	Chemical Reaction Engineering	TFT 353	3	3	0	0	30	20	-	50	50	100
3	PCC	Food Biochemistry	TFT 355	4	3	0	2	15	20	15	50	50	100
4	PCC	Food Chemistry	TFT 357	5	3	0	4	15	20	15	50	50	100
5	PCC	Technology of Animal & Milk Products	TFT 359	3	3	0	0	30	20	-	50	50	100
6	OEC (Humanities)	Entrepreneurship Development	HHS 341	3	3	0	0	30	20	-	50	50	100
<b>Total Credits: 22</b>												<b>600</b>	

**(Applicable from Session 2021-2022)**  
**Year III, Semester-VI**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	PCC	Instrumentation & Process Control	TFT 352	3	2	1	0	30	20	-	50	50	100
2	PCC	Principle of Food Preservation	TFT 354	3	2	1	0	30	20	-	50	50	100
3	PCC	Technology of Cereals, Pulses and Oilseeds	TFT 356	4	3	1	0	30	20	-	50	50	100
4	PCC	Fruits, Vegetable and Plantation Products	TFT 358	3	3	0	0	30	20	-	50	50	100
5	PCC	Fermented Foods & Beverage Technology	TFT 360	3	3	0	0	30	20	-	50	50	100
6	PCC	Food Processing Lab	TFT 362	3	0	0	6	-	20	30	50	50	100
7	OEC (Maths)	Operations Research	BMA 342	3	3	0	0	30	20	-	50	50	100
<b>Total Credits: 22</b>												<b>700</b>	

**(Applicable from Session 2022-2023)**  
**Year IV, Semester-VII**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	PCC	Food Safety and Quality Control	TFT 451	3	2	0	2	15	20	15	50	50	100
2	PCC	Food Packaging & Storage Engineering	TFT 453	2	2	0	0	30	20	-	50	50	100
3	PEC	<b>Program Elective Course I</b> Principle of Food Analysis	TFT 455	3	3	0	0	30	20	-	50	50	100
		Food Process and Product Development	TFT 457										
4	PEC	<b>Program Elective Course II</b> Food Processing	TFT 459	3	3	0	0	30	20	-	50	50	100
		Waste Management, Quality Management of Frozen Foods	TFT 461										
5	OEC (Food Tech.)	Basic Concepts of Food Processing & Preservation	TFT 491	3	3	0	0	30	20	-	50	50	100
6		Industrial Training	TFT 493	2	0	0	4		50		50	50	100
7		Seminar	TFT 495	2	0	0	4		50		50	50	100
8		Project	TFT 497	4	0	0	8		50		50	50	100
9		Educational Tour	TFT 499	0	0	0	0						
<b>Total Credits: 22</b>												<b>800</b>	

**(Applicable from Session 2022-2023)**  
**Year IV, Semester-VIII**

S. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1.	PEC	<b>Program Elective Course III*</b> Innovative Techniques in Food Processing Application of Computer in Food Processing	TFT 452 TFT 454	4	3	1	0	30	20	-	50	50	100
2.	PEC	<b>Program Elective Course IV*</b> Unit Operation in Food Processing, Nutraceutical & Functional Foods	TFT 456 TFT 458	4	3	1	0	30	20	-	50	50	100
3.	OEC (Food Tech)	Nutritional aspects of Natural & Processed Foods	TFT 492	4	3	1	0	30	20	-	50	50	100
4.		Project	TFT 498	10	0	0	20	-	50	-	50	50**	100
<b>Total Credits: 22</b>												<b>400</b>	

\*These courses are either MOOC/NPTEL online courses of equal weightage and similar title available at the start of the semester

OR regular courses in case students do not opt industry-based project.

\*\* Project Viva-Voice will be conducted by External Examiner.

**List of Program Elective Courses**

S. No.	PEC Names	Subject Name	Subject Code	C (L-T- P) (new)
1	<b>Program Elective Course I</b>	Principle of Food Analysis	TFT 455	3 (3-0-0)
		Food Process and Product Development	TFT 457	
2	<b>Program Elective Course II</b>	Food Processing Waste Management	TFT 459	3 (3-0-0)
		Quality Management of Frozen Foods	TFT 461	
3	<b>Program Elective Course III</b>	Innovative Techniques in Food Processing	TFT 452	4 (3-1-0)
		Application of Computer in Food Processing	TFT 454	
4	<b>Program Elective Course IV</b>	Unit Operation in Food Processing	TFT 456	4 (3-1-0)
		Nutraceutical & Functional Foods	TFT 458	

**List of Open Elective Courses**

S. No.	OEC Names	Subject Name	Subject Code	C (L-T-P)
1.	<b>Open Elective Course I (Humanities)</b>	Entrepreneurship Development	HHS 341	3 (3-0-0)
2.	<b>Open Elective Course II (Maths)</b>	Operations Research	BMA 342	3 (3-0-0)
3.	<b>Open Elective Course III (FOOD TECH) (Except Food Technology Students)</b>	Basic Concepts of Food Processing & Preservation	TFT 491	3 (3-0-0)
4	<b>Open Elective Course IV (FOOD TECH) (Except Food Technology Students )</b>	Nutritional aspects of Natural & Processed Foods	TFT 492	4 (3-1-0)

**TFT-251: MATERIAL & ENERGY BALANCE**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objective of the course is to impart:

- The knowledge of principles of material and energy balances applied during unit operation in food processing
- The knowledge of designing and optimizing the process in food technology

**Course outcomes**

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

CO1	Understand the basic of engineering principles for the calculation of material and energy balance	Understanding
CO2	Apply material and component balance in unit operation of food processing	Apply
CO3	Understand fluid flow required to perform material balance in mechanical and rheological operations of food materials	Understanding
CO4	Apply energy balance for the calculation of thermal and freezing load in unit operation of food processing	Apply
CO5	Understand material and energy balance simultaneously during analysis for multicomponent systems	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	1	1	-	-	-	1	-	-	-	-	-	1	2	2
<b>CO2</b>	2	1	1	1	-	1	1	-	-	-	-	2	3	3
<b>CO3</b>	2	-	-	-	-	-	1	-	-	-	-	1	1	1
<b>CO4</b>	2	1	-	-	-	1	1	-	-	-	-	2	2	2
<b>CO5</b>	2	1	-	-	-	1	1	-	-	-	-	2	2	2
<b>Average</b>	2	1	1	1	1	1	1	1	3	1	1	2	2	2

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Review of basic Engineering mathematics
- Basics of unit and dimensions
- Fundamental of material and energy balance
- Stress-strain behavior in materials
- Fundamentals of fluid flow

#### **Course Outcome 2 (CO2)**

- Basics of material and component balance
- Material balance in unit operation
- Problems related to material balance in food processing

#### **Course Outcome 3 (CO3)**

- Fundamentals of fluid flow study in food processing
- Mass balance continuity equation
- Newtonian and Non-Newtonian Fluids power law equation
- Calculation of Energy losses and Pressure drops in flow systems

#### **Course Outcome 4 (CO4)**

- Energy balance in food operations
- Enthalpy Changes in Foods during Freezing
- Application of Humidity and psychrometric chart in food processing
- Properties of Saturated and Superheated Steam

#### **Course Outcome 5 (CO5)**

- Understanding simultaneous Material and Energy Balances
- Material and energy balance during analysis for multicomponent systems
- Unsteady State Material and Energy Balances

### **Syllabus**

#### **Module-I: Introduction to material & Energy Balance**

Review of basic engineering mathematics; units and dimensions; material and energy balance. Principles of Fluid Flow - Introduction to stress strain behavior in materials; properties of fluid viscosity; capillary tube viscometer; power law equation for pseudo plastic; Newtonian and dilatant fluids; flow in pipes-friction, laminar and turbulent flow equations, considerations in pumping fluid.

### **Module-II: Material Balance**

Basic Principles: Law of Conservation of Mass, Process Flow Diagrams, System Boundaries, Total Mass Balance, Component Mass Balance, Material Balance Problems Involved in Dilution, Concentration, and Dehydration, Steady State, Volume Changes on Mixing, Batch versus Continuous processing, Blending of Food Ingredients, Total Mass and Component Balances, Use of Specified Constraints in Equations, Problems related to material balance in food processing.

### **Module-III: Fluid-Flow Theory**

Introduction, Fluid statics, fluid pressure, absolute pressures, gauge pressures, head, Fluid dynamics, Mass balance continuity equation; Energy balance; Potential energy; Kinetic energy; Pressure energy; Friction loss; Mechanical energy; Other effects; Bernoulli's equation flow from a nozzle; Viscosity shear forces viscous forces; Newtonian and Non-Newtonian Fluids power law equation; Streamline and turbulent flow; dimensionless ratios; Reynolds number; Energy losses in flow; Friction in Pipes Fanning equation Hagen Poiseuille equation; Blasius equation; pipe roughness; Moody graph; Energy Losses in Bends and Fittings; Pressure Drop through Equipment; Equivalent Lengths of Pipe; Compressibility Effects for Gases; Calculation of Pressure Drops in Flow Systems

### **Module-IV: Energy balance**

General Principles, Energy Terms, Heat Content, Enthalpy, Specific Heat of Solids and Liquids, Enthalpy Changes in Foods during Freezing, Freezing Point Depression by Solutes, Sensible Heat of Water and Ice at Temperatures Below the Freezing Point, Total Enthalpy Change, Specific Heats of Gases and Vapours. Humidity and psychrometric chart, Energy balance calculations in humidification and adiabatic cooling. Steam table, Properties of Saturated and Superheated Steam

### **Module-V: Analysis of Material and Energy Balance**

Simultaneous Material and Energy Balances: Degrees of freedom analysis for multicomponent systems, combined steady state material and energy balances for units with multiple sub-systems, Unsteady State Material and Energy Balances: Transient materials and energy balances involving with and without chemical reactions.

### **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Authors</b>
Fundamentals of Food Process Engineering; 2nd ed, 2000, CBS Publishers	Toledo RT;
Fundamentals of Food Process Engineering	D.R.Heldman and R.P.Singh
Basic Principles and Calculations in Chemical Engineering	David Himmelblau; Printice Hall of India
Chemical process Principles, Material and Energy Balances, 2 <sup>nd</sup> Edition, New Age International.	Hougen,O.A., Watson, K.M., and Ragatz, R.A.

**TFT-253 FLUID FLOW & UNIT OPERATIONS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>2</b>	<b>5</b>

**Course objectives:** The objective of this course is to impart

- Knowledge of various fluid properties and their measurement.
- Knowledge of different types flow and flow behavior during flow of fluid through pipes.
- Knowledge of various losses occurs during fluid flow.

<b>CO1</b>	Understand the concept of viscosity and other fluid properties and their measurement.	Understanding
<b>CO2</b>	Differentiate various types of fluid flows and understand the types of motion.	Understanding
<b>CO3</b>	Understand and apply differential balance of fluid flow to solve the problems related to fluid flow.	applying
<b>CO4</b>	Understand the concept of energy losses during fluid flow in a pipe.	Understanding
<b>CO5</b>	Understand the principle involved in various unit operations.	Understanding
<b>CO6</b>	Conduct various experiments to apply the concepts of fluid mechanics and unit operations.	Analyzing

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	1	-	-	-	-	-	-	-	1	-	1	1	1
<b>CO2</b>	2	1	1	1	-	1	-	-	-	-	-	1	2	2
<b>CO3</b>	3	2	2	2	-	1	1	-	-	1	-	1	3	3
<b>CO4</b>	3	1	1	1	-	1	1	-	-	-	-	1	2	2
<b>CO5</b>	3	2	1	1	-	-	-	-	-	-	-	2	3	3
<b>CO6</b>	3	2	2	1	1	1	1	1	3	1	1	2	3	3
<b>Average</b>	<b>3</b>	<b>1.5</b>	<b>1.4</b>	<b>1.5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1.33</b>	<b>2.33</b>	<b>2.33</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

## **Syllabus**

### **Module I: Introduction and properties of fluids**

Introduction to fluids, properties of fluids: viscosity, thermodynamic properties, compressibility, Surface tension and Capillarity, Vapour pressure and cavitation, Pressure and its measurement; fluid pressure at a point, pressure variation in a fluid at rest, simple manometers and differential manometers, hydrostatic forces on submerged surfaces, buoyancy and floatation.

### **Module II: Kinematics of fluid flow**

Introduction, methods of describing fluid flow, types of fluid flow; steady and unsteady; uniform and non-uniform, laminar and turbulent, rotational and irrotational, Rate of flow or discharge, continuity equation, velocity potential and flow net, types of motion and vorticity.

### **Module III: Dynamics of fluid flow**

Conservation laws, Euler's equation of motion, Bernoulli's equation, applications of Bernoulli's equation, viscous flow, Raleigh's method and Buckingham's  $\pi$  theorem, types of similarities, dimensional analysis, dimensionless numbers. **Flow Measurements and pumps:** Orifice and venturi meter, Pitot tube, Rotameter and other flow measuring instruments, Positive displacement and centrifugal pumps.

### **Module IV: Flow through pipes, orifices and flow over submerged objects**

**Internal flow:** laminar and turbulent flow in pipes, general equation for head loss – Darcy-Weisbach and Fanning's equations, Moody's diagram, energy losses through pipe fittings, flow through network of pipes. **Boundary layer flows-**Introduction, Prandtl's boundary layer equation and Boundary layer separation. Flow around submerged bodies: Drag force, lift and drag coefficient, drag on flat plate circular cylinder and sphere.

### **Module V: Unit operations**

Different types of screening equipment in industries, Screen efficiency, **Filtration:** Governing equations, constant pressure operation, constant flow operation, cycle time, types of filters. **Centrifuges and Cyclones:** Gravity settling, centrifugal separation, cyclone separations,

separation efficiency, pressure loss, **Size reduction** - Rittingers Law, Kicks law, Bondscrushing law, Work index, Problems, Classification of size reduction equipment : Crushers, Grinders, Ultra-fine grinders, Cutting machines, Problems.

### **Module VI: Laboratory experiments**

Determine coefficient of discharge of an orifice meter, venturimeter, determine the friction factor for the pipes, verify the Bernoulli's Theorem, find critical Reynolds number for a Pipe flow, determine the meta-centric height of a floating body, determine the minor losses due to sudden enlargement, sudden contraction and bends.

### **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Authors</b>
A textbook of fluid mechanics and hydraulic machines. Laxmi publications	Bansal, R. K. (2004)
Unit Operations of Chemical Engineering: McGraw Hill	McCabe and Smith

**TFT-255: INTRODUCTION TO FOOD TECHNOLOGY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objective of the course is to impart

- The knowledge about basic concepts of food technology and recent trends
- The knowledge about basic biology, chemistry, and microbiology of foods

**Course outcomes**

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

CO1	Understand the status of Indian Food Industry	Understanding
CO2	Understand the importance of nutrition, desirable & undesirable components present in food, and Recommended Dietary Allowances (RDA)	Understanding
CO3	Understand the characteristics of living cells, difference between plant animal cells	Understanding
CO4	Understand the basics concepts of food biochemistry	Understanding
CO5	Understand the basics concepts of food microbiology	Understanding
CO6	Determine the basic composition of foods experimentally	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	1	1	-	-	-	1	-	-	-	-	-	1	2	2
<b>CO2</b>	2	1	1	1	-	1	1	-	-	-	-	2	3	3
<b>CO3</b>	2	-	-	-	-	-	1	-	-	-	-	1	1	1
<b>CO4</b>	2	1	-	-	-	1	1	-	-	-	-	2	2	2
<b>CO5</b>	2	1	-	-	-	1	1	-	-	-	-	2	2	2
<b>Average</b>	2	1	1	1	1	1	1	1	3	1	1	2	2	2

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

*If there*

*is no correlation, put “-”*

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Difference between Food Science and Technology
- Sub-disciplines of Food Science
- Challenges & opportunities in Food industry
- Reasons for slow growth of Indian food industry
- Market scenario of food products

#### **Course Outcome 2 (CO2)**

- Bioavailability of nutrients
- Importance of desirable & undesirables constituents of food
- Nutritional Deficiencies

#### **Course Outcome 3 (CO3)**

- Characteristics of living system
- Plant and animal diversity

#### **Course Outcome 4 (CO4)**

- Metabolic Regulations
- Bioenergetics

#### **Course Outcome 5 (CO5)**

- Interactions between microorganisms and the food environment
- Significance and activities of microorganisms in food.
- Food hygiene and application of microbes in food.

### **Syllabus**

#### **Module-I: Introduction to Food Technology, Its Scope, Opportunities & Challenges**

Food Science and Technology, Status of food processing industry in India and abroad Reasons for slow growth of Indian food industry, Market scenario and scope - Dairy, Bakery, Confectionary, Beverages and Snack foods etc Potential and prospects of Indian food Industry.

#### **Module-II: Concept of Food Nutrition and Human Health**

Human nutrition and health, Recommended Dietary Allowances (RDA), Desirable and potentially undesirable food constituents and their importance, Factors affecting bioavailability of nutrients. Common nutritional deficiencies such as PEM, iron, vitamin A, iodine, calcium and vitamin D, zinc etc, Emerging common degenerated disorders.

#### **Module-III: Basic biology related to food**

Living cells, organization of living system, characteristics, Plant and animal diversity, digestion and absorption of biomolecules.

**Module-IV: Role of Biochemistry in Food**

Bioenergetics, Energy transformation in living cells, metabolic pathways, Regulation and Control

**Module-V: Microbiological Aspects of Food**

Characterization, classification and identification of microorganisms, Microscopy, Morphology and Structure, Pure culture and its characteristics, Reproduction Growth and Cultivation, Control of microorganisms, Beneficial uses of microbes in foods, General principles of food hygiene.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Agriculture Survey of India	The Hindu
Nutritive value of Indian Foods	C. Gopalan
Food Chemistry	L. H. Mayer
Quality control for Food Industry	Kramner & Twigg
Food facts and Principles.	Manay N.S. Shadakshasawamy M
Microbiology	M.J. Pelczar
Principle of biochemistry	A.L. Lehninger

**TFT 257 ANALYSIS OF FOOD CONSTITUENTS LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**Course Objectives:** The objectives of this course are to impart:

- Accuracy and Precision of analysis
- Proximate, vitamin and mineral determination of food
- Qualitative testing of food

**Course Outcomes:** On the successful completion of the course the students will be able to:

CO 1	Learn about the biomolecules and estimation of biomolecules	Understand & Analysis
CO 2	Understand the analytical techniques including UV-spectrophotometer, Atomic Absorption Spectrophotometer and determine the pesticides and adulterants in food products	Understand & Analysis

<b>S. No.</b>	<b>Name of Practical</b>	<b>Hr.</b>
1	Introduction to food analysis techniques	04
2	Sampling techniques and method of sample preparation	04
3	Determination of moisture content of foods	04
4	Determination of crude fat content by solvent extraction methods in foods	04
5	Determination of crude protein in foods by Kjeldhal methods	04
6	Determination of crude fibre content in foods	04
7	Determination of total and acid insoluble ash content in foods	04
8	Determination of reducing and total sugar content in foods	04
9	Determination of specific vitamin content of food such as ascorbic acid	04
10	Chromatographic separation and identification of sugars and amino acids	04
11	Determination of specific mineral contents in foods such as Calcium, Iron, Phosphorus, Chloride etc.	04
12	Analysis of foods for pesticides	04
13	Determination of various adulterants in foods	04

**Reference Books and Suggested Readings:**

- Laboratory Manual
- Practical manual on Manual for Analysis of Cereal and Cereal Products, Published by FSSAI-2016  
([https://old.fssai.gov.in/Portals/0/Pdf/Manual\\_Cereal\\_25\\_05\\_2016.pdf](https://old.fssai.gov.in/Portals/0/Pdf/Manual_Cereal_25_05_2016.pdf))

**TFT-252: HEAT TRANSFER OPERATIONS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objective of the course is to impart:

- Basic understanding of the phenomena of heat transfer, to develop methodologies for solving a wide variety of practical application in food processing
- Useful information concerning the performance and design of particular heat transfer systems like heat exchanger and processes used in food processing operations.

**Course outcomes**

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

CO1	Understand the basic of engineering principles of heat transfer and their significance in practical applications	Understanding
CO2	Apply steady state heat conduction with heat generation like heat flow through slab, hollow sphere and cylinder with linear heat transfer, including uniform/non-uniform heat generation	Apply
CO3	Understand unsteady state heat conduction and convection widely used in thermal processing of food materials	Understanding
CO4	Apply mechanism of radiation heat transfer in systems used for advanced food processing operations including solar radiation	Apply
CO5	Understand the concept of heat exchanger and application of different types of heat exchangers used in dairy and food processing industry	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	-	-	-	2	-	-	-	-	-	1	2	2
CO2	2	1	1	1	-	1	1	-	-	-	-	2	3	3
CO3	2	-	-	-	-	-	1	-	-	-	-	2	1	1
CO4	2	1	-	-	-	2	1	-	-	-	-	2	2	2
CO5	2	2	-	-	-	1	1	-	-	-	-	2	1	2
<b>Average</b>	2	1	1	1	1	2	1	1	3	1	1	2	2	2

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

*If there*

*is no correlation, put “-”*

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Knowledge about basic heat transfer modes
- Basics of food properties measurements and errors
- Fundamental of conduction as heat transfer
- heat transfer through materials

#### **Course Outcome 2 (CO2)**

- concept of steady state heat conduction with heat generation
- temperature distribution with different boundary conditions
- Understanding extended surfaces (fins) of uniform area
- Effectiveness and efficiency of the fins used in food processing

#### **Course Outcome 3 (CO3)**

- Fundamentals of unsteady state heat conduction
- Concept of system with negligible internal resistance in various geometries
- Understanding convection heat transfer and film coefficient
- Calculation of Energy losses and Pressure drops in flow systems

#### **Course Outcome 4 (CO4)**

- Energy balance in food operations
- Enthalpy Changes in Foods during Freezing
- Application of Humidity and psychrometric chart in food processing
- Properties of Saturated and Superheated Steam

#### **Course Outcome 5 (CO5)**

- Understanding simultaneous Material and Energy Balances
- Material and energy balance during analysis for multicomponent systems
- Unsteady State Material and Energy Balances

### **Syllabus**

#### **Module-I: Introduction to Heat Transfer**

Basic heat transfer processes, heat transfer coefficients, properties related to heat transfer, food properties measurements and errors; One-dimensional steady state conduction: Theory of heat conduction, Fourier's law and its derivation, Concept of electrical analogy and its application for thermal circuits, heat transfer through composite walls and insulated pipelines

### **Module-II: Steady State Heat Conduction with Heat Generation & Dissipation**

One-dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation, development of equations of temperature distribution with different boundary conditions; Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (fins) of uniform area of cross-section and with Equation of temperature distribution with different boundary conditions; Effectiveness and efficiency of the fins

### **Module-III: Unsteady State Heat Transfer and Convection**

Introduction to unsteady state heat conduction: System with negligible internal resistance and in various geometries; Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer; Newton's Law of cooling, film coefficient, and correlation of dimensionless number, Combined free and forced convection; Dimensionless numbers: Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heisler charts and calculations

### **Module-IV: Heat Transfer by Radiation**

Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors; Radiation: Stefan –Boltzmann law, emissivity, mechanism of radiation heat transfer in systems including solar radiation, collectors. Heat transfer analysis involving conduction, convection and radiation

### **Module-V: Heat Exchanger & Application**

Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Overall heat transfer coefficient, fouling factors, log mean temperature difference heat exchange mechanism in various types of heat exchangers, e.g. Tubular, extended surface and plate heat exchangers, effectiveness – NTU relationship; Application of different types of heat exchangers in dairy and food industry

### **Reference Books and Suggested Readings:**

- Eduardo Cao. 2010. Heat Transfer in Process Engineering. The McGraw-Hill Companies, Inc., New York, USA.
- J.P. Holman. 2010. Heat Transfer, 10th Ed. McGraw-Hill Book Co., Boston, USA.
- Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.
- R. K. Rajput. 2008. Heat and Mass Transfer. S. Chand and Co., New Delhi
- John H. Lienhard IV and John H. Lienhard V. 2008. A Heat Transfer Textbook. Phlogiston Press, Cambridge, MA, USA.

- Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7<sup>th</sup> Ed. McGraw-Hill, Inc., NY, USA.
- Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles, 4th Ed. Prentice-Hall, NY, USA.
- J. M. Coulson, J. F. Richardson, J. R. Backhurst and J. H. Harker. 1999. Coulson & Richardson's Chemical Engineering, Vol. 1, Fluid Flow, Heat Transfer and Mass Transfer, 6th Ed. Butterworth–Heinemann, Oxford, UK.

**TFT 254: CHEMICAL ENGINEERING THERMODYNAMICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:**

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.

**Course outcomes**

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

CO1	Understand the basic of thermodynamics and the terminology associated with engineering thermodynamics.	Understanding
CO2	Understand the knowledge of contemporary issues related to chemical engineering thermodynamics	Understanding
CO3	Understand and apply the knowledge of phase equilibria in two-component and multicomponent systems.	Understanding
CO4	Understand the thermodynamic properties of substances in gas or liquid state of ideal and real mixture	Understanding
CO5	Apply the knowledge of various thermodynamic cycles	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	1	1	-	-	1	1	-	-	-	-	1	3	3
<b>CO2</b>	3	2	1	-	-	1	1	-	-	-	-	2	2	2
<b>CO3</b>	3	1	-	-	-	2	1	-	-	-	-	2	3	3
<b>CO4</b>	2	1	-	-	-	2	1	-	-	-	-	2	3	3
<b>CO5</b>	3	2	1	1	-	1	1	-	-	-	-	2	3	3
<b>CO6</b>	3	3	2	2	1	1	1	1	3	1	1	2	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

## **Syllabus**

### **Module 1**

Basic Concepts & First Law of Thermodynamics: Scope of thermodynamics, System & Surroundings, Properties -Force, Temperature & pressure, Equilibrium, Processes- Reversible & Irreversible, Work, Heat, Energy, Phase rule, Joule's Experiment, Internal energy, Enthalpy, Heat capacities, Application of first law to closed & open systems. Volumetric properties of pure fluids: PVT behavior of pure substances, Virial equation of state and its application, ideal gas and cubic equation of state, Generalized correlations for gases and liquids.

### **Module 2**

Second Law of Thermodynamics: Heat engine and its efficiency, Heat pump, Refrigerator, COP, Second law of Thermodynamics, Kelvin–Planck statement & Clausius Statement, Carnot's cycle and Carnot theorems, Clausius inequality, Entropy balance for open systems, ideal work and lost work, Principle of entropy.

### **Module 3**

Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-vT behaviour of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, ideal gas equation of state and van der Waals equation of state; law of corresponding states, compressibility factor and generalized compressibility chart, T-ds relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibilities, Clapeyron and Clapeyron-Clausius equations.

### **Module 4**

Dalton's and Amagat's laws, properties of ideal gas mixtures, air-water vapor mixtures and simple thermodynamic processes involving them; specific and relative humidities, dew point and wet bulb temperature, adiabatic saturation temperature, psychrometric chart.

### **Module 5**

Carnot vapor cycle, ideal Rankine cycle, Rankine reheat cycle, air-standard Otto cycle, air-standard Diesel cycle, air-standard Brayton cycle, vapor-compression refrigeration cycle.

## **Reference**

1. "Introduction to Chemical Engineering Thermodynamics" by J.M. Smith and H.C. Van Ness,
2. McGraw Hill International Ltd, 2005.
3. "Chemical Engineering Thermodynamics" by Y.V.C. Rao, Universities Press (India) Ltd.

**TFT-256: FOOD MICROBIOLOGY**

L	T	P	C
3	1	3	5

**Course objectives:** The objective of this course is to impart

- Knowledge of the characteristics of important pathogens and spoilage microorganisms in foods and identifying the ways to control them.
- Knowledge about beneficial role of microorganisms in fermented foods and in food processing.
- Knowledge to utilize laboratory techniques to detect, quantify, and identify microorganisms in foods.

**Course Outcome**

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

CO1	Understand the relevant genera and species of microorganisms determining the microbiological quality and safety of food and environmental factors affecting microbiological stability / spoilage	Understanding
CO2	Understand the techniques by which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.	Understanding
CO3	Understand the characteristics of foodborne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification	Understanding
CO4	Understand the microbiology of different types of food commodities	Understanding
CO5	Understand the necessity of microbiological quality control programs in food production.	Understanding
CO6	Understand the effects of fermentation in food production and its influence on the microbiological quality and status of the food product.	Understanding
CO7	Understand problem solving capabilities in practicals working in teams in laboratory-based virtual experiments to gather and evaluate microbial data using a range of current food analysis techniques.	Applying

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	-	-	1	1	-	-	-	-	1	3	3
CO2	3	2	1	-	-	1	1	-	-	-	-	2	2	2
CO3	3	1	-	-	-	2	1	-	-	-	-	2	3	3
CO4	2	1	-	-	-	2	1	-	-	-	-	2	3	3
CO5	3	2	1	1	-	1	1	-	-	-	-	2	3	3
CO6	3	3	2	2	1	1	1	1	3	1	1	2	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>3</b>

**Syllabus**

**Module -I: Microorganisms in Foods & Spoilage**

Introduction to Food Microbiology, Incidence of microorganisms in foods, Microorganisms of importance in foods, Primary sources of contamination in foods, Intrinsic and Extrinsic parameters of foods that affect microbial growth, Food Spoilage, Causes of Food spoilage, Food Preservation.

**Module-II: Preservation of Foods**

Principles underlying preservation of foods, Methods of food preservation, Fitness of foods, Determination of thermal resistance of bacterial spores, Radiation-resistant bacteria, Mechanism of action of antimicrobial agents

**Module – III: Food Poisoning & Infection**

Food poisoning and food-borne infections, Screening, detection and enumeration techniques including rapid detection techniques for Food Micro-organisms including pathogens.

**Module-IV: Spoilage and Preservation of Various Food Products**

Contamination, spoilage and preservation of Fruit and Vegetable products, Milk and Milk products, Cereal products, Sugar products, Meat products, Fish and Sea foods, Egg and Poultry products and other foods, Indicators of Food Safety and Quality, Microbiological Standards of foods.

**Module-V: Food Plant Sanitation & HACCP**

Food Plant Sanitation, inspection and control, Personnel Hygiene, HACCP in Food Industry in controlling microbial hazards, Beneficial microorganisms and their utilization in food fermentation, Introduction to abiotic, biotic and probiotics.

**Module-VI: Laboratory Experiments**

Preservation techniques of cultures in laboratory., Micrometry and determination of size of microorganisms, Simple and differential staining of microorganisms and their examination, Direct total, viable, and non-viable count of microorganisms in milk and other foods, Pure culture isolation techniques, Determination of Standard Plate Count (SPC) in natural and/or processed foods, Microbiological examination of some selected natural and processed foods, Microbiological examination of potable water and milk: Total and coliform count, Enumeration of coliform organism in some selected processed foods, Detection of Salmonella in foods, Determination of Phosphatase test in milk.

### Reference Books and Suggested Readings

Title	Authors
Modern Food Microbiology	James M. J.
Food Microbiology	Frazier W. C. & Westhoff D.C.
Food Microbiology	Adam M. R. & Moss M.O.
Fundamental Food Microbiology	Bibek Ray
Manual of Food Quality Control- Microbiological Analysis	Refai M. K.
Food microbiology	Roberts D. & Greenwood M

Module No.		No. of Lectures
<b>1.</b>	<b>Microorganisms in Foods &amp; Spoilage</b>	<b>8</b>
1.1	Introduction to Food Microbiology, Incidence of microorganisms in foods	02
1.2	Microorganisms of importance in foods, Primary sources of contamination in foods	02
1.3	Intrinsic and Extrinsic parameters of foods that affect microbial growth	02
1.4	Food Spoilage, Causes of Food spoilage, Food Preservation.	02
<b>2.</b>	<b>Preservation of Foods</b>	<b>8</b>
2.1	Principles underlying preservation of foods, Methods of food preservation	02
2.2	Fitness of foods	01
2.3	Determination of thermal resistance of bacterial spores	02
2.4	Radiation-resistant bacteria, Mechanism of action of antimicrobial agents.	03
<b>3.</b>	<b>Food Poisoning &amp; Infection</b>	<b>8</b>
3.1	Food poisoning and food-borne infections	02
3.2	Screening, detection and enumeration techniques for Food Microorganisms including pathogens	03
3.3	Rapid detection techniques for Food Micro-organisms including pathogens	03
<b>4.</b>	<b>Spoilage and Preservation of Various Food Products</b>	<b>8</b>
4.1	Contamination, spoilage and preservation of Fruit and Vegetable	02

	products	
4.2	Milk and Milk products	02
4.3	Cereal products, Sugar products	01
4.4	Meat products, Fish and Sea foods, Egg and Poultry products and other foods	02
4.5	Indicators of Food Safety and Quality and Microbiological Standards of foods.	01
<b>5.</b>	<b>Food Plant Sanitation &amp; HACCP</b>	<b>6</b>
5.1	Food Plant Sanitation, inspection and control, Personnel Hygiene	01
5.2	HACCP in Food Industry in controlling microbial hazards	02
5.3	Beneficial microorganisms and their utilization in food fermentation	02
5.4	Introduction to abiotic, biotic and probiotics	01
<b>Total Hours of Theory</b>		<b>38</b>
<b>6.</b>	<b>Laboratory Experiments</b>	
6.1	Microscopy	03
6.2	Micrometry: determination of size of micro-organisms	03
6.3	Simple staining of microorganisms and their examination	03
6.4	Differential staining of microorganisms and their examination	03
6.5	Preparation of Growth media	03
6.6	Direct total, viable, and non-viable count of microorganisms in milk and other foods	03
6.7	Determination of Standard Plate Count (SPC) in natural and/or processed foods	03
6.8	Microbiological examination of some selected natural and processed foods	03
6.9	Microbiological examination of potable water and milk: Total and coliform count	03
6.10	Enumeration of coliform organism in some selected processed foods	03
6.11	Detection of Salmonella in foods	03
6.12	Determination of Phosphatase test in milk.	03
6.13	Determine the D-value of selected microorganism	03
6.14	Draw the growth curve of selected microorganism	03

**TFT-351: MASS TRANSFER OPERATIONS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objective of the course is to impart:

- Basic understanding of the phenomena of mass transfer, to develop methodologies for solving a wide variety of practical application in food processing
- Useful information concerning the principle and working of particular mass transfer unit operations like drying, evaporation used in food processing operations.

**Course outcomes**

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

CO1	Understand the basic of engineering principles of mass transfer and their significance in practical applications	Understanding
CO2	Understand the concept of mass transfer coefficients and related dimensionless numbers	Understanding
CO3	Understand principles of drying, equilibrium and free moisture widely used in handling and storage of food materials	Understanding
CO4	Apply mechanism of evaporation in food processing operation by using different type of evaporators	Apply
CO5	Apply the concept of absorption and crystallization used in different food processing operations	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	1	1	-	-	-	1	-	-	-	-	-	1	2	2
<b>CO2</b>	2	2	2	1	-	1	1	-	-	-	-	2	3	3
<b>CO3</b>	2	-	-	-	-	-	2	-	-	-	-	1	1	1
<b>CO4</b>	2	1	-	-	-	2	1	-	-	-	-	2	2	2
<b>CO5</b>	2	2	-	-	-	2	2	-	-	-	-	2	1	2
<b>Average</b>	2	2	1	1	1	1	1	1	3	1	1	2	2	2

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

*If there*

*is no correlation, put “-”*

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Knowledge about basic mass transfer operation
- Basics of molecular diffusion in fluids
- Fundamental of diffusion in mass transfer
- Diffusion coefficient measurement and prediction

#### **Course Outcome 2 (CO2)**

- concept of steady state heat conduction with heat generation
- temperature distribution with different boundary conditions
- Understanding extended surfaces (fins) of uniform area
- Effectiveness and efficiency of the fins used in food processing

#### **Course Outcome 3 (CO3)**

- Fundamentals of drying as mass transfer operation
- Concept of drying conditions including constant-rate and falling-rate
- Calculation of drying time under different drying conditions
- Principle and designing of different dryer

#### **Course Outcome 4 (CO4)**

- Fundamentals of evaporation as mass transfer operations
- Application of evaporation in food processing
- Principal and working of different evaporators
- Design of single and multiple effect evaporator

#### **Course Outcome 5 (CO5)**

- Understanding absorption for binary and multi component systems
- Material and energy balance during absorption and crystallization
- Principles of Crystallization and their application
- Types of Crystallizers used in practice

### **Syllabus**

#### **Module-I: Introduction to Mass Transfer**

Introduction to Mass transfer operation, Concentration, Mass & Molar Avg. Velocity, Mass & Molar Flux, N & J flux, Fick's law of diffusion, Steady state molecular diffusion in fluids under stagnant and laminar flow conditions, steady state diffusion: of A through non-diffusing B, equimolar counter diffusion. Effect of Temperature and Pressure on diffusivity; Diffusion coefficient measurement and prediction

### **Module-II: Interphase Mass Transfer & M.T. Coefficients**

Concept of Equilibrium, Diffusion between two phases, Modes of Convective Mass transfer; Introduction to Mass transfer coefficients, Gas Phase & Liquid Phase M.T. coefficients, Local & Overall M.T. coefficients, Dimensionless Numbers in Mass transfer, Simultaneous Heat & Mass Transfer, Steady state co- current & counter-current processes

### **Module-III: Drying**

Importance of drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, constant drying conditions, constant-rate, period, critical moisture content and falling-rate period, porous solids and flow by capillarity, calculation of drying time under constant drying conditions. Classification of dryers, solids handling in dryers, equipment for batch and continuous drying processes: working principle of tray dryers, tower dryers, rotary dryers, spray dryers. Concept of freeze drying

### **Module-IV: Evaporation**

Introduction, single- and multiple- effect operation, long tube vertical evaporators, agitated-film evaporators, evaporator capacity, BPE and Duhring's rule, evaporator economy, enthalpy balances for single effect evaporator. Multiple effect evaporators, methods of feeding, capacity and economy of multiple effect evaporators, multiple effect calculations

### **Module-V: Absorption & Crystallization**

Absorption - Equilibrium solubility of gases, Material balance for transfer of one component. Counter current multistage operations for binary and multi component systems. Continuous contactors, absorption with chemical reaction Concept of HTU and NTU; Industrial Absorbers; Sparged vessels (bubble columns), mechanically agitated vessels for a single phase and gas liquid contact; Principles of Crystallization, Super saturation, Nucleation, Crystal growth, Material & Energy Balance applied to Crystallizers, Types of Crystallizers used in practice.

### **Reference Books and Suggested Readings:**

- Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7<sup>th</sup> Ed. McGraw-Hill, Inc., NY, USA.
- Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles, 4th Ed. Prentice-Hall, NY, USA.
- J, M. Coulson, J. F. Richardson, J. R. Backhurst and J. H. Harker. 1999. Coulson & Richardson's Chemical Engineering, Vol. 1, Fluid Flow, Heat Transfer and Mass Transfer, 6th Ed. Butterworth– Heinemann, Oxford, UK.
- M. Necati Özişik. 2008. Heat Conduction, 2nd Ed. John Wiley & Sons, NY, USA.
- Robert E. Treybal. 2014. Mass Transfer Operations, 3rd Ed. McGraw-Hill Book Company, Auckland, USA.
- Earle RL. 2012. Unit Operations in Food Processing. Pergamon Press.

**TFT-353 CHEMICAL REACTION ENGINEERING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:**

- To apply knowledge from calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems,
- To examine reaction rate data to determine rate laws, and to use them to design chemical reactors,
- To simulate several types of reactors in order to choose the most appropriate reactor for a given need,
- To design chemical reactors with associated cooling/heating equipment.

CO1	Able to develop an understanding of the basic concepts involved in using reaction rate equations and kinetic constant	Understand Apply
CO2	Perform derivations of rate equations for non-elementary reactions both in homogenous and in heterogeneous reacting systems	Apply
CO3	Able to understand the role of temperature and concentration in the rate equation	Understand
CO4	Perform constant volume batch reactor calculations	Apply
CO5	Develop calculations using the integral method and applying differential method of analysis using reactions with different orders	Understand Apply

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	-	-	-	-	-	1	-	1	1	1
CO2	3	3	3	1	-	1	-	-	-	1	-	1	2	2
CO3	3	3	3	2	-	2	-	-	-	1	-	1	2	2
CO4	3	3	1	-	2	1	-	-	-	1	-	1	2	2
CO5	3	3	2	2	2	1	-	-	2	1	-	3	2	2
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.4</b>	<b>1.6</b>	<b>2</b>	<b>1.2</b>			<b>2</b>	<b>1</b>		<b>1.4</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Module- I**

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, temperature dependency from thermodynamics, collision and activated complex theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.

### **Module-II**

Interpretation of variable volume batch reactions for zero, first and second order reactions, Space-time and state-velocity, design equation for ideal batch, steady-state continuous stirred tank, steady-state plug flow reactors for isothermal reaction.

### **Module- III**

Design for single reactions, Size comparison of single reactors, Multiple reactor systems, plug flow/mixed flow reactors in series and parallel, reactors of different types in series, optimum reactor size, recycle reactor, autocatalytic reactions.

### **Module -IV**

Introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size, selectivity, the side entry reactor, irreversible first-order reactions in series, Quantitative treatment: plug flow or batch reactor, Quantitative treatment: mixed flow reactor, Successive irreversible reactions of different orders, reversible reactions, irreversible series-parallel reactions, the Denbigh reactions and their special cases, Heat of reaction from thermodynamics, equilibrium constants from thermodynamics, General graphical design procedure for non-isothermal reactors, Optimum temperature progression, Heat effects: Adiabatic operations and non-adiabatic operations, Exothermic reactions in mixed flow reactors.

### **Module -V**

Residence time distribution of fluids in vessels, State of aggregation of the flowing systems, Earliness of mixing, Role of RTD, State of Aggregation and earliness of mixing in determining reactor behavior, E, F and C curves, Conversion in Non-ideal flow reactors.

### **Reference Books:**

Levenspiel, O. (1998). Chemical reaction engineering book, 3rd edn,

### TFT- 355: FOOD BIOCHEMISTRY

L	T	P	C
3	0	2	4

**Course objectives:** The objective of this course is to impart

- Knowledge of engineering principles applied in post-harvest technology with particular reference to horticulture produce.
- Understanding and ability to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.
- Knowledge of animal tissues and biochemical reactions responsible for quality of the food.
- Knowledge of the principles that underlies the biochemical/enzymatic techniques used in food analysis.

#### Course Outcome

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

CO1	Understand the chemical, biological and nutritional properties of fruits and vegetables.	Understanding
CO2	Understand the basic post-harvest physiology and consequences during handling of fresh produce.	Understanding
CO3	Understand the facilities and techniques of treatment & storage of fruit and vegetables.	Understanding
CO4	Understand the major biochemical reactions that affects the quality of meat and meat products	Understanding
CO5	Understanding the role of enzymes in food processing and profits in the food industry.	Understanding
CO6	Understand problem solving capabilities in practicals working in teams in laboratory-based virtual experiments to gather and evaluate data using a range of current food analysis techniques.	Applying

## Syllabus

### **Module-I: Composition of Fruits and Vegetables**

Structure and composition of fruit and vegetables: Definition, cellular components, chemical composition and nutritional value.

### **Module-II: Post Harvest physiology of fruits and vegetables**

Physiology and biochemistry of fruit and vegetables: Post harvest handling, physiological development; growth, maturation and senescence, fruit ripening, physiology of respiration, effect and role of ethylene, biochemistry of respiration; aerobic and anaerobic metabolism, chemical changes during maturation

### **Module-III: Post harvest Handling and storage of fruits & vegetables**

Control atmosphere storages, effect of temperature, water loss and humidity, methods for modifying carbon dioxide and oxygen concentration, physiological disorders: low temperature disorders, mineral deficiency disorders.

### **Module-IV: Biochemistry of muscle and meat**

Structure and growth of muscle, chemical and biochemical constitution of muscle, ante-mortem and post-mortem factors affecting quality of meat Biochemical reactions leading to changes in composition, color, flavour and texture of meat.

### **Module-V: Enzymes: Functions, importance and role in food industry**

Application of enzymes in food processing: Endogenous enzymes and their role in modification of foods, enzyme added to foods during processing sources, conversions and specific applications.

### **Module-VI: Laboratory Experiments**

Application of polymerization techniques to synthesize polymers at lab scale, Determination of molecular weight of polystyrene and K-value of PVC by Ostwald Viscometer.

## **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Authors</b>
Food Chemistry	Fennema O.R.
Principles of Biochemistry	Lehninger A.L., Nelson D.L. and Cox MM
Post Harvest Biotechnology of Vegetables	Salunkhe D.K. and Desai B. B
Food Preservation by Modified Atmospheres	Calderon M. and Golan R. V.
Enzymes in Food Technology	Whitehurst R. and Law B. A.

**TFT-357: FOOD CHEMISTRY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>4</b>	<b>5</b>

**Course objectives:** The objectives of this course are to impart

- Knowledge on innate properties of food molecules and their interactions with other food constituents
- The knowledge of food additives and their applications in food processing
- Understanding of analytical techniques for identification and quantification of various biomolecules present in the food

**Course outcomes:** On the successful completion of the course the students will be able to

CO1	Understand the chemistry of water and carbohydrate and their interaction with other food components	Understanding
CO2	Understand the basic structure of lipid and reaction involved during processing	Understanding
CO3	Understand the chemistry and properties of food proteins and modification of food proteins during processing	Understanding
CO4	Understand the sources and their deficiency during processing and apply the knowledge to minimize their losses during processing	Applying
CO5	Discuss the functionality of food additives and their application in food industry	Applying
CO6	Determination and analysis of food constituents	Analyzing

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	-	1	-	-	-	-	1	3	3
CO2	3	1	-	-	-	-	-	-	-	-	-	1	3	3
CO3	3	1	-	-	-	-	-	-	-	-	-	1	3	3
CO4	3	2	1	1	-	1	1	-	-	-	-	1	3	3
CO5	3	2	1	-	-	1	1	-	-	-	-	1	3	3
CO6	3	2	1	1	1	1	1	1	2	1	1	1	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

## **Course Level Assessment Questions**

### **Course Outcome 1 (CO1)**

- Concept of water in food and water activity
- Concept of sorption isotherm and molecular mobility and food stability
- Classification and function of carbohydrate
- Reactions and properties of carbohydrate and Modified carbohydrates

### **Course Outcome 2 (CO2)**

- Classification and function of lipids
- Effect of oxidation in lipid
- Processing and modification of oil
- Nutritional and safety aspects of fat

### **Course Outcome 3 (CO3)**

- Classification and function of proteins
- Reactions of protein during processing
- Processing and modification of proteins

### **Course Outcome 4 (CO4)**

- Sources, Functions and Deficiency diseases of vitamins and minerals
- Stability of vitamins during processing
- Bioavailability of minerals
- Pigments and flavors in foods and their retention in processed foods

### **Course Outcome 5 (CO5)**

- Definition and source of food additives used in food industry
- Functions and regulatory aspects of food additives

## **Syllabus**

### **Module-I: Water and Carbohydrate**

Water in Foods: Structure, Properties, Interactions, Water activity and sorption isotherm, molecular mobility and food stability

Carbohydrates: Classification, Functions, Reactions and properties of simple and complex carbohydrate, Selection of Natural or Modified carbohydrates for incorporation into processed food.

### **Module-II: Lipids**

Classification, Consistency of commercial fat, Lipolysis, Auto oxidation, Thermal decomposition and effect of ionizing radiation, Refining of oils, Modification of oils and fats, Role of food lipids in flavor, Nutritional and safety aspects of natural and modified fats.

### **Module-III: Proteins**

Classification, nutritional and functional properties of food proteins, Nutritive value and its determination, Chemical reactions and interactions of amino acids and proteins, De-naturation and its implications, Functional properties of food proteins, Modification of food proteins in processing and storage and its implications.

### **Module-IV: Vitamins, Minerals, Pigments and Flavors**

Vitamins, Minerals, Pigments and Flavors: Sources, Functions, Deficiency diseases, Chemistry and stability of water and fat-soluble vitamins during processing, Chemical properties of minerals and their bioavailability, Enrichment and fortification. Natural pigments in foods and their retention in processed foods, Flavoring constituents in foods, Development of process and reaction flavor volatiles.

### **Module-V: Food Additives**

Definitions, sources, uses and functions and regulatory aspects of food additives

### **Module-VI: Laboratory Experiments**

1. Quality analysis of water
2. Determination of moisture content in food by hot air oven method
3. Non-enzymatic browning reactions and its determinations
4. Determination of rate of hydrolysis of sucrose/starch
5. Determination of free fatty acid content and oxidative rancidity in fats and oils
6. Determination of heat stability of vitamin C
7. Determination of functional properties of proteins
8. Determination and identification of additives added to food
9. Determination and identification of adulterants in some foods
10. Determination of salt content in processed products

### **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Food Chemistry	O.R. Fennema
Food Facts and Principal	N. Shakuntala Manay & M. Shadaksharaswamy
Food Chemistry	L.H. Meyer
Food Chemistry	H.D. Belitz and W. Grosch
Food Additives	S.N. Mahindru
Hand book of analysis and quality control for fruits and vegetable products	S. Ranganna

**TFT 359: TECHNOLOGY OF ANIMAL AND MILK PRODUCTS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objectives of this course are to impart:

- Knowledge about milk industry evolution & physico-chemical characteristics of milk
- Knowledge of commercial milk processing technology
- Knowledge about structure and processing of meat, marine, poultry and eggs

**Course outcomes:** On the successful completion of the course the students will be able to

CO1	Understand scenario of milk industry, compositional variability of milk and standards of milk & milk products	Understanding
CO2	Explain the market milk processing technology & defect in market milk during processing	Understanding
CO3	Explain about the various milk products, packaging and cleaning	Understanding
CO4	Understand the concept of methods involved in meat and marine products processing	Understanding
CO5	Understand the concept of methods involved in poultry and egg processing	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	2	2
CO2	3	1	-	-	-	-	-	-	-	-	-	1	2	2
CO3	3	1	-	-	-	-	-	-	-	-	-	1	2	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1	2	1
CO5	3	1	-	-	-	-	-	-	-	-	-	1	2	1
<b>Average</b>	<b>3</b>	<b>1</b>	-	-	-	-	-	-	-	-	-	<b>1</b>	<b>2</b>	<b>1</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

1. Concept of physico-chemical characteristics of milk
2. History of milk revolution and scenario of milk industry
3. Standards of milk and milk products
4. Production and collection systems of milk

#### **Course Outcome 2 (CO2)**

1. Working principles and parts of processing equipment used in dairy industry i.e chiller, clarifier, homogenizer, pasteurizer, sterilizer and UHT Processing
2. Defects in market milk processing

#### **Course Outcome 3 (CO3)**

- Classification, processing and physico-chemical properties of cream, butter, butter oil and Ice cream
- Concept of manufacturing, packaging and storage of evaporated, condensed, roller and spray dried milk
- Cleaning of dairy equipment

#### **Course Outcome 4 (CO4)**

1. Structure, processing and by-product of meat and marine products

#### **Course Outcome 5 (CO5)**

1. Structure, processing and by-product of poultry and egg

### **Syllabus**

#### **Module -I: Basic Idea of Milk**

Composition of milk and factors affecting it, Physico-chemical characteristics of milk, Production, collection, cooling and transportation of milk, White revolution, Present milk industry scenario and its future.

#### **Module -II: Processing of Market Milk**

Reception, chilling, clarification and storage, Bactofugation: Theory and microbiology, Homogenization: Definition, principles, types and application, Pasteurization: Definition, principles, types and application, sterilization, UHT Processing, Defects in market milk processing.

#### **Module -III: Milk Products, Packaging and Cleaning**

Cream, Butter, Butter oil and Ice cream: Definition, classification, processing and physico-chemical properties. Evaporated and condensed milk: Method of manufacture, Roller and spray drying of milk solids. Packaging, storage and distribution of pasteurized milk: whole, standardized, toned, double toned and skim milk, Cleaning and sanitation of dairy equipments.

**Module -IV: Technology of meat and marine products**

Status of meat and meat products in India and Abroad, Chemical composition and structure of meat, Pre-mortem and post mortem changes influencing the quality of meat, Meat by-product utilization. Commercially important marine products from India, Chemical composition and structure of fish, Transportation system of fish, Pickling and preparation of fish protein concentrate, fish oil and other byproducts.

**Module -V: Technology of Poultry and Egg**

Quality characteristics of poultry products, Poultry meat processing operations and equipment, Poultry meat products, Plant sanitation, Poultry meat by-products, Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage.

**Reference Books and Suggested Readings:**

**Title**

Outlines of Dairy Technology. Oxford University Press

Dairy Technology- Principles of Milk Properties and Processes; Marcel Dekker Inc.

Meat and Meat Products: Technology, Chemistry and Microbiology, Champan & Hill, London, 1995.

Poultry Meat and Egg Production, CBS Publications, New Delhi, 1997.

Fish and Fish Products, Agrobios, Bikaner, 1997.

**Author**

De Sukumar

P. Walstra., T.J. Geuits.,  
A. Noomen, A. Jellema  
and M.A.J.S. Van  
Boekel

H.V. Alan and P.S. Jane

R.O Carmen and J.M.  
George

A.L. Winton and K.B.  
Winton

**TFT 352: INSTRUMENTATION PROCESS CONTROL**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**Course Objectives:** The objectives of this course are to impart:

- To gain the knowledge of different process instruments widely used in food and chemical industries.

**Course Outcomes:** On the successful completion of the course the students will be able to:

CO 1	Understand the principles involved in measurements and attain knowledge on different measurement methods employed in industrial processing and manufacturing.	Understand
CO 2	Application of different pressure measurement devices in food and chemical industries.	Analysis & Create
CO 3	Application of different temperature measurement devices in food and chemical industries.	Understand, Analysis & Create
CO 4	Application of various level and flow measurement devices in food and chemical industries.	Analysis & Create
CO 5	Measurement of viscosity, thermal conductivity, chromatography, moisture analyzers, etc.	Create & Analysis

**CO-PO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	-	-	-	1
CO2	3	1	1	1	-	3	3	3	1	1	-	1
CO3	3	3	2	2	3	-	-	-	1	-	-	2
CO4	3	3	3	2	3	1	1	-	-	-	-	2
CO5	3	3	2	2	3	-	-	-	1	1	3	2
<b>Avg.</b>	3	2	1.6	1.4	3.0	2.0	1.67	3.0	1.0	1.0	3.0	2

## **Syllabus**

### **Module-I**

Characteristics of measurement system, classification, performance characteristics, dynamic calibration, errors, statistical error analysis, reliability and related topics

### **Module-II**

Temperature measurement, definitions and standards, techniques and classification-temperature measurement using change in physical properties, electrical type temperature sensors, radiation thermometry

### **Module-III**

Measurement of pressure: Manometers, Elastic pressure transducers, Measurement of Vacuum.

### **Module-IV**

Flow measurement; head types-area flow meters, mass flow meters, positive displacement type flow meters, electrical type flow meters and solid flow measurement. Level measurement; float types- hydrostatic types, thermal effect types, electrical methods and solid level measurement, density and viscosity measurement

### **Module-V**

Instruments for analysis, spectroscopic analysis by absorption, emission, mass, diffraction and color, gas analysis by thermal conductivity, chromatography, moisture analysis and liquid composition analysis, measurement of pH

## **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Industrial Instrumentation and Control, Prentice Hall of India, 2016.	Singh, S. K.
Industrial Instrumentation, Wiley Eastern Ltd., New York, 1990.	Eckman, D.P.
Principles of industrial instrumentation, Tata McGraw Hill, 2008.	Patranabis
Instrumentation Measurement and Analysis, Tata McGraw Hill, 1978.	Nakra and Chaudhary

**TFT-354: PRINCIPLES OF FOOD PRESERVATION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>

**Course Objectives:** The objective of this course is to impart

- Knowledge of basic principle in food preservation.
- Knowledge in processing methods to control food spoilage and deterioration
- Knowledge of equipment used in food processing to control spoilage.

**Course Outcomes:**

On the successful completion of the course the student will be able to

CO1	Understand fundamental principles of food preservation	Understanding
CO2	Understand the principles of low temperature preservation	Understanding
CO3	Understand the principle of thermal processing and applying high temperature processing in food industry	Applying
CO4	Understand the concept of water activity and preservation by reduction of water removal	Understanding
CO5	Understand the principles of non-thermal preservation methods	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3	1	-	1	-	1	1	-	-	-	-	1	3	3
<b>CO2</b>	3	2	-	1	-	1	1	-	-	-	-	1	3	3
<b>CO3</b>	3	2	-	1	-	1	1	-	-	-	-	1	3	3
<b>CO4</b>	3	2	-	1	-	1	-	-	-	-	-	1	3	3
<b>CO5</b>	3	2	1	-	-	-	-	-	-	-	-	1	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Aims for preservation
- Processing techniques of Indian crops
- Chemistry of food constituents

#### **Course Outcome 2 (CO2)**

- Effect of Refrigeration on food spoilage.
- Freezing process and its consequences on food quality.
- Concept of Modified atmospheric storage and Controlled atmospheric storage.

#### **Course Outcome 3 (CO3)**

- Calculation of thermal processing time : D, Z, F value
- Canning and retort processing
- Effect of thermal processing, aseptic processing on food quality.

#### **Course Outcome 4 (CO4)**

- Principle and Technological aspect of of evaporation
- Principle of drying and dehydration techniques and drying rate calculations.
- Working principle of different types of dryer.

#### **Course Outcome 5 (CO5)**

- Principle and working mechanism of irradiation.
- Mechanism of actions preservatives.
- Concept of hurdle technology

### **Syllabus**

#### **Module-I: Introduction and need of food preservation**

Aims and objectives of preservation of foods, Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods: Microbial, Physical, Chemical & Miscellaneous, wastage of foods. Concept of Water activity, Intermediate moisture Food, osmosis and diffusion

#### **Module – II: Preservation of foods by low temperatures**

Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Applications and procedures, Controlled and Modified atmosphere storage of foods, Post storage handling of foods. Freezing temperatures: Freezing process, slow and fast freezing of foods and its consequence other occurrences associated with freezing of foods. Technological aspects of prefreezing, Actual freezing, Frozen storage and thawing of foods,

**Module –III: Preservation of foods by high temperatures**

Basic concepts. Lethality requirement and assessing the adequacy of a thermal process: D value, Z Value, F value etc., Blanching, Pasteurization: Batch and continuous. Commercial sterilization of foods: Conventional canning process, batch and continuous retorts, aseptic processing.

**Module – IV: Preservation by water removal**

Principles, Technological aspects and application of evaporative concentration process; Freeze concentration and membrane process for food concentrations. Principles, Technological aspects and application of drying and dehydration of foods, Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods

**Module – V: Preservation by Non-thermal methods**

Principles, Technological aspects and application of sugar and salt, Natural food preservation system, Antimicrobial agents (Nitrates, Benzoates, Propionates, Sorbates etc.), mechanism of actions of different preservatives, Biological agents, nonionizing and ionizing radiations in preservation of foods. Hurdle technology.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Food Process Engineering & Technology	Zeki Berk
Food Processing and Preservation	B. Sivasankar
Food Processing Technology : Principles and Practice	P.J Fellows
Food Processing Technology : Principles and Practice	M.Shafeiur Rahman
Fruits and Vegetables processing: Improving quality	Wim Jongen
Introduction of Food processing Engineering	P. G. Smith

**TFT-356: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objectives of this course are to impart:

- Knowledge about the structure and processing of cereals, pulses and oilseeds
- Knowledge about technology of bakery products
- Knowledge on processing of edible oil and its modification

**Course outcomes:** On the successful completion of the course the students will be able to

CO 1	Understand the composition, structure and storage of food grains	Understanding
CO 2	Understand the technology of paddy processing and its products	Understanding
CO 3	Understand the traditional and modern milling operations of wheat and technology of bakery and extruded products	Understanding
CO 4	Understand the processing of coarse cereals and legume-pulses and their value added products	Understanding
CO 5	Understand the processing of oil & oilseeds and utilization of their byproducts	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	1	1	-	1	1	-	-	-	-	1	3	3
CO2	3	1	1	1	-	1	1	-	-	-	-	1	3	3
CO3	3	1	1	1	-	1	1	-	-	-	-	1	3	3
CO4	3	1	1	1	-	1	1	-	-	-	-	1	3	3
CO5	3	1	1	1	-	1	1	-	-	-	-	1	3	3
CO6	3	2	1	2	1	1	1	1	3	1	1	2	3	3
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Production status of cereal grains
- Composition, structure and processing characteristic of cereal grains, legumes and oilseeds
- Post-harvest practices for their safe storage

#### **Course Outcome 2 (CO2)**

- Different methods of parboiling and milling of paddy
- Processing of rice
- Different types of processed rice products

#### **Course Outcome 3 (CO3)**

- Grading and quality characteristics of flour and semolina
- Baked products
- Breakfast cereals

#### **Course Outcome 4 (CO4)**

- Milling of corn
- Barley processing
- Processing of legume-pulses

#### **Course Outcome 5 (CO5)**

- Processing of oil seeds and oil
- Processing of de-oiled cake
- Different protein and oil based food products.

### **Syllabus**

#### **Module-I: Composition and Structure**

Production trends, Composition, structure and processing characteristic of cereal grains, Legumes and oilseeds, Post-harvest, Post processing practices for their safe storage.

#### **Module-II: Paddy Processing and Products**

Parboiling and milling of paddy, curing and aging of rice, processed rice products.

#### **Module-III: Wheat Processing and Products**

Wheat and its quality characteristics for milling into flour and semolina, Flour milling, Turbo grinding and air classification, Flour grades and their suitability for baking purposes, Assessment of flour quality and characteristics, Milling of Durum wheat, Ingredients, Technology and

quality parameters for baked products: Bread, biscuits and cakes; Breakfast cereals, Macaroni products.

**Module-IV: Processing of Coarse Cereals and Legumes-Pulses**

Dry and Wet milling of corn, Starches and its conversion products, Malting of barley, Pearling of millets, Milling of legume-pulses by traditional and improved processes.

**Module-V: Processing of Oil seeds**

Processing of oil seeds for direct use and consumption, Oil and protein products, Refining, Hydrogenation and Interesterification of oil, Processing of de-oiled cake into protein concentrates and isolates, Textured protein, Functional protein preparations, Peanut butter, Margarine and Spread.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Mysore Manuals on Rice and its Processing	C.F.T.R.I.
Food Science	N.N. Potter
Cereal Technology	S.A. Matz
Bakery Technology	S.A. Matz
Cereals and Cereal Processing: Chemistry and Technology	DAV Dendy and B.J. Dobraczyk
Cereal Technology	Kent

**TFT-358: FRUITS, VEGETABLES AND PLANTATION PRODUCTS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objective of this course is to impart

- Skill and knowledge required to apply the principles and concepts behind fruit, vegetable, spices and plantation products processing.
- Knowledge on post-harvest handling, specific processing technologies, preparing, quality analysis and stabilizing shelf life of fruit, vegetable, spices and plantation based products

**Course Outcomes:**

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

CO1	Discuss the factors affecting the shelf life of fruits and vegetables	Analyzing
CO2	Understand the physiological changes in fruits after harvesting	Understanding
CO3	Understand the role and importance of preservation techniques to improve the shelf life of seasonal fruits	Understanding
CO4	Understand the processing of fruits, vegetables, spices and plantation products	Understanding
CO5	Understand the technology behind canning of fruits and vegetable products	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3	2	1	2	-	2	1	-	-	-	-	1	3	3
<b>CO2</b>	3	1	-	1	-	1	1	-	-	-	-	1	3	3
<b>CO3</b>	3	1	1	1	-	2	2	-	-	-	-	1	3	3
<b>CO4</b>	3	1	1	1	-	1	1	-	-	-	-	1	3	3
<b>CO5</b>	3	1	1	1	-	1	1	-	-	-	-	1	3	3
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>-</b>	<b>1</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Review on status of production and processing of fruits and vegetables
- Factors affecting the shelf
- Chemical composition of fruits and vegetables
- Physicochemical treatments to improve shelf life of fruits and vegetables

#### **Course Outcome 2 (CO2)**

- Physiological changes after harvesting
- Maturity indices
- Flavour synthesis during ripening

#### **Course Outcome 3 (CO3)**

- Chilling and freezing of fruits and vegetables
- Drying and dehydration of fruits and vegetables

#### **Course Outcome 4 (CO4)**

- Processing of fruits and vegetables
- Processing of major and minor spices
- Processing of Plantation products
- Processing of Cocoa and Cocoa products

#### **Course Outcome 5 (CO5)**

- Canning of fruits and vegetables
- Factors affecting canning of fruits and vegetables

### **Syllabus**

#### **Module – I: Post Harvest Handling of Fruits & Vegetables**

Current status of production and processing of fruits and vegetables, Chemical composition, pre- and post-harvest changes, harvesting and maturity standards for storage and desirable, characteristics of fruits and vegetable for processing. Role of plants growth regulators in relation to storage, Physical and chemical treatment to increase the shelf-life, Conditions for transportation and storage, Disease and injuries during marketing, Biosynthesis of flavours, Flavour characteristics.

### **Module – II: Preservation of Fruits & Vegetables**

Low temperature preservation, Types of cold preservation, freezers and freeze concentrates, Thermal processing: Canning and bottling, spoilage of canned foods, detection and control, Drying and dehydration of fruits and vegetables.

### **Module – III: Processing Technology of Fruit & vegetable based Products**

Juices, pulps, Concentrates, powders, Squashes, cordials and other beverages. Jams, Jellies, Marmalades, Preserves, candies and crystallized fruits. Tomato processing: Puree, Paste, Ketchup, Sauce and soup. Chutneys, pickles and other products.

### **Module – IV: Processing Technology of Spices & Plantation products.**

Spices: Composition, Structure and characteristics. Preservation and processing of major and minor spices of India; whole spice, Spice powder, Paste and extracts, Spice oils and oleoresins. Composition, Production and processing of Tea leaves: Black tea, Green tea and Oolong tea, Instant tea. Production and processing of coffee cherries: wet and dry methods, grinding, storage and preparation of brew, Soluble/Instant coffee, Use of chicory in coffee, decaffeinated coffee. Composition, structure and characteristics of Cashew-nut and other dry fruits.

### **Module – V: Processing of Cocoa & Cocoa Products**

Production, processing and chemical composition of cocoa beans: Cleaning, roasting, alkalization, cracking and fanning, Nib grinding for cocoa liquor, cocoa butter and cocoa powder. Manufacturing process for chocolate: Ingredients, Mixing, Refining, Conching, Tempering, Moulding etc. to obtain chocolate slabs, chocolate bars. Enrobed and other confectionary products.

### **Reference Books and Suggested Readings**

<b>Title</b>	<b>Author</b>
Advances in Postharvest Fruit and Vegetable Technology	Ron B.H. Wills., John Golding
Preservation of fruits and vegetables	Girdharilal, Siddappaa, G.S.
Handbook of analysis and quality control for fruits and vegetable products	Ranganna S
Foods: Facts and Principles, New Age Publishers.	Manay, S. & Shadaksharaswami

**TFT 360: FERMENTED FOODS & BEVERAGE TECHNOLOGY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objectives of this course are to impart:

- Knowledge about existing traditional fermented foods
- Knowledge on principles and procedures involved in the fermented food production
- Characterize production methods of both alcoholic and non-alcoholic beverages, basic concepts of their quality parameters.

**Course outcomes:** On the successful completion of the course the students will be able to

CO1	Understand the importance and production of common Indian traditional foods	Understanding
CO2	Understand the concept of microbial culture selection for particular fermented product	Understanding
CO3	Understand the processing of fermented milk, meat and fish products and analyze their qualities	Analyzing
CO4	Understand about different categories of beverages and the techniques involved in the production of different beverages.	Understanding
CO5	Apply the knowledge of carbonated and non carbonated beverage to develop new products	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	1	1	-	-	-	-	1	2	2
CO2	3	1	-	-	-	-	1	-	-	-	-	1	2	2
CO3	3	1	1	1	-	-	1	-	-	-	-	1	3	3
CO4	3	1	-	-	-	1	1	-	-	-	-	1	2	2
CO5	3	1	1	1	-	1	1	-	-	-	-	1	3	3
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

5. Knowledge of Indian traditional foods and their basic chemistry
6. Preparation methods and health benefits of papads, idli, dosa and dhokla

#### **Course Outcome 2 (CO2)**

3. Basic concept of preparation and maintenance of microbial culture for fermentation
4. Concept of Lactic acid bacteria and their health-promoting effects
5. Mushrooms Processing

#### **Course Outcome 3 (CO3)**

- Basic idea of fermentation and different types of microorganisms involved in food fermentations
- Preparation, spoilages, defects and their control of dairy products
- Processing of fermented meat and fish products

#### **Course Outcome 4 (CO4)**

2. Technological concept of beer and wine production
3. Technological concept of cider and vinegar production
4. Fermented vegetables

#### **Course Outcome 5 (CO5)**

2. Technological concept of baker's yeast, microbial proteins, fats and enzymes production
3. Concept of oriental fermented foods

### **Syllabus**

#### **Module-I: Traditional Fermented Foods and Preparation, Maintenance of Microbial Culture**

Indian traditional fermented food products: idli, dosa, dhokla, sauerkraut, kimchi, Kumis and pickles; Preparation and Maintenance of bacterial, yeast and mold cultures for food fermentations.

#### **Module-II: Fermented Dairy, Meat and Fish Products**

Fermentation-Definition and types, Microorganisms used in food fermentations, Lactic acid bacteria-activities and health-promoting effects; Dairy Products: Cheeses, curd & yoghurt, Butter milk; Fermented meat and fish products, Spoilages, defects and their control.

#### **Module-III: Fermented Cereals, Fruits and Vegetables Products**

Baker's yeast; Production of beer, wines, cider and vinegar, Fermented vegetables, Mushrooms: Cultivation and preservation.

**Module-IV: Introduction of beverage technology**

Types of beverages and their importance; Status of beverage industry in India; Manufacturing technology for juice-based beverages; Synthetic beverages.

**Module-V: Carbonated and Non Carbonated Beverages**

Technology of still, Carbonated, Low-calorie, Dry beverages, Isotonic and Sports drinks, Role of various ingredients of soft drinks, Carbonation of soft drinks.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Handbook of Indigenous Fermented Foods	K.H. Steinkrus
Outlines of Dairy Technology	De Sukumar
Industrial Microbiology	Prescott & Dunn
Industrial Microbiology	L.E. Casida
Food Microbiology	W.C. Frazier and D.C. Westhoff
Handbook of Brewing”, 1st edition, Marcel Dekker, 1995.	W. A. Hardwic
Handbook of Food and Beverage Fermentation Technology, 2nd edition, Marcel Dekker, 2004.	Y. H. Hui

**Course contents and Lecture schedule**

<b>Module No.</b>	<b>Course contents and Lecture schedule</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Indian Traditional Foods</b>	<b>7</b>
1.1	Indian traditional sweet, savory and snack food products: idli, dosa and dhokla	04
1.2	Sweetmeats, namkins, potato products and papads	03
<b>2.</b>	<b>Preparation and Maintenance of Microbial Culture</b>	<b>8</b>
2.1	Preparation and Maintenance of bacterial, yeast and mold cultures for food fermentations	04
2.2	Lactic acid bacteria-activities and health-promoting effects	02
2.3	Mushrooms: Cultivation and preservation	02
<b>3.</b>	<b>Fermented Dairy, Meat and Fish Products</b>	<b>8</b>
3.1	Fermentation-Definition and types, Microorganisms used in food	01

	fermentations	
3.2	Dairy Products: Cheeses, curd & yoghurt, Butter milk and the fermented milks, Spoilages, defects and their control	03
3.3	Fermented meat	02
3.4	Fermented fish products	02
<b>4.</b>	<b>Fermented Cereals, Fruits and Vegetables Products</b>	<b>8</b>
4.1	Production of beer and wines	04
4.2	Production of cider and vinegar	01
4.3	Fermented vegetables	03
<b>5.</b>	<b>Industrial microbial products</b>	<b>7</b>
5.1	Production of Baker's yeast, Microbial proteins, fats and enzymes	04
5.2	Oriental fermented foods	03
<b>Total Hours</b>		<b>38</b>

**TFT 362: FOOD PROCESSING LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>6</b>	<b>3</b>

**Course Objectives:** The objectives of this course are to impart:

- Accuracy and Precision of analysis
- Processing and preservation of non-alcoholic beverage, fruits & vegetables and milk products
- Processing of cereal, pulses and bakery products

**Course Outcomes:** On the successful completion of the course the students will be able to:

CO 1	Learn about the processing and preservation of perishable and semi perishable food products	Understand & Analysis
CO 2	Learn about the estimation of physical and functional properties of food products	Understand & Analysis

S. No.	Name of Practical	Hr.
1	Processing and preservation of Non-alcoholic fruit beverages: RTS, Cordial and Squash	6
2	Processing and Preservation of Jam, Jelly and Marmalade	6
3	Processing and Preservation of Sauce	6
4	Processing and Preservation of Peas by Canning Method	6
5	Processing of Dehydrated Onion Powder	6
6	Processing of Chocolate	6
7	Estimation of Total Phenolic Content in Tea	6
8	Evaluation of Quality of Rice and Wheat Flours	6
9	Determination of Average Size of Pulses Flour by Sieve Analysis	6
10	Determination of Cleaning Efficiency of a Grading Screen	6
11	Preparation of Bread, Biscuit and Cake	6
12	Preparation of Soy Milk and Tofu (Soy Paneer)	6

**Reference Books and Suggested Readings:**

- Laboratory Manual
- Practical manual for Analysis of Cereal And Cereal Products, published by FSSAI-2016 ([https://old.fssai.gov.in/Portals/0/Pdf/Manual\\_Cereal\\_25\\_05\\_2016.pdf](https://old.fssai.gov.in/Portals/0/Pdf/Manual_Cereal_25_05_2016.pdf))
- Practical manual on Jam, Jelly and Marmalade (<http://courseware.cutm.ac.in/wp-content/uploads/2020/06/Study-Material-Lecture-04-FSSAI-specification-for-Jam-Jelly-Marmalade-and-glazed-crystallised-fruits.pdf>)

**TFT-451: FOOD SAFETY AND QUALITY CONTROL**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**Course Objectives:** The objectives of this course is to enable the students

- Fundamental knowledge of quality control and total quality management system in food industry.
- Knowledge about food hygiene and importance of safe food
- Knowledge of Food safety management system

**Course Outcome**

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

CO1	Understand concepts of Food quality and role of total quality management system in food industry	Understanding
CO2	Assessments of quality of food products using various techniques	Applying
CO3	Understand the safety aspects of various foods	Understanding
CO4	Understand the national & international food laws and regulations for quality of foods	Analyzing
CO5	Understand the standards of international regulatory bodies	Applying
CO6	Understand the concept and application of knowledge about food safety management system in food industry	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	-	1	-	-	-	-	1	2	2
CO2	3	2	1	1	-	-	1	-	-	-	-	1	3	3
CO3	3	-	-	-	-	2	2	-	-	-	-	1	2	2
CO4	3	1	-	-	-	1	2	-	-	-	-	1	3	2
CO5	3	1	1	-	-		-	-	-	-	-	1	2	2
CO6	3	2	2	1	2	-	-	1	2	-	-	2	3	3
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>3</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Aspects of Food Quality control and Quality Assurance
- Sensory evaluation of foods & textural characteristics
- Engineering properties of foods and their measurements

#### **Course Outcome 2 (CO2)**

- Significance of food safety
- Potential hazards and contaminations in food industry
- Food additives and their functions

#### **Course Outcome 3 (CO3)**

- Food standards and Specifications
- National and International food regulations
- Food Safety and Standards Act (2006)

#### **Course Outcome 4 (CO4)**

- Global standards for contaminants and toxins in foods
- Codex Alimentarius and different food safety practices

#### **Course Outcome 5 (CO5)**

- Food Safety Management System and its significance
- Implementation of food safety management system in food industries
- ISO 22000 role and implementation

#### **Course Outcome 6 (CO6)**

- Testing and evaluation of various parameters of food quality
- Assessment of quality of foods from different food category
- Different techniques to perform sensory evaluation study of foods

### **Syllabus:**

#### **Module-I: Food Quality and Quality Evaluation**

Ways of describing of Food Quality, Quality control and Quality Assurance functions, Total Quality Control (TQC) and the role of management/TQM, Statistical quality control, Quality costs. Sensory evaluation of foods, Instrumental measurements of sensory attribute of foods: Engineering properties. Textural characteristics, Texture profile analysis, Correlation between instrumental and Sensory analysis of food quality attributes

### **Module-II: Food Safety**

Operational sense of food safety, Potential Food derived health hazard- Microbial contamination, Nutritional Imbalance, Pesticide residues, Environmental Contamination, Naturally occurring compounds and permitted food additives, Consumer awareness about food safety, safety of various food categories: Fruits and vegetables, milk and milk products, meat Fish, Sea foods, Egg and poultry products.

### **Module-III: Food Standards and Regulations**

Food standards and Specifications: Compulsory and voluntary trade and Company standards. Consumer, company, In-process and finished product specifications, AgMark, and BIS Standards, Food regulations: Food Safety and Standards Act (2006) and subsequent regulation 2012 onwards

### **Module-IV: Global Scenario of Food Safety Management**

Introduction to Codex Alimentarius and FSIS, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Agricultural Practices (GAP), ISO series, HACCP systems: Global standards for contaminants and toxins in foods.

### **Module-V: Food Safety Management System**

Introduction, prerequisite program of food safety management system, understanding and implementation of food safety management system in food industries, understanding and implementation of ISO 22000.

### **Module-VI: Laboratory Experiments**

Sensitivity tests (Threshold/Dilution) to measure individual ability for sensory analysis, Difference tests to evaluate qualitative and quantitative differences and/or preference between test products, Assessment of quality of wheat flour (Water Absorption Power, Gluten Content, Sedimentation Value etc.), Evaluation of quality of Bakery Products: Bread, Biscuits, Cakes etc. Quality evaluation of Dairy Products (Over run, fat content, Specific gravity), Quality assessment of Jam, Jelly, Marmalades, Squashes& Cordials and Food beverages.

### **Reference Books and Suggested Readings**

<b>Title</b>	<b>Author</b>
Food Quality Assurance: Principles and Practices	Inteaz Alli
Rheology and Texture in Food Quality	J.M.DeMan
Food Analysis: Theory and practice	Y.Pomeranz
Principles of Sensory Analysis of Food	M.A. Amerine

**Course contents and Lecture schedule**

<b>Module No.</b>	<b>Topic of Content</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Food Quality and Quality Evaluation</b>	<b>10</b>
1.1	Ways of describing of Food Quality	01
1.2	Quality control and Quality Assurance functions	01
1.3	Total Quality Control (TQC) and the role of management/TQM, Statistical quality control, Quality costs	02
1.4	Sensory evaluation of foods, Instrumental measurements of sensory attribute of foods	02
1.5	Engineering properties of Foods	01
1.6	Textural characteristics and Texture profile analysis	01
1.7	Correlation between instrumental and Sensory analysis of food quality attributes	02
<b>2.</b>	<b>Food Safety</b>	<b>08</b>
2.1	Operational sense of food safety	01
2.2	Potential Food derived health hazard- Microbial contamination	01
2.3	Nutritional Imbalance, Pesticide residues, Environmental Contamination	02
2.4	Naturally occurring compounds and permitted food additives	01
2.5	Consumer awareness about food safety	01
2.6	Safety of various food categories: Fruits and vegetables, milk and milk products, meat Fish, Sea foods, Egg and poultry products	02
<b>3.</b>	<b>Food Standards and Regulations</b>	<b>06</b>
3.1	Food standards and Specifications	01
3.2	Compulsory and voluntary trade and Company standards	01
3.3	Consumer, company, In-process and finished product specifications	01
3.4	AgMark, and BIS Standards	01
3.5	Food regulations: Food Safety and Standards Act (2006) and subsequent regulation 2012 onwards	02
<b>4.</b>	<b>Global Scenario of Food Safety Management</b>	<b>06</b>
4.1	Introduction to Codex Alimentarius and FSIS,	01
4.2	Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Agricultural Practices (GAP),	02
4.3	ISO series, HACCP systems	01
4.4	Global standards for contaminants and toxins in foods	02
<b>5.</b>	<b>Food Safety Management System</b>	<b>06</b>

5.1	Introduction to food safety management system	01
5.2	Prerequisite program of food safety management system	01
5.3	Understanding and implementation of food safety management system in food industries	02
5.4	Understanding and implementation of ISO 22000	02
<b>Total Hours</b>		<b>36</b>
<b>6</b>	<b>Laboratory Experiments</b>	
6.1	Sensitivity tests (Threshold/Dilution) to measure individual ability for sensory analysis	06
6.2	Difference tests to evaluate qualitative and quantitative differences and/or preference between test products	06
6.3	Assessment of quality of wheat flour (Water Absorption Power, Gluten Content, Sedimentation Value etc.)	06
6.4	Assessment of quality of vegetable oils	06
6.5	Evaluation of quality of Bread	06
6.6	Evaluation of quality of Biscuits	06
6.7	Evaluation of quality of Cakes	06
6.8	Quality evaluation of Milk (fat content, Specific gravity, pH, acidity etc.)	06
6.9	Quality evaluation of Cheese (fat content, Specific gravity, pH, acidity etc.)	06
6.10	Quality evaluation of Ice cream (Overrun, fat content, Specific gravity etc.)	06
6.11	Quality assessment of Jam, Jelly, Marmalades, Squashes & Cordials etc.	06
6.12	Quality assessment of different food beverages	06
<b>Total Hours</b>		<b>72</b>

**TFT 453: FOOD PACKAGING AND STORAGE ENGINEERING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- Knowledge of packaging, package developments and packaging laws and regulations in food industries
- Knowledge of different types of packaging materials and their forms used in food packaging
- Knowledge about package performance and various testing of packaging materials
- Knowledge about storage of food and food products

**Course Outcome**

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

CO1	Understand basic concept of packaging, printing and packaging laws & regulations in food industries	Understanding
CO2	Understand different types of packaging material and their properties and apply the knowledge in packaging various food commodities	Applying
CO3	Understand the selection of packages for specific food & agricultural commodities and advancement in food packaging	Understanding
CO4	Analyze the performance and quality of packaging materials	Analyzing
CO5	Understand the designing of storage structures for food commodities	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	2	-	-	-	-	2	2	2
CO2	3	1	1	-	-	-	1	-	-	-	-	1	2	2
CO3	3	-	-	-	-	-	1	-	-	-	-	1	2	2
CO4	3	2	-	-	-	-	1	-	-	-	-	1	2	2
CO5	3	1	1	-	-	-	1	-	-	-	-	1	2	2
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-."

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Challenges & opportunities in Food packaging industry
- Printing and packaging laws & regulations
- Significance of packaging in Food industry

#### **Course Outcome 2 (CO2)**

- Packaging Materials
- Types of packaging materials in food industry
- Selection criteria for packaging of food products

#### **Course Outcome 3 (CO3)**

- Packages for specific food & agricultural commodities
- Advancement in food packaging

#### **Course Outcome 4 (CO4)**

- Testing of packaging materials
- Shelf life analysis of packaged foods

#### **Course Outcome 5 (CO5)**

- Spoilage of grains, fruits & vegetables and their prevention
- Design parameter for different storage bins
- Designing of cold storage and other types of storage structures

### **Syllabus:**

#### **MODULE-I: Introduction of Packaging**

Concept of packaging, Important functions of package, Packaging laws and regulations: Printing techniques; Package labeling: functions and regulations; Environmental aspect of food packaging

#### **MODULE-II: Packaging Materials and Forms**

Glass containers and closures, Metal containers: tin-plate containers, tin free steel containers, aluminum and other metal containers. Protective lacquers and coatings for metal containers. Wooden crates, plywoods, cellulosic papers, pouches, bags and card board / corrugated paper boxes. Rigid and flexible plastics containers and films and their mechanical sealing and barrier properties.

#### **MODULE-III: Advances in Food Packaging**

Selection of Packaging materials, forms and machinery for various food commodities: Fruits and vegetable and their products, Milk and milk products, Meat, fish, egg etc., cereals, pulses and oil

seeds products, confectionery etc. Evaluation of quality, safety and interaction with foods of various types of packaging materials. Gas, vacuum, CAP, MAP and aseptic packaging, Tetra packing, Smart packaging, Intelligent Packaging, Active Packaging and Antimicrobial packaging, Retortable pouches, biodegradable and edibles packaging materials and films.

**MODULE-IV: Testing of Packaging Material**

Destructive & Nondestructive test of rigid, semi rigid and flexible packaging material: tensile strength, compression, bursting, tear and impact test for packages, integrity testing. Cushioning effect on packaged foods, deterioration of packaged foods, shelf life study for packaged foods. Corrosion and toxicity of packaging material.

**MODULE-V: Storage of Foods**

Design parameter for different storage bins for different grains, Milk silo, Design parameter, selection of parameter for designing cold storage for foods different storage. Spoilage of fruits & vegetables during transportation & storage and its prevention. Factors affecting quality of grain during storage. Causes and prevention of spoilage of grain during storage.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author(s)</b>
Food Packaging: Principles and Practice	Robertson G.L.
Food Packaging Materials	Mahadeviah M. and Gowramma R.V.
Principles of Food Packaging	Saclarow S. and Griffin R.C.,
Food and Package Engineering	Scott A. Morris
Food Packaging and Preservation	Alexandru Grumezescu Alina Maria Holban

**Course contents and Lecture schedule**

<b>Module No.</b>	<b>Topic of Content</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Introduction of Packaging</b>	<b>06</b>
1.1	Concept of packaging, Important functions of package	01
1.2	Packaging laws and regulations: Printing techniques	02
1.3	Package labeling functions and regulations	02
1.4	Environmental aspect of food packaging	01
<b>2.</b>	<b>Packaging Materials and Forms</b>	<b>08</b>
2.1	Glass containers and closures	02
2.2	Metal Containers: tin-plate containers, tin free steel containers, aluminum and other metal containers	02
2.3	Protective lacquers and coatings for metal containers	01
2.4	Wooden crates, plywood, cellulosic papers, pouches, bags and	01

	card board/corrugated paper boxes	
2.5	Rigid and flexible plastics containers and films and their mechanical sealing and barrier properties	02
<b>3.</b>	<b>Advances in Food Packaging</b>	<b>08</b>
3.1	Selection of Packaging materials, forms and machinery for various food commodities: Fruits and vegetable and their products, Milk and milk products, Meat, fish, egg etc., cereals, pulses and oil seeds products, confectionery etc.	02
3.2	Evaluation of quality, safety and interaction with foods of various types of packaging materials	01
3.3	Gas, vacuum, CAP, MAP and aseptic packaging, Tetra packing	02
3.4	Smart packaging, Intelligent Packaging, Active Packaging and Antimicrobial packaging	02
3.5	Retortable pouches, biodegradable and edibles packaging materials and films	01
<b>4.</b>	<b>Testing of Packaging Material</b>	<b>08</b>
4.1	Destructive & Non-destructive test of rigid, semi rigid and flexible packaging material	01
4.2	Tensile strength, compression, bursting, tear and impact test for packages, integrity testing	02
4.3	Cushioning effect on packaged foods, deterioration of packaged foods	02
4.4	Shelf life study for packaged foods	02
4.5	Corrosion and toxicity of packaging material	01
<b>5.</b>	<b>Storage of Foods</b>	<b>08</b>
5.1	Design parameter for different storage bins for different grains, Milk silo	02
5.2	Design parameter, selection of parameter for designing cold storage for foods different storage	02
5.3	Spoilage of fruits & vegetables during transportation & storage and its prevention	01
5.4	Factors affecting quality of grain during storage	02
5.5	Causes and prevention of spoilage of grain during storage	01
<b>Total Hours</b>		<b>38</b>

**TFT-455: PRINCIPLES OF FOOD ANALYSIS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objective:** The objective of the course is to impart

- Knowledge to students on principles and techniques of food analysis by using physical, chemical, biological and instrumental methods
- To apply their knowledge and skills acquired to solve real-world problems associated with food analysis.

**Course Outcomes:**

On the successful completion of the course the student will be able to

CO1	Understand the regulations and standards of food analysis and concept of sampling	Understanding
CO2	Understand and apply the methods for compositional analysis of food	Applying
CO3	Explain the methods for chemical properties and characterization of food	Understanding
CO4	Understand the working principle of instrument used in food analysis: Spectroscopy and chromatography	Understanding
CO5	Understand color analysis and the rheological methods in food analysis	Understanding
CO6	Selection and apply the appropriate method and instrument to perform particular analysis	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	1	-	-	-	-	1	-	-	-	-	1	1	2
<b>CO2</b>	3	2	-	-	-	-	-	-	-	-	-	1	2	1
<b>CO3</b>	3	2	-	-								1	2	1
<b>CO4</b>	3	2	-	-	-	-	-					1		
<b>CO5</b>	3	2	1	-	-	-	-	-				1	2	2
<b>CO6</b>														
<b>Total</b>														

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions3**

#### **Course Outcome 1 (CO1)**

- United States Government Regulations and International Standards Related to Food analysis
- Nutritional Labelling
- Sampling methods and sample preparation.

#### **Course Outcome 2 (CO2)**

- Different methods of moisture content, fat content, protein content and ash content in food.
- Analysis of micronutrients.
- Traditional methods for mineral analysis.

#### **Course Outcome 3 (CO3)**

- Analysis of chemical properties of food.
- Characterization of food.
- Application of enzyme in food analysis.

#### **Course Outcome 4 (CO4)**

- Principle of spectroscopy and its application in food analysis.
- Basic principle of chromatography and its application in food analysis.
- Limitations Basic of spectroscopy and chromatography in food analysis.

#### **Course Outcome 5 (CO5)**

- Rheological principles of food analysis.
- Thermal analysis of food: DSC, TGA, modulated DSS etc.
- Color analysis

### **Syllabus**

#### **MODULE-I: General information**

Introduction to Food Analysis, United States Government Regulations and International Standards Related to Food Analysis , Nutrition Labeling, Evaluation of Analytical Data, Sampling and Sample Preparation.

#### **MODULE-II: Compositional Analysis of Foods**

Determination of moisture in foods by different methods, ash content of foods, wet, dry ashing, microwave ashing methods, significance of sulphated ash, water soluble ash and acid insoluble ash in food , Determination of total fat in foods by different methods Moisture and Total Solids Analysis, Ash Analysis, Protein Analysis, Carbohydrate Analysis, Vitamin Analysis, Traditional Methods for Mineral Analysis.

**MODULE-III: Chemical Properties and Characteristics of Foods**

pH and titrable acidity, fat characterization , protein separation and characterization procedures, application of enzymes in food analysis, immunoassays, analysis of food contaminants, residues and chemical constituents of concern, analysis for extraneous matter, determination of oxygen demand

**MODULE-IV: Spectroscopy & Chromatography**

Basic principles of spectroscopy, ultraviolet, visible and fluorescence spectroscopy, infrared spectroscopy, atomic absorption and emission spectroscopy, mass spectrometry, nuclear magnetic resonance and electron spin resonance, Basic principles of chromatography, chromatographic techniques: paper, thin-layer and column chromatography. High performance liquid chromatography (HPLC) and gas chromatography (GC).

**MODULE-V: Physical Properties of Foods**

Rheological principle for food analysis, thermal analysis: Differential Scanning Calorimetry Modulated DSC, color analysis.

**References:**

<b>Title</b>	<b>Author</b>
Food Analysis, 3rd Edition	Nielson, S. Suzanne
Food Analysis : Theory and Practice 3rd Edition	Pomeranz, Yeshajahu and Clifton E. Meloan
Chemical Analysis of Food and Food Products	Jacobs, Morris B
Handbook of Food Analysis, 2nd edition	Nollet, Leo M.L.
Food Analysis by HPLC. 2nd Edition	Nollet, Leo M.L
Methods of Analysis for Functional Foods and Nutraceuticals	Hurst, Jeffrey W

**Course contents and Lecture schedule**

<b>Module No.</b>		<b>No. of Lectures</b>
<b>1.</b>	<b>General information</b>	
1.1	Introduction to Food Analysis	01
1.2	United States Government Regulations and International Standards Related to Food Analysis	01
1.2	Nutrition Labeling	01
1.3	Sampling and Sample Preparation	01
<b>2.</b>	<b>Compositional Analysis of Foods</b>	
2.1	Overview of low temperature processing: refrigeration, chilling and freezing. Effect of low temperature (refrigeration) on food spoilage	01
2.2	Applications and procedures, Controlled and Modified atmosphere	02

	storage of foods, Post storage handling of foods	
2.3	Freezing curve of water and real solution, colligative properties in freezing	01
2.4	Slow and fast freezing of foods and its consequence other occurrences associated with freezing of foods.	01
2.5	Calculation of freezing rate and freezing time.	01
2.6	Principles of Vapour Compression Refrigeration	01
2.7	Freezing equipment's and thawing.	02
<b>3.</b>	<b>Chemical Properties and Characteristics of Foods</b>	
3.1	Basic concepts. Lethality requirement and assessing the adequacy of a thermal process: D value, Z value , F value etc.	01
3.2	Calculation of thermal process time and probability of spoilage.	02
3.3	Commercial sterilization, concept of 12D and 5D	01
3.4	Consequences of thermal processing on food quality and safety.	01
3.5	Canning process	01
3.6	Spoilage in canned food	01
3.7	Retorting, batch and continuous retorts and aseptic processing	02
<b>4.</b>	<b>Physical Properties of Foods</b>	
4.1	Principles & Technological aspects and application of evaporative concentration process;	01
4.2	Principle and Technological aspects of drying and dehydration, drying curve.	01
4.3	Drying time calculation – constant rate drying, falling rate drying, Constant rate of drying including conduction and convection both, constant rate of drying including convection only.	02
4.4	Sorption Isotherm and Gab model	01
4.5	Freeze concentration and membrane process for food concentrations.	01
4.6	Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods.	02
<b>5.</b>	<b>Preservation by Non-thermal methods</b>	
5.1	Principles, Technological aspects and application of sugar and salt,	01
	Natural food preservation system, Fermentation, pickling, curing, smoking	02
5.2	Antimicrobial agents (Nitrates, Benzoates, Propionates, Sorbates etc.), Mechanism of actions of different preservatives,	01
5.3	Nonionizing and ionizing radiations in preservation of foods	02
5.4	Hurdle technology	02
<b>Total Hours</b>		<b>40</b>

**TFT 457-: FOOD PROCESS AND PRODUCT DEVELOPMENT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objective of this course is to impart

- Knowledge about product implementation stage of food product development
- Knowledge for the workforce challenges of creating innovative food products to meet market demand.
- Knowledge to work in teams with cooperating entrepreneurs and companies to develop products of interest.

**Course Outcome:**

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

CO1	Understand the basics of innovation in food industry and apply the stage-gate process to product development.	Understanding
CO2	Interpret a brief specifying the requirements for a product	Understanding
CO3	Understand factors that affect viability and potential of new food products. Patent literature, competition, costs.	Understanding
CO4	Understand new products from consumer viewpoint.	Understanding
CO5	Understand critically assessing of the development cycle of a food product and review relevant principles of marketing theory.	Understanding
CO6	Understand the design and execute product development trials to efficiently optimise the product formulation and process	Understanding

**Syllabus**

**Module-I: Concept of product development**

Innovation and product development concept. Generation of ideas. Desk Research. Screening/appraisal of initial ideas.

**Module- II: Analysis of market**

Detailed study of product and market, Planning and development activities and evaluating them.

**Module- III: Development of product**

Development of prototype product and its testing for acceptance.

**Module- IV: Development of process**

Development of process and planning for production trials. Planning the test market. Actual production trials and test marketing. Evaluation of test results.

**Module- V: Launching**

Launching of the product. Advertising and marketing plans. Suggestions for improving success.

**Suggested References & Books:**

<b>Title</b>	<b>Author(s)</b>
Food product development	Earle, M., Earle, R., & Anderson, A.
Hydrocolloids: Practical Guides for the Food Industry	Hoefler, A.C.
Food Processing Technology	P.J Fellows
Food Product Development: Based on Experience	Side, C.
New Food Product Development: From Concept to Marketplace	Fuller, G.W.

**TFT-459: FOOD PROCESSING WASTE MANAGEMENT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objectives of this course are to impart:

- Knowledge of standards and acts for protecting the environment during food processing
- Knowledge of by-products obtained during food processing and their utilization
- To understand the management of wastewater during processing of food

**Course outcomes:** On the successful completion of the course, the students will be able to

CO1	Understand and gain knowledge about food wastage, waste management and environment (Protection) act standards of food processing wastes	Understanding
CO2	Gain knowledge about by-products obtained from different food processing industries and apply the knowledge for their utilization	Applying
CO3	Understand the characteristics of food industry wastes and involved unit operation in effluent treatment	Understanding
CO4	Understand the concept of biological oxidation and aeration devices systems & their modifications.	Understanding
CO5	Understand the advance Technology for waste water treatment	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	-	-	-	-	2	3	-	-	-	-	1	2	2
<b>CO2</b>	3	1	-	-	-	2	3	-	-	-	-	1	2	2
<b>CO3</b>	2	1	-	-	-	1	2	-	-	-	-	1	2	2
<b>CO4</b>	2	1	-	-	-	1	2	-	-	-	-	1	2	2
<b>CO5</b>	3	2	1	1	-	2	3	-	-	-	-	2	3	3
<b>Average</b>	2.4	1.25	1	1	-	1.6	2.6	-	-	-	-	1.2	2.2	2.2

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Introduction of food industry wastes and their treatment
- Concept of ISO 14001 standards and Environment (Protection) Act, 1986
- Management of food processing wastes

#### **Course Outcome 2 (CO2)**

- By-products characterization and utilization of cereal, pulses, oilseeds,
- By-products characterization and utilization of milk, fish, meat, egg and poultry processing industries
- By-products characterization and utilization fruits and vegetables.

#### **Course Outcome 3 (CO3)**

- Concept of food Industry effluents
- Unit concept of treatment of food industry effluent
- Environmental pollution and their treatment

#### **Course Outcome 4 (CO4)**

- Concept of biological oxidation
- Aeration devices systems
- Advanced modifications of aeration devices systems

#### **Course Outcome 5 (CO5)**

- Advanced waste water treatment systems
- Membrane technology
- Physico-chemical separations
- Disinfection and handling disposal of sludge

### **Syllabus**

#### **Module-I: Standards and Acts**

Food industry wastes, Food waste treatment, ISO 14001 standards, Standards for emission or discharge of environmental pollutants from food processing Industries as per Environment (Protection) Act, 1986, Elements of importance in the efficient management of food processing wastes.

#### **Module-II: By products and their utilization**

Characterization and utilization of by-products from cereal, pulses, oilseeds, fruits and vegetables, plantation products, fermented foods, milk, fish, meat, egg and poultry processing industries.

### **Module-III: Food Industry Waste and Environmental Pollution**

Characterization of food Industry effluents, Physical and chemical parameters, Oxygen demands and their interrelationships, Residues (solids), Fats, Oils and grease, Forms of nitrogen, sulphur and phosphorus, Anions and cations, Surfactants, Color, Odor, Taste, Toxicity, Unit concept of treatment of food industry effluent, Screening, Sedimentation /Floatation as pre and primary reactants.

### **Module-IV: Biological Oxidation**

Objectives, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological contactors and their variations and advanced modifications.

### **Module-V: Waste Water Management**

Waste water treatment systems, Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis, Physico-chemical separations: activated carbon adsorption, Ion-exchange electro dialysis and magnetic separation, Chemical oxidation and treatment coagulation and flocculation, Disinfection, Handling disposal of sludge.

### **Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Food Processing Waste Management Environment (Protection) Act	J.H. Green
Proceedings of the Symposium on By-products From food Industries: Utilization and Disposal	AFST(I) & CFTRI
Environmental Protection and Laws	H. Jadhav & V.M. Bhosale
Environmental Management	K.D Wanger
Waste Water treatment	M.N Rao & A.K. Datta

### **Course contents and Lecture schedule**

<b>Module No.</b>		<b>No. of Lectures</b>
<b>1.</b>	<b>Standards and Acts</b>	<b>6</b>
1.1	Food industry wastes, Food waste treatment	02
1.2	ISO 14001 standards	02
1.3	Standards for emission or discharge of environmental pollutants from food processing Industries as per Environment (Protection) Act, 1986	01
1.4	Elements of importance in the efficient management of food processing wastes	01
<b>2.</b>	<b>By products and their utilization</b>	<b>7</b>

2.1	Characterization and utilization of by-products from cereal, pulses, oilseeds	02
2.2	Characterization and utilization of by-products from fruits and vegetables, plantation products and fermented foods industries	02
2.3	Characterization and utilization of by-products from milk, fish and meat industries	02
2.4	Characterization and utilization of by-products from egg and poultry processing industries	01
<b>3.</b>	<b>Food Industry Waste and Environmental Pollution</b>	<b>4</b>
3.1	Characterization of food Industry effluents, Physical and chemical parameters, Oxygen demands and their interrelationships	01
3.2	Characterization of surfactants, color, odor, taste and toxicity	01
3.4	Unit concept of treatment of food industry effluent, Screening, Sedimentation /Floatation as pre and primary reactants	02
<b>4.</b>	<b>Biological Oxidation</b>	<b>6</b>
4.1	Secondary treatments: Biological oxidation, aeration, oxidation pond and their designs	02
4.2	Aeration devices Systems: Lagoons, Activated sludge process and Oxidation ditches	02
4.3	Rotating biological contactors and their variations and advanced modifications	02
<b>5.</b>	<b>Waste Water Management</b>	<b>8</b>
5.1	Advanced waste water treatment systems (physical, physicochemical and chemical treatments)	02
5.2	Physical separations, Micro-strainers, Filters, Ultra filtration and reverse osmosis	02
5.3	Physico-chemical separations: activated carbon adsorption, Ion-exchange electro dialysis and magnetic separation	02
5.4	Chemical oxidation and treatment coagulation and flocculation, Disinfection, Handling disposal of sludge	02
<b>Total Hours</b>		<b>31</b>

**TFT 461: QUALITY MANAGEMENT OF FROZEN FOODS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objective of this course to impart

- The knowledge on quality aspects of frozen foods
- The knowledge on the total quality management of frozen food industry

**Course Outcomes:**

On the successful completion of the course the student will be able to

CO1	Understand the concepts of food freezing systems and their aspects	Understand
CO2	Discuss about the quality losses of frozen foods	Analysing
CO3	Apply different techniques to minimize quality losses of frozen foods	Applying
CO4	Identify different tests required for monitoring quality of frozen foods	Remembering
CO5	Identify different strategies to improve frozen food quality in future	Remembering

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	1	-	-	-	-	-	-	-	-	-	1	1	1
<b>CO2</b>	3	2	1	-	-	-	-	-	-	-	-	1	1	1
<b>CO3</b>	3	1	-	-	-	-	-	-	-	-	-	1	2	2
<b>CO4</b>	3	-	-	-	-	-	-	-	-	-	-	1	2	2
<b>CO5</b>	3	1	2	-	-	1	1	-	3	-	-	2	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>2</b>	-	-	<b>1</b>	<b>1</b>	-	<b>3</b>	-	-	<b>1</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

**Syllabus****Module I: Theoretical and Experimental Aspects of Food Freezing**

Introduction, Food freezing systems, overview of physicochemical aspects of Freezing, Future trends in Food freezing Processes Measurement and Interpretation of the Glass Transition in Frozen Food, Modeling of Food Freezing.

**Module II: Quality Losses associated with Frozen Food**

Moisture Migration and Ice Recrystallization in Frozen Foods, Freeze-Cracking, and Quality Deterioration in Frozen Foods Associated with Hydrolytic Enzyme Activities, Protein Denaturation and Functionality Losses, Lipid Oxidation: Flavor and Nutritional Quality Deterioration in Frozen Food, Relationship of Frozen-Food Quality to Microbial Survival.

**Module III: Techniques to Minimize Quality Losses**

Cryoprotectants for Improving Frozen-Food Quality, Antioxidants and Their Application to Frozen Food, Edible Coatings and Films Product Composition and the Quality of Frozen Foods, Role of Packaging in Quality Preservation of Frozen Food,

**Module IV: Monitoring of Quality in Frozen Food**

Physical and Ultrastructural Measurement, Chemical Measurements of Frozen Foods, Sensory Evaluation Methods to Measure Quality of Frozen Food, Shelf-Life Testing: Procedures and Prediction Methods

**Module V: Strategies to Ensure Frozen Product Quality Today and Tomorrow**

Consumer Acceptance of Frozen Foods: Market Segmentation , Quality in Frozen Foods from the Consumer's Perspective, Consumer Education, Marketing Frozen Foods, Total Quality Management for the Frozen-Food Industry, Quality Enhancement

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Quality in Frozen food	Marilin C. Erikson
The Freezing Preservation of Foods	Tressler D.K.& EversC.F
Cold and Chilled Storage Technology	Clive DellinoD.J
Food Processing Technolgy – Principles and applications	Fellows, P.J
Frozen Food Technology	Ed.Mallet C.P

**Course contents and Lecture schedule**

<b>Module No.</b>		<b>No. of Lectures</b>
<b>1.</b>	<b>Theoretical and Experimental Aspects of Food Freezing</b>	
1.1	Introduction to food freezing and various methods of food freezing	01
1.2	Physicochemical changes during freezing of foods	02
1.3	Measurement of glass transition temperature	01

1.4	Modeling of food freezing process	02
1.5	Future trends in food freezing	01
<b>2.</b>	<b>Quality Losses associated with Frozen Food</b>	
2.1	Migration of moisture and formation of ice crystals during freezing of foods	01
2.2	Quality losses during freezing of foods, Enzymatic deterioration, protein changes	02
2.3	Flavor and nutritional changes during freezing of foods	01
2.4	Relationship between Quality deterioration & Microbial degradation of frozen foods	01
<b>3.</b>	<b>Techniques to Minimize Quality Losses</b>	
3.1	Application of cryoprotectents for improving quality of frozen foods	01
3.2	Antioxidants used in frozen foods	01
3.3	Edible coatings for frozen foods	01
3.4	Packaging of frozen foods	02
<b>4.</b>	<b>Monitoring of Quality in Frozen Food</b>	
4.1	Physical methods for measuring quality of frozen foods	01
4.2	Instrumental methods used for measuring quality of frozen foods	01
4.3	Sensory methods used for measuring quality of frozen foods	02
4.4	Texture analysis of frozen foods	01
4.5	Time Temperature integrators for monitoring quality of frozen foods	03
<b>5.</b>	<b>Strategies to Ensure Frozen Product Quality Today and Tomorrow</b>	
5.1	Market segmentation of frozen foods	01
5.2	Marketing of frozen foods	02
5.3	TQM of frozen food industry	03
5.4	Consumer perception, education about frozen foods	01
<b>Total Hours</b>		<b>32</b>

**TFT 492: NUTRITIONAL ASPECTS OF NATURAL AND PROCESSED FOODS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Course objectives:** The objective of this course is to impart

- Knowledge about the nutritional importance of the different constituents of the foods and their digestion and absorption in human body
- Nutrient's role in controlling the physiological processed foods and development of different diets.
- Balance & therapeutic diet for different individuals and groups and Assessment of calorific value and nutritional quality of natural and processed foods.

**Course Outcomes**

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

CO1	Understand the basic concepts of food nutrition and RDI	Understanding
CO2	Understand the digestion of nutrients in the human body	Understanding
CO3	Formulate different diets	Applying
CO4	Calculate calorific value of food	Analyzing
CO5	Perform sensory analysis of food	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	2	-	-	-	-	2	2	2
CO2	3	1	1	-	-	-	1	-	-	-	-	1	2	2
CO3	3	-	-	-	-	-	1	-	-	-	-	1	2	2
CO4	3	2	-	-	-	-	1	-	-	-	-	1	2	2
CO5	3	1	1	-	-	-	1	-	-	-	-	1	2	2
Average	3	1	1	NA	NA	NA	1	NA	NA	NA	NA	1	2	2

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Knowledge about the function of food and diet
- Nutrients and its role in human diet
- Recommended Dietary Intakes (RDI) and its significance

#### **Course Outcome 2 (CO2)**

- Different categories of foods and its sources
- Nutritional changes during processing & storage of foods
- Restoration, Enrichment, Fortification and Supplementation of foods

#### **Course Outcome 3 (CO3)**

- Digestion, Absorption and Metabolism of food nutrients
- Protein & lipid digestion in human body

#### **Course Outcome 4 (CO4)**

- Balanced diets for different groups
- Therapeutic diets for people in various ailments and disorders
- Functional foods and nutraceuticals

#### **Course Outcome 5 (CO5)**

- Assessment of calorific value of foods
- Nutritional quality of natural and processed foods by different means
- Sensory qualities and acceptability of foods

### **Syllabus**

#### **Module-I: Basic concept of nutrients of food & RDI**

Food and its functions, Role of nutrients, Effects of deficient or excess intake of the individual essential nutrients. Recommended Dietary Intakes (RDI) and its uses. Factors affecting nutritional requirement of an individual.

#### **Module-II: Composition of Foods**

General and Specific for different foods of plant and animal origin. General causes of loss of nutrients. Nutritional changes during processing & storage and their implications. Potentially undesirable constituents in foods. Restoration, Enrichment, Fortification and Supplementation of foods.

**Module -III: Fate of Food in human body**

Digestion, Absorption and Metabolism of Carbohydrate: Glycolytic pathway, TCA cycle, ETP, PPP. Protein & lipid digestion, absorption and metabolism. Digestion, absorption and metabolism of Vitamins and Minerals.

**Module-IV: Therapeutic diet and its role**

Balanced diets for normal individuals, Therapeutic diets for people suffering from various ailments and disorders, Functional foods.

**Module-V: Nutritional and Sensory qualities of Food**

Assessment of calorific value and nutritional quality of natural and processed foods by chemical and biological means. Sensory qualities and acceptability of foods.

**Reference Books and Suggested Readings:**

<b>Title</b>	<b>Author</b>
Nutrition and Dietetics	Shubhangini A.Joshi
Nutritive Value of Indian Foods	Gopalan C and others
Food Chemistry'	Fennema O. R
Basic Nutrition in Health & Disease	P.S. Howe & W.B. Saunders
Food and Nutrition	Swaminathan M

**Course contents and Lecture schedule**

<b>Module No.</b>	<b>Topic of Content</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Basic concept of nutrients of food &amp; RDI</b>	<b>06</b>
1.1	Food and its functions, Role of nutrients	01
1.2	Effects of deficient or excess intake of the individual essential nutrients.	01
1.3	Recommended Dietary Intakes (RDI) and its uses	02
1.4	Factors affecting nutritional requirement of an individual	02
<b>2.</b>	<b>Composition of Foods</b>	<b>08</b>
2.1	General and Specific for different foods of plant and animal origin.	02
2.2	General causes of loss of nutrients	01
2.3	Nutritional changes during processing & storage and their implications.	02
2.4	Potentially undesirable constituents in foods.	01

2.5	Restoration, Enrichment, Fortification and Supplementation of foods.	02
<b>3.</b>	<b>Fate of Food in human body</b>	<b>06</b>
3.1	Digestion, Absorption and Metabolism of Carbohydrate	02
3.2	Glycolytic pathway, TCA cycle, ETP, PPP	01
3.3	Protein & lipid digestion, absorption and metabolism.	01
3.4	Digestion, absorption and metabolism of Vitamins and Minerals	02
<b>4.</b>	<b>Therapeutic diet and its role</b>	<b>06</b>
4.1	Balanced diets for normal individuals	02
4.2	Therapeutic diets for people suffering from various ailments and disorders	02
4.3	Functional foods and Nutraceuticals	02
<b>5.</b>	<b>Nutritional and Sensory qualities of Food</b>	<b>06</b>
5.1	Assessment of calorific value	02
5.2	Nutritional quality of natural and processed foods by chemical and biological means	02
5.3	Sensory qualities and acceptability of foods	02
<b>Total Hours</b>		<b>32</b>

**TFT-493: Industrial Training**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

The students offer summer internship of 6 to 8 weeks would be giving presentation on the work they performed or learned during training

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- To expose to industrial environment
- To acquaint with the various machines for the manufacturing of food products
- For testing of raw materials and finished products

**Course Outcome**

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

CO1	Understand the plant layout, work culture and human relationship.	Understand
CO2	Apply the theoretical knowledge in understanding the working of various machines and manufacturing processes	Apply
CO3	Understand the process sequence and optimization of process parameters.	Apply, Analyze
CO4	To get exposure to various conventional and modern tools and equipment for testing of raw materials and finished products	Apply
CO5	To analyze the research problem and devise methodology/ steps to solve it and development of products	Analyze, Create

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	1	3	2	-	-	2	1	3	3	2	3	3	2	2
<b>CO2</b>	3	2	2	1	2	2	-	1	2	-	2	3	2	2
<b>CO3</b>	3	3	3	2	3	2	1	2	2	2	2	3	2	2
<b>CO4</b>	3	3	2	3	3	-	-	-	-	-	1	3	2	2
<b>CO5</b>	3	3	3	3	3	3	2	1	3	2	3	3	2	2
<b>Average</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-"

**TFT-495: Seminar**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- Study a topic of latest developments/innovative technology on their own and to prepare a dissertation report on this topic.
- Present a lecture on the topic on power point format.
- Improve the communication skill of the students.

**Course Outcome**

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

CO1	Review existing literature related to the selected topic of interest	Understand
CO2	Organize and present the reviewed literature in the form of a coherent technical report.	Apply
CO3	Use innovative digital tools and technologies to enhance the quality and effectiveness of seminar presentations	Apply
CO4	Deliver an effective seminar presentation and respond appropriately to audience queries	Evaluate
CO5	Participate actively as an audience member by attentively listening to peer presentations, learning from them, and asking relevant questions	Understand, Apply

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	1	3	2	3	3	2	2	-	2	-	2	3	2	2
<b>CO2</b>	3	3	2	2	3	2	3	2	2	3	2	2	2	2
<b>CO3</b>	3	-	-	-	2	2	2	-	2	3	2	2	2	2
<b>CO4</b>	3	-	-	-	-	1	1	2	3	3	1	2	2	2
<b>CO5</b>	2	-	1	2	1	2	3	1	3	3	2	3	2	2
<b>Average</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-"

**TFT-497: PROJECT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>8</b>	<b>4</b>

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- To identify a food product that can be manufactured in India or a research problem and conduct experiment.
- To prepare a report for a project based on manufacturing of product/ development of technology
- To present a lecture on the topic on power point format.
- To improve the communication skill of the students.

**Course Outcome**

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

CO1	Review existing literature and identify the research gap in the chosen domain	Understand, Analyze
CO2	Finalize an appropriate research topic and clearly define research objectives	Apply
CO3	Design an experimental plan to achieve the defined research objectives	Apply
CO4	Identify and predict the potential outcomes of the proposed research work	Analyze
CO5	Compile and present a structured synopsis for the proposed research work	Apply

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3	-	-	3	-	2	1	-	1	-	2	3	2	2
<b>CO2</b>	3	2	2	2	1	2	3	-	2	3	3	2	2	2
<b>CO3</b>	3	3	3	2	3	2	2	2	3	3	3	3	2	2
<b>CO4</b>	3	2	2	-	2	1	2	3	3	3	3	3	2	2
<b>CO5</b>	3	3	3	-	1	2	3	3				3		2
<b>Average</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

**TFT-452: INNOVATIVE TECHNIQUES IN FOOD PROCESSING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course Objective:** The objective of the course is to impart

- Knowledge about working principles of various innovative techniques in food processing
- Knowledge about the advantage & disadvantage of innovative techniques to improve quality and yield of production.

**Course outcomes:**

On the successful completion of the course the student will be able to

CO1	Understand the membrane technology: MF, UF, NF & RO and Super critical fluid extraction process in food industry	Understanding
CO2	Understand the application of microwave and radio frequency wave technology in food processing	Understanding
CO3	Understand the working principle and advantage of High pressure processing in food preservation	Understanding
CO4	Understand the working principle and advantage of Ohmic and Radiation heating process in food processing	Understanding
CO5	Understand the Hurdle Technology and apply it to extend the shelf-life of food products	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	2	1	-	-	-	-	1	-	-	-	-	1	3	3
<b>CO2</b>	2	1	-	-	-	1	1	-	-	-	-	1	3	3
<b>CO3</b>	3	2	-	-	-	1	1	-	-	-	-	1	3	3
<b>CO4</b>	3	2	-	-	-	1	1	-	-	-	-	1	3	3
<b>CO5</b>	3	2	1	1	-	1	1	-	-	-	-	2	3	3
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>1</b>	<b>1</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>3</b>	<b>3</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

### **Course Level Assessment Questions3**

#### **Course Outcome 1 (CO1)**

- Principle and technology of membrane processing
- Working and application of microfiltration, UF, NF and RO
- Supercritical fluid extraction concept

#### **Course Outcome 2 (CO2)**

- Mechanism of heat generation.
- Working of Microwave and Radio frequency processing
- Application of Microwave and Radio Frequency Processing in sterilization and finish drying.

#### **Course Outcome 3 (CO3)**

- Principle and Technological aspect of High pressure processing (HPP).
- Mechanism of Microbial inactivation in food during HPP.
- Principle, Technology and application of ultrasonic processing in food industry.

#### **Course Outcome 4 (CO4)**

- Principle, Technology and application of Ohmic heating in food processing and preservation
- Principle and Technology of IR heating, inductive heating and X-rays.
- Application of IR heating, inductive heating and X-rays in food processing and preservation.

#### **Course Outcome 5 (CO5)**

- Concept of physical and chemical hurdles.
- Principle and application of Hurdle Technology.
- Design hurdles for a given process.

### **Syllabus**

#### **Module-I: Membrane technology**

Introduction to pressure activated membrane processes: microfiltration, UF, NF and RO and their industrial application, Supercritical fluid extraction concept, property of near critical fluids NCF, extraction methods.

#### **Module-II: Microwave and Radio Frequency Processing**

Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying.

**Module-III: High Pressure Processing,**

Concept, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing, Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques.

**Module-IV: Ohmic and Radiation heating**

Concept and technology of ohmic heating, IR heating, inductive heating and X-rays in food processing and preservation,

**Module-V: Hurdle technology**

Concept of physical and chemical hurdles, Principle of hurdle technology and its application in food preservation, Shelf-stable food products

**Reference Books and Suggested Readings**

**Title**

Emerging Technologies for Food Processing.

Novel Food Processing Technologies

Innovation in Food Engineering: New Techniques and Products,

Nonthermal Processing Technologies for Food

Non-thermal Food Engineering Operations

Food Processing Technologies: Impact on Product Attributes

**Author**

Da-Wen Sun

M. P. Cano, M. S. Tapia, and G. V.

Maria Laura Passos, Claudio P. Ribeiro

Howard Q. Zhang. et al., 2000

Enrique Ortega-Rivas

Amit K. Jaiswal

<b>Module No.</b>	<b>Course contents and Lecture schedule</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Membrane Technology</b>	
1.1	Principle of Membrane processing, theory of Microfiltration.	01
1.2	Depth and cross flow filtration, materials and design for membrane.	01
1.3	Performance, membrane fouling, back flushing, Uniform trans membrane pressure	01
1.4	Theory, working and application of Ultra filtration.	01
1.5	Theory, working and application of Nano filtration	01
1.6	Theory, working and application of Reverse osmosis.	01
1.7	Principle of Supercritical fluid extraction process, Properties of super critical fluid and near critical fluid.	01
1.8	Application and working of supercritical fluid extraction process.	01
<b>2.</b>	<b>Microwave and Radio Frequency Processing</b>	
2.1	Theory of Microwave processing: Mechanism of Heat generation	01

2.2	Application of Microwave in food processing and preservation.	01
2.3	Principle and working of Radio Frequency processing	01
2.4	Application of Radio Frequency in food processing and preservation.	01
2.5	Advantage and disadvantage of Microwave and Radio frequency Processing in food industry, Highlight on some recent research work related to the Microwave and Radio frequency processing.	01
<b>3.</b>	<b>High Pressure Processing,</b>	
3.1	Principle and Working of High pressure Processing (HPP).	01
3.2	Mechanism of microbial inactivation in food processing.	01
3.3	Advantages, disadvantages and application of HPP in food processing.	01
3.4	Ultrasonic processing and its properties	01
3.5	Application of Ultrasonic as processing techniques in food processing	01
3.6	Working mechanism of ultrasonic processing for various food materials	01
3.7	Advantages and limitations of ultrasonic processing and its scope	01
<b>4.</b>	<b>Ohmic and Radiation heating</b>	
4.1	Principle and working of ohmic heating	01
4.2	Application of ohmic heating in food processing and preservation.	01
4.3	Principle and technology of IR heating, inductive heating and X-rays in food processing and preservation.	02
4.4	Application of IR heating, inductive heating and X-rays in food processing and preservation	02
4.5	Highlight on recent research work on Ohmic heating, IR heating, inductive heating and X-rays in food processing	02
4.6	Advantages and limitations of ohmic heating, IR heating, inductive heating and X-rays	01
<b>5.</b>	<b>Hurdle Technology</b>	
5.1	Concept of physical and chemical hurdles.	01
	Principle of hurdle technology	01
5.2	Application of hurdle technology in food preservation.	01
5.3	Design Hurdle for juice manufacturing process.	01
5.4	Design Hurdle for milk processing.	01
<b>Total Hours</b>		<b>32</b>

**TFT-454: APPLICATION OF COMPUTER IN FOOD PROCESSING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objective of the course is to impart the

- Basic knowledge about the different parts of the computers and their functions
- The knowledge of computer based instrumentation and process control
- Basic knowledge of modeling and simulation

**Course outcomes**

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

CO1	Understand the basic components of the computer and their functions	Understanding
CO2	Analyze the data using the simple softwares	Analyzing
CO3	Perform the linear regression of a given data	Applying
CO4	Understand the concepts of modeling and simulation	Understanding
CO5	Understand the importance of new techniques in problem solving	Understanding

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	2	2	1	1	3	-	-	-	-	-	-	-	1	3	1
CO3	3	3	1	1	2	-	-	-	-	-	-	-	1	3	1
CO4	3	1	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
<b>Average</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>	-	-	-	-	-	-	1	<b>2</b>	<b>1</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put “-”

**Course Level Assessment Questions****Course Outcome 1 (CO1)**

- Different components of a computer
- Functions of CPU
- Different storage devices and their functions
- Different input and output devices
- Features of operating systems

**Course Outcome 2 (CO2)**

- Importance of data analysis
- Types of data
- Statistical analysis,
- Hypothesis testing, ANOVA

**Course Outcome 3 (CO3)**

- Determination of regression coefficients
- Linear regression in EXCEL
- Non-linear regression using MATLAB

**Course Outcome 4 (CO4)**

- What is modelling?
- Types of modelling
- Characteristics of different models
- Kinetic modelling

**Course Outcome 5 (CO5)**

- Application of RSM in process optimization
- Application of RSM in Product development
- Application of fuzzy logics in sensory analysis
- Application of Numerical methods in food process modelling

**Syllabus**

**Module-I: Basics of Computer software and Hardware**

Introduction to computer hardware and operations, CPU, input and output devices, memory, secondary storage, operating system, spreadsheet fundamentals, data base management, graphics application.

**Module-II: Data analysis**

Classical and recently developed statistical procedures, basic principles of statistical inference, Problems of estimation, hypothesis testing, large sample theory, probability, regression-linear and nonlinear.

**Module-III: Instrumentation and process control**

Computer based instrumentation for data acquisition and their control, virtual instruments, reliability and fault finding, concept of process control -first order, second order, and third order processes

**Module-IV: Modelling and simulation**

Concept, advantages and limitations of dimensional analysis, Models - Types of models and modelling approaches, features of models, Curve fitting method of least squares, estimation of coefficients of simple determination and simple correlation, properties of least square residuals. Simulation and simulation language.

**Module-V: New techniques of computation**

Response surface methodology, artificial neural network, fuzzy logic, genetic algorithm, finite difference, finite element, computational fluid dynamics: concepts and their application in food processing with examples.

**Reference Books and Suggested Readings:****Title**

Elements of Practical Statistics  
 Basic Statistics  
 Computer Applications in Food Technology  
 PC based Instrumentation and control  
 Design and analysis of experiments

**Author**

Kapur, K.  
 Simpson, O.J.  
 Paul Singh R  
 Mike Tooley  
 Douglas C. Montgomery

**Course contents and Lecture schedule**

<b>Module No.</b>		<b>No. of Lectures</b>
<b>1.</b>	<b>Basics of Computer software and Hardware</b>	
1.1	Introduction to computer hardware and different parts of a computer	01
1.2	CPU, Input, output and storage devices	01
1.3	Operating systems	01
1.4	Fundamentals of spread sheet and data base management	03
1.5	Graphics	01
<b>2.</b>	<b>Data analysis</b>	
2.1	Introduction to data analysis, types of data and importance of data analysis	01
2.2	Recently developed statistical techniques in data analysis	01
2.3	Basic principles of statistical interference	01
2.4	Types of hypothesis and Hypothesis testing	01
2.5	Linear regression	02
2.6	Non-linear regression	02
<b>3.</b>	<b>Instrumentation and process control</b>	
3.1	Introduction to Instrumentation and process control, importance of computer based instrumentation and control	01

3.2	Virtual instruments, Characteristics of instruments	01
3.3	Determination of reliability, fault finding	01
3.4	Introduction to process control, first-order processes	01
3.5	Process control of second order processes	02
3.6	Process control of second order processes	02
<b>4.</b>	<b>Modelling and simulation</b>	
4.1	Introduction to process modeling and simulation	01
4.2	Concept of dimensional analysis, advantages and limitations	01
4.3	Types of models: Physical and empirical, their characteristics	02
4.4	Curve fitting, Least square method	01
4.5	Determination of regression coefficients	01
4.6	Properties of least square residuals	01
4.7	Introduction to simulation and simulation language	02
<b>5.</b>	<b>New techniques of computation</b>	
5.1	Introduction and importance of computation	01
5.2	Introduction to Response surface methodology	03
5.3	Introduction to fuzzy logic	03
5.4	Introduction to Numerical modelling: FDE, FEM, CFD	04
<b>Total Hours</b>		<b>43</b>

**TFT 456: UNIT OPERATIONS IN FOOD PROCESSING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**Course objectives:** The objective of this course

- To familiarize the students to the theory and application of basic unit operations performed in various food processing industries.
- .
- To familiarize the students with the separation of valuable components from the liquid, solid streams by physical, contact equilibrium processes as well as distillation process

**Course Outcomes:** on the successful completion of the course the student will be able to

CO1	Describe and discuss the processing of foods in terms of common unit operations like size reduction, mixing, and separation	Applying
CO2	Apply his computational skills in calculating the energy required in size reduction, mixing operations.	Applying
CO3	Understand the construction, working and applicability of various size reduction, mixing and separation equipments.	Understanding
CO4	analyse the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system	Analysing
CO5	able to understand the principle and application of leaching and extraction process	Understanding

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3	1	2	-	-	-	-	-	1	-	-	2	3	3
<b>CO2</b>	3	1	2	-	-	-	-	-	1	-	-	2	3	3
<b>CO3</b>	3	1	-	-	-	-	-	-	-	-	-	1	2	2
<b>CO4</b>	3	2	2	-	-	-	-	-	1	-	-	2	3	3
<b>CO5</b>	3	1	-	-	-	-	-	-	-	-	-	1	2	2
<b>Avg3</b>	<b>3</b>	<b>3</b>	<b>2</b>	-	-	-	-	-	<b>1</b>	-	-	<b>2</b>	<b>3</b>	<b>3</b>

## Syllabus

### Module I:

**Size reduction:** Theory of comminution, Rittinger's law, Kick's law, Bond's law and their applications in calculation of energy required in grinding, Crushing efficiency, Size reduction equipment used in food industry. **Mixing** :Theoretical aspects of solid mixing. Mixing index, rate of mixing, Theory of liquid mixing, Equipment for liquid and solid mixing.

### Module II:

**Sieving:** Separation based on size, Effectiveness of screens, Types of screens, Factors affecting the sieving process, Fineness modules and particle size distribution **Sedimentation:** Theory, Gravitational sedimentation of particles in liquids and gases, Sedimentation equipment

### Module III:

**Centrifugal separation:** Basic equation, centrifugal clarification, Equipments. **Filtration:** Theoretical aspects, Fundamental equation for filtration, Filtration equipment **Crystallization:** Rate of crystallization, crystallization equilibrium

### Module IV:

**Distillation:** Liquid vapor equilibrium, distillation of binary mixtures, simple distillation, continuous distillation, flash distillation, steam distillation. **Leaching and extraction:** Gas – Liquid equilibria, Solid – Liquid equilibria, Extraction-Solid Liquid extraction, Liquid-Liquid extraction, stage equilibrium extraction.

### Module V:

**Food freezing:** Introduction, Freezing point curve for food and water, Freezing points of common food materials, Principles of food freezing, Freezing time calculation by using Plank's equation, Freezing systems **Aseptic Processing:** Principles, Analysis of thermal resilience, Duration mathematics of conduction heating, Blanching- Principle and equipment, Homogenization, Emulsification

### Reference Books and Suggested Readings:

Title	Author
1. Food Processing Technology	P. Fellows
2. Unit Operations in Food Processing	R. L. Earl

**TFT-458: NUTRACEUTIAL AND FUNCTIONAL FOODS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- Fundamental knowledge of nutraceuticals and functional foods
- Knowledge about health promoting effect of nutraceuticals
- Knowledge about various metabolic disorders and their prevention and treatment by nutraceuticals
- Knowledge of processing and storage of functional foods

**Course Outcomes:** On the successful completion of the course, students will be able to:

CO1	Understand concepts of nutraceuticals and functional foods and their health benefits	Understanding
CO2	Understand the functional food ingredients of various foods and their mechanism	Understanding
CO3	Understand the national & international food laws and regulations for quality of foods	Analyzing
CO4	Understand the role of functional beverages and herbs and their market aspects	Applying
CO5	Understand the marketing and regulatory issues of nutraceuticals and functional foods	Applying

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	-	-	-	-	1	-	-	-	-	1	2	2
CO2	3	2	1	1	-	-	1	-	-	-	-	1	3	3
CO3	3	-	-	-	-	2	2	-	-	-	-	1	2	2
CO4	3	1	-	-	-	1	2	-	-	-	-	1	3	2
CO5	3	1	1	-	-		-	-	-	-	-	1	2	2
<b>Average</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>NA</b>	<b>NA</b>	<b>1</b>	<b>3</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-"

### **Course Level Assessment Questions**

#### **Course Outcome 1 (CO1)**

- Aspects of nutraceuticals and functional foods
- Classifications of nutraceuticals and functional foods
- Biochemical properties and health benefits of nutraceuticals

#### **Course Outcome 2 (CO2)**

- Metabolic disorders and disturbances
- Recommended foods in different disorders
- Nutraceutical approach and prevention of metabolic disorders

#### **Course Outcome 3 (CO3)**

- Functional role of nutraceuticals
- Dietary fibers and complex carbohydrates as functional food ingredients
- Probiotic foods and their functional role

#### **Course Outcome 4 (CO4)**

- Health promoting activity of common herbs
- Functional vegetable products, oil seeds and sea foods
- Functional beverages and health benefits

#### **Course Outcome 5 (CO5)**

- Marketing and regulatory issues of Nutraceuticals and functional foods
- Effects of processing and storage of nutraceuticals
- Recent developments and advances in the area of Nutraceuticals and functional foods

### **Syllabus:**

#### **Module-I: Technological Aspects of Nutraceuticals and functional Foods**

Defining nutraceuticals and functional foods, nature, type and scope. Nutraceuticals and functional foods applications and their health benefits, classification based on chemical and biochemical nature with suitable and relevant descriptions.

#### **Module-II: Nutraceuticals for Specific Diseases**

Food recommended and restricted in metabolic disorders and disturbances, gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculoskeletal diseases; allergies.

#### **Module-III: Functional Role of Food Components**

Antioxidants, phytochemicals, isoflavones, lycopene, their role in Nutraceutical and functional foods, dietary fibers and complex carbohydrates as functional food ingredients. Proteins as a functional food ingredient, probiotic foods and their functional role.

**Module-IV: Role of Specific Food Products as a Functional Food**

Herbs as functional foods, health promoting activity of common herbs. Cereal products as functional foods- Oats, Wheat bran, rice bran etc. Functional vegetable products, oil seeds and sea foods. Coffee, tea and other beverages as functional foods/ drinks and their protective effects

**Module-V: Legal Aspects of Nutraceuticals**

Effects of processing and storage, interaction of various environmental factors on the potentials of such foods. Marketing and regulatory issues of Nutraceuticals and functional foods and. Recent developments and advances in the area of Nutraceuticals and functional foods.

**Reference Books and Suggested Readings**

<b>Title</b>	<b>Author</b>
Handbook of Nutraceutical and Functional Foods	Wildman REC
Anti-angiogenic Functional and Medicinal Foods	Losso JN
Handbook of Nutraceuticals	Pathak YV
Innovations in Healthy and Functional Foods	Ghosh D et al
Nutrition and Dietetics	Joshi SA

**Course Contents and Lecture Schedule**

Module No.	Topic of Content	No. of Lectures
<b>1.</b>	<b>Technological Aspects of Nutraceuticals and functional Foods</b>	<b>06</b>
1.1	Defining nutraceuticals and functional foods, nature, type and scope	02
1.2	Nutraceuticals and functional foods applications and their health benefits	02
1.3	classification based on chemical and biochemical nature with suitable and relevant descriptions	02
<b>2.</b>	<b>Nutraceuticals for Specific Diseases</b>	<b>08</b>
2.1	Food recommended and restricted in metabolic disorders and disturbances	02
2.2	Gastrointestinal disorders; fever and infection; liver, gall, bladder and pancreatic disturbances	02
2.3	Blood, circulatory and cardiac diseases	02
2.4	Urinary and musculoskeletal diseases; allergies	02

<b>3.</b>	<b>Functional Role of Food Components</b>	<b>06</b>
3.1	Antioxidants, phytochemicals, isoflavones, lycopene, their role in Nutraceutical and functional foods	02
3.2	Dietary fibers and complex carbohydrates as functional food ingredients.	02
3.3	Proteins as a functional food ingredient	01
3.4	Probiotic foods and their functional role	01
<b>4.</b>	<b>Role of Specific Food Products as a Functional Food</b>	<b>06</b>
4.1	Herbs as functional foods, health promoting activity of common herbs.	01
4.2	Cereal products as functional foods- Oats, Wheat bran, rice bran etc.	02
4.3	Functional vegetable products, oil seeds and sea foods.	01
4.4	Coffee, tea and other beverages as functional foods/ drinks and their protective effects	02
<b>5.</b>	<b>Legal Aspects of Nutraceuticals</b>	<b>04</b>
5.1	Effects of processing and storage, interaction of various environmental factors on the potentials of functional foods	02
5.2	Marketing and regulatory issues of Nutraceuticals and functional foods and.	01
5.3	Recent developments and advances in the area of Nutraceuticals and functional foods	01
<b>Total Hours</b>		<b>30</b>

**TFT-498: PROJECT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>

**COURSE OBJECTIVES:** The objectives of this course is to enable the students

- To articulate a clear research question or problem and formulate a hypothesis
- To identify and practice research ethics and responsible conduct in research
- To communicate confidently and constructively with fellow students and faculty as mentors explain their research to others in the field and to broader audiences through research presentation

**Course Outcome:** On the successful completion of the course, students will be able to:

effective CO1	effective	effective
CO2	effective	effective
CO3	effective	effective
CO4	effective	effective
CO5	effective	effective

**CO-PO Mapping**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>CO1</b>	3	-	-	3	-	2	1	-	1	-	2	3	2	2
<b>CO2</b>	3	2	2	2	1	2	3	-	2	3	3	2	2	2
<b>CO3</b>	3	3	3	2	3	2	2	2	3	3	3	3	2	2
<b>CO4</b>	3	2	2	-	2	1	2	3	3	3	3	3	2	2
<b>CO5</b>	3	3	3	-	1	2	3	3	2	1	2	3	2	2
<b>Average</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

If there is no correlation, put "-."