

# DEPARTMENT OF FOOD TECHNOLOGY



## B.Tech FOOD TECHNOLOGY

# CURRICULUM AND SYLLABUS 2021R

**KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION**  
(Deemed to be University)  
Anand Nagar, Krishnankoil - 626126

<b>Institute Vision</b>	<b>Institute Mission</b>
To be a University of Excellence of International Repute in Education and Research.	<ol style="list-style-type: none"> <li>1. To provide a scholarly teaching-learning ambience which results in creating graduates equipped with skills and acumen to solve real-life problems.</li> <li>2. To promote research and create knowledge for human welfare, rural and societal development.</li> <li>3. To nurture entrepreneurial ambition, industrial and societal connect by creating an environment through which innovators and leaders emerge.</li> </ol>
<b>Department Vision</b>	<b>Department Mission</b>
To be a center of repute in the frontier areas of Food Technology through quality research and education.	<ol style="list-style-type: none"> <li>1. To impart knowledge in the realm of food technology through research and education.</li> <li>2. To nurture professional leaders in the field of food technology with entrepreneurship skills.</li> <li>3. To cultivate strong ethical values for sustainable growth in food processing to fulfill the needs of the society</li> </ol>

### Program Educational Objectives (B.Tech – Food Technology)

<b>PEO 1</b>	The graduates will exhibit competence as professionals in academic and research in food processing industry or related disciplines through professional development.
<b>PEO 2</b>	The graduates will have acumen to be a successful entrepreneur in areas related to food and allied technologies.
<b>PEO 3</b>	The graduates will promote ethics, sustainability and environmental responsibility in their practice.

### Programme Specific Outcomes (B.Tech – Food Technology)

A graduate of the Food Technology program will demonstrate:

<b>PSO1</b>	Professional Skills: The ability to understand, evaluate and prepare ways to process, preserve, package, or store food, according to industrial requirements.
<b>PSO2</b>	Problem Solving Skills: The ability to apply standard practices and regulation in developing the food and allied products.
<b>PSO3</b>	Career and Entrepreneurship: The ability to employ modern technologies to produce new or value added products in the area of Food Technology.

**Program outcomes:**

<b>PO 1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO 2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO 3</b>	<b>Design/development of solutions:</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.
<b>PO 4</b>	<b>Conduct investigations of complex problems:</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.
<b>PO 5</b>	<b>Modern tool usage:</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.
<b>PO 6</b>	<b>The engineer and society:</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.
<b>PO 7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO 8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO 9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO 10</b>	<b>Communication:</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.
<b>PO 11</b>	<b>Project management and finance:</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.
<b>PO 12</b>	<b>Life-long learning:</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.

### Curriculum Structure

<b>Environment/ Indian Constitution</b>	<b>44</b>	<b>Foundation Core</b>	<b>Mathematics and Sciences</b>
			Engineering Sciences
			Computing
			Sustainable Product Development
			Human Values and communication
			Entrepreneurship and Innovation
	<b>16</b>	<b>University Elective</b>	Engineering (outside school)
		Liberal arts (or) Mathematics and Sciences	
<b>Complementary Skills</b>	<b>52</b>	<b>Program Core</b>	
	<b>24</b>	<b>Program Elective</b>	
	<b>16</b>	<b>Experiential Core</b>	Design Project
			Capstone
	<b>8</b>	<b>Experiential Elective</b>	CSP/ Internship/ UG Research/ Competitions
<b>Total</b>	<b>160</b>		

**PROGRAM CORE COURSES**

S.No	Course code	Course Title	Course type	L	T	P	X	Credits
1	212FTE1301	FOOD MICROBIOLOGY	IC-T	3	0	2	0	4
2	212FTE1302	FOOD CHEMISTRY	IC-T	3	0	2	0	4
3	212FTE1303	ENGINEERING PROPERTIES OF FOOD MATERIALS	IC-T	3	0	2	0	4
4	212FTE2404	UNIT OPERATIONS IN FOOD PROCESSING	IC-P	2	2	2	0	4
5	212FTE2405	HEAT AND MASS TRANSFER	IC-P	2	2	2	0	4
6	212FTE2406	TECHNOLOGY OF FRUITS/VEGETABLES	IC-P	2	0	2	3	4
7	212FTE1107	PRINCIPLES OF FOOD PROCESSING AND PRESERVATION	TC	2	0	0	3	3
8	212FTE2108	DAIRY TECHNOLOGY	TC	2	0	0	3	3
9	212FTE2109	CEREALS, PULSES, OILSEEDS PROCESSING TECHNOLOGY	TC	2	0	0	3	3
10	212FTE2110	FOOD PACKAGING TECHNOLOGY	TC	2	0	2	0	3
11	212FTE1111	FOOD PROCESS CALCULATION	TC	2	2	0	0	3
12	212FTE1112	FOOD ADDITIVES	TC	3	0	0	0	3
13	212FTE1113	BASIC HUMAN NUTRITION	TC	3	0	0	0	3
14	212FTE3114	INSTRUMENTATION AND PROCESS CONTROL	TC	2	2	0	0	3
15	212FTE3215	FOOD ANALYSIS LABORATORY	PC	0	0	2	0	1
16	212FTE2216	FOOD ENGINEERING AND TECHNOLOGY LABORATORY	PC	0	0	2	0	1
17	212FTE2217	FOOD PRODUCT DEVELOPMENT LABORATORY	PC	0	0	2	0	1
18	212FTE2218	BAKERY AND CONFECTIONARY LABORATORY	PC	0	0	2	0	1

**PROGRAM ELECTIVES**

S.No	Course code	Course name	Course type	L	T	P	X	Credits
<b>FOOD PRODUCT TECHNOLOGY</b>								
1	213FTE2101	SPICES AND PLANATTION TECHNOLOGY	TC	2	0	0	3	3
2	213FTE2102	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY	TC	3	0	0	0	3
3	213FTE2103	BAKING AND CONFECTIONARY TECHNOLOGY	TC	3	0	0	0	3
4	213FTE2104	SUGARCANE AND BEVERAGE TECHNOLOGY	TC	3	0	0	0	3
5	213FTE2105	TECHNOLOGY OF SNACK AND EXTRUDED PRODUCTS	TC	2	0	0	3	3
<b>DESIGN AND DEVELOPMENT</b>								
6	213FTE3106	FOOD PROCESS EQUIPMENT DESIGN AND PLANT LAYOUT	TC	3	0	0	0	3
7	213FTE2107	FOOD PRODUCT DEVELOPMENT AND SENSORY ANALYSIS OF FOOD	TC	3	0	0	0	3
8	213FTE2108	FOOD WASTE MANAGEMENT AND BY-PRODUCT UTILISATION	TC	2	0	0	3	3
<b>FOOD SAFETY AND QUALITY</b>								
9	213FTE2109	FOOD SAFTEY AND QUALITY	TC	3	0	0	0	3
10	213FTE2110	FOOD LAWS AND REGULATIONS	TC	3	0	0	0	3
11	213FTE2111	FOOD ALLERGENS AND TOXICOLOGY	TC	3	0	0	0	3
12	213FTE3112	FOOD STORAGE AND INFESTATION CONTROL	TC	3	0	0	0	3
<b>ADAVANCED FOOD PROCESSING TECHNOLOGY</b>								
13	213FTE3113	EMERGING TEHCNOLOGIES IN FOOD PROCESSING	TC	3	0	0	0	3

14	213FTE3114	ENZYME AND ITS APPLICATIONS IN FOOD PROCESSING	TC	3	0	0	0	3
15	213FTE3115	FUNCTIONAL FOODS AND NUTRACEUTICALS	TC	3	0	0	0	3
16	213FTE3116	ADVANCED HUMAN NUTRITION	TC	3	0	0	0	3

### OPEN ELECTIVES

S. No	Course code	UNIVERSITY ELECTIVES -OPEN	Course type	L	T	P	X	Credits
1	214FTE2101	FOOD PROCESSING TECHNOLOGY	TC	3	0	0	0	3
2	214FTE2102	TECHNOLOGY OF CONVENIENCE FOODS	TC	3	0	0	0	3
3	214FTE2103	FOUNDATION OF FOOD AND NUTRITION	TC	3	0	0	0	3
4	214FTE2104	COMPOSITION, QUALITY & SAFETY OF FOODS	TC	3	0	0	0	3
5	214FTE2105	FOOD LAWS AND STANDARDS	TC	3	0	0	0	3
6	214FTE2106	BAKERY AND CONFECTIONARY TECHNOLOGY	TC	3	0	0	0	3
7	214FTE2107	BEVERAGE TECHNOLOGY	TC	3	0	0	0	3
8	214FTE2108	FERMENTED FOOD PRODUCTS	TC	3	0	0	0	3
9	214FTE2109	PACKAGING TECHNOLOGY OF FOODS	TC	3	0	0	0	3
10	214FTE2110	NUTRACEUTICALS AND FUNCTIONAL FOODS	TC	3	0	0	0	3
11	214FTE2111	PROCESSING OF FOOD PRODUCTS	TC	3	0	0	0	3

**HONOURS COURSES**

S. No	Course code	HONOURS	Course type	L	T	P	X	Credits
1	215FTE1101	IT APPLICATION IN FOOD INDUSTRY	TC	3	0	0	0	3
2	215FTE2102	FAT AND OIL TECHNOLOGY	TC	3	0	0	0	3
3	215FTE2103	RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS	TC	3	0	0	0	3
4	215FTE2104	TECHNOLOGY OF FOOD EMULSION, FOAMS AND GELS	TC	3	0	0	0	3
5	215FTE2305	COMPREHENSIVE TECHNIQUES IN FOOD ANALYSIS	IC-T	3	0	2	0	4
6	215FTE3306	EXPERIMENTAL DESIGN AND OPTIMIZATION IN FOOD PROCESSING	IC-T	3	0	2	0	4
7	215FTE2107	INNOVATION AND FUTURE TRENDS IN FOOD MANUFACTURING AND SUPPLY CHAIN TECHNOLOGIES	TC	3	0	0	0	3
8	215FTE3108	FOOD SAFETY MANAGEMENT	TC	3	0	0	3	3
9	215FTE2109	VALORIZATION OF FOOD PROCESSING BY-PRODUCTS	TC	3	0	0	0	3



**MINOR COURSES**

S. No	Course code	MINOR	Course type	L	T	P	X	Credits
1	216FTE1301	FUNDAMENTALS OF FOOD SCIENCE	IC-T	3	0	2	0	4
2	216FTE2302	FOOD LABELLING AND PACKAGING	IC-T	3	0	2	0	4
3	216FTE1303	FOOD PRESERVATION TECHNIQUES	IC-T	3	0	2	0	4
4	216FTE1304	TECHNOLOGY OF FOOD PRODUCT DEVELOPMENT	IC-T	3	0	2	0	4
5	216FTE1105	POST HARVEST TECHNOLOGY	TC	3	0	0	0	3
6	216FTE1106	NUTRITION AND HEALTHY LIFE	TC	3	0	0	0	3
7	216FTE1107	FOOD SUPPLY CHAIN MANAGEMENT	TC	3	0	0	0	3
8	216FTE1108	ENTREPRENEURSHIP IN FOOD PROCESSING	TC	3	0	0	0	3
9	216FTE1109	FOOD PLANT HYGIENE AND SANITATION	TC	3	0	0	0	3
10	216FTE1110	FOOD BIOTECHNOLOGY	TC	3	0	0	0	3
11	216FTE1111	CHEMICAL ENGINEERING FOR FOOD INDUSTRY	TC	3	0	0	0	3
12	216FTE1112	BASICS OF FOOD SAFETY AND QUALITY	TC	3	0	0	0	3

## PROGRAM CORE COURSES

<b>212FTE1301</b>	<b>FOOD MICROBIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	2	0	4
<b>Pre-Requisite</b>	: NIL	<b>Course Category</b>	: Program Core	<b>Syllabus Revision</b>	2021	
Course Level	: 1	<b>Course Type</b>	: Integrated Course Theory			

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Acquire knowledge on historical developments in microbiology & classify the structure of microorganisms.

CO2 Interpret significance of microbial spoilage in different foods

CO3 Apply the knowledge of microorganisms in fermentation process.

CO4 Categorize food borne diseases and intoxication caused by microorganisms

CO5 Formulate microbiological quality control programmes for growth control.

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M											L	L	L	
CO2	M	L	M			M	M		M	H	M	M	M	M	L
CO3	H	M	H	L		M	M		H	H	L	M	H	M	M
CO4	H	M	M	M	M	M		M	M	M	H	H	M	M	L
CO5	H	H	M	M	L	H	H	L	M	M	L	M	M	M	H

### Syllabus

#### Unit -1:

**9 hours**

Introduction, historical developments in the food microbiology and its Significance, Microbial growth pattern, Microbial growth and death kinetics, synchronous growth, doubling/generation time. Study of microorganisms- Morphology, structure, classifications - bacteria, virus, yeast and mold, Microbiological Methods of enumeration and isolation of microbes.

#### Unit -2:

**9 hours**

Sources of contamination, Spoilage of foods-Factors affecting Spoilage, Biochemical changes caused by microorganisms, Contamination and spoilage of foods- Fruits & vegetables, cereals & pulses, milk, sea foods and meat during Handling and processing.

**Unit -3:****9 hours**

Importance of microbes in food fermentation, batch, fed batch and continuous fermentation, Homo and hetro-fermentative bacteria, yeast & mould; Biochemistry of fermentation-pathway involved, Types of fermentation - lactic acid fermentation, alcoholic fermentations, Yeast fermentations, fungal fermentations. Fermented foods – Sauerkraut, Idli, Vinegar, soy products.

**Unit -4:****9 hours**

Factors affecting growth of microorganism in food - intrinsic and extrinsic factors, foodborne Pathogens- Bacterial food borne diseases, Food Borne Viral Pathogens, Toxigenic algae and fungi, Food Borne Animal Parasites, Food poisoning, food infection and intoxication.

**Unit -5:****9 hours**

Control of microorganisms- physical and chemical agents, Anti-microbial agents- their mechanism of action. Benefits of microbes. 9

**Experiments**

1. Microscope its parts and utility in identification and differentiation of bacteria, yeast and mold
2. Micrometry and determination of size of different microbes
3. Simple and differential staining of microorganisms and their examination
4. Preparation and sterilization of culture media for microbial counts
5. Direct total, viable, and non-viable count of microorganisms in milk
6. Determination of Standard Plate Count (SPC) in natural and processed foods
7. Preparation of different types of plating techniques
8. Isolation of bacteria in food
9. Resazurin test in milk
10. Enumeration of microbes in swab test
11. Microbiological examination of potable water: Total and coliform count
12. Enumeration & Isolation of *E. coli* from processed meat/chicken
13. Swab test

**Reference Books:**

1. Frazier, W.C. and Westhoff. "Modern Food Microbiology". Tata McGraw Hill Publishing Co. Ltd., New Delhi, 4th Edition, 2008.
2. Adams M.R. and Moss M.O. "Food Microbiology". New Age International Ltd Publication. 2007.
3. Bibek Ray. "Fundamental food microbiology". CRC Press. 3rd Edition. 2005.

**212FTE1302****FOOD CHEMISTRY****L T P X C**

3 0 2 0 4

**Pre-  
Requisite** : NIL**Course  
Category** : Program Core**Syllabus  
Revision** 2021

Course Level : 2

**Course Type** : Integrated Course Theory

Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Explain the role of water activity that influence food quality and shelf life

CO2 Interpret the structure and properties of carbohydrates

CO3 Recall the structure and properties of polysaccharides

CO4 Describe the protein and its properties in food

CO5 Infer the structure and properties of lipids

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M					M	H					H	H	M	M
CO2	H	L				M	L		M	M		M	M	M	L
CO3	H		L	M	H	L		L	M	H	M	M	H	L	L
CO4	H	M	L	M	L	M		M	M	H	M	L	M	L	L
CO5	H	H	M	M	M	M	M	M	M	H	M	M	H	M	L

**Syllabus****Unit -1:****9 hours**

Water in food systems – Chemistry, physical properties, free, bound & entrapped water, water activity and its impact on food processing and storage. Drinking water, mineral water, water hardness, water quality for food processing.

**Unit -2: Glycosides I****9 hours**

Carbohydrates- classification, structure; properties. Chemical reactions such as caramelization, Maillard reaction, gelatinization and dehydration; identification and estimations. Sources of carbohydrates. Structure of dietary fibre – complex carbohydrates and Polyols.

**Unit -3: Glycosides II****9 hours**

Sucrose – manufacture from sugar cane and sugar beet; starches – isolation from varied sources; amylose/amylopectin, size/shape, gelation, retrogradation, pasting behavior, functional properties; Commercially important products – glucose, glucose syrups, high fructose corn syrups, and maltodextrins

**Unit -4: Proteins****9 hours**

Proteins- chemistry of amino acids and their properties (isoelectric pH, solubility profile); Peptides; classification of proteins; structure (primary, secondary, tertiary and quaternary); Sources of protein; Denaturation of proteins; estimation of proteins in foods; purification methods. Isolation of food proteins (soya, fish, whey); Functional properties of proteins; Maillard browning; concept of modified proteins. The sources of proteins.

**Unit -5 Lipids****10 hours**

Chemistry of lipids- fatty acids, Mono-, di and triacylglycerols; The sources of lipids; Classification of lipids- simple, compound and derived; unsaponifiable constituents of lipids such as sterols and hydrocarbons and waxes Rancidity and reversion of fats and oils and thermal stability- its measurement and inhibition; analytical parameters of oils and fats. Extraction, alkali refining, degumming, deodorization, winterization, inter-esterification, hydrogenation etc. of vegetable and animal fats, margarines and hydrogenated vegetable oil

**Experiments.**

- 1 Estimation of Sucrose by Lane and Eynon's Method
- 2 Estimation of Sucrose and Lactose
- 3 Identification of Sugars & amino acids by Paper Chromatography
- 4 Estimation of reducing sugar and non-reducing sugars
- 5 Determination of dextrose equivalent
- 6 Extraction and estimation of starch
- 7 Estimation of protein
- 8 Qualitative Analysis of Sugar and fats
- 9 Determination of peroxide value of oil
- 10 Determination of TBA value of oil
- 11 Determination of titratable acidity, sugar acid ratio and pH of food products
- 12 Estimation of Copper and Ferric ions
- 13 Estimation of iodine value and acid value
- 14 Analysis of water – Hardness and Total solids (TDS+TSS).
- 15 Estimation of Antioxidant activity
- 16 Proximate Analysis of Foods

**REFERENCE BOOKS**

1. Belitz, H.D., Grosch .W., Schieberle .P. “ Food Chemistry”. Springer Publication, 4th Edition, 2009.
2. Dulsy Fatima. “Biochemistry”. Saras Publication, 2015.
3. John M. deMan. “Principles of Food Chemistry”. An Aspen Publication. 1999.
4. Owen R.Fennema. “Food Chemistry”. Marcel Dekker. 3rd Edition. 1996.
5. Sadasivam S. and Manickam A., —Biochemical Methods, 3rd Edition, New Age International, New Delhi, 1996.
6. Ranganna S., —Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2nd Edition, Tata McGraw Hill, New Delhi, 2008.

**212FTE1303 ENGINEERING PROPERTIES OF FOOD MATERIALS**      **L T P X C**

3 0 2 0 4

**Pre-Requisite** : NIL      **Course Category** : Program Core      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Integrated Course Theory

### Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1 Interpret the physical properties of food materials

CO2 Identify the suitable technique for measurement of thermal properties of foods

CO3 Make use of optical and electromagnetic properties of food materials in food processing

CO4 Compare the various rheological behaviour of food materials

CO5 Choose suitable textural and color measurement techniques for food materials

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	M	M				L	M	M		M	M	M	M
CO2	H	M	M	L		M	L		M	M	M	L	H	L	M
CO3	H	M	M	M	L	M	L		M	H	M	L	L	H	M
CO4	H	M	M	L	L		L		H	H	M	M	M	H	H
CO5	M	L			M	L		L	H	M		M	H	L	M

### Syllabus

#### Unit -1: Physical Properties

**9 hours**

Importance of engineering properties, Physical properties of food materials- size, shape, volume, density, porosity and surface area – definitions and measurements, Frictional properties – coefficient of friction, angle of repose – types and its determination, Aerodynamic properties – Drag coefficient, Terminal Velocity and its application

#### Unit -2: Thermal Properties

**9 hours**

Definition of specific heat, enthalpy, thermal conductivity, thermal diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity, thermal diffusivity, Calorific value of food, Bomb calorimeter, Boiling point elevation and freezing point depression, Applications of thermal properties.

#### Unit -3: Optical Properties

**9 hours**

Refractive index of food items, Abbe's refractometer, Sorting of food material using optical properties, Optical activity, Polarimeter, Spectrophotometer, Gloss, color, translucency – Definitions, measurement and applications.

Colour: Interaction of object with light, Colorimeter- Color order systems- Munsell color system, CIE color system, Hunter lab color space, Lovibond system.

**Unit -4: Rheological-Properties****9 hours**

Classification of rheology, Rheological models, Stress Strain behavior of Newtonian and Non-Newtonian fluids- Bingham and Non Bingham. Stress-strain relationships in solids, liquids and visco elastic behavior- stress relaxation test, creep test and dynamic test, stress-strain diagrams. Viscosity – Principle, Types- Capillary, Orifice, Falling and Rotational viscometers.

**Unit -5: Textural & Dielectric Properties****9 hours**

Types of food textures, Texture measuring instruments- Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA, Properties of food powders.

Electromagnetic Properties: Electrical properties- electrical conductivity and its measurement, dielectric properties and its measurement methods, microwave heating and other applications.

**Experiments**

1. To determine the size and shape of food materials
2. To determine the angle of repose and co-efficient of friction of grains
3. To determine the density of the foods
4. To determine the gelling and retrogradation of a food product
5. Determination of calorific value by bomb calorimeter
6. To determine the temperature changes inside the food during freezing
7. To find refractive index of the given liquid samples.
8. To determine the viscosity of the liquid
9. To measure rheological properties of foods
10. To analyze the hardness, firmness of the foods
11. To measure the sphericity
12. Demonstrate the shear thinning and shear thickening properties of foods.
13. Measurement of hardness and springiness

**Reference Books:**

1. Rao, M. A. and Rizvi, S. S. H., “Engineering Properties of Foods”, Mercel Dekker Inc. New York, 1998.
2. Mohesnin, N.N., “Physical Properties of Plant and Animal Materials”, Volume. I, Gordon and Breach Science Publishers. New York, 1970.
3. Serpil Sahin and Servet Gulum Sumnu, “Physical Properties of Foods”, 1st Edition, Springer, New York, 2006.

**Other References (Web, MOOC):**

1. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1008>
2. <http://courseware.cutm.ac.in/wp-content/uploads/2020/05/2-Engineering-Properties.pdf>

**212FTE2404 UNIT OPERATIONS IN FOOD PROCESSING**

L	T	P	X	C
2	2	2	0	4

**Pre-Requisite** : NIL      **Course Category** : Program Core      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Integrated Course- Practical

## Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1: Characterize particles and perform size reduction and size analysis of particles

CO2: Explain the principles of agitation & mixing and its applications

CO3: Derive the concepts of Filtration & Sedimentation and its applications

CO4: Elucidate the principles of Evaporators and its industrial application

CO5: Enumerate the performance of material and energy balance in Distillation

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	H	H	L		L						M	H	M	L
CO2	H	H	M	H	M	L	M		M	L		M	M	H	M
CO3	M	M	H	M	M	L	L		M	M		M	M	M	M
CO4	M	M	H	M	L	M		L	M	M	L	M	M	M	H
CO5	H	H	M	M		L	L	M	L	L	L	M	H	H	H

**Syllabus****Unit -1:****9 hours**

Size reduction principles. Need for size reduction.

Laws: Kicks law, Rittingers law and Bonds law, Size reduction operation Compression & Attrition, Impact, Cutting & Grinding equipment Sieving Principles and equipment

**Unit -2:****9 hours**

Liquid transport system- properties of liquid, Handling system for Newtonian Liquids, Energy equation for steady flow of liquid- Flow characteristics of non Newtonian fluids. Types of impellers and blades, Power for agitation, Agitation of liquids -Gas-liquid systems Gas-solid, and liquid –solid emulsification Gas-solid, and liquid –solid suspensions

Agitator scale

**Unit -3:****9 hours**

Filtration Principle method and uses. Constant pressure and constant volume filtration Batch filtration, continuous filtration, Filter types . Plate & frame, Centrifugal and rotary drum filter, Vacuum leaf filter and pressure filter, Sedimentation Types and methods. Batch sedimentation test Centrifugation, Flocculation.



**Unit -4:****9 hours**

Evaporator- Principle, Uses, Application Steam economy, capacity, Study on boiling point elevation Types of evaporators -Open pan evaporator, Horizontal tube and vertical tube evaporator, Long tube and forced circulation evaporator, Film type evaporators working principle and applications. Multiple effect evaporators Feed forward and feed backward operations

**Unit -5:****9 hours**

Distillation Principle, Application. Vapour - liquid equilibrium, Law for Distillation- Raoult's law and deviations from ideality, Simple Distillation - calculations using Rayleigh equation, Flash vaporization Principle- Working Steam distillation Principle- Working, Design of multistage tray towers Design for binary systems using McCabe Thiele method, Application.

**Experiments**

1. Experiments on size reduction of fibrous food
2. Experiments on flow measuring device — in closed conduit using (a) Venturimeter, (b) Orifice meter, (c) Rota meter.
3. Experiments on grinding machine to determine the new surface created
4. Experiments on pneumatic separation
5. Experiment on sieve analysis
6. Experiment on drying
7. Experiment on mixing and Homogenization
8. Experiment on simple distillation
9. To study the working characteristics of a Jaw Crusher
10. To study the working characteristics of a Ball Mill,
11. Experiment on filtration and centrifugation
12. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube

**Reference Books:**

1. McCabe, W. L., Smith, J.C., Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill, NewYork,7th edition., 2005.
2. Brennan ,J. G., Butters, J.R., Cowell, N.D. and Lilly, A.E., Food Engineering Operations, Applied Science, London, 3rd Edition, 1990.
3. Coulson, J.M., Richardson, J.F, Backhurst J.R. and Harker J.M., Coulson and Richardson's Chemical Engineering, Volume-I, Butterworth Heinemann, Oxford, NewYork,5th Edition,2002.
4. David, M.Himmel blau, Basic Principles and Calculations in Chemical Engineering, Prentice-Hall of India, New Delhi, 7thEdition, 2004.

<b>212FTE1405</b>	<b>HEAT AND MASS TRANSFER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		2	2	2	0	4

**Pre-Requisite** : NIL      **Course Category** : Program Core      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Integrated Course- Practical

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Infer the fundamental concept of heat conduction
- CO2 Make use of dimensional analysis for solving convective heat transfer coefficient
- CO3 Apply the concepts of convection in solving heat transfer problems
- CO4 Design a heat exchanger for food process operations
- CO5 Classify and quantify the diffusion in gas, liquid and solid

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	M	L										M	M	M
CO2	H	H	H	H			L		H			M	M	H	
CO3	H	H	H	H	H	M	M	M	H	H	M	M	H	H	H
CO4	H	H	H	H	H	H	M	M	H	H	M	M	H	H	H
CO5	M	H	M		M	M	M	M	M	M		M	M	L	M

#### Syllabus

##### Unit -1: INTRODUCTION

**8 hours**

Introduction to various modes of heat transfer, Fourier's law of heat conduction, effect of temperature on thermal conductivity, convection-free & forced, Laws of Radiation. Introduction to mass transfer operation & its application in food industries.

##### Unit -2: CONDUCTION

**10 hours**

Steady-state conduction, compound resistances in series, heat flow through a cylinder, and critical radius of insulation in pipes. Heat flux, average temperature of fluid stream, overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients.

##### Unit -3: CONVECTION

**9 hours**

Heat transfer coefficient calculation for natural and forced convection, heat transfer to fluids with phase change: heat transfer from condensing vapours, drop-wise and film-type condensation, heat transfer coefficients calculation for film-type condensation.

**Unit -4: HEAT EXCHANGING EQUIPMENTS****9 hours**

Typical heat exchange equipment, counter current and parallel-current flows, enthalpy balances in: heat exchangers, total condensers. Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel-counter flow exchanger, 2-4 exchanger, heat transfer coefficients in shell-and-tube exchanger, correction of LMTD for cross flow. Condensers: shell-and-tube condensers, kettle-type boilers, Calculation of number of tubes & Heat transfer area in heat exchangers 9

**Unit-5: DIFFUSION****9 hours**

Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through non-diffusing B, equimolar counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through non-diffusing B, equimolar counter diffusion. Convective mass transfer calculations

**Experiments**

- 1 Experimental investigation of conduction through sphere
- 2 Experimental investigation of natural convection
- 3 Experimental investigation of forced convection
- 4 Determination of Stefan boltzman's constant
- 5 Experimental investigation of emissivity measurement
- 6 Experiment on Atmospheric batch drying
- 7 Experimental investigation of heat exchanger test -parallel flow
- 8 Experimental investigation of heat exchanger test -counter flow
- 9 Separation factors of the experiments with distillation
- 10 Experiment on simple leaching
- 11 Experiment on adsorption
- 12 Studies on Humidification/Dehumidification
- 13 Separation factors of the experiments with solid-liquid extraction
- 14 Mass transfer operation equipments – Rotary evaporator, Vacuum drier

**Reference Books:**

1. Warren L. McCabe, Julian C. Smith and Peter Harriott, "Unit Operations of Chemical Engineering", 7th Edition., McGraw Hill International Edition, New York 2014.
2. Donald Q. Kern, "Process Heat Transfer", Tata McGraw Hill Book Co., New Delhi, 1997
3. Robert E. Treybal, "Mass-Transfer Operations", 3rd Edition., McGraw Hill International Edition, Singapore, 1980
4. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "Coulson & Richardson's Chemical Engineering", Vol. I, 6th Edition., Butterworth Heinemann, Oxford

Other References (Web, MOOC): NPTEL videos: <https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785>

**212FTE2406 TECHNOLOGY OF FRUITS/ VEGETABLES L T P X C**

2 0 2 3 4

**Pre-Requisite** : NIL **Course Category** : Program Core **Syllabus Revision** 2021

**Course Level** : 2 **Course Type** : Integrated Course- Practical

### Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1 Interpret physiological and post-harvest changes in fruits and vegetables

CO2 Select suitable pre-processing operations and storage methods for fruits and vegetables

CO3 Choose suitable preservation techniques employed for fruits and vegetables

CO4 Make use of techniques to process different fruit beverages

CO5 Develop various fruits and vegetable products

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	L	L			L						M	M	L	H
CO2	H	M	M		M	L						L	H	M	H
CO3	H	M	M		M	M		L				L	H	H	H
CO4	H	M	M			M		L				L	H	M	H
CO5	H	M	M			M		L				L	H	M	H

### Syllabus

#### Unit-1: Physiology and post-harvest changes of fruits and vegetables **9 hours**

Scope of Fruits and Vegetables Processing Industry in India and World-present status. Classification of Fruits and Vegetables, Physiological Development, Harvesting methods, Postharvest changes of fruits and vegetables, Methods of reducing post-harvest changes. Climacteric and non-climacteric topics

#### Unit-2: Pre-processing Operations and Storage Methods **9 hours**

Pre-processing operations: Pre-cooling, Evaporative Cooling, Washing, Peeling, Grading, Blanching. Storage methods: Storage of fruit and vegetables - under ambient conditions, low temperature storage.

#### Unit-3: Preservation of Fruits and Vegetables products **9 hours**

Chilling, Freezing, Pasteurization, Sterilization, Irradiation, Waxing, Edible coating, Controlled Atmospheric Storage (CAS), Modified Atmospheric Storage (MAS). Introduction-function of enzymes in fruit juice processing- Applications and future trends.

**Unit-4: Fruit beverages****9 hours**

Classification of fruit beverages, Juice, Squash, cordial, concentrated juice, nectar, Ready to Serve (RTS). Fermented fruit beverages - Wine and vinegar production. Juice making equipment.

**Unit-5: Processing of fruits and vegetables products****9 hours**

Production of Intermediate Moisture Foods (IMF)- jam, jellies and marmalades, Defects in Jam and Jelly. Candied preserve, fruit bar, tutti fruity, fruit powder, Fermented vegetables products – Pickle, sauerkraut

**Reference Books:**

1. Srivastava R.P & Sanjeev Kumar., "Fruit and Vegetable Preservation: Principles and Practices", 3rd Edition, CBS Publishers & Distributors, New Delhi, 2014.
2. Rajarathnam S & Ramteke R.S., "Advances in Preservation and Processing Technologies of Fruits and Vegetables", 1st Edition, New India Publishing Agency, New Delhi, 2011.

**Other References (Web, MOOC):**

1. <http://www.iifpt.edu.in/fvp.php>
2. <http://www.jnkvv.org/PDF/23042020143158224202205.pdf>

**X-activity**

- 1 Value addition on Seasonal Fruit 1
- 2 Value addition on Seasonal Fruit 2
- 3 Value addition on Seasonal Fruit 3
- 4 Osmotic dehydration
- 5 Dehydration of fruits and vegetables
- 6 Development of instant mix.
- 7 Market survey
- 8 Case study
- 9 Review based quiz
- 10 Mini project
- 11 Seminar
- 12 Interpretation of graphs
- 13 Sensory analysis
- 14 New product development
- 15 Research based article evaluation

**212FTE1107 PRINCIPLES OF FOOD PROCESSING AND PRESERVATION**

**L T P X C**  
2 0 0 3 3

**Pre-Requisite** : Nil      **Course Category** : Core course      **Syllabus Revision** 2021

**Course Level** : 1      **Course Type** : Theory Course

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 Understand the importance and principle of food processing and preservation

CO2 Apply different freezing methods gain knowledge on low temperature preservation methods

CO3 Evaluate the principle and application of high temperature to preserve foods

CO4 Apply different dehydration methods to remove moisture from foods

CO5 Analyse the application of non-thermal methods to preserve the foods

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M												H	L	M
CO2	H		M	M	M	M	M	M		M	L	M	L	M	L
CO3	H	H	H	H	H	H	H	H	L	H	M	H	H	M	H
CO4	H	M	H	M	H	M	M	M	M	M	M	M	M	M	H
CO5	H	M	H		H	H	H	M	H	M	H	H	L	L	H

**Syllabus**

**Unit -1 PRINCIPLES OF FOOD PRESERVATION**

**9 Hours**

Sources of food - plant, animal and microbial origin; Different groups of food; Scope and importance of food preservation – Historical development – principles and techniques of food preservation – Food Spoilage – Factors responsible for spoilage – changes due to spoilage – spoilage of different foods - Water activity of food – Role, Effect of processing on carbohydrates, proteins, vitamins and minerals

**Unit -2 PRESERVATION BY USE OF LOW TEMPERATURES**

**9 Hours**

Refrigeration and Freezing: introduction to refrigeration – Refrigerated storage – chilling injury; Controlled and modified atmospheric storage - Freezing - Phase diagram, ice crystal formation, changes occur during freezing - freezing types – slow and quick freezing – thawing – changes during thawing. Freezing methods: air freezing, plate freezing, liquid immersion freezing and cryogenic freezing. Individual Quick Freezing (IQF) - Freeze concentration of liquid foods.

**Unit -3            PRESERVATION BY USE OF HIGH TEMPERATURES            9 Hours**

Basic concepts in thermal destruction of microorganisms -D, Z, F values. Heat resistant and thermophilic microorganisms – assessing efficacy of thermal processing of foods - Methods of applying heat to foods – Cooking – Blanching – Pasteurization – sterilization. Sterilization - methods and equipments – general process for canning of foods - UHT sterilization, Aseptic processing and packaging. Extrusion, baking, roasting, frying, dielectric heating, ohmic, microwave and infrared heating

**Unit -4 PRESERVATION BY REMOVAL OF MOISTURE            9 Hours**

Theory and mechanism of drying-water activity and its effect on the keeping quality, sorption isotherms and their use, factors affecting rate of drying, methods of drying of various food products - batch and continuous drying, cabinet, tunnel, belt, bin, drum, spray, fluidized bed, vacuum and freeze drying of foods

**Unit -5 PRESERVATION BY NON-THERMAL TECHNOLOGIES            9 Hours**

Non-thermal technology: overview - Use of non-thermal technologies (microfiltration, bacteriofugation)- Ultra high voltage electric Field, Pulse electric fields, high pressure processing, irradiation, thermosonication - Alternate-thermal technologies (ohmic heating, dielectric heating) Infrared and induction heating Biological technologies (antibacterial enzymes, bacteriocins, proteins and peptides) in food processing - Application of salt, sugar, antimicrobial agents, biological agents - Hurdle technology. Effects of various food processing operations on the nutritive value of foods.

**Reference Books:**

1. B. Sivasankar. “Food Processing and Preservation”. PHI Learning Private Limited. 2015.
2. Fellows, P.J. “Food Processing Technology : Principles and Practice”. Wood head Pub. Ltd, 2nd Edition, 2002.
3. M. Shafeiur Rahman (1999). Handbook of Food Preservation, Marcel Dekker, Inc.
4. Khetarpaul N. “Food Processing and Preservation”. Dya Publishing House, New Delhi. 2005

**212FTE2108****DAIRY TECHNOLOGY****L T P X C**

3 0 0 3 3

**Pre-  
Requisite** : Nil**Course  
Category** : Program core**Syllabus  
Revision** 2021

Course Level : 2

**Course Type** : Theory Course**Course Outcomes (COs' :)**

On successful completion of the course, the students would be able to;

CO1 Understand the composition of milk and physical and chemical properties of milk

CO2 Apply the principles and process of Homogenization and cream separation in milk processing

CO3 Analyze the process flow for the preparation of different dairy products

CO4 Analyze the process flow for the preparation of different dairy by-products

CO5 Understand the sanitation and effluent treatment in dairy industry.

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M			L							H	L	H
CO2			H	L		M	M						M	L	M
CO3	M	M		M	M	M	M					L	H	L	H
CO4		L	M		L	M		L	M	M		L	M	M	H
CO5		H	L			H	H	L			M		M	M	M

**Syllabus****Unit-1: INTRODUCTION****9 hours**

Introduction, History white revolution present milk industry scenario and its future. Milk – Types, composition, nutritive value, factors affecting composition, physico- chemical properties- Color, Flavour, Specific Gravity, Boiling point, Freezing point, Refractive Index, Acidity and pH, Viscosity, Surface Tension, System of pricing of milk.

**Unit-2: PRIMARY PROCESSES OF MILK****9 hours**

Raw milk collection – cooling and transportation – milk reception – Platform tests- Quality and Quantity tests at reception- contaminants, Smell, Appearance, Temperature, Sediment, Acidity, Lactometer Reading, Fat, Solids-Not-Fat, Dye Reduction Test: MBRT test, Resazurin tests, Mastitis test -Processing of milk, filtration, clarification, Bactofugation of milk, Cooling and storage of raw milk, Bulk transportation technologies – carbon dioxide impregnation. Milk Standardization, cream separation, Homogenization, Milk Pasteurization & heat treatment of milk-Milk Sterilization



**Unit-3: MANUFACTURE OF DAIRY PRODUCTS****9 hours**

Fluid Milk Processing, Milk product Processing – cream, Butter, Khoa, Paneer, Ice- cream, condensed milk & evaporated milk. Judging & grading of milk & its products. Dried milk products -Buttermilk powder, Whey Powder, Ice Cream mix Powder, Infant milk food, WMP& SMP. Manufacturing of Fermented products – Yoghurt, Curd, acidophilus milk, buttermilk, and Cheddar cheese. Traditional Products – Rabri, Basundi, Kalakand - Manufacturing process, packaging, storage, defects and their prevention

**Unit-4: BYPRODUCTS UTILIZATION****9 hours**

Introduction, Classification & composition of byproducts, Principles & methods of Utilization –whey utilization, Skim milk utilization and Buttermilk Utilization. Applications of enzymes in dairy industry

**Unit-5: CLEANING AND SANITATION OF DAIRY EQUIPMENTS****9 hours**

Dairy plant sanitization – Basic principles, Cleaning in place-types and design of CIP System, agents and methods – bottle and can washing- Rotary type and Straight through type, cleaning of tankers and silos – Energy use in Dairy plant - sources and cost of energy, Control of energy losses and Energy conservation. Dairy effluent treatment and disposal

**Text Books:**

- 1 Sukumar De, Outlines of Dairy Technology, Oxford University Press, 2nd edition, 2001.
- 2 James N. Warner, Principles of Dairy Processing, Wiley Eastern Ltd, 3rd edition 1998.
- 3 Tufail Ahmed, —Dairy Plant Engineering and Management, Kitab Mahal, New Delhi, 2012.
- 4 Y. H. Hui. —Dairy Science and Technology Handbook-I. Wiley Publication. 2005.
- 5 Jane Selia dos Reis Coimbra, Jose A. Teixeira, —Engineering Aspects of Milk and Dairy Products, CRC Press, New York, 2010.
- 6 Robinson R.K., —Modern Dairy Technology: Advances in Milk Products, Volume 2, Springer London Ltd., 2012.

**212FTE2109 CEREALS, PULSES, OILSEEDS PROCESSING TECHNOLOGY**

**L T P X C**  
2 0 0 3 3

**Pre-Requisite** : Nil      **Course Category** : Program core  
**Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

**Course Outcomes (COs')**

On successful completion of the course, the students would be able to;

- CO1 Understand the processing of wheat & Rice
- CO2 Describe the milling processing of pulses
- CO3 Analyze the oil seeds based on its properties
- CO4 Classify the methods of oil extraction
- CO5 Analyze the method of refining oil.

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	H	L	L	L	M	M		M	L		H	H	L	M
CO2	H	H	L	L	L	M	M		M	L		H	H	M	L
CO3	H	H	L	M	L	M	M		M	L		H	M	H	M
CO4	H	H	L	M	L	M	M		M	L		H	M	M	L
CO5	H	H	L	L	L	M	M		M	L		H	H	L	L

**Syllabus**

**Unit-1: 15 hours**

Structure, types, composition, quality characteristics and physicochemical properties of wheat & Rice. Cleaning, tempering and conditioning, and milling processes for different wheat. Milling and parboiling of paddy, Curing and ageing of paddy and rice.

**Unit-2: 15 hours**

Structure, composition and properties of legumes. Cleaning, grading, pretreatments for difficult-to-mill (urad, arhar, moong, moth) and easy-to-mill (chana, masoor and pea) legumes, milling practices and actual milling of different legumes.

**Unit-3: 15 hours**

Sources; chemical composition; physical and chemical characteristics;. Post-harvest and storage and processing of oilseeds for direct use and consumption, importance of oil seeds processing in India

**Unit-4: 15 hours**

Extraction of oil by mechanical expelling and solvent extraction and obtaining de oiled cakes Suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ.

**Unit-5:****15 hours**

Degumming, refining, bleaching, hydrogenation, fractional crystallization, inter-esterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining), bleaching, deodorization techniques/processes. Blending of oils. Chemical adjuncts- lecithins, monoglycerides and derivatives, propylene glycol esters, polyglyco esters, Hydrogenation, fractionation, winterzation, inter esterification etc for obtaining tailor--made fats and oils.

**Text Books:**

1. Bailey, Industrial Oil and Fat Products, John Wiley and Sons 6th edition 2005
2. N.L.Kent, Technology of Cereals, Wood Head Publishing, 4th edition 2004.
3. Shankuntala N.Mannay, Food Facts and Principles , New age International (p) Ltd, 2008
4. M.M. Chakrabarty, Chemistry and Technology of Oils & Fats, Applied Publisher, 2003.
5. Wolf Hamm, Richard J. Hamilton, Gijs Calliauw, Edible Oil Processing, 2nd Edition Wiley-Blackwell, 2013
6. DAV Dendy and B.J.Dobraszerk, Cereals and cereals Products- Chemistry and Technology, Aspen Publication 2001.

**212FTE2110                      FOOD PACKAGING TECHNOLOGY                      L    T    P    X    C**

**2    0    0    3    3**

**Pre-                      :    NIL                      Course                      :    Program Core                      Syllabus                      2021**  
**Requisite                      Category                      Revision**

**Course Level    :    2                      Course Type                      :    Theory Course**

Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1: Infer basic concepts in food packaging and its importance in food Industry.

CO2: Classify plastics and elaborate their properties

CO3: Choose appropriate metal and glass containers for food packaging

CO4: Use recent trends in food packaging for right application in Food Industry

CO5: Explain the laws, regulations and environmental standards pertaining to food packaging

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	L	L				M						L		M
CO2	H	H	M	L	H		H	L				L	H	H	M
CO3	H	M	M	L	M	L	L		L			L	H	M	M
CO4	H	H	H	H	M	H	L	L	M	L		L	H	M	L
CO5		M				H	M	H				M	M	L	H

### Syllabus

#### Unit-1: INTRODUCTION TO FOOD PACKAGING

**15 hours**

Packaging terminology –definition. Functions of Food Package, Packaging environment. Food marketing and role of packaging. Characteristics of food stuff that influences packaging selection - Packaged product quality and shelf life. Food Labelling. Hazards to the Packaging. Shelf Life Estimation. Current status in food packaging in India.

#### Unit-2: PLASTIC AND PAPER PACKAGING

**15 hours**

Pre-processing operations: Pre-cooling, Evaporative Cooling, Washing, Peeling, Grading, Blanching. Storage methods: Storage of fruit and vegetables - under ambient conditions, low temperature storage.

#### Unit-3: GLASS & METAL PACKAGING

**15 hours**

Importance of microbes in food fermentation, batch, fed batch and continuous fermentation, Homo and hetro-fermentative bacteria, yeast & fungi; Biochemistry of fermentation-pathway involved, Types of fermentation - lactic acid fermentation, alcoholic fermentations, Yeast fermentations, fungal fermentations. Fermented foods – Sauerkraut, Idli, Vinegar, soy products.

**Unit-4: TRENDS IN PACKAGING OF FRESH AND PROCESSED FOODS 15 hours**

Factors affecting growth of microorganism in food - intrinsic and extrinsic factors, foodborne Pathogens- Bacterial food borne diseases, Food Borne Viral Pathogens, Toxigenic algae and fungi Food Borne Animal Parasites, Food poisoning, food infection and intoxication.

**Unit-5: REGULATIONS AND ENVIRONMENTAL ISSUES IN PACKAGING 15 hours**

Control of microorganisms- physical and chemical agents, Anti-microbial agents- their mechanism of action. Use of non-thermal technologies (microfiltration, bacteriofugation, ultra high voltage electric fields, pulse electric fields, high pressure processing, irradiation, therosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating) and biological technologies (antibacterial enzymes, bacteriocins, proteins and peptides) in food processing.

**Text Books:**

1. Richard Coles and Mark J. Kirwan, —Food and Beverage Packaging Technology, 2nd Edition, Blackwell Publishing Asia Pty Ltd, CRC press, USA, 2011.
2. Robertson Gordon L., —Food Packaging: Principles and Practice, 3rd Edition, Marcel Dekker Inc, USA, 2012.
3. Han Jung H., —Innovations in Food Packaging, 2 nd Edition, Academic Press, USA 2013.
4. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, —Food Packaging Science and Technology, CRC press, USA, 2008.
5. Otto G . Piringer and A.L. Baner, —Plastic Packaging Materials for Food, 1st Edition, Wiley VCH, Germany, 2008.
6. Ahvenainen,R. — Novel Food Packaging Techniques. CRC Press. 2003.
7. Coles, R., McDowell, D. and Kirwan, M.J. —Food Packaging Technology. CRC Press.2003.

**212FTE1111 FOOD PROCESS CALCULATION L T P X C**

2 2 0 0 3

**Pre-Requisite** : Nil **Course Category** : Program Core **Syllabus Revision** 2021

Course Level : 1 **Course Type** : Theory course

### Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1 Make use of different systems of units and dimensions, estimate compositions of mixtures and solutions

CO2 Outline the stoichiometry principles and apply material balance for different unit operations

CO3 Apply material balance for recycle operations and perform humidification calculations

CO4 Make use of energy balance for system without chemical reactions

CO5 Make use of material and energy balance in various process and determine the GHV, NHV and composition of fuels

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L	L										M	L	M	L
CO2	M	M											M	L	L
CO3	L	M	L										M	M	M
CO4	M	M	M										L	L	
CO5	L	L	L									L	M	H	H

### Syllabus

**Unit-1:** **9 hours**

**Units and Dimensions, Fundamental Calculations:** Basic and derived units, unit conversions, use of model units in calculations, methods of expression, compositions of mixture and solutions, ideal and real gas laws – gas constant - calculations of pressure, volume and temperature using ideal gas law, use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

**Unit-2:** **9 hours**

**Material Balance Calculation:** Stoichiometric principles, material balance without chemical reaction - application of material balance to unit operations: distillation, evaporation, crystallization, drying, blending of food ingredients and extraction.

**Unit-3: 9 hours**

**Recycle Operations:** Recycle stream, block diagram, purging operations, purge ratio, recycle ratio and purge stream. Humidity and Saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, wet and dry bulb temperature, dew point - Humidity chart usage.

**Unit-4: 9 hours**

**Energy Balance Calculation:** Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, enthalpy changes in food. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction.

**Unit-5: 9 hours**

**Combustion:** Combustion of solids, liquid and gas, determination of NHV and GHV. Determination of composition by Orsat analysis - Calculation of excess air, theoretical oxygen requirement. Process Flow Sheet Calculation: Material and Energy Balance for selected food Process.

**Reference Books:**

1. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall of India, New Delhi, 2013.
2. Yanniotis S., "Solving Problems in Food Engineering", Springer, New York, 2008.
3. Toledo Romeo T., "Fundamentals of Food Process Engineering", 4th Edition, Springer Publishers, New York, 2018.

**212FTE1112****FOOD ADDITIVES****L T P X C**

3 0 0 0 3

**Pre-Requisite** : Nil**Course Category** : Program Core**Syllabus Revision** 2021

Course Level : 1

**Course Type** : Theory course

Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Interpret the applications of food additives in Food Industry

CO2 Identify adulterants in food additives

CO3 Classify preservative and its limitation in food processing industries

CO4 Categorize colorant and flavor of food additives

CO5 Relate Laws and quality standards related to food additives

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		L									L	H	M	H
CO2	M	M	H	L		M	L	M				M	H	M	M
CO3	H	M	H			M	L	M				M	H	H	L
CO4	H	M	H	L		H	L	M	L	L		M	H	M	L
CO5	M	H	H			H	H	H	L	L		M	H	L	H

**Syllabus****Unit-1:****10 hours**

Food additives definition Determination of the limit for addition, Functions of food additives Base Buffer systems, Low calorie Non-nutritive sweeteners, level of addition Polyols

**Unit-2:****9 hours**

Acidulates, Types, chemical properties, levels of additions Preservatives Class I and Class II preservative differences Antioxidants - Anti-caking agents Thickeners, Chelating agents-Anti-browning agents, Emulsifiers and gums

**Unit-3:****9 hours**

Dough conditioners, Flour improvers. Humectants Enzymes, Starches Types, chemical properties, levels of additions Toxicology effect Application,

**Unit-4:****9 hours**

Colorants, Natural , Artificial Types, Flavorant Natural Types, Artificial, Flavour enhancers, Fat substitutes, Replacers , chemical properties levels of additions toxicity



**Unit-5:****9 hours**

Food adulteration, definition , Reasons for food adulteration .Methods of adulteration. Methods of detection. Consumer's responsibilities, consumer organizations. The safety in terms of Toxicity, Acceptable Daily Intake concepts

**Reference Books:**

1. Food additives by Brannen A.L., Davidson P.M., Salminen S. and Thorngate J.H. Second Edition, Revised and Expanded. Marcel dekker Inc. USA, 2002.
2. Jim Smith, Lily Hong – Shum. "Food Additives Data Book". John Wiley & Sons. 2 nd Edition.2011.
3. Richard J. Lewis, Sr. "Food Additives Handbook". International Thomson Publication. 1989.

**212FTE1113**                      **BASIC HUMAN NUTRITION**                      **L T P X C**

3 0 0 0 3

**Pre-Requisite** : Nil                      **Course Category** : Program Core                      **Syllabus Revision** 2021

Course Level : 2                      **Course Type** : Theory course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Compute energy value of foods and understand body's need for energy

CO2 Describe requirements and role of macronutrients in human health

CO3 Interpret the structure and properties of carbohydrates and their metabolism

CO4 Describe effect of food processing, preservation and storage on nutritional quality of foods

CO5 Classify the anti-nutritional factors and its affects in health

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H												H		
CO2			M			M							M	L	M
CO3						M				M			M		M
CO4			H			H		M		M					M
CO5			M			H		M		M		M		L	M

### Syllabus

#### Unit-1: AN OVERVIEW OF NUTRITION

**8 hours**

Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, energy balance, and estimation of energy value from proximate composition.

Metabolic rate and calorie needs, Definition nutrition, six classes of nutrients, malnutrition.

Balanced diet planning: Food plate, Pyramid, and Food Exchange. Obesity, BMR and its factors, BMI calculations. Nutritional assessment of individuals and populations

#### Unit-2: INERALS, VITAMINS IN NUTRITION

**10 hours**

Minerals and Vitamins: Recommended daily intake, sources, toxicities, deficiencies, hypervitaminosis, factors affecting bioavailability, Stability under food processing conditions.

General Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients

**Unit-3: CARBOHYDRATE****9 hours**

Requirements and role of carbohydrates (including dietary fibers), Digestion and absorption of carbohydrates, lactose intolerance; blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, the sources of carbohydrate. Artificial sweeteners; Glycemic Index and Glycemic load.

**Unit-4: PROTEINS IN NUTRITION****9 hours**

Biological value of proteins; the sources of protein Protein, digestion and absorption, Estimation of protein quality – in vitro and in vivo methods; Effect of processing, preservation and storage on nutritional quality of foods.

**Unit-5: LIPIDS IN NUTRITION****9 hours**

Lipid digestion, absorption and transport; the sources of lipids. Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Eicosanoids, Polysterols and structured lipids. Anti-nutritional factors in plant foods, Food nutrification and labelling

**Reference Books:**

1. Introduction to human nutrition. Gibney. M.J (2006)
2. Harper, ALFRED E., et al. "Modern nutrition in health and disease. (1999)
3. Nutritive Value of Indian Foods.- by C. Gopalan, B. V. Rama Sastri, S. C. Balasubramanian Published by National Institute of Nutrition, Indian Council of Medical Research, 1989
4. Shils, Maurice E., James A. Olson, and Moshe Shike. "Modern nutrition in health and disease." (1994).
5. Aust, L. "Modern Nutrition in Health and Disease. Herausgegeben von RS Goodhart und ME
6. Principles of human nutrition- Eastwood (2006)
7. Introduction to Human Nutrition: A Global Perspective on Food and Nutrition. H. H. Vorster
8. Discovering nutrition- Paul Insel (2004)

**212FTE3114 INSTRUMENTATION AND PROCESS CONTROL L T P X C**

2 0 0 3 3

**Pre-Requisite** : Nil      **Course Category** : Program Core      **Syllabus Revision** **2021**

**Course Level** : 4      **Course Type** : Theory course

Course Outcomes (COs')

On successful completion of the course, the students would be able to;

CO1: Explain the principle, Construction and operation of instruments

CO2: Infer the concepts of feedback controller, its dynamic response and automation

CO3: Apply Laplace transformation for second order control systems and determine its dynamic response

CO4: Extend Laplace transformation for first order control systems

CO5: Interpret the stability criteria for various controllers

Mapping:

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	H	M	L								M	M	L	L
CO2	H	M	M	L	H	H			M	H		M	M	M	M
CO3	H	H	M	L		M	L	M	M	H		L	M	M	H
CO4	M	H	M	L	H	H	L	M	H	M		L	H	M	L
CO5	H	M	M	L	H	M	L		M	H	L	M	H	M	M

### Syllabus

#### Unit-1:

**15 hours**

Introduction of process variables, static and dynamic characteristic of instruments and their General classification. Elements of measuring system and their function, principles, construction and operation of instruments for the measurements, transmission, control/ indication/recording of process variables like pressure, flow, level, humidity and composition. Principles of transducers: electro pneumatic, pneumatic, electrical and multi pressure.

#### Unit-2:

**15 hours**

Proportional, integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

#### Unit-3:

**15 hours**

Process instrumentation for process equipments such as distillation column, heat exchangers, fluid storage vessel. Dynamic behavior of first order, second order and two or more first order systems in series.

**Unit-4:****15 hours**

Laplace Transform- Linear open loop system, first and second order system and their Transient response. Interacting and non-interacting system. Transportation lag, linear closed loop system, block diagram of closed loop transfer function, controllers, transient response of closed loop systems.

**Unit-5:****15 hours**

Stability concept Routh stability criterion, relative stability, huwitz Stability criterion, Nyquist's criterion. Root locus technique, introduction to frequency response, Bode diagrams, Bode stability criterion, gain and phase margins.

**Text Books:**

1. Coughnowr, D.R., Process Systems Analysis and Control, McGraw Hill, New York, 3rd Edition, 2013
2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., NewDelhi,1990
3. Doeblin Ernest, Measurement Systems, Mc GrawHill, New York, 6th edition 2017
4. C.A. Smith and A.B. Corripio, Principles and Practice of Automatic Process Control, John Wiley and Sons, New York, 3rd Edition, 2005.
5. Luyben, M.L., Luyben, W. L., Essentials of Process Control, McGraw Hill, New York, 1997.

**212FTE3215****FOOD ANALYSIS LABORATORY****L T P X C**

0 0 2 0 1

**Pre-Requisite** : 212FTE4114 **Course Category** : Program Core

**Syllabus 2021 Revision**

Course Level : 3 **Course Type** : Practical

Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1 Analyze various food products

CO2 Detect adulteration in food samples

CO3 Determine the textural and color profile of food materials

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	H	H	L			L	H	M		M	H	H	H
CO2	H	M	H	H	L			L	H	M		M	M	H	H
CO3	H	M	H	H					H	M		M	M	H	H

### Experiments

1. Estimation of starch and pectin substances in food.
2. Textural and Colour profile analysis of food material.
3. Determination of energy value of foods.
4. Analysis of Jam/Jelly/ Marmalade / Juices
5. Experiment on sampling techniques for analysis
6. Analysis of milk and milk products.
7. Determination of moisture in spices powder by distillation method and Hot air oven method.
8. Sensory Evaluation- Difference Test- triangle Test
9. Determination antioxidant activity of foods
10. Determination of antibacterial property of food extracts
11. Column Chromatographic Separation of Plant Pigments
12. The identification of sugars in fruit juice using TLC.
13. Sensory Evaluation- Preference Test- Paired Preference Test.
14. Statistical tool for designing experiments
15. Preparing Nutrition Labels for Sample
16. Detection of adulteration in Foods
17. Estimation of polyphenol content in foods

## Reference Books:

1. Sadasivam S and Manickam A, "Biochemical Methods", New Age International Publishing, New Delhi, 1996.
2. Mahindru, S N, "Food Additives, Characteristics, Detection and Estimation", Tata McGraw-Hill, New Delhi, 2000.

## Other References (Web, MOOC):

1. <https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php>

<b>212FTE2216</b>	<b>FOOD ENGINEERING AND TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
	<b>LABORATORY</b>	0	0	2	0	1

**Pre-Requisite** : Nil      **Course Category** : Program Core      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Practical

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Adapt details of Material composition for effective construction of machines depending on food product

CO2 Knowledge of basics of process equipment design and important parameters of equipment design

CO3 Knowledge of physical properties of food

CO4 Knowledge on strength of material

CO5 Ability to design the drying parameters

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M			L			M	M			H	M	L
CO2	M	M	H	M	M				H	M	M		M	L	H
CO3	H	M	H	M	M				M	H	M	M	H	M	H
CO4	H	M		H		L		M	H	H	M	M	L	M	L
CO5	H	L	M			L		M	L	L	L	M	M	L	L

#### Syllabus

##### LIST OF EXPERIMENTS

1. Determination of drying rate of food materials
2. Experiments on determination of physical properties of foods
3. Experiments on rheological properties of foods
4. Experiment on sieve analysis
5. Experiment on hardness of foods.
6. Experiment of osmotic dehydration of foods
7. Determination of tear strength of packaging material
8. Experiments on determination of firmness of foods.
9. Experiment on properties of food through microwave oven heating
10. Experiment on determination of cooking properties of parboiled and raw rice





**212FTE2217 FOOD PRODUCT DEVELOPMENT LABORATORY**

**L T P X C**  
0 0 2 0 1

**Pre-Requisite** : Nil      **Course Category** : Program Core

**Syllabus Revision**      **2021**

**Course Level** : 2      **Course Type** : Practical

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 To analyze the integration of processing in food formulations

CO2 To design and develop the process flow chart for any product development.

CO3 To design the product and process formulations in food industry

CO4 To evaluate the processing cost of any developed product

CO5 To understand the factor affecting the shelf life of product

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		M		M		M	M				L	L		M	
CO2		M		M		M	M				L	L		M	
CO3		M	M			L	L				L	L		M	
CO4		M	M			L	M				L	L		M	
CO5		M	M			L	L				L	L		M	H

**Syllabus**

**Experiments**

1. Preparation of mango products
2. Preparation of apple products
3. Preparation of lime products
4. Preparation of guava products
5. Preparation of tomato products
6. Preparation of coconut products
7. Preparation of fish and chicken products
8. Preparation of fried products
9. Preparation of rice products
10. Preparation of white or red wine
11. Preparation of fermented food products
12. Preparation of salad dressing and peanut butter
13. Preparation of Indian sweets
14. Preparation of mayonnaise
15. Preparation of confectionary products

**Reference Books:**

1. Fuller, G.W. (2011). *New Food Product Development: From Concept to Marketplace*, 3rd ed, CRC Press, UK.
2. Theodoros Varzakas, Constantina Tzia. (2015). *Handbook of Food Processing: Food Safety, Quality, and Manufacturing Processes*, CRC Press, UK.
3. Giridhari Lal, G.S. Siddappa, G.L. Tandon. (1998). *Preservation of Fruits and Vegetables*, ICAR, New Delhi.

**212FTE2218    BAKERY AND CONFECTIONERY LABORATORY    L    T    P    X    C**  
**0    0    2    0    1**

**Pre-Requisite :** Nil                      **Course Category :** Program Core                      **Syllabus** 2021  
**Revision:**

**Course Level :** 2                      **Course Type :** Practical

Course Outcomes (COs' :)

On successful completion of the course, the students would be able to;

CO1 Analyze the quality of flour and other ingredients used for preparation of bakery products

CO2 Prepare the bakery product and evaluate its properties

CO3 Formulate confectionery products and perform sensory properties

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	M	M		L		L	H	M		M	H	H	H
CO2	H	M	M	M		L		L	H	M		M	H	H	H
CO3	H	M	M	M		L		L	H	M		M	H	H	H
CO4															
CO5															

**Syllabus**

**Experiments**

**Expt.**

No.	Name of the Experiment	Hours
1.	Estimation of quality parameters of bakery ingredients.	40
2.	Estimation of wet and dry gluten content of wheat flour.	
3.	Determination of dough rising capacity of yeast.	
4.	Estimation of diastatic activity and maltose value of flour	
5.	Estimation of water absorption power, alkaline water retention and sedimentation value of flour.	
6.	Preparation and analysis of bread.	
7.	Preparation and analysis of biscuits and cookies.	
8.	Preparation and analysis of cake.	
9.	Preparation of sugar boiled confectionery.	
10.	Preparation of toffee and fudge.	
11.	Preparation of cocoa based confectionery.	
12.	Virtual Lab: Demonstration on Yeast Fermentation.	

**Reference Books:**

1. Duncan Manley., "Biscuit, Cracker and Cookie Recipes for the Food Industry", 1st Edition, Wood head Publishing, England, 2001.
2. Yogambal Ashok kumar., "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012

## PROGRAM ELECTIVES

213FTE2101	SPICES AND PLANTATION TECHNOLOGY	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		2	0	0	3	3

**Pre-Requisite** : Nil      **Course Category** : Program Elective Course      **Syllabus** 2021  
**Revision:**

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Demonstrate the processing stages involved in plantation processing
- CO2 Utilize functional properties of spices and herbs in product development
- CO3 Select processing steps required for spices processing
- CO4 Choose processing steps required for herbs processing
- CO5 Adapt technologies for essential oil and oleoresin extraction

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L	H	H	H	M	H		L	H	L	M	M	H	H	H
CO2	M	H	H	H	M	H		M	H	M	H	M	M	M	H
CO3	L	M	H	H	M	H		H	H	M	M	M	H	H	H
CO4	L	M	H	H	L				M	H	H	L	M	M	H
CO5	L	H	L	H	L		L		H	H	M	L	H	H	H

### Syllabus

#### Unit-1: Plantation Crops

**10 hours**

Plantation Crops: Description of various types of Plantation crops. Processing of tea – Manufacturing of black tea, CTC tea Green tea, Oolong tea, flavoured tea. Grading of Tea. Coffee – Occurrence, Manufacturing of coffee powder, instant coffee. Cocoa Processing – Cocoa liquor, cocoa powder manufacturing. Coconut – Processing and by products. Cashew nut and Oil palm Processing. Processing of tuber crops – tapioca. Processing of potatoes-processed potato products.

#### Unit-2: Spices and Condiments

**9 hours**

Spices and Condiments: Description of various types of spices and condiments, their composition, functional properties, flavouring agents. Nutritive value of spices and their health benefits. Importance in culinary preparations. Scope of spice processing in India, Spice qualities and specifications, Antioxidant and antimicrobial qualities, medicinal values of spices.

**Unit-3: Processing of spices****9 hour**

Processing of major spices-Pepper, Cardamom, ginger and turmeric-Oleoresins and essential oils –Method of manufacture- Chemistry of the volatiles. Minor spices- Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla Oleoresins and essential oils –Method of manufacture- Chemistry of the volatiles. Importance of Cryogenic grinding of spices. Spice Oils – Concept and importance. Extraction methods - Solvent extraction, Steam distillation.

**Unit-4: Herbs & Flavouring materials****9 hours**

Herbs & Flavouring materials: Description of various types of herbs. Basil, Cilantro, Dill, Coriander, Mint, Oregano, Borage, Thyme, bilva leaves, Safflower. Nutritive value and health benefits. Processing and post - harvest handling.

**Unit-5: Flavouring materials of natural origin****9 hours**

Flavouring materials of natural origin: Natural flavours, sources of natural flavouring materials – Herbs and spices. Microbiology of spices, gas sterilization of spices, gamma irradiation, Heat treatment, Distillation, Extraction. Distillation of volatile oils, Application of spice essential oils. Oleoresins - Extraction, Quality and Application of oleoresins. Biosynthesis of flavours – Microorganisms, Enzymes, Plant suspension cultures

**REFERENCE BOOKS:**

1. Kumar N., "Introduction to spices, plantation crops, medicinal and aromatic plants", 2nd Edition, Oxford and IBH Publishing, New Delhi, 2006
2. Panda H., "Handbook on Spices and Condiments (Cultivation, Processing and Extraction)", 2nd Edition, National Institute of Industrial Research, New Delhi, 2010.
3. Peter K. V., "Handbook of Herbs and Spices", 2nd Edition, Wood head Publishing, USA, 2012.
4. Minifie Bernard W., "Chocolate, Cocoa and Confectionery Technology", 3rd Edition, Aspen publication, USA, 1999.

**213FTE2102 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY**

**L T P X C**  
3 0 0 0 3

**Pre-Requisite** : NIL      **Course Category** : Professional Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1: Select appropriate techniques for meat processing

CO2: Explain hygiene and sanitation procedures in meat industry

CO3: Elaborate handling and processing of meat

CO4: Select suitable processing techniques for poultry products

CO5: Illustrate fish processing and preservation techniques

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		L										M	L	
CO2	L					L	M	M					L		
CO3	M					L						L	H		L
CO4	M	L	M			L	L					L		L	M
CO5	L	L	L				L							M	M

**Syllabus**

**Unit-1: INTRODUCTION**

**9 hours**

Meat composition from different sources; muscle structure and compositions; post-mortem muscle chemistry; Factors influencing the quality of meat. Meat Microbiology and safety.9

**Unit-2: SLAUGHTERING AND STUNNING METHOD**

**9 hours**

Ante mortem inspection and handling, Stunning types, Slaughtering types. Steps in slaughtering (Pig, Cattle, Sheep/ Goat) and dressing. Slaughter house operations-Hoisting rail and traveling pulley system; Modern abattoirs, typical layout and features, Offal handling and inspection. Grading of meat- retail and whole sale cuts. Operational factors affecting meat quality. Byproduct utilization. Meat plant hygiene – GMP and HACCP.

**Unit-3: PROCESSING OF MEAT**

**9 hours**

Processing and preservation of meat: Chilling and freezing of meat, Canning, cooking, drying, pickling, curing and smoking; prepared meat products like sausages, kebabs, etc.. Intermediate moisture and dried meat products, Packaging of meat products.



**Unit-4: POULTRY PRODUCTS****9 hours**

Poultry: methods of slaughtering, Slaughtering equipment and operations, dressing, handling, storage and preservation of poultry meat. Spoilage and its control. Freezing and chilling of poultry. Whole sale and retail cuts. Eggs: Composition, handling, candeling, washing, coating, packaging and storage. Egg processing (Egg powder manufacturing, pasteurization, etc., Spoilage and its control.

**Unit-5: FISH PRODUCTS****9 hours**

Commercially important marine products from India, Proximate composition, Post mortem changes in fish muscle. Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish , Freezing of fish and shell fish contaminants and naturally occurring toxicants in fish; by product utilization; waste from fish industry.

**Reference Books:**

1. Legarreta, I.G, “ Handbook of Poultry Science and Technology” (Volume I and Volume II), John Wiley & Sons, Inc., Hoboken, 2010.
2. Mead M. “Poultry Meat Processing and Quality”. Woodhead Publ. 2004.
3. Pearson, A.M. & Gillett, T.A. “Processed Meat”. 3rd Ed. Chapman & Hall, 2006.

<b>213FTE2103</b>		<b>BAKING AND CONFECTIONARY TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
			3	0	0	0	3
<b>Pre-Requisite</b>	: NIL	<b>Course Category</b>	: Professional Elective Course	<b>Syllabus Revision</b>	2021		
Course Level	: 2	<b>Course Type</b>	: Theory Course				

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 Recognize the importance, standards and regulations related to bakery industry

CO2 Discuss the chemistry of dough and understand the equipments, process and ingredients for bread, bun and pizza base.

CO3 Explain the role of ingredients, equipments and the process involved in the preparation of cake, cookies, biscuits and crackers.

CO4 Summarize the role of ingredients, equipments and the process involved in the preparation of confectionery products.

CO5 Discuss the production and quality parameters of breakfast cereals, macaroni products and malt

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	M	M	M		L	L	M	M		M	M	L	H
CO2	H	M	M		M		M		M	L	M	M	H	M	M
CO3	H	M	H				L	L	H	M	M	M	M	H	H
CO4	M		M				M		H	L	M	H	M	M	M
CO5	L	M	L	L	M		L		M	L		M	L	M	L

**Syllabus****Unit-1: BAKERY INDUSTRY****10 hours**

Current status, growth rate, and economic importance of Bakery Industry in India. Product types, nutritional quality and safety of products, pertinent standards & regulations.

**Unit-2: BREAD, BUNS AND PIZZA BASE****9 hours**

The Chemistry of dough Development. Rheology of dough Farinograph, Amylograph, Alveograph and Extensiograph. Ingredients & processes for breads, buns, pizza base, Equipments used, product quality characteristics, faults and corrective measures

**Unit-3: CAKES, BISCUITS, COOKIES & CRACKERS****9 hours**

Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and Corrective measures. Different types of icings.

**Unit-4: CONFECTIONARY PRODUCTS****9 hours**

Hard-boiled candies, Caramel, Fudge, toffees fruit drops, chocolates and other confectionaries:- ingredients, equipments & processes, product quality parameters, faults and corrective measures.

**Unit-5: BREAKFAST CEREALS, MACARONI PRODUCTS AND MALT 9 hours**

Production and quality of breakfast cereals, macaroni products and malt, Production & quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products, sprouted grains.

**Reference Books:**

3. Beckette, Industrial Chocolate Manufacture, Wiley-blackwell publisher, 3rd edition, 2009
4. Faridi Faubion, Dough rheology and baked product texture, CBS publications, 1997.
5. Pyle, Baking science and Technology, Sosland Pub Co, 2009

<b>213FTE2104</b>	<b>SUGARCANE AND BEVERAGE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : NIL      **Course Category** : Professional Elective Course      **Syllabus Revision** 2021

Course Level : 2      **Course Type** : Theory Course

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Identify sugar cane constituents and apply preprocessing operations

CO2 Choose appropriate clarification methods for sugarcane juice

CO3 Adapt filtration and evaporative techniques for quality output

CO4 Setup process flow line with quality standards in sugar manufacturing unit

CO5 Apply the acquired knowledge on quality control for beverage industry

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M				L						L		L		
CO2	M				L	M					L		L		
CO3	M				L	M					L		L		
CO4		M			L		M			M	L		L		
CO5			M		L					M		L	L		M

#### Syllabus

##### Unit-1:PRE PROCESSING OPERATIONS AND JUICE EXTRACTION      9 hours

Sugarcane-Constituents, Composition of Sugarcane and Juice - Harvesting indices – Cane cutting - Manual, Mechanical – Transportation – loading – Unloading –Cane conveyor – Washing – Shredders - Types. Crushing –Crushers - Types, Crushing efficiency – Extraction of juice -methods, Accumulators – types – Maceration – Theory of cane diffusivity – different diffuser - ring diffuser - weighing of juice.

##### Unit-2: CLARIFICATION      9 hours

Clarification – methods - clarifying agent - bleaching agent-Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice and its importance. Filtration of mud.

##### Unit-3: FILTRATION AND EVAPORATION      9 hours

Filter types –filter press, rotary vacuum filter – Rapi - Flocc process. Filter cake washing. Evaporation - Evaporation rate - types of evaporators used in cane sugar industry - Cleaning of evaporators.

**Unit-4: SUGAR PRODUCTION****9 hours**

Entrainment separator – methods - Boiling in Vacuum pan-Footing magma - Masecuite. A, B, C - Mother liquor, Molasses A, B, C Molasses exhaustibility. Crystallization-Supersaturation- Crystallizers type-batch and continuous. Centrifuge - types. Drying of sugar –conveyors for sugar- by- product from sugar mills - utilization.

**Unit-5: TECHNOLOGY OF BEVERAGES MANUFACTURE (ALCOHOLIC AND NON ALCOHOLIC)****9 hours**

Manufacture of beer, wine and champagne - Quality characteristics, Manufacture of distilled beverages including whisky, brandy, rum and gin – Quality aspects Manufacture of carbonated beverages – quality aspects – Manufacture of sugar-free, sugarless, carbonated beverages.9

**Reference Books:**

1. Ram Behari Lal and Mathur. 1972., Hand book of cane sugar technology. Oxford and IBH Publishing company New Delhi
2. W.V. Cruces, Technology of wine making food science, Agrobios Publishers, 2009
3. Baikow, V.E. 1967. Manufacturing and refining of raw cane sugar. Elsevier Publishing Company, New York
4. Girdhilal and Siddappa, Preservation of Fruits and Vegetables, Kalyani Publishers 2001.

<b>213FTE2105</b>	<b>TECHNOLOGY OF SNACK AND EXTRUDED PRODUCTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		2	0	0	3	3

<b>Pre-Requisite</b>	: NIL	<b>Course Category</b>	: Program Elective Course	<b>Syllabus Revision</b>	2021
Course Level	: 2	<b>Course Type</b>	: Theory Course		

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Classify the different types of extrusion methods with their principle

CO2 Adapt the concept of modeling to design the extruders

CO3 Analyze the impact of physio-chemical characters of food ingredients and process parameters on quality of extruded products

CO4 Adapt the impact of process parameters on Nutritional aspect extruded product

CO5 Infer the Applications and Advantages of Extruders

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		H	M	H								M		
CO2		M	M	M	H								M		
CO3	M		M	M	H								M		
CO4	H			M	H								M		
CO5	H		M	M	H		M				M	M	M		M

#### Syllabus

##### **Unit-1: INTRODUCTION AND CLASSIFICATION OF EXTRUDERS 10 hours**

Food extrusion: Introduction – Advantages – history of food extrusion –principle of extrusion process -Application of extrusion processing - Components of extruder: extrusion drive, feed assembly, extrusion screw, extruder barrel, extruder discharge- classification of extruders: single screw, twin screw, cold extruder, extrusion cooking, Low pressure and high-pressure extrusion

##### **Unit-2: RHEOLOGICAL PROPERTIES OF EXTRUDED FOODS AND SELECTION OF EXTRUDER 9 hours**

Rheology of feeds, rheological properties of materials during extrusion process - extruder selection, design and operation for different food applications – operating variables involved in extrusion measurements and experimentation

**Unit-3: COMPOSITION AND PHYSICAL REQUIREMENTS OF EXTRUDER FEEDS 9 hours**

Raw materials for extrusion of foods - Preconditioning of extruder feeds, benefits, types of pre conditioners (atmospheric and pressurized), single/double shaft, DDDS, Effects of extruder parameters and feed composition on characteristics of extruded products: gelatinization of starch feeds, denaturation of protein feeds

**Unit-4: CHANGES CAUSED BY EXTRUSION 9 hours**

Structural changes – expansion, texturization -impacts of extrusion processing on nutritional components in cereals and legumes: carbohydrates, protein, lipid, vitamins, minerals - Quality parameters of extrudates and methods for determination 9

**Unit-5: INDUSTRIAL APPLICATION OF EXTRUSION TECHNOLOGY TO DEVELOP SNACK FOODS 9 hours**

Food – Protein based, sugar based and cereal based (Ex. RTE Breakfast cereals, meat substitutes, textured plant and milk proteins, specialty foods, toffee, surimi, snacks etc.,) Precooked/thermally modified starch, flours and grain. Animal feed- pet foods, aquatic feed, cattle feed. Quality improvement – Texture alteration, Enzymes inactivation, partial dehydration, Homogenization, Protein denaturing, Gelatinization, destruction of microbes and toxic compounds. Meat analogues. 9

**Reference Books:**

1. Medeni Maskan, Aylin Altan - Advances in Food Extrusion Technology - CRC Press (2016)
2. N. D. Frame - The Technology of Extrusion Cooking - Springer science business media (2012)
3. Judson M Harper
4. Judson M Harper, Extrusion of Foods, Volume I, CRC Press (2019)
5. Girish M Ganjyal, Extrusion Cooking: Cereal grains processing, 2nd edition, Woodhead Publishing, (2020)
6. Jean-Marie Bouvier and Osvaldo H. Campanella -Extrusion Processing Technology: Food and Non-Food Biomaterials – Wiley – (2014)

**213FTE3106 FOOD PROCESS EQUIPMENT DESIGN AND PLANT LAYOUT**

**L T P X C**  
3 0 0 0 3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1: Illustrate details of Material composition for effective construction of machines depending on food product

CO2: Illustrate the design equipments based on material handling capacity and quality of materials

CO3: Enumerate food transportation within processing unit with Conveyor belts and Elevators

CO4 Explain the importance of plant layout

CO5 Describe the requirement plant setup and scale up

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	M			M	M						H	L	M
CO2	H	M	H		M	M		L					H	M	M
CO3	H	H	H	H		M		L	M	M		M	M	H	H
CO4	H	H	H	H	H	M	M	L	M	M		H	M	H	H
CO5	H	H	H	H	H	M	M	L	L	L	H	H	M	H	M

**Syllabus**

**Unit-1: INTRODUCTION**

**11 hours**

Introduction to various mechanical properties of materials to be used as material of construction, resistance of metals to corrosion under varying conditions of temperature and pressure etc. Application and use of various codes and standards in design.

**Unit-2: DESIGNING OF HANDLING EQUIPMENT**

**9 hours**

Design of material handling equipment: Belt conveyor, bucket elevator, screw conveyor, chain conveyor, pneumatic conveyor. Design of seed processing equipments: Air screen cleaner, rotary cleaner, graders based on size shape and surface produce and led, seed treater.

**Unit-3: DESIGNING OF OTHER EQUIPMENT**

**9 hours**

Design of nozzles, openings and re inforcements, Bolts, flanges, gaskets. Process Design of double pipe heat exchanger; Shell & Tube Heat Exchanger. Design of Evaporator

**Unit-4: SITE SELECTION AND PLANT LAYOUT**

**9 hours**

Site selection - Factors - Case Study: Site Selection - Product Capacity and quality – Storage of Raw materials and Product - Waste Disposal, Utilities

New Plant Layout- Product and process layout - Expansion and Improvements of Existing/ Facilities- Case Study



**Unit-5: PLANT DESIGN****9 hours**

Manufacturing Plant Design, Expansion – Plant Location –Classification of dairy and food plants, farm level collection and chilling Centre, space requirements.

Best practices of hygienic design - Cleaning and decontamination, personal hygiene, drainages, hazard management

**Reference Books:**

1. Dennis R. Heldman and Daryl B. Lund. “Hand Book of Food Engineering”, Second edition, CRC Press, Taylor and Francis Group, 2007.
2. William D. Baasel. “Preliminary chemical engineering plant design”, Second edition Van Nostrand Reinhold, 1990.
3. PetersMax.S.,Timmerhaus Klaus D.and Ronald E West., Plant Design and Economics for Chemical Engineers, McGrawHill (2003)
4. Perry,R.Hand Chitton, Perry's Chemical Engineers Handbook, McGrawHill, NewYork,7th Edition,1997.

<b>213FTE2107</b>	<b>FOOD PRODUCT DEVELOPMENT AND SENSORY ANALYSIS OF FOOD</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Explain the fundamentals of food product development
- CO2 Recognize the importance of sensory analysis in Food product development
- CO3 Discuss about the sensory methods and its importance
- CO4 Select the appropriate sensory analysis technique as per the requirement
- CO5 Summarize the important role of QC, packaging, labelling in new product development

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	L										M		L
CO2	H	M	L				L						M	L	
CO3	H	M	L	L	M		L	L	L	L		M	H	M	M
CO4	H	H	M	L	M		M	L	L	L		M	H	H	H
CO5	H	H	M	M	H	M	M	H	H	H	M	M	H	M	H

#### Syllabus

##### Unit-1: INTRODUCTION

**12 hours**

Overview of Food Product Development (FPD), Product Development Process, Ideation and Screening Process, FP Marketing and Market Research, Legal and Fiscal, – Test Markets and Launches, Successes and Failure. Optimization methods in product development.

##### Unit-2: CASE STUDY & SENSORY EVALUATION

**9 hours**

Technical Aspects of New Product Development – Case studies of product development. Sensory analysis of food, Application of sensory analysis in food industry. Fundamental concepts of taste, odour, colour, texture, and sound.

##### Unit-3: INTRODUCTION

**11 hours**

Factors affecting sensory analysis; Do's and Don'ts of sensory analysis. Types of panels members and selection of panel members. Threshold test for basics taste, dilution test and taste recognition test. Difference test –Simple paired test, Duo-trio, triangle test and ranking test

**Unit-4: RATING TEST AND DESCRIPTIVE TEST****9 hours**

Rating test – simple monadic test, extended triangle test, Directional paired test, hedonic scale, Multiple sample difference test, Numerical scoring test, and composite scoring test.

Descriptive test – product bench marking, texture profiling, flavor profiling, quantitative descriptive analysis etc.,

**Unit-5: QUALITY ASPECTS****9 hours**

QC/QA Aspects of Food Product Development, Microbial Aspects of New Product Development, Package design and Development , Shelf Life of Packaged Foods, Nutrients and Fortification, Labeling and Pertinent Regulations

**Reference Books:**

1. Brody, A.L. and Lord,J. 2008. Developing New Food Productsfor a Changing Marketplace, 2nd Edition. CRC Press, Boca Raton, FL.
2. Campbell-Platt,G. 2009. Food Science and Technology. Blackwell Publishing Ltd., Oxford,UK.
3. Rao E. S. (2013). Food Quality Evaluation, Variety Books
4. Fuller,G.W. 2011. New Food Product Development, 3rd Edition. CRC Press, Boca Raton, FL.
5. Moskowitz,H., Saguy, I. S., and Straus, T. 2009. An Integrated Approach to New Food Product Development. CRC Press, Boca Raton, FL.

**213FTE108 FOOD WASTE MANAGEMENT AND BY-PRODUCT UTILISATION**

**L T P X C**  
3 0 0 0 3

**Pre-Requisite** : NIL **Course Category** : Professional Elective Course **Syllabus Revision** 2021

**Course Level** : 2 **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Analyse the global scenario of food wastage and characterize the by-products from food industry

CO2 Explain the regulatory issues with the waste generated from food industry

CO3 Understand various treatment methods of solid wastes

CO4 Understand various treatment methods of liquid wastes

CO5 Analyse the waste and by-products utilization from food industries

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	H				L	H	M			H	M	L		
CO2		M	M			H	H	M				M	M		
CO3		H	M			H	H	M		M	H	M			L
CO4		M	M			H	H	M		M	H	M			L
CO5			M				H	M				M			M

### Syllabus

**Unit-1: CHARACTERIZATION OF FOOD INDUSTRY WASTE 9 hours**

Introduction, food wastage – food loss – global scenario – sources of food waste causes - impact of food losses and waste- characterisation and Composition of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Need for minimization of food waste - food waste hierarchy – need for treating waste from various food industries

**Unit-2: REGULATORY ISSUES WITH FOOD INDUSTRY WASTE 9 hours**

International and national scenario on disposal of waste from food industries – Regulatory issues with food industry waste - Standards for emission or discharge of environmental pollutants from food processing industries covered under EPA Act. Environmental Management Systems for Food Industries – ISO14000 for Food Industries

**Unit-3: TREATMENT METHODS OF SOLID WASTE FROM FOOD INDUSTRIES**  
**9 hours**

Food waste treatment methods – Principles and practices of solid food waste treatment, 3R concept - land filling – composting – thermal processes drying, incineration, gasification, digestion -aerobic and anaerobic, briquetting

**Unit-4: TREATMENT METHODS OF LIQUID WASTE FROM FOOD INDUSTRIES**  
**9 hours**

Physical pretreatment: Screening, sedimentation, filtration, floatation, back washing, membrane separation - Principles of chemical treatment - BOD and COD, biological oxidations: objectives, organisms, reactions, oxygen requirements, aeration devices. Improved biocatalysts and innovative bioreactors for enhanced bioprocessing of liquid food wastes. Effect on characteristic parameters of effluents in treatments using lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biological contractors and their variations and advanced modifications.

**Unit-5: BY PRODUCT UTILIZATION****9 hours**

Key drivers for waste management and co-product recovery in Food Processing - Key issues and technologies for food waste separation and co-product recovery – Potential uses of treated waste from dairy, fruits and fruit juice, vegetables, cereal, meat, fish and sea food industries.

**Reference Books:**

1. Lawrence K. Wang, Yung-Tse Hung., Waste water treatment in the food processing industry, CRC press, 2nd edition, 2006
2. N.F.Gray., Water technology:an introduction for environmental scientists and engineers, Elsevier Butterworth-Heinemann,2nd Edition,2002
3. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 1st edition, 2008
4. Patwardhan., Industrial Waste Water Treatment, Prentice-Hall of India Pvt Ltd,1st edition, 2008
5. K.C.Agrawal., Environmental pollution and law, Agro Botanical Publishers, 1995
6. Riley, Garrett Leonard., Food waste: practices, management and challenges, Nova Science Publishers, 2016

<b>213FTE2109</b>	<b>FOOD SAFETY AND QUALITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand the food quality and quality assurance methods
- CO2 Gain knowledge on food adulterants and food contaminants
- CO3 Understand the food safety and quality management systems
- CO4 Apply the hygienic and safe practices to produce quality and safe food
- CO5 Summarize the important role of QC, packaging, labelling and regulations

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	L	M	H	L						M	H	M	L
CO2	H	M	L	H	H	M	M					M	H	H	M
CO3	H	H	H	H	M	L	M		H	M	H	H	M	M	H
CO4	M	M	M			L	L	M	M	M	M	M	M	M	H
CO5			M			L		M				M	M	M	H

### Syllabus

#### UNIT 1: BASIC CONCEPT

Definition and terminology-quality, safety, quality management, quality assurance, quality control, Factors affecting food safety Quality attributes/measures of foods-Benefits and drawbacks, Methods of quality determination-Subjective and Objective methods, Food Sampling and statistical tools

#### UNIT 2: CONTAMINANTS, ADULTERANTS AND ADULTERANTS

Sources of Contamination-physical, chemical and microbial, Hazards, Food Toxicants, Food intoxication. Foodborne pathogens and diseases, Food contaminants, Pesticide residues, and Antibiotics; Common adulterants in food and detection methods-principle

#### UNIT 3: FOOD HYGIENE

Personal hygiene, Water in the food industry-Water sources, Water uses, Water quality, Treatments; Cleaning and sanitation, Clean in Place (CIP)- Cleaning agents, Sanitizing agents, Evaluation of sanitation efficacy, Pest Control, Pest Classification (insects, rodents and birds)-Prevention and control.

**UNIT 4: CONCEPT OF RISK ANALYSIS**

HACCP-definition; Principles, Identification of critical control point (CCP) in food production, applications and Implementation; Risk assessment, Risk characterization, Risk management-general principles and Implementation, Risk communication

**UNIT 5: QUALITY MANAGEMENT SYSTEM**

Fundamentals and Standards requirements- QMS (ISO: 9000:2000); Total quality management (TQM) tools and techniques; Average outgoing quality limit (AOQL), Food Safety Management System (FSMS) Tools- PRPs, GHPs, GMPs, GAPs, GLPs, and SSOPs; Environmental Management System (EMS)

## Reference Books:

1. S.Ranganna. – Hand Book of Analysis and Quality Control for Fruit and Vegetables Products. Tata McGraw –Hill. 2nd Edition. 1986.
2. Manoranjan Kalia. - Food Quality Management. Agrotech Publishing Academy. 2nd Edition. 2014.
3. Taxmann's. - Guide to the Food Safety and Standards Act 2006. Allied Services Pvt. Ltd. 2006.
4. Rajesh Mehta and J. George - Food Safety Regulation Concerns and Trade. Published by Macmillan India Ltd., New Delhi. 2005.

<b>213FTE2110</b>	<b>FOOD LAWS AND REGULATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3
<b>Pre-Requisite</b>	: NIL	<b>Course Category</b>	: Program Elective Course	<b>Syllabus Revision</b>	2021	
Course Level	: 2	<b>Course Type</b>	: Theory Course			

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

- CO1 Explain the national food laws and regulations  
 CO2 Describe the international laws  
 CO3 Summarize the importance of voluntary laws  
 CO4 Explain the import and export laws  
 CO5 Recognize the quality management system

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M			L		H	M	M	L	M	M	H	
CO2		H						H	M	M	L	M		H	
CO3		M	H					H	M	M	L	M		H	
CO4		M	M					H	M	M	L	M		H	
CO5		M	H				H	H	M	M	L	M		H	

**Unit-1: INTERNATIONAL FOOD LAWS AND REGULATIONS 9 hours**

Structure, organization and practical operation: WTO Implications: SPS and TBT agreement, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR), CAC (Codex Alimentarius Commission) - Structure of Codex, Scientific Basis, Harmonization of National Standard with Codex, International Consultative Group on Food Irradiation (ICGFI). Other International Standard Setting Bodies: ISO, OIE, IPPC, AOAC, ASTM, EU and USFDA 13

**Unit-2: NATIONAL FOOD LAWS AND REGULATIONS 9 hours**

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules & Essential Commodities Act, 1955. FPO, SWMA, MPO. Structure, organization and practical operation of BIS, AGMARK & FSSAI. Organic food certification - NPOP, EIC.

**Unit-3: VOLUNTARY AND MANDATORY REGULATIONS 9 hours**

Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Need for labelling, limitations of labelling- safety issues, labelling for irradiated foods, genetically modified foods, nutritional labelling, health claims



**Unit-4: EXPORT & IMPORT LAWS AND REGULATIONS****9 hours**

Foreign Trade Policy. Export (Quality Control and Inspection) Act, 1963, Promotion Bodies, Plant and Animal Quarantine, Customs Act and Import Control Regulations. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Marine Products Export Development Authority of India (MPEDA)

**Unit-5: STANDARDS****9 hours**

ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

**Reference Books:**

1. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country Perspective, Macmillan, 2005.
2. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons
3. J. Andres Vasconcellos, Quality Assurance for the Food Industry: A Practical Approach, 1st Edition, 2003.

**213FTE2111 FOOD ALLERGENS AND TOXICOLOGY**

L	T	P	X	C
2	0	0	3	3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course  
**Syllabus Revision** : 2021

**Course Level** : 2      **Course Type** : Theory Course

**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 Infer the concepts of food toxicology

CO2 Classify toxins, allergens and interpret its sensitivity in human food chain

CO3 Identify toxicants formed during food processing

CO4 Analyze the risks involved in human exposure to toxicants

CO5 Select suitable method for detection of toxins

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M			L	H						L	M	
CO2	M		M			L	M	L						M	
CO3		M	M	L			M							H	
CO4		M		M		L	H			L				H	
CO5			H	M			H	L		L		M		H	

**Syllabus****Unit-1: INTRODUCTION****9 hours**

Definition and need for understanding food toxicology; Hazards – Microbiological, nutritional and environmental. Basics of immune resources – humoral and cell media resources. Allergen and mechanism of allergic resources

**Unit-2: PRINCIPLES OF TOXICOLOGY****9 hours**

Natural food toxicants – toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, toxin absorption in the G.I. track, Industrial microflora, blood, brain barrier, storage and excretion of toxins

**Unit-3: FOOD ALLERGY AND SENSITIVITY****9 hours**

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

**Unit-4: TOXICANTS DURING FOOD PROCESSING****9 hours**

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens – Polycyclic aromatic hydrocarbons, N – nitrosamines, Acrylamide and their mode of action

**Unit-5: DETERMINATION OF TOXICANTS IN FOOD SAMPLING 9 hours**

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immunotoxicity.

**REFERENCE BOOKS**

1. Helferich, William and Carl K. Winter “Food Toxicology” CRC Press, 2001.
2. Alluwalla, Vikas “Food Hygiene and Toxicology” Paragon International Publishers, 2007.
3. Shibamoto, Takayuki and Leonard F. Bjeldanzes “Introduction to Food Toxicology” 2nd Edition. Academic Press, 2009.
4. Maleki, Soheila J. A. Wesley Burks, and Ricki M. Helm “Food Allergy” ASM Press, 2006
5. Labbe, Ronald G. and Santos Garcia “Guide to Food Borne Pathogens” John Wiley and Sons, 2001.
6. Cliver, Dean O. and Hans P. Riemann “Food Borne Diseases” 2nd Edition. Academic Press/Elsevier, 2002.
7. Riemann, Hans P. and Dean O. Cliver “Food Borne Infections and Intoxications” 3rd Edition. Academic Press/Elsevier, 2006

<b>213FTE3112</b>	<b>FOOD STORAGE AND INFESTATION CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

**Course Level** : 3      **Course Type** : Theory Course

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 To understand the fundamentals of infestation

CO2 To recognize the storage loss and insect ecology

CO3 To explain the grain storage and management

CO4 To emphasis the importance of pest control

CO5 To understand quality control concept in grain storage

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		L		L		L			L	M		M		
CO2	M		M		L		L			L	M		M		
CO3		M	M		L		L			L	M		M		
CO4		M	M		L		L			L	M		M		
CO5		M	M		L		L			L	M		M		

#### Syllabus

##### Unit-1: Fundamentals of Storage Infestation

**9 hours**

Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post- harvest losses - total production of food grains in India. Scientific and socio-economic factors responsible for grain losses. Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products.

##### Unit-2: Ecology of Insects and Storage Losses

**9 hours**

Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.

**Unit-3: Grain Storage and Management****9 hours**

Grain storage, Types of storage structures - traditional, improved and modern storage structures in current usage. Ideal seeds and commodities storage conditions. Important rodent pests associated with stored grains and their non- chemical and chemical control. Pest Birds – role and its management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods.

**Unit-4: Pest Control Measures****9 hours**

Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative. Pesticides – characteristics, uses and precautions in handling. Integrated approaches to stored grain pest management.

**Unit-5: Quality Control in Grains****9 hours**

Detection of insect infestation in stored food grains, losses in stored food grains – weevilled and unweevilled grains, determination of moisture content in stored food grains, Quality control aspects in storage godowns, central warehouse. Demonstration of preventive and curative measures including fumigation techniques; treatment of packing materials and their effect on seed quality.

**Reference Books:**

1. Narayanasamy P., Mohan S & Awaknavar J. S., "Pest Management in Store Grains", 1st Edition, Satish Serial Publishing House, New Delhi, 2009.
2. Nair K.R., "Integrated Production and Pest Management", 1st Edition, Gene-Tech Books publisher, New Delhi, 2009.

<b>213FTE3113</b>	<b>EMERGING TECHNOLOGY IN FOOD PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

Course Level : 3      **Course Type** : Theory Course

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Explain the concepts and effects of high-pressure processing

CO2 Organize non thermal processing of food and its application in food processing

CO3 Choose novel non thermal methods for sterilization of food

CO4 Show basic hurdle technology, mechanism and its action in food

CO5 Experiment with freeze concentration and its effect on food

#### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M		M									M	L	M
CO2	H	M	H										M	M	M
CO3	H	M	M		L								M	M	H
CO4	H	M	H	H									H	M	H
CO5	H	M	L										M	M	L

#### Syllabus

##### Unit-1: HIGH PRESSURE PROCESSING OF FOODS

**9 hours**

Introduction, principles & mechanisms, applications of high pressure processing (HPP) to food systems, HPP of Salads, ready meals, meats, sea foods, fruits and fruit products – Effects of high pressure on microorganisms, enzyme activity, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, effect of high pressure freezing on microorganisms and enzyme inactivation

##### Unit-2: PULSED ELECTRIC FIELDS PROCESSING

**9 hours**

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

**Unit-3: FOOD IRRADIATION****9 hour**

Introduction - Fundamentals of food Irradiation - Type and sources of radiation, dosimetry, mode of action of ionizing radiation - Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations.

**Unit-4: MICROWAVES IN FOOD PROCESSING 9 hours**

Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating – combined microwave-vacuum drying, microwave freeze-drying - applications.

**Unit-5: ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES 9 hours**

High intensity pulsed light technology - Principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ultrasound Processing: Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultra sound on properties of foods – Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms

**Reference Books:**

1. Da-Wen Sun,—Emerging Technologies for Food Processing, Academic press/ Elsevier, London, UK,2005.
2. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food Stability safety and quality, Kluwer Academics / Plenum Publishers, New York (2002)
3. Da –Wen Sun, —Thermal Food Processing: New Technologies and Quality Issues, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, Florida,USA, 2012.
4. Gustavo V.Barbosa-Canovas, Maria S.Tapia and M.Pilar Cano, —Novel Food Processing Technologies. CRC Press, 2004
5. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, Novel Food Processing Technologies. CRC Press, 1st Edition, 2004.
6. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.

**213FTE3114 ENZYMES AND ITS APPLICATIONS IN FOOD PROCESSING**      **L T P X C**

2 0 0 3 3

**Pre-Requisite** : NIL      **Course Category** : Program Elective Course      **Syllabus revision**      **Pre-Requisite**

**Course Level** : 2      **Course Type** : Theory Course

Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Infer the enzyme kinetics and production of industrial enzymes

CO2 Select suitable enzymes for milk processing and brewing

CO3 Choose appropriate enzymes for non alcoholic beverage production

CO4 Apply and relate the effect of enzymes in baking process

CO5 Make use of enzymes in processing of meat and meat products

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	L											M	L	
CO2	M	L											M	L	
CO3	H	M	L	M	L	M		M	M	L			H	M	M
CO4	H	M	L			M							H	M	
CO5	H	M	L			L	M	M	M	L		L	M	M	H

## Syllabus

### Unit-1: Enzyme kinetics and Production of industrial enzymes 9 hours

Enzyme kinetics: Enzyme-Classification and Nomenclature, Units of Activity, General Characteristics. Enzyme Kinetics - Michaelis Menden Equation, Linear Plots / Km and Vmax. Production of industrial enzymes: Sources of enzymes, microbial fermentation and downstream processing, Enzyme formulation. Enzyme Immobilization - Physical and chemical techniques for enzyme immobilization-adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples, advantages and disadvantages.

### Unit-2: Enzymes in milk processing and brewing industry 9 hours

Milk Processing: Milk clotting enzymes, Lacto peroxidase, Cheese-ripening enzymes, Lysozyme, Lactase, Lipase, Transglutaminase Brewing: Malting, Brew house processing, Enzyme applications and their role during fermentation, Beer stabilization.

### Unit-3: Enzymes in non alcoholic beverage 9 hours

Application of enzymes in tea and cocoa processing. Role of the enzymes in fruit juice production, factors affecting the enzymatic activity. Enzymatic clarification of apple and guava juices, factors affecting the clarification of fruit juices.



**Unit-4: Enzymes in baking industry****9 hours**

Enzymes for baking industry, Use of the proteinases, lipases and pentosans in baking industry, Starch degrading enzymes: sources, analysis and application of starch degrading enzymes. Hemicellulase, xylanases: sources, analysis and application.

**Unit-5: Enzymes in meat processing****9 hours**

Enzymes used for meat processing: protease and peptidase, lipases, trans glutaminase, oxidative enzyme. Meat tenderization with added enzyme, Enzymatic generation of flavour in meat products, Restructuring of unheat meat.

**Reference Books:**

1. Robert J. Whitehurst & Maarten van oort., "Enzymes in Food Technology", 2nd Edition, John Wiley & Sons, UK, 2009.
2. Muthusamy Chandrasekaran, "Enzymes in Food and Beverage Processing", 1st Edition, CRC Press, USA, 2016
3. Robert Rastall., "Novel Enzyme Technology for Food Applications", 1st Edition, Wood head Publications, USA, 2007.

**213FTE3115****FUNCTIONAL FOODS AND  
NUTRACEUTICALS****L T P X C**  
3 0 0 0 3**Pre- Requirement** : Nil **Course Category** : Program Elective Course **Syllabus Revision** 2021**Course Level** : 3 **Course Type** : Theory Course

## Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Classify the functional foods and its properties

CO2 Infer regarding Metabolic disorders and its relation with functional foods

CO3 Adapt the methods to formulate fortification in Food supplements

CO4 Utilize food waste for nutrition enrichment and its functions

CO5 Identify the importance of herbal medicine and nutraceuticals foods

## Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M		L		L							L		
CO2		M	H			M		H		M		L	L	L	
CO3	M	M				M		M			M	L		L	
CO4	L		M			M	L	L			L	L	L		
CO5	L		M			M	H	M			M	M	M		

## Syllabus

**Unit-1: NUTRACEUTICALS AND ITS CLASSIFICATION****9 hours**

Nutraceuticals – History – Sources - Classification based on chemical nature - market demand – potential role in human health – nutraceutical factors in specific foods – mechanism of action

**Unit-2: FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS****9 hours**

General background on phytochemicals as antioxidants - flavonoids and lipoprotein oxidation - Evidence for specific Antioxidant mechanisms of flavonoids - Dietary carotenoid and carotenoid absorption - Approaches to measurement of absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents

**Unit-3: OMEGA-3 FATTY ACIDS AND CLA****9 hours**Introduction to Lipoprotein metabolism - PUFA and Cardiac arrhythmias - Preventative role of n-3 fatty acids in cardiac arrhythmias - Mechanism of action on n-3 PUFA's -  $\omega$  – 3 fish oils and their role in glycemic control-  $\omega$  – 3 fatty acids and rheumatoid arthritis - Chemistry and nomenclature of CLA – Analysis of CLA in food and biological samples – CLA in food products and biological samples – Biological actions and potential health benefits of CLA – Mechanisms of CLA action – Potential adverse effects of CLA.

**Unit-4: LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS****9 hours**

Lycopene overview, lycopene and disease - Garlic – Chemistry and its implication in Health - Olive oil – CHD – Cancer - Nuts – Nutrient components and composition - Nut consumption and CHD, Human nutritional studies on nut consumption and serum lipid changes, Mechanism of action- Probiotics- products on market – Microbiology of the gastrointestinal tract - Prebiotics – future for probiotics and prebiotics.

**Unit-5:HERBS AS FUNCTIONAL FOODS****9 hours**

Herbal medicine – Herbs as ingredients in functional foods – actions of herbal and evidence of efficacy - Kinetic modelling of chemical reactions – Accelerated shelf-life testing - Evolution of marketing environment for functional foods and nutraceuticals - Regulatory background - Introduction to consumer marketing issues for nutraceuticals - Potential product positioning.

**Reference Books:**

1. Robert E.C Wildman. Handbook of Nutraceuticals and Functional Foods, Ed., Robert E.C. Wildman, CRC Press LLC. ISBN – 0849387345, 2001
2. Schmidl, M.K. and T.P. Labuza. (2000). Essentials of Functional Foods. Aspen Publishers, inc., Gaithersburg, MD. ISBN 978-0-8342-1261-9
3. Tomris Altug. (2003). Introduction to Toxicology and Food. CRC Press, Boca Raton, FL. ISBN 9780849314568
4. Stanley T. Omaye . (2004). Food and Nutritional Toxicology CRC Press, Boca Raton, London. eBook ISBN: 978-0-203-48530-9

<b>213FTE3116</b>	<b>ADVANCED HUMAN NUTRITION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Program Elective Course      **Syllabus Revision** 2021

**Course Level** : 3      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 To understand the technological aspects of nutrition
- CO2 To recognize the importance of therapeutic nutrition
- CO3 To develop a formulation for the maternal and sport nutrition
- CO4 To emphasis the importance of nutrition in aging, cancer and cardiovascular diseases
- CO5 To understand the inborn errors and antinutritional factors

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	L											M	L	
CO2	M	L											M	L	
CO3	H	M	L	M	L	M		M	M	L			H	M	M
CO4	H	M	L			M							H	M	
CO5	H	M	L			L	M	M	M	L		L	M	M	H

### Syllabus

#### Unit-1: INTRODUCTION

**10 hours** Recent

advances in biochemistry of food metabolism and nutritional aspects of foods; Food components and nutrients affecting immune systems, behaviour and performance; Functional aspects of dietary fibre, amino acids & peptides, lactic acid bacteria, antioxidants, vitamins, fatty acids etc

#### Unit-2: THERAPEUTIC NUTRITION

**9 hours**

Therapeutic nutrition & formulation of special dietary foods; Relation of food and diseases; Deficiencies of essential nutrients; Assessment of nutritional status & RDA; Effect of processing on nutrients; Functional foods and nutraceuticals with attributes to control cardiovascular diseases, cancer, obesity, ageing etc

#### Unit-3: NUTRITION FOR SPECIALIZED PURPOSE I

**9 hour**

Sports nutrition –Lactic acid energy system, Endurance and power athlete's nutrition requirement, child and adult athlete's nutrition requirement. Nutrition for specialized purposes – Maternal nutrition, Nutrition during pregnancy, Paediatric nutrition

**Unit-4: NUTRITION FOR SPECIALIZED PURPOSE II****9 hours**

Geriatric nutrition, Functional foods for Ageing –Theories of ageing – Nutrition and ageing  
Cancer and its prevention - Age-related metabolic disorders – Nutrition in the treatment of age-related disorders like hypertension, diabetes, Alzheimer's disease

**Unit-5: INBORN ERRORS OF CARBOHYDRATE, PROTEIN AND FAT METABOLIS****9 hours**

Inborn errors of carbohydrate, protein and fat metabolisms - Nutrition and disorders associated with organs such as liver and kidney - Naturally occurring anti-nutritional factors – Cyanogens, lectins, enzyme inhibitors, phytoalexins, phytates

**Reference Books:**

1. Martin Eastwood. Principles of Human nutrition – Second Edition, Ed. Wiley - Blackwell Publishing, 2003.
2. Advances in food and nutrition research by Steve L. Taylor
3. Robert E.C Wildman. Handbook of Nutraceuticals and Functional Foods, Ed., Robert E.C. Wildman, CRC Press LLC. ISBN – 0849387345, 2001

## OPEN ELECTIVES

**214FTE2101                      FOOD PROCESSING TECHNOLOGY                      L    T   P   X   C**

3    0   0   0   3

**Pre-                      : Nil                      Course                      : University Elective                      Syllabus                      2021**  
**Requisite                      :                      Category                      : Course                      Revision**

Course Level : 2                      Course Type : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Explain the current scenario of food demand in India& world
- CO2 Understand the unit operations to control the factors affecting foods
- CO3 Apply Unit Operations and Unit Processes in food process industries
- CO4 Explain about the packaging technologies for various kinds of foods
- CO5 Apply the manufacturing techniques in the production of value added food products under aseptic conditions in food process industries

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M		L		L		M				L	M	M	
CO2	M		L	M						L	L		M	L	
CO3	M		L		M	L					M		L		L
CO4	M		M		L	L					M		L		L
CO5	M	L	M		L	L	H	M			L		M		

### Syllabus

#### Unit-1: INTRODUCTION

**9 hours**

General aspects of food industry; World food need and Indian situation; Constituents of food; Quality and nutrition aspects; Food additive and standards

#### Unit-2: DETERIORATIVE FACTORS

**9 hours**

Deteriorative factor and their control; Preliminary processing methods; Conservation and Preservation Operations

#### Unit-3: PRESERVATION METHODS

**9 hours**

Preservation by heat and cold; Dehydration; Concentration; Frying; Drying; Irradiation; Microwave heating.

**Unit-4: PACKING METHODS****9 hours**

Sterilization and pasteurization; Fermentation; Pickling; Packing methods. Cereal, grains; pulses; Vegetables; Fruits; Spices; Fats and Oils.

**Unit-5: PRODUCTION AND UTILIZATION OF FOOD PRODUCTS****9 hours**

Bakery, confectionery and chocolate products; Soft and alcoholic beverages; Dairy products; Meat; poultry and fish products: - Factory Hygiene -Wastewater disposal and pollution control in food industry

**Reference Books:**

1. P.J. Fellows. — Food Processing Technology –Principles and Practicell. Woodhead Publication. 3rd edition.2009.
2. Toledo, R. T., Fundamentals of Food Process Engineering, Aspen Publishers, 2nd Edition, 2002.
3. Stephanie Clark, Stephaine Jung, Buddhi Lamsal. — Food Processing: Principles and Applicationsl. Wiley Blackwell. 2nd Edition.2014.

<b>214FTE2102</b>	<b>TECHNOLOGY OF CONVENIENCE FOOD</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : University Elective      **Syllabus** : 2021  
**Revision**

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs’):

On successful completion of the course, the students would be able to;

- CO1 Understand the food habits and food preparation from historical and cultural point of view  
CO2 Explain the production of dairy products and traditional beverages using traditional methods  
CO3 Understand the traditional food patterns in different regions of India  
CO4 Explain the commercial production of traditional food products  
CO5 Compare and analyse the health effects of traditional foods with fast foods

### Mapping of COs’ with POs’/PSOs’

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M					H		L		L			L		
CO2			M		L	L					M		M		
CO3		M	M			H					M		M		
CO4			M			M					M		M		
CO5	M		M			H	M				H			H	

### Syllabus

**Unit -1: HISTORICAL AND CULTURAL PERSPECTIVES**      **9 hours**

Importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, festive occasions, specific religious festivals, mourning; Kosher, Halal foods.

**Unit -2: TRADITIONAL METHODS OF FOOD PROCESSING**      **9 hours**

Dairy Products- paneer, butter and ghee manufacture; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi.      9

**Unit -3: TRADITIONAL FOOD PATTERNS**      **9 hours**

Typical breakfast, meal and snack foods of different regions of India, Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods



**Unit -4: COMMERCIAL PRODUCTION OF TRADITIONAL FOODS      9 hour**

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods, Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.      9

**Unit -5:      HEALTH ASPECTS OF TRADITIONAL FOODS      9 hours**

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments/illnesses.      9

**Reference Books:**

1. Sen, Colleen Taylor —Food Culture in India Greenwood Press, 2005.
2. Davidar, Ruth N. —Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

<b>214FTE2103</b>	<b>FOUNDATION OF FOOD AND NUTRITION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : University Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand the basic concepts of nutrition
- CO2 Explain the importance of micronutrients and implement diet planning
- CO3 Understand the role of carbohydrates in human health
- CO4 Evaluate the quality of protein and nutrition of a population
- CO5 Understand the function of lipids and its health effects

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M			M							L		
CO2	M		M			M	L						L		
CO3	M		L			M		L			L		M	M	
CO4	M		L	L		L							M		
CO5	M	L	M	L		H		L			M		M	M	

### Syllabus

#### Unit -1: AN OVERVIEW OF NUTRITION

**10 hours**

Introduction to nutrition, classification of nutrition. Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, energy balance, and estimation of energy value from proximate composition. malnutrition.

#### Unit -2: MINERALS, VITAMINS IN NUTRITION

**9 hours**

Balanced diet planning: Food plate, Pyramid, and Food Exchange. Obesity, BMR and its factors, BMI calculations. Minerals and Vitamins: Recommended daily intake, toxicities, deficiencies, hypervitaminosis.

#### Unit -3: CARBOHYDRATE

**9 hours**

Requirements and role of carbohydrates (including dietary fibres), Digestion and absorption of carbohydrates, lactose intolerance; blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Glycemic Index and Glycemic load.

#### Unit -4: BPROTEINS IN NUTRITION

**9 hours**

Biological value of proteins; Protein digestion and absorption, Estimation of protein quality – in vitro and in vivo methods; Nutritional assessment of individuals and populations, Food fortification and labelling.

**Unit -5: LIPIDS IN NUTRITION****9 hours**

Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Eicosanoids, Polyesters and structured lipids.

**Reference Books:**

1. Modern Nutrition in Health and Disease - Young & Shils
2. Modern nutrition in health and disease –Goodhart, R.S(1973)
3. Introduction to human nutrition – Gibney. M.J(2006)
4. Discovering nutrition- Paul Insel (2004)
5. Principles of human nutrition- Eastwood (2006)
6. Nutrition in health and disease – Anderson (1988)

**214FTE2104 COMPOSITION, QUALITY & SAFETY OF FOODS**      **L T P X C**

3 0 0 0 3

**Pre-Requisite** : Nil      **Course Category** : University Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Explain the quality attributes of food

CO2 Evaluate the sensory characteristics of foods

CO3 Understand how the quality is being monitored in food industry

CO4 Analyse the defects in food quality and apply strategies to prevent and control it

CO5 Understand antinutritional factors in foods and apply the concept of food safety managements systems

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		L			L							M		
CO2		H	M	M	M						M				
CO3		M	H		L	M		M		M	H	M			
CO4		M	H		L	L			L	M	H		M		
CO5	L	M	H			M		M		L	M				

### Syllabus

#### Unit -1: INTRODUCTION

**9 hour**

Ways of describing food quality: Composition, appearance, kinesthetic and flavor attributes. Nutritional quality of foods and its assessment (content and quality of nutrients). Microbiological quality of foods.

#### Unit -2: SENSORY

**9 hour**

Sensory quality and its evaluation, instrumental measurement of sensory attributes such as color, viscosity, texture etc.

#### Unit -3: QUALITY CONTROL

**9 hours**

Quality control, quality assurance and total quality management in food industry

#### Unit -4: DEFECTS IN FOOD QUALITY

**9 hours**

Defects in food quality, its sources, classification, prevention and control. Statistical quality control, Quality costs. 9

**Unit -5: ANTI NUTRITIONAL FACTORS****9 hour**

Anti-nutritional factors in food. Undesirable constituents developing in Process and storage of food. Microbial contamination, pesticide residues, concept of HACCP, physical, chemical and microbiological safety of food.

**Reference Books:**

1. Mark Clute, Quality Control for the food industry, CRC press, Nov 2008.
2. V k Joshi, Sensory Science: Principles And Application In Food Evaluation, Agrotech Books, 2nd edition,2006
3. Elena Castell- perez, LjubicaDokic, PetarDokic, P.W.Vowsy, Rheology Applications To Food Quality And Product Development, Blackwell Pub Professional, 2010

<b>214FTE2105</b>	<b>FOOD LAWS AND STANDARDS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Open Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand the food safety system and quality
- CO2 Describe the HACCP principles and implementation
- CO3 Explain the International laws
- CO4 Describe the National laws and regulations
- CO5 Describe the labelling standards

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M			L		H	M	M	L	M	M	H	
CO2		H						H	M	M	L	M		H	
CO3		M	H					H	M	M	L	M		H	
CO4		M	M					H	M	M	L	M		H	
CO5		M	H				H	H	M	M	L	M		H	

### Syllabus

#### Unit -1: GENERAL PRINCIPLES FOR FOOD SAFETY AND HYGIENE 9 hours

Principles of food safety and quality - Food Safety System - Quality attributes - Total Quality Management. Good Hygienic Practices, Good Manufacturing Practices

#### Unit -2: HACCP 9 hours

HACCP –Introduction, Seven Principles, – AOQL (Average Outgoing Quality Limit) – HACCP plan chart.

#### Unit -3: INTERNATIONAL BODIES 9 hours

Structure, organization and practical operation of International Standardization Organization (ISO), Codex Alimentarius, World Trade order, World Health Organization

#### Unit -4: NATIONAL STANDARDS 9 hours

Food standards and Specifications: FSSAI- Structure, Organization and Functions, PFA, AGMARK, and BIS Standards., Vegetables Oil Products(Control) Order, 1998 , Edible Oils Packaging (Regulation) Order, 1998, Environment (Protection) Act, 1986, Fruit Products Order, 1955 (FPO), Meat Food Products Order, 1973 (MFPO), Milk and Milk Product Order, 1992 (MMPO),

**Unit -5: FOOD LABELLING STANDARDS****9 hours**

Food labelling –Standards for processed food, irradiated foods, Safety aspects of drinking water and Indian regulations for bottled water

**Reference Books:**

1. Neal D. Fortin. 2009. Food regulation, Wiley Publishers
2. Naomi Rees. David Watson. 2000. International standards for food safety, An Aspen Publications
3. O'Rourke. 2005. European Food law, 3rd Edition, Thomson, Sweet and Maxwell.

**214FTE2106                      BAKERY AND CONFECTIONARY TECHNOLOGY**

**L    T   P   X   C**  
3    0   0   0   3

**Pre- Requisite** : Nil            **Course Category** : Open Elective Course            **Syllabus Revision**            2021

**Course Level** : 2            **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Explain the uses of ingredients and food additives in bakery products
- CO2 Describe the function of equipment's used in bakery industry
- CO3 Explain the bread manufacturing operations
- CO4 Infer the manufacturing process of confectionary products
- CO5 Explain the preparation of breakfast cereals and macaroni products

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M			L		M			L		M		
CO2		M	M			L				M	L		M		
CO3	L	M	M			L				M	L		M		
CO4		H	M			L				M	L		M		
CO5		M	M			L				M	L		M		

### Syllabus

#### Unit -1: INTRODUCTION TO BAKERY

**9 hours**

Classification of bakery products. Bakery ingredients and their functions-Essential ingredients:Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.. Product types, nutritional quality and safety of products, pertinent standards & regulations.

#### Unit -2: EQUIPMENT

**9 hours**

Introduction to utensils and equipments used in bakery industry with their purpose.Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating-Fermentation enclosures and brew equipment - Ovens and Slicers; Extrusion. Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph.

#### Unit -3: BREAD MAKING PROCESS

**9 hour**

The Chemistry of dough Development. Bread making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process- Dough retarding and freezing-emergency No time process. Advantages and



disadvantages of various methods of bread-making. Characteristics of good bread: Internal characters; external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.

**Unit -4: CONFECTIONARY PRODUCTS****9 hours**

Hard-boiled candies, toffees fruit drops, chocolates and other confectionaries: ingredients, equipments & processes, product quality parameters, faults and corrective measures. Hydrocolloids, Hydrocolloid pre treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products.

**Unit -5: BREAKFAST CEREALS, MACARONI PRODUCTS AND MALT 9 hours**

Production and quality of breakfast cereals, macaroni products and malt, Production & quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products, sprouted grains

**Reference Books:**

1. Beckett, Industrial Chocolate Manufacture, Wiley-blackwell publisher, 3rd edition, 2009
2. Faridi Faubion Dough rheology and baked product texture, CBS publications, 1997
3. S Pyle, Baking science and Technology, Sosland Pub Co, 2009

<b>214FTE2107</b>	<b>BEVERAGE TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Open Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Differentiate alcoholic and non-alcoholic beverages
- CO2 Explain the manufacturing process of alcoholic beverages
- CO3 Describe the manufacturing process of non- alcoholic beverages
- CO4 Outline the manufacturing process of tea, coffee and cocoa
- CO5 Assess the quality of food

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M			L		M					H	L	
CO2	M		M		L	L					L		H		
CO3	M		M		L	L					L		H		
CO4	M		M				L				L		M		
CO5	M										L		H		

### Syllabus

#### Unit -1: Introduction

**10 hours**

Introduction: Current status of beverage industry in India- Types of beverages- Non-Alcoholic and Alcoholic. Nutritional and therapeutic benefits. Raw materials - Water, Sweeteners, Bulking agents, Acidulants, Emulsifiers, Stabilizers, Flavoring and Coloring agents

#### Unit -2: Alcoholic Beverages

**9 hours**

Alcoholic Beverages: Types of alcoholic beverages. Wine – types – production and defects. Beer – Types – Production and defects. Distilled beverages – Brandy, Whiskey, Rum, Gin – Production and defects

#### Unit -3: Non Alcoholic Beverages

**9 hours**

Non Alcoholic Beverages: Natural Fruit based beverages, Fermented non alcoholic beverages (kombucha, kefir), Synthetic/Artificial beverages. Carbonated beverages- Properties of carbon dioxide, carbonation – carbonators. Preparation of syrup, filling and packaging. Measurement of carbonation.

#### Unit -4: Specialty and Malt Beverages

**9 hours**

Specialty Beverages: Coffee & Instant coffee, Tea – black and green tea, Spices, Plant extracts. Malt beverages– Branded malt beverages in market. Coco Based Beverages. Traditional Beverages. Sport beverages – Physiological needs and formulation.9

**Unit -5: Quality Control****9 hours**

Quality Control: Effective application of quality controls- Sanitation and Hygiene in Beverage industries. Quality of water in beverages. Threshold limits of ingredients according to FSSAI, EFSA& FDA. Requirements of Soluble solids and titratable acidity in beverages.

**Reference Books:**

1. Philip R. Ashurst ., "Chemistry and Technology of Soft Drinks and Fruit Juices", 2nd Edition, Blackwell Publishing Ltd, UK, 2005.
2. Paquin P., "Functional and Speciality Beverage Technology", 1st Edition, Wood Head Publishing in Food Science Technology and Nutrition, USA, 2009.
3. Bamforth., "Brewing: New Technologies", 1st Edition, Woodhead Publishing Limited, England, 2006.

**214FTE2108                      FERMENTED FOOD PRODUCTS                      L    T    P    X    C**

**3    0    0    0    3**

**Pre-                      : Nil                      Course                      : Open                      Elective                      Syllabus                      2021**  
**Requisite                                           Category                                           Course                                           Revision**

**Course Level    : 2                      Course Type    : Theory Course**

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Explain the fermentation and fermented products

CO2 Describe the process of maintaining culture

CO3 Outline the benefits of fermented products

CO4 Outline the process of manufacturing fermented drinks

CO5 Explain the enzymes and microbial protein used in food industry

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M					L							L		
CO2	L	M						L					L		
CO3	M		M			L					M		M		
CO4			M			M					M		M		
CO5			M			M					M		M		

### Syllabus

#### Unit -1: INTRODUCTION TO FERMENTATION

**11 hours**

Definition-benefit of fermentation nutritive value of fermented foods-microbial changes in fermented foods-microorganism-proteolytic, lipolytic and fermentative bacteria

#### Unit -2: CULTURE MAINTENANCE

**9 hours**

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Probiotics - Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

#### Unit -3: FERMENTED PRODUCTS

**9 hours**

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Buttermilk and the fermented milks. Spoilages and effects of fermented dairy products and their control. Fermented meat and fish products, Oriental fermented foods

**Unit -4: FERMENTED DRINKS****9 hours**

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin, whisky), Fermented Vegetables (Pickles).

**Unit -5: MICROBIAL PROTEINS****9 hour**

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases, protease, lipases, pectinases, rennin), HFCS (High Fructose Corn Syrup)

**Reference Books:**

1. Sukumar De, Outlines of Dairy Technology, Oxford University Press Delhi, 1991.
2. Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009
3. L.E. Casida, Industrial Microbiology, New Age International (p) Ltd Delhi, 2007
4. W.C. Frazier and D.C. Westhoff, Food Microbiology, Tata Mcgraw Hill publisher, 3rd edition, 2008.

**214FTE2109 FOOD PACKAGING TECHNOLOGY**      **L T P X C**  
 3 0 0 0 3

**Pre-Requisite** : Nil      **Course Category** : Open Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Explain the function of food package

CO2 Describe the different packaging methods

CO3 Interpret the properties of packaging materials

CO4 Outline the methods of packing fresh and processed foods

CO5 Explain the packing regulations and interaction with environment

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	L	L				M						L		M
CO2	H	H	M	L	H		H	L				L	H	H	M
CO3	H	M	M	L	M	L	L		L			L	H	M	M
CO4	H	H	H	H	M	H	L	L	M	L		L	H	M	L
CO5		M				H	M	H				M	M	L	H

### Syllabus

#### Unit -1:INTRODUCTION TO FOOD PACKAGING

**12 hours**

Packaging terminology – definition. Functions of Food Package, Packaging environment. Food marketing and role of packaging. Characteristics of food stuff that influences packaging selection, Shelf Life Estimation. Packaged product quality and shelf life. Food Labelling.

#### Unit -2: PACKAGING METHODS

**9**

**hours**

Active packaging, Special packaging methods-vacuum and gas packaging - CAP & MAP. shrink package, retort pouches, Biodegradable packages. Self-heating and cooling cans

#### Unit -3: PACKAGING MATERIAL AND THEIR PROPERTIES

**9 hours**

Manufacturing of Metal cans, glass containers, plastic containers and pouches, paper and paperboard. Properties of plastics, Filling and sealing of Flexible plastic containers

**Unit -4:           PACAKGING OF FRESH AND PROCESSED FOODS           9    hours**

Packaging of Fruits and vegetables, Fats and Oils, Spices, meat, Poultry and sea foods, Dairy Products, Bakery, beverages, Dehydrated and frozen foods. Liquid and powder filling machines –bottling machines, Form Fill Seal (FFS) and multilayer aseptic packaging machines.

**Unit -5:           ENVIRONMENTAL ISSUES IN PACKAGING           9 hours**

Packaging Laws and Regulations, Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials, Environmental & Economic issues, recycling and water disposal

**Reference Books:**

1. Robertson,G.L. —Food Packaging: Principles and Practice ( 2nd Edn). Taylor & Francis.2006.
2. Han,J.H. — Innovations in Food Packaging#. Elsevier Academic Press,2005.
3. Ahvenainen,R. — Novel Food Packaging Techniques#. CRC Press. 2003.
4. Coles,R., McDowell,D. and Kirwan,M.J. — Food Packaging Technology#. CRC Press.2003.

<b>214FTE2110</b>	<b>NUTRACEUTICALS AND FUNCTIONAL FOODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Open Elective Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

#### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Classify the functional foods and its properties

CO2 Infer regarding Metabolic disorders and its relation with functional foods

CO3 Adapt the methods to formulate fortification in Food supplements

CO4 Utilize food waste for nutrition enrichment and its functions

CO5 Identify the importance of herbal medicine and nutraceuticals foods

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M		L		L							L		
CO2		M	H			M		H		M		L	L	L	
CO3	M	M				M		M			M	L		L	
CO4	L		M			M	L	L			L	L	L		
CO5	L		M			M	H	M			M	M	M		

#### Syllabus

##### **Unit -1:NUTRACEUTICALS: HISTORICAL AND CLASSIFICATION      13 hours**

Introduction – Historical Reviews - Teleology of nutraceuticals - Organization models for nutraceuticals – Classification of Nutraceuticals based on the sources– Animal, Plant and Microbial – Nutraceuticals in specific foods.

##### **Unit -2: FOOD RECOMMENDED FOR METABOLIC DISORDER      9 hours**

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 musculo skeletal diseases; allergies.

##### **Unit -3:      NUTRITIONAL DEFICIENCIES      9 hours**

Nutritional deficiencies and its correction through fortification and supplementation of foods. Beneficial effect of spices, honey, spirulina etc.

##### **Unit -4:      HEALTH BENEFITS OF MICRO NUTRIENTS      9 hours**

Health benefits/mode of action of PUFA/gamma linolenic acids, antioxidants, dietary fiber, oligo saccharides, sugaralcohols, peptides and proteins, glycosides, alcohols, iso-prenoides, and vitamins, choline, LAB, phenolics, flavonols, minerals



**Unit -5: HERBS AS FUNCTIONAL FOODS****9 hours**

Herbal medicine – Herbs as ingredients in functional foods – actions of herbal and evidence of efficacy, Cruciferous vegetables and cancer prevention, Evolution of marketing environment for Functional foods and Nutraceuticals, Potential product positioning

**Reference Books:**

1. Robert E.C Wildman. Handbook of Nutraceuticals and Functional Foods, CRC Press LLC. ISBN – 0849387345, 2001.

<b>214FTE2111</b>	<b>PROCESSING OF FOOD PRODUCTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Open Elective Course      **Syllabus** 2021  
**Revision**

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Explain the processing of milk products
- CO2 Describe the baking and confectionary process
- CO3 Outline the manufacturing of fruit and vegetable products
- CO4 Explain the cereal product manufacturing process
- CO5 Describe the oil manufacturing process

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M												L		
CO2	M					L	H						M		L
CO3	M	M		L	L						L		L	L	
CO4	L		M								M		M		
CO5	L	M	M	L	L						L		M		

### Syllabus

#### Unit -1: MILK AND MILK PRODUCTS PROCESSING 14 hours

Milk and milk products in India - Classification of dairy products; Butter: Definition, composition; processing and production steps, butter defects, causes and their prevention, packaging and storage; Butter oil and ghee: Definition, composition, processing; Paneer and Cheese: Definition, composition, types, processing steps, process flow diagram; Ice cream and frozen desserts: Definition, composition, types, processing steps and flow diagram, equipment, quality testing, defects causes and prevention, Khoa: classification, standards methods of manufacture and preservation factors affecting yield of khoa, physicochemical changes during manufacture and storage of khoa, mechanization in manufacture of khoa, khoa based products. Cultured/Fermented milk products: Dahi and yoghurt: standard methods of manufacture, packaging and preservation, cheese, Traditional products: Srikhand, and lassi Heat-acid coagulated milk products:

#### Unit -2: BAKERY AND CONFECTIONERY PRODUCTS PROCESSING 9 hours

Bakery products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Product quality characteristics, defects, causes and corrective measures;

**Unit -3:FRUITS AND VEGETABLE PRODUCTS PROCESSING 9 hours**

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated, fruit beverages. Processing using salt - Brining - Preparation of pickles, chutney and sauces, ketchup. Canning and bottling of fruits and vegetable products - Machinery involved in processing of fruits and vegetables products

**Unit -4: CEREAL PROCESSING 9 hours**

Present status and future prospects of cereals and millets; Morphology: physico-chemical properties; chemical composition and nutritive value Rice: Paddy processing and rice milling-processed foods from rice – breakfast cereals, flakes, puffing, canning and instant rice. Wheat: break system, purification system and reduction system; extraction rate and its effect on flour composition; Quality characteristics of flour and their suitability for baking - Millets: Importance of Millet, composition, processing of millets for food uses, major and minor millets - breakfast cereal foods – flaked, puffed, expanded, extruded and shredded product

**Unit -5: LEGUMES AND OILSEED PROCESSING 9 hours**

Present status and future prospects of legumes and oilseeds; Classification and types of legumes and oilseeds ; Milling of legumes: home scale, cottage scale and modern milling methods, milling quality, efficiency and factors affecting milling; problems in dhal milling industry; Oilseeds: composition, methods of extraction, Desolventization and refining of oils: degumming, neutralization bleaching, filtration, deodorization, etc. New technologies in oilseed processing; By-product of pulses and oil milling and their value addition

**Reference Books:**

1. Chakraverty A. Post harvest technology of cereals: pulses and oilseeds, Oxford & ibh publishing company, 2014
2. Verma L. R. and Joshi V. K, Post-harvest Technology of Fruits and Vegetables – Vol. 1 , Indus Publishing Company, Delhi, 2000
3. Zhou and Hui, Bakery Products Science and Technology, John Wiley and Sons, 2014
4. Lampert, Lincoln M. “Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products”. Chemical Publishing Company, 1998.
5. Selia, Jane dos Reis Coimbra and Jose A. Teixeir “Engineering Aspects of Milk and Dairy Products”. Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009
6. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA

## HONORS COURSES

**215FTE1101**                  **IT APPLICATION IN FOOD INDUSTRY**                                  **L      T    P    X    C**  
 3           0    0    0    3

**Pre-Requisite** : Nil                  **Course Category** : Honors Course                  **Syllabus**                  2021  
**Revision**

Course Level : 2                  **Course Type** : Theory Course

### Course Outcomes (COs’):

On successful completion of the course, the students would be able to;

- CO1 Explain the basic concept on Computerization in food industry  
 CO2 Analyze the problem related to Storage and enzymes  
 CO3 Use of Ms Excel to solve the problem related to thermal processing  
 CO4 Understand the concept related to statistical tool in Food Processing  
 CO5 Knowing about the concept of MATLAB in food industry

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M							M	H	M	M		
CO2	M		H							L	H	M	M		
CO3		M	H			M		H		L	M	M	L	M	
CO4		M	M			M	M			M	H	M	L		
CO5	L	H	M				M			M	H	M	L		

### Syllabus

**Unit -1: Introduction to ICT** **15 hours**

Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems; Spreadsheet applications

**Unit -2: MS Excel to solve the problems of Food Technology** **9 hours**

Determining rate constant of zero order reaction - First order rate constant and half life of reactions - Determining energy of activation of vitamin degradation during food storage - Rates of Enzymes catalyzed reaction

**Unit -3: MS Excel to solve the problems Microbial distraction in thermal processing of food** **9 hours**

Determining decimal reduction time from microbial survival data - Thermal resistance factor, Z-values in thermal processing of food - Sampling to ensure that a lot is not contaminated with more than a given percentage

**Unit -4: Statistical quality control 9 hours**

Probability of occurrence in normal distribution - Using binomial distribution to determine probability of occurrence - Probability of defective items in a sample obtained from large lot

**Unit -5: MATLAB 9 hours**

MATLAB, function discovery, regression, the basic fitting interface, three dimensional plots; Introduction to toolboxes useful to food industry, curve fitting toolbox, fuzzy logic toolbox, neural network toolbox, image processing toolbox, statistical toolbox

**Reference Books:**

1. R. Paul Singh Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis, Academic Press, London. 2014
2. National Instruments Corporation, Introduction to LabVIEW: 3-Hour Hands-On, NI, Austin, Texas. 2005
3. William J. Palm Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA. 2011

**215FTE2102                      FAT AND OIL TECHNOLOGY                      L    T   P   X   C**

3    0   0   0   3

**Pre-                      : Nil                      Course                      : Honors Course                      Syllabus                      2021**  
**Requisite                      Category                      Revision**

Course Level : 2                      Course Type : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand the physical and chemical properties of fat and oil
- CO2 Utilize different methods of oil extraction for edible purpose
- CO3 Analyze the techniques involved in oil extraction process
- CO4 Develop value added products from fat and oil
- CO5 Identify proper packaging and storage conditions for fat and oil

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	L				L							M	L	L
CO2			M		L						L		M	H	M
CO3	L				L	L					L		H	M	M
CO4	L					L					L		L	H	M
CO5	L		M			L					L		M	M	L

### Syllabus

#### Unit -1: PHYSICAL AND CHEMICAL PROPERTIES OF OIL                      9 hours

Sources; chemical composition; physical and chemical characteristics; functional and Nutritional importance of dietary oils and fats. Post-harvest and ling storage and processing of oilseeds for directs use and consumption, importance of oil seeds processing in India.

#### Unit -2:                      EXTRACTION METHODS                      9 hours

Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes Suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ,etc.

#### Unit -3:                      REFINING OF OILS                      9 hours

Degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining), bleaching, deodorization techniques/processes. Blending of oils. Chemical adjuncts- lecithins, monoglycerides and derivatives, propylene glycolesters, polyglycoesters, Hydrogenation, fractionation, winterzation, inter-esterification etc. for obtaining tailor-made fats and oils.

**Unit -4: FAT AND OIL PRODUCTS 9 hours**

Production of butteroil lard, tallow, Margarine, Cocoabutter equivalents, shortenings, low Fat spreads, peanut butter etc. Speciality fats and designer lipids for nutrition and dietetics, especially by biotechnology. Mayonnaise and salad dressings. Confectionery coatings. Imitation dairy products- peanut butter and vegetable ghee.

**Unit -5: PACKAGING OF EDIBLE OILS 9 hours**

Packing and storage of fats and oils, cocoa butter, fat substitutes. Changes during storage of oil – rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.

**Reference Books:**

1. Bailey, Industrial Oil and Fat Products, John Wiley and Sons. 6th edition 2005
2. M.M. Chakrabarty, Chemistry and Technology of Oils & Fats, Applied Publisher, 2003.
3. Wolf Hamm, Richard J. Hamilton, Gijs Calliauw, Edible Oil Processing, 2nd Edition Wiley-Blackwell, 2013

**215FTE2103****RADIATION PRESERVATION AND  
PROCESSING OF FOOD PRODUCTS****L T P X C**

3 0 0 0 3

**Pre- Requisite** : Nil **Course Category** : Honors Course**Syllabus** 2021**Revision**Course Level : 2 **Course Type** : Theory Course**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 Explain and apply the concept of Radiation chemistry on food preservation

CO2 Analyze the effect of dosage of radiation on plant and animal foods

CO3 Exemplify and analyze the effect of microwave in food processing

CO4 Analyze the effect of Infra-red radiation in food processing

CO5 Justify and assess the effect of radio frequency on foods

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H											L	M		L
CO2	M	L		L		H		M					M	M	
CO3	M	L	L	L		M		M					H	L	L
CO4	M	L		L		M		M					H	L	L
CO5	M	M	L			M		M					M	M	

**Syllabus****Unit -1: BASICS OF RADIATION CHEMISTRY****10 hours**

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods

**Unit -2: RADIATION CHEMISTRY OF FOOD COMPONENTS****9 hours**

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues

**Unit -3: MICROWAVES IN FOOD PROCESSING****9 hours**

Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures



**Unit -4: INFRA RED RADIATION****9 hours**

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits

**Unit -5: RADIO FREQUENCY HEATING PRINCIPLES****9 hours**

RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

**Reference Books:**

1. Welter M. Urbain: Food Irradiation Academic Press, New York, 1986
2. Ohlsson and Bengtson, Microwave Processing Technologies Woodhead Publishing, Cambridge, UK, 2002
3. Gould G.W., New Methods of Food Preservation, Aspen Publishers Inc., Maryland, 1999.
4. S.G.Llyasor and V.V. Krasnikov, Physical Principles of Infra Red Irradiation of Food Stuff: Hemisphere Publishing Corporation, London, 1991
5. Philip Richardson, Thermal Technologies for Food Processing, Wood head Publishing Limited, CRC Press, 2001.
6. Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

<b>215FTE2104</b>	<b>TECHNOLOGY OF FOOD EMULSION, FOAMS AND GELS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Explain the importance of food dispersions
- CO2 Elaborate the interaction of food constituents in maintaining food emulsion
- CO3 Interpret the functions and properties of foam and its stability
- CO4 Classify the structure of gel and its applications
- CO5 Develop new products which are nutritional with the help of gel theory

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M			M								M		
CO2	H	M			M								M		M
CO3	H	M				M					L		M	M	L
CO4	H	M				M					M		M		L
CO5	H	M				M					M		M		M

### Syllabus

#### Unit -1: FOOD DISPERSIONS

**11 hours**

Food dispersions, their characteristics and factors affecting food dispersions.

#### Unit -2: FOOD EMULSIONS

**9 hours**

Food emulsions; emulsifiers and their functions in foods; the HLB concept in food emulsifiers; emulsion formation and stability; polymers and surfactants.

#### Unit -3: FOAM AND STRUCTURES

**9 hours**

Milk foams and their applications, structure of foams, egg foams and uses, foam formation and stability.

#### Unit -4: STRUCTURE OF GELS

**9 hours**

Structure of dairy foods representing emulsions, foams and gels; physical structure of fat rich, concentrated, fermented, coagulated and dried products.

#### Unit -5: THEORY OF GEL FORMATION

**9 hours**

Theory of gel formation; pectic substances and jellies; fruit pectin gels; milk jellies.

**Reference Books:**

1. Stig E.Friberg., Kare Larsson and Johan Sjoblom. "Food Emulsions". CRC Press .2003.
2. David Julian Mc Clements. " Food Emulsions". CRC Press. 1998.
3. Blanshard JMV & Lillford P. " Food Structure and Behaviour".Academic Press.1987

<b>215FTE2305</b>	<b>COMPREHENSIVE TECHNIQUES IN FOOD ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Demonstrate the basic principles of modern techniques used in food analysis for quality assurance

CO2 Infer about labels for food products based on food analysis

CO3 Develop analytical techniques for on-line monitoring of food quality during processing and storage

CO4 Ensure consumer safety through analysis of food contaminants and adulterants and apply them in the light of regulatory requirements

CO5 Discuss about the newer and relevant analytical techniques in food systems

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		M	L	H	L							M		L
CO2	H		M	L	H	L					M	M			H
CO3		M	H	L	H	L					M	M			H
CO4	L		M	L	H	L		H				M		M	
CO5			H	L	H	L		M		L	M			M	

### Syllabus

#### Unit -1: Chromatography analysis 9 hours

Analysis of chemical constituents, their characterization and significance; Application of modern techniques including spectroscopy, chromatography including GC, GC –MS, HPLC, HPTLC, gel permeation, ion-exchange, etc

#### Unit -2: Rapid detection of food quality 9 hours

Enzymes in food analysis; Novel techniques in food analysis; Rapid methods for detection of food pathogens, biosensors, automation and use of computers in food analysis

**Unit -3: Thermal methods****9 hours**

Thermal methods: thermos balance, derivative thermos gravimetric analysis- Thermogravimetry, Differential thermal analysis, Differential Scanning Calorimetry – Principle, Instrumentation, Applications in food quality.

**Unit -4: Electrophoresis and PCR****9 hours**

Basic principles of electrophoresis, theory and application of paper and gel. Application of electrophoresis in food quality. PCR and its applications in food analysis.

**Unit -5: Sensory evaluation****9 hours**

Sensory evaluation – different scales, training, skills and importance for consumer acceptance, Quantification of sensory attributes - Artificial Tongue, Artificial Nose; Life cycle analysis

**Reference Books:**

1. Introduction to Chemical Analysis of Foods. By Nielsen, S.(Eds), Jones & Bartlett, 1994.
2. Food Chemistry by W. Grosch by Belitz, H.D., Grosch, W. 2nd ed., 1999
3. Spectral method in food analysis by Magdi Mossoba, 1999

**List of experiments**

1. Separation and identification of amino acids using TLC
2. Separation of bio actives from plant extract using column chromatography
3. Qualitative determination of adulteration in flour and edible oils using FTIR spectroscopy
4. Determination of functional groups in food products using FTIR spectroscopy
5. Microstructure of food products using SEM
6. Encapsulation of bioactives using Spray drying technique
7. Determination of particle size using particle size analyser
8. Study of crystalline nature of food products using XRD
9. Texture profile analysis of food products
10. Assess the quality of spices using extraction methods
11. Estimation of volatile compounds in food products using gas chromatography
12. Determination of tensile strength and burst strength of packaging material
13. Estimation of pathogenic microorganism in the fermented foods
14. Case study on interpretation of DSC and TGA results

<b>215FTE2306</b>	<b>EXPERIMENTAL DESIGN AND OPTIMIZATION IN FOOD PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Analyze different the statistical tests and hypothesis testing methods used in food processes

CO2 Apply the concept of experimental design in different food processes

CO3 Develop empirical equation using experimental data

CO4 Apply fuzzy logic and neural network models for sensory analysis of foods

CO5 Apply multivariate analysis on a data set

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		L	M	M			L				M		L	
CO2	H		M	H	H			L						L	
CO3	H		M	H	M			L						M	
CO4	H		M	M	H			L						M	
CO5	H		M	M	M			L						L	

### Syllabus

#### Unit -1: STATISTICAL TESTS

**9 hours**

Identification of design, operating and performance parameters in different food processing operations; Statistical tests; significance tests (t-tests, F-test, Z-test, chi square test); Analysis of Variance (one way & two way), hypothesis testing.

#### Unit -2: EXPERIMENTAL DESIGN

**9 hours**

Factorial (Full and mixed), fractional factorial and rotatable central composite, face centered composite experimental design. Response surface methodology; Numerical optimization.

#### Unit -3: EMPIRICAL EQUATIONS

**9 hours**

Developing mathematical relationship between the independent and dependent variables affecting the food processing operations. Developing empirical equations using experimental data.

#### Unit -4: FUZZY LOGIC AND NEURAL NETWORKS MODELS

**9 hours**

Predictive modelling using Neural network. Application of Genetic algorithm in process optimization; Fuzzy logic for descriptive sensory analysis and ranking of foods.

**Unit -5:            MULTIVARIABLE STATISTICAL ANALYSIS                            9 hours**

Multivariate statistical analysis; MANOVA; Principal component analysis; Multiple linear and non-linear regressions; Cluster analysis; Partial least square regression.

**Reference Books:**

1. S.C. Gupta, V.K. Kapoor. 2020. Fundamentals of Mathematical Statistics. 12th Edition. Sultan Chand & Sons Publishers. ISBN 978-93-5161-173-8 & (TC-499)
2. Cheryl Ann Willard · 2020. Statistical Methods An Introduction to Basic Statistical Concepts and Analysis. Taylor & Francis. ISBN:9780429523151, 0429523157
3. Kevin Gurney, 1997. An Introduction to Neural Networks, Taylor & Francis. ISBN: 9781857286731
4. Herbert Stone, Rebecca N. Bleibaum, Heather A. Thomas · 2012. Sensory Evaluation Practices. Academic Press, Elsevier Science.
5. Rajagopal Vadivambal, Digvir S. Jayas · 2015. Bio-Imaging Principles, Techniques, and Applications. CRC Press.

**List of experiments:**

1. Determination of mean, standard deviation, precision and accuracy for the food analysis results using MS Excel
2. Validation of food analysis methods
3. Test for significance – t-test using MS Excel
4. Test for significance – F-test using MS Excel
5. Test for significance – Chi square test using MS Excel
6. Analysis of Variance – one way ANOVA using MS Excel
7. Analysis of Variance – two-way ANOVA using MS Excel
8. Optimization of food ingredients using Response surface methodology
9. Correlation – correlation coefficient and testing its significance using MS Excel
10. Fitting of simple linear regression using MINITAB
11. Analysis and interpretation of RSM results
12. Sensory analysis using fuzzy logic approach
13. Case study on one factor approach experimental design
14. Case study on artificial neural network for bioactive extraction

<b>215FTE2107</b>	<b>INNOVATION AND FUTURE TRENDS IN FOOD MANUFACTURING AND SUPPLY CHAIN TECHNOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 To gain knowledge on present and emerging trends in building design requirements

CO2 Implement hygienic engineering design in food factory setup

CO3 Select the emerging non thermal food processing technologies to preserve food

CO4 Implement advanced heating technologies for food production

CO5 Apply information technology for the purposes of food supply chain and production monitoring

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	M		L	L	M	M			M	M	M	L	L
CO2	H		M		L	M	M				L	L	M		L
CO3	H		M		L	L	L						L	L	
CO4	H		M		L	L	L						L	L	
CO5	H		M		H	M	L			H				M	M

### Syllabus

#### Unit -1: EMERGING TRENDS IN FOOD FACTORY DESIGN 9 hours

Applying Multivariate Analytics for Productivity and Yield Gains – renovation of existing food factory - building a new food factory – introduction of new technologies and automation in design: introduction of robotics, visual communication and remote diagnostics, In, On and At-line sensors, build for present and future requirement, versatility, workers safety. Efficient cleaning and maintenance, energy best practices 9

#### Unit -2: HYGIENIC ENGINEERING IN DESIGN OF FOOD FACTORIES 9 hours

Food Plant Building Concepts to Prevent Entry of Pests – Building foundation, external walls, roofs, windows, doors, loading and unloading docks – piping – lighting – waste handling facilities – bird control techniques – interior building layout: zoning for microbial and non-microbial contamination control – reducing size of production area – air handling systems – interior construction elements – floor – drains - Integration of Process Piping and Utilities in process zone - Methods to Keep Walls and Ceilings Uncluttered – controlled wet and dry cleaning zones.



**Unit -3: INNOVATIVE NON-THERMAL FOOD PROCESSING TECHNOLOGIES 9 hours**

Advances in Refrigeration, freezing method of food preservation – emerging non-thermal food processing technologies: power ultrasound – pulsed electric field – pulsed light – ozone processing – cold atmospheric plasma technique

**Unit -4: ADVANCED HEATING TECHNOLOGIES FOR FOOD PROCESSING 9 hours**

Application of novel techniques in food manufacturing: Ohmic heating – Radiofrequency and microwave heating – dielectric heating applications in drying, baking, defrosting, tempering – safety aspects of advanced heating technologies.

**Unit -5: ROLE OF INFORMATION TECHNOLOGY DEVELOPMENTS IN FOOD SUPPLY CHAIN INTEGRATION AND MONITORING 9 hours**

Introduction – IT components in General – supply chain management – block chain and food traceability – food processing and packaging – information technology in food processing and packaging – nanotechnology in food processing and packaging – big data and the food industry

**Reference Books:**

1. C.E. Leadley. 2016. Innovation and Future Trends in Food Manufacturing and Supply Chain Technologies, Woodhead Publishing. ISBN: 978-1-78242-447-5
2. António Carrizo Moreira, Luís Miguel D. F. Ferreira, Ricardo A. Zimmermann. 2018. Innovation and Supply Chain Management Relationship, Collaboration and Strategies, Springer International Publishing AG, Part of SPRINGER nature.
3. Murlidhar Meghwal, Megh R. Goyal. 2016. Food Process Engineering: Emerging Trends in Research and their applications. CRC Press.
4. Kai Knoerzer and Kasiviswanathan Muthukumarappan. 2020. Innovative Food processing technologies: A comprehensive review, Volume 1, Elsevier Science.
5. Tanweer Alam. 2021. Packaging and Storage of Fruits and Vegetables: Emerging Trends. Apple academic Press.

<b>215FTE2108</b>	<b>FOOD SAFETY MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 To achieve certification of ISO compliance or to ensure your business satisfies internationally recognized procedures.

CO2 Outline the ISO 9000 standards

CO3 Outline the ISO 22000 standards

CO4 To establish the requirements specific to Food Testing Laboratories

CO5 To apply international standards in response to market needs.

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H	M	L	M	H	L						L	H	M	L
CO2	M	M	L	H	H	M	M		H	H	M	H	H	H	M
CO3	M	M	H	M	M	L	M		M	M	M		M	M	M
CO4						L	L	M			H	M	M	M	M
CO5		L	L		L	L		M			H	M	M	M	M

### Syllabus

**Unit -1: Management Systems, Auditing and Accreditation 10 hours**

Introduction to Management Systems-Auditing Unit-Standard and Accreditation

**Unit -2: ISO 9001: 2000 9hours**

ISO 9001:2000: An overview-ISO 9001:2000: Structure-Clause wise Interpretation of ISO 9001: 2000-ISO 9001:2000: Case Studies.

**Unit -3: ISO 22000:2005 9 hours**

ISO 22000:2005: An overview-ISO 22000:2005: Structure-Clause wise Interpretation of ISO 22000:2005-ISO 22000: 2005: Case Studies.

**Unit -4: Laboratory Quality Management System 9 hours**

An Overview and Requirements of ISO 17025 Unit-Requirements Specific to Food Testing Laboratories-Physical and Chemical Parameters-Requirements Specific to Food Testing Laboratories-Biological Parameters-General Topics: Related to Food Testing Laboratories.

**Unit -5: Retailer Standards G****9 hours**

BRC Food and BRC IOP Standards: An Overview -IFS: International Food Standard - SQF: 1000, SQF: 2000-Global Gap and India Gap.

**Reference Books:**

1. Da-Wen Sun., "Handbook of Food Safety Engineering", 1 st Edition, John Wiley & Sons, New Jersey, 2011.
2. Ronald H. Schmidt and Gary E. Rodrick., "Food Safety Handbook",1st Edition, John Wiley & Sons, New Jersey, 2003

<b>215FTE2109</b>	<b>VALORIZATION OF FOOD PROCESSING BY- PRODUCTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Honors Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Classify food waste and explain the strategies for waste minimization

CO2 Utilize the wastes from cereal industries for developing byproducts

CO3 Make use of wastes from oilseeds and tuber processing industries for developing byproducts

CO4 Utilize the animal processing industries waste for developing byproducts

CO5 Apply the concept of waste utilization of fruit and vegetable, sugar and packaging industries

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M	L	L		L		M					L	M	M	M
CO2	H	M	L	L	L		M					L	H	M	H
CO3	H	M	L	L			M					L	H	M	H
CO4	H	M	L	L			M					L	H	M	H
CO5	H	M	L	L	L		M					L	H	M	H

### Syllabus

#### Unit -1: Introduction on Waste and disposal strategies: 9 hours

**Introduction : Different Sources of waste** from Food Industries and their availability in India, nature of different waste, potentials and prospects of developing by products in India. Characteristics of Industrial Waste and disposal strategies : Classification of waste, characterization of waste, magnitude of waste generation in different food processing industries, importance of waste management, Economical aspects of waste treatment and disposal, Strategies for minimizing waste, Application of 3R's and Life Cycle Assessment (LCA).

#### Unit -2: Waste utilization in Cereal Food Industries: 9 hours

Waste utilization in Cereal Food Industries: Waste utilization from rice mill – thermal and biotechnological uses of rice husk- pyrolysis and gasification of rice husk- cement preparation and different thermal applications- utilization of rice bran- stabilization – defatted bran utilization.

**Unit -3: By Products from Oil Seed and Tuber Processing Industries: 9 hours**

By Products from Oil Seed and Tuber Processing Industries: Oil processing industries – Introduction, De-oiled cake, animal feed, fertilizer, bio sorbents, waxes, soap stock, cocoa butter replacer. Tuber processing industries- Introduction, enzyme production, biogas, bakers yeast, bio-ethanol, animal feed, corn syrup, organic acids, nutraceuticals.

**Unit -4: By Products from Animal Product based Industries: 9 hours**

By Products from Animal Product based Industries: Dairy industry - Introduction-opportunities – whey, bio surfactants, bacteriocin. Meat, fish, poultry processing industries- bio active peptide, protein extract, gelatin, heparin, pepsin, bio molecule from bone and blood, keratin from animal hair, bone meal, meat meal, chondroitinsulfate, squalene, fish oil, micro nutrients- vitamins and minerals, pigments.

**Unit -5: Utilization of Fruits, Vegetables and Food Packaging Waste: 9 hours**

Utilization of Fruits and Vegetables waste: processes for waste utilization from fruits and vegetable industries –Pectin, essential oils, antioxidants, and organic acids. Distillation for production of alcohol, SCP production, by products of sugar industry. Handling of Food Packaging Waste: Handling and treatment, far waste, incineration of solid food waste and its disposal

**Reference Books:**

1. Vasso Oreopoulou & Winfried Russ., "Utilization of By-Products and Treatment of Waste in the Food Industry", 1st Edition, Springer Science and Business Media, USA, 2006.
2. Chandrasekaran M., "Valorization of Food Processing By-Products", 1st Edition, CRC Press, USA, 2016.
3. Keith Waldron., "Handbook of waste management and co-product recovery in food processing", 1st Edition, Wood head Publishing Ltd, England, 2007.

## MINOR COURSES

<b>216FTE1301</b>	<b>FUNDAMENTALS OF FOOD SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3
<b>Pre-Requisite</b>	: Nil	<b>Course Category</b>	: Minor Course	<b>Syllabus Revision</b>	2021	
<b>Course Level</b>	: 2	<b>Course Type</b>	: Theory Course			

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 To impart fundamental aspects on Food, nutrition and its Functions.

CO2 To know about the needs of the individuals, and their requirements.

CO3 To describe the defiance diseases due to lack of Macro and Micro nutrients.

CO4 To educate about the nutritional status of all age groups.

CO5 To learn about Recommended Dietary Allowances

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M		M							M					
CO2	M		M							M			M		
CO3												M		M	
CO4	M														M
CO5	M	M													M

### Syllabus

#### Unit-1: Introduction 9 hours

Food and its function, physico-chemical properties of foods, food preparation techniques, nutrition, relation of nutrition to good health. Characteristics of well and malnourished population. Energy, definition, determination of energy requirements, food energy, total energy needs to the body.

#### Unit -2: Basic components in Foods 9 hours

Carbohydrates: Classification properties, functions, source, requirements, digestion, absorption and utilization. Protein, Classification properties, functions, sources, requirements, digestion, absorption, essential and non-essential amino acids, quality of proteins, PER/NPR/NPU, supplementary value of proteins and deficiency.

#### Unit -3: Lipids in Foods 9 hours

Lipids - Classification, properties, functions, sources, requirements, digestion, absorption and utilization, saturated and unsaturated fatty acids, deficiency, rancidity, refining of fats.

**Unit -4: Vitmain and mineral in foods 9 hours**

Mineral: macro and micro-minerals (Ca, Fe and P), function, utilization, requirements, sources, effects of deficiency. Vitamins: functions, sources, effects of deficiency, requirements of water soluble and fat-soluble vitamins.

**Unit -5: Food Diet 9 hours**

Balanced Diet recommended dietary allowances for various age groups, assessment of nutritional status of the population.

**Reference Books:**

1. Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest
2. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013
3. Roday,S. Food Science, Oxford publication, 2011.
4. B. Srilakshmi, Food science, New Age Publishers,2002
5. Meyer, Food Chemistry, New Age,2004

<b>216FTE2302</b>	<b>FOOD LABELLING AND PACKAGING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	2	0	4

**Pre-Requisite** : Nil      **Course Category** : MINOR COURSE      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : INTEGRATED THEORY COURSE

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand the properties, types and applications of different packaging materials
- CO2 Apply the correct packaging materials for right application in Food Industry
- CO3 Analyze the suitable packaging for different food products
- CO4 Evaluate the packaging efficiency using different tests
- CO5 Analyze the role of food labeling and its laws and regulations.

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	L	L					L						L		
CO2	M	L	M	L		M	L						H	L	
CO3	L	L	M	L		M	M						M	L	L
CO4	M	L	M	M	L								H	M	
CO5	L	M				L						M		H	L

### Syllabus

#### Unit-1: ` TYPES OF PACKAGING 9 hours

Definitions, objectives and functions of packaging and packaging materials - types of packaging materials: paper: glass, methods of bottle making; metals: tinplate containers, tinning process, components of tinplate, types of cans, aluminum containers, lacquers; plastics: types of plastic films, laminated plastic materials

#### Unit-2: ` PACKAGING MACHINERY 9 hours

Packaging equipment and machinery - vacuum machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machine; carton making machine

#### Unit-3: ` FOOD PACKAGING SYSTEMS 9hours

Food packaging systems- different forms of packaging such as rigid, semirigid and flexible forms, retortable pouches, tetrapack - packaging system for dehydrated foods, frozen foods, dairy products, fresh fruits and vegetables, meat, fish, poultry, sea foods, vanaspati ghee & basmati rice



**Unit-4: ` TESTING OF PACKAGING MATERIALS 9hours**

Principles of measuring water vapour transmission rate and gas permeability rate through given flexible film, OUR from food and OTR from film .Testing of packaging materials using – UTM Mullen Bursting strength tester- drop tester- Pouch burst tester- cob tester- gauge tester- torque tester tear tester- gas analyzer-cushioning materials. 9

**Unit-5: ` FOOD LABELING 9hours**

Food labeling and Nutrition labeling – Health claims, Nutrition Claims, Nutrition labels allowed on food labels, laws relating to food labeling 9

**Reference Books:**

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Second Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2005
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.



**Unit -4: Low temperature preservation: 9 hours**

Introduction, need, methods - Chilling and Freezing - theory and equipments, principle and effect on food quality, refrigerated and cold storage. Controlled atmosphere and modified atmosphere storage, Freeze concentration. 9

**Unit -5: Food Fermentation and Irradiation: 9 hours**

Theory of fermentation, Types of Fermentation, equipments, effect on foods, fermented food products - soy sauce, curd, sauerkraut, vinegar - role in human health. Irradiation - Theory and mechanism of action, sources of irradiation, equipments, applications in foods, effect on food materials.

**Reference Books:**

1. Fellows P.J., "Food processing Technology: Principles and Practice", 3rd Edition, Wood head Publishing Ltd, New Delhi, 2009.
2. Paul Singh R & Dennis R. Heldman., "Introduction to Food Process Engineering", 5th Edition, Academic Press, USA, 2014.
3. Sivasankar B., "Food Processing and Preservation", 1st Edition, Prentice Hall of India, New Delhi, 2005.

<b>216FTE1304</b>	<b>TECHNOLOGY OF FOOD PRODUCT DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	2	0	4

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 To impart the knowledge of various aspects of Creativity, Innovation and New Product development

CO2 Evaluate and screening ideas for new products

CO3 Plan for proto type production and introduce new products to consumer market

CO4 Apply patent for developed product

CO5 Evaluate the cost of food products

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	L	H		L												M
CO2			H										M	M	M	
CO3			H										M	M	M	
CO4			H			H	H	M								M
CO5						H	H	M			M					M

### Syllabus

#### Unit -1: INTRODUCTION 9 hours

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.

#### Unit -2: PROJECT SELECTION AND EVALUATION 9 hours

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (Evaluation techniques)

#### Unit -3: NEW PRODUCT PLANNING 9 hours

Design of proto type - testing - quality standards - marketing research - introducing new products

**Unit -4: NEW PRODUCT DEVELOPMENT****9 hours**

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

**Unit -5: MODEL PREPARATION & EVALUATION****9 hours**

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

**Reference Books:**

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.
3. Gordon W Fuller New Food Product Development from concept to Market place, 3rd Edition, CRC Press, 2016
4. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.

<b>216FTE1105</b>	<b>POST HARVEST TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : MINOR COURSE      **Syllabus revision**      2021

**Course Level** : 2      **Course Type** : Integrated Course Theory

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Evaluate Engineering Properties / Management of storage structures and losses during Storage agricultural Produce

CO2 Explain the application of scientific principles in the processing technologies specific to the materials.

CO3 Describe the storage conditions of different foods

CO4 Classify the methods to reduce the post-harvest losses during storage

CO5 Relate the shelf life and packaging materials

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			M							M			M		
CO2	M		M							M			M		
CO3	M											M		M	
CO4	M														M
CO5															M

### Syllabus

#### **Unit -1: Introduction of post-harvest technology 9 hours**

Introduction to post harvest technology of agricultural produce; Status of Production, Losses, Need, Scope and Importance, various post harvest operations such as Primary Processing Operation Vs. Secondary Operation, Operations like Harvesting, Handling cleaning, grading, sorting, drying, storage, milling, size reduction, expelling, extraction, blending, heat treatment, separation, material handling (transportation, conveying, elevating), washing; their functions and use in the post harvest processing

#### **Unit -2: Drying of Cereals and Pulses 9 hours**

Introduction, importance of drying, principles of drying and factors affecting drying, types of drying methods i.e. sun drying & artificial drying by mechanical means – Psychometric Chart, Moisture content representation, equilibrium moisture content, determination of moisture content by direct and indirect method Principles and operation of different types of Dryers viz. Deep Bed Dryers, Flat Bed Dryers, Continuous Flow Dryers, L.S.V. Dryers, Spray Dryer, Fluidized Bed Dryers, Rotary Dryer, Spouted Beds, Freeze Dryer, Tray And Tunnel Dryers

**Unit -3: Storage of Cereals and Pulses 9 hours**

Introduction, need and importance, general principles of storage. Temperature and moisture changes during storage i.e. influence of moisture content, relative humidity, temperature, fungi etc. on stored product amiliarization with the various types of storage structures. Deep and shallow bins. Traditional and modern storage structures. Management of storage structures. Losses during storage and their control, space requirement of bag storage structure

**Unit -4: Post Harvest Technology of Fruits and Vegetables 9 hours**

Methods of Harvesting and Post harvest losses in fruits and vegetables, Handling of Fruits and Vegetables. Introduction to the storage of fruits and vegetables. Need and importance of storage. Principle of storage of fruits and vegetables. Recommended storage operation conditions for some important fruits and vegetables and their storage life.

**Unit -5: Treatment and Packaging 9 hours**

Post-harvest treatment to increase shelf life i.e. freezing, chilling, dehydration, canning, thermal processing, Introduction to Packaging of fruits and vegetables and types of packaging. Concept of modified atmosphere packaging.

**Reference Books:**

1. Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest
2. Technology. Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi.PP.
3. Morris, Peter C and Bryce, J.H. “Cereal Biotechnology”, CRC / Wood Head, 2000.
4. Arthey, David and Ashwat P.R. “Fruit Processing: Nutrition, Products, and Quality

<b>216FTE1106</b>	<b>NUTRITION AND HEALTHY LIFE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Understand basic concepts of nutrition
- CO2 Recognize the structural and functional role of proteins & fats
- CO3 Interpret the structure and properties of carbohydrates and their metabolism
- CO4 Understand the effects of processing, storage on nutritional quality
- CO5 Classify the anti-nutritional factors and its affects in health

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	M												M		
CO2			M			M							M	L	M
CO3						M				M			M		M
CO4			M			H		M		M					M
CO5			M			H		M		M		M		L	M

### Syllabus

#### Unit -1: AN OVERVIEW OF NUTRITION

**9 hours**

Introduction to nutrition, classification of nutrition. Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, energy balance, and estimation of energy value from proximate composition. malnutrition.

#### Unit -2: MINERALS, VITAMINS IN NUTRITION

**9 hours**

Balanced diet planning: Food plate, Pyramid, and Food Exchange. Obesity, BMR and its factors, BMI calculations. Minerals and Vitamins: Recommended daily intake, toxicities, deficiencies, hypervitaminosis.

#### Unit -3: CARBOHYDRATE

**9 hours**

Requirements and role of carbohydrates (including dietary fibres), Digestion and absorption of carbohydrates, lactose intolerance; blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Glycemic Index and Glycemic load.



**Unit -4: PROTEINS IN NUTRITION****9 hours**

Biological value of proteins; Protein digestion and absorption, Estimation of protein quality – in vitro and in vivo methods; Nutritional assessment of individuals and populations, Food fortification and labelling.

**Unit -5: Lipids in nutrition****9 hours**

Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Eicosanoids, Polyesters and structured lipids.

**Reference Books:**

1. Harper, ALFRED E., et al. "Modern nutrition in health and disease." (1999)
2. Shils, Maurice E., James A. Olson, and Moshe Shike. "Modern nutrition in health and disease." (1994).
3. Aust, L. "Modern Nutrition in Health and Disease. Herausgegeben von RS Goodhart und ME Shils. XV und 1153 Seiten. Lea und Febiger, Philadelphia (1976): 101-101.

<b>216FTE1107</b>	<b>FOOD SUPPLY CHAIN MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Describe the methods of logistics and concepts of supply chain management.

CO2 Handle supply chain in procurement and warehousing.

CO3 Design logistics and supply chain network for transport and distribution of foods.

CO4 Combine packaging and information technology in logistics and supply chain management.

CO5 Explain the global level logistics and supply chain management.

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	H		M	M	M			L						L		
CO2	M		L		M			L						L		
CO3	M		L		M			L						L		
CO4	H		L		M			L		L		L		L		
CO5						M	M	L		M		L		L		

**Syllabus**

**Unit -1: INTRODUCTION 9 hours**

Logistics and supply chain management - Scope, Significance and Drivers; Basic Model – Primary and Secondary Activities; Role and challenges of logistics and supply chain management in food industry.

**Unit -2: PROCUREMENT AND WAREHOUSING 9 hours**

Demand and supply management, Forecasting techniques, Strategic planning for material sourcing, Outsourcing strategies, Warehouse strategies, Inventory models and control techniques

**Unit -3: DISTRIBUTION AND TRANSPORTATION 9 hours**

Various sources of distribution channels, Distribution models, 3PL and 4PL, Distribution network planning, Modes of transportation, Design of transshipment. Blockchain technology, Food traceability.

**Unit -4: PACKAGING AND INFORMATION TECHNOLOGY 9 hours**

Applications of Packaging in logistics, Types of packaging and packaging materials, Export & import packaging and labelling details, Containerization, Pervasiveness of IT in Supply Chain Management – ERP, Bar-coding, RFID, GPS, E-Procurement.

**Unit -5: GLOBAL LSCM 9 hours**

Export and import procedure and Documentation, Risk management in global logistics, Customer relationship management in LSCM. Performance metrics in Supply Chain, Indian agencies- EIC, EIA, APEDA, MEPEDA. Rapid alert system. Artificial intelligence and Big data in Food.

**Reference Books:**

1. D K Agarwal. 2010. Logistics and supply chain management, Macmillan Publishers India Ltd., Eighth Impressions.
2. Sunil Chopra and Peter Meindi. 2010. Supply chain management Pearson Education publishers.

<b>216FTE1108</b>	<b>ENTREPRENEURSHIP IN FOOD PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Describe the meaning and role of an entrepreneur and the functions

CO2 Understand the policies and regulations for entrepreneurship

CO3 Analyze business plan and evaluate the feasibility

CO4 Generate and launch small business plan

CO5 Apply the guidelines of developed business plan to manage small business

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1																L
CO2	L	M				L						L		M	M	
CO3	L	M		M		L								L	M	
CO4	L					L								L	H	
CO5	L	M		M												H

### Syllabus

#### Unit -1: ENTREPRENEURIAL COMPETENCE

**9 hours**

Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality  
Characteristics- Knowledge- Skills- Attitude Requirement

#### Unit -2: ENTREPRENEURIAL ENVIRONMENT

**9 hours**

Business Environment- Role of Family and Society- Entrepreneurship Development Training  
and Other Support Organizational Services- Central and State Government Industrial Policies  
and Regulations- International Business

#### Unit -3: BUSINESS PLAN PREPARATION

**9 hours**

Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product-  
Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the  
Project- Feasibility Report Preparation and Evaluation Criteria

#### Unit -4: LAUNCHING OF SMALL BUSINESS

**9 hours**

Finance and Human Resource Mobilization Operations Planning- Market and Channel  
Selection- Growth Strategies- Product Launching

**Unit -5:       MANAGEMENT OF SMALL BUSINESS****9    hours**

Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

**Reference Books:**

1. Hisrich, "Entrepreneurship", Tata McGraw Hill, New Delhi, 2005.
2. Saravanavel, P., 'Entrepreneurial Development', Ess Pee kay Publishing House, Chennai, 2005
3. Khanka, S S., "Entrepreneurial Development", S.Chand and Co Limited, New Delhi, 2001.

<b>216FTE1109</b>	<b>FOOD PLANT HYGIENE AND SANITATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Select suitable hygiene and sanitation procedures for Food industry
- CO2 Select integrated pest management approach and curative measures in food storage
- CO3 Infer the safety aspects of water
- CO4 Choose suitable cleaning operations for food industry
- CO5 Classify food waste and explain the strategies for waste minimization

### Mapping of COs' with POs'/PSOs'

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H				M	M							M	L	
CO2	H												L		
CO3	H	M										L	L		
CO4	H												M	M	
CO5	M	L	L		L		M							M	

### Syllabus

#### Unit -1: General principle of food hygiene: 9 hours

Hygiene in rural and urban areas in relation to food preparation, personal hygiene and food handling habits. Place of sanitation in food plants. Sanitary aspects of building and equipment: Plant layout and design, Comparative studies on sanitary fabrication of different types of processing equipment.

#### Unit -2: Safe and effective insect and pest control 9 hours

Extraneous materials in foods, Principles of Insects and pests control. Physical and chemical control. Effective control of micro-organisms: microorganisms important in food sanitation, micro-organisms as indicator of sanitary quality. Physical and chemical methods.

#### Unit -3: Sanitary aspects of water supply 9 hours

Source of water, quality of water, water supply and its uses in food industries. Purification and disinfection of water preventing contamination of potable water supply.

**Unit -4: Effective detergency and cleaning practices: 9 hours**

Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices.

**Unit -5: Sanitary aspects of waste disposal 9 hours .**

Establishing and maintaining sanitary practices in food plants, role of sanitation, general sanitary consideration and sanitary evaluation of food plants.

**Reference Books:**

1. Food Hygiene and Sanitation. S. Roday, Tata McGraw Hill, 1st Edition, 1998.
2. Principles of Food Sanitation. N. G. Marriott, Springer, 5th Edition, 2006.
3. Hobbs Food Poisoning and Food Hygiene. Jim Mclauchlin and Christine Little (Eds), 7th Edition, 2007.
4. Practical Food Microbiology & Technology. Harry H. Weiser, Mountney, J. and Gourd, W.W. AVI Publishing House, 2nd Edition, 1971.
5. Sanitation in Food Processing. John Troller, Academic Press, 2nd Edition, 1993

**216FTE1110****FOOD BIOTECHNOLOGY****L T P X C**

3 0 0 0 3

**Pre-  
Requisite** : Nil**Course  
Category** : Minor Course**Syllabus** 2021  
**Revision****Course Level** : 2**Course Type** : Theory Course**Course Outcomes (COs':)**

On successful completion of the course, the students would be able to;

CO1 Describe the Prospectus of Bio-Technology

CO2 Adapt the different microbial fermented products

CO3 Adapt enzyme technology and its uses in industry

CO4 Apply biotechnological aspects in plant tissue culture

CO5 Classify the functions of vaccine and bioremediation

**Mapping of COs' with POs'/PSOs'**

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H					L					L	L	L		L
CO2		M	H			L		L							
CO3	M					L									
CO4	M		M								L	L	M		
CO5	L	M	M										M		M

**Syllabus****Unit -1: BIOTECHNOLOGY****9 hours**

Definition, Scope , Application. Gene cloning - Definition, Basic concepts, Characteristics of ideal cloning vector, Plasmid, Bacteriophages, Cosmid and Phasmid Eg. PBR 322.

**Unit -2: FERMENTATION TECHNOLOGY****9 hours**

Definition, Steps in fermentation, Design of bio reactors, Medium &amp; Micro organism. Microbial products - Primary, secondary metabolites, Vit B12, Citric Acid, Penicillin &amp; alcohol.

**Unit -3: ENZYME TECHNOLOGY****9 hours**

Production of enzymes - Amylase, Protease, Lipase, Lactase and pectinase, Use of enzymes in food &amp; beverage industry (eg Cheese, fruit, juice, Wine, Meat tenderizing &amp; dairy)

**Unit -4: PLANT TISSUE CULTURE****9 hours**

Basic requirement for tissue culture Lab, Media &amp; Techniques (Basics only)Animal cell culture - Primary culture cell line, media requirement &amp; application (only outline)



**Unit -5: BIOTECHNOLOGY & HEALTH CARE****9 hours**

Types, Biogas & Bio ethanol production, Concept of Bio - remediation, Hazards of genetic engineering.

**Reference Books:**

1. Biotechnology, Kumar's V. Saris Publications, Kanyakumari.
2. Biotechnology, Singh B.D. Kalyani Publications, New Delhi.
3. A text book of Biotechnology, Dubey , R.C. S Chand & Co, New Delhi.
4. Gene Technology, Davson, M.T., Powel, R., and Gannon F. Bios scientific publishers Ltd U.K.
5. Basic Biotechnology, Rev, Fr, Dr. Ignasimuthu, S.J. Tata Mc Graw Hill Publication Co Ltd., New Delhi.

<b>216FTE1111</b>	<b>CHEMICAL ENGINEERING FOR FOOD INDUSTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : MINOR COURSE      **Syllabus Revision** 2021

**Course Level** : 2      **Course Type** : THEORY COURSE

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

CO1 Compute moisture content of food materials and to select the suitable dryer for dehydration of food materials

CO2 Describe the mechanical separation process

CO3 Choose the evaporator for food processing operations.

CO4 Apply knowledge for size reduction of various kind of food ingredients.

CO5 Develop unit operation system for food ingredient mixing.

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		L				M						H	L	
CO2	H		L										H		
CO3	H		L												
CO4	H														L
CO5	H		L	M		M						M	H	L	L

### Syllabus

#### Unit -1: PSYCHROMETRY AND DRYING 9 hours

Moisture and its measurements - direct and indirect methods – Equilibrium moisture content – importance of EMC- water activity, Drying theory – Drying rate – Mechanical Drying – hot air dryers – Types- fixed -fluidized bed – LSU drier-Spray drier- Osmotic dryer - vacuum shelf dryer – freeze dryer.

#### Unit -2: MECHANICAL SEPARATION 9 hours

Screening: Types, Equipments; Filtration: Filter media types and requirement – constant rate filtration – constant pressure filtration – filter cake resistance – filtration equipments – filter press – rotary drum filters – sedimentation – gravitational sedimentation – Stoke's law – sedimentation in cyclones. Centrifugal separations – rate of separation – centrifuge equipment.

#### Unit -3: EVAPORATION 9 hours

Definition – liquid characteristics – Types of evaporators -single and multiple effect evaporators - once through and circulation evaporators – Agitated film evaporators. Performance – evaporator capacity – boiling point elevation and Duhring's rule. Heat transfer coefficients – Evaporators economy – enthalpy balance of single effect evaporator – multiple effect evaporator – methods of feeding. Capacity and economy of multiple effect evaporator.

**Unit -4: SIZE REDUCTION****9 hours**

Principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products – energy and power requirements – Rittinger's, Kick's and Bond's law – Size reduction equipments – crushers – hammer mill – Ball Mill-Colloidal mill-attrition mills

**Unit -5: MIXING****9 hours**

Definitions and principles– Basic equations standards. Evaluation of constants – work, energy and Power – Agitation and Mixing – Purpose of agitation – Agitated vessels – impellers – propellers – turbine –High efficiency impellers – Impellers for high viscosity liquids. Draft tubes – Power number – mixing and blending of miscible liquids, mixing index.

**Reference Books:**

1. DG Rao, "Fundamentals of Food Engineering" PHI Learning Private Limited, New Delhi.
2. Earle, R.L. "Unit Operations in Food Processing". Pergamon Press, 2nd Edition, UK, 2003.
3. Geankoplis, CJ, "Transport Processes and Separation Processes Principles" .Printice Hall India, New Delhi, ISBN-978-81-203-2614-9, 2008.
4. Warren, L McCabe, J.C. Smith and Peter Harriot."Unit Operations of Chemical Engineering " McGraw Hill International ,7thEdition ,Singapore, ISBN-007-424740-6, 2005.

<b>216FTE1112</b>	<b>BASICS OF FOOD SAFETY AND QUALITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>X</b>	<b>C</b>
		3	0	0	0	3

**Pre-Requisite** : Nil      **Course Category** : Minor Course      **Syllabus Revision** : 2021

**Course Level** : 2      **Course Type** : Theory Course

### Course Outcomes (COs':)

On successful completion of the course, the students would be able to;

- CO1 Characterize different type of food hazards, physical, chemical and biological in the industry
- CO2 Explain the food safety management system
- CO3 Adapt the international food laws and standards
- CO4 Adapt the national food laws and standards
- CO5 Apply the food labeling regulations

CO/ PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	H		L			H		L					L	L	
CO2			M		M	M				M				H	
CO3	M														
CO4	M	L												M	
CO5	M	M	M							H				M	

### Syllabus

#### Unit -1: INTRODUCTION TO QUALITY CONTROL 9 hours

Principles of food safety and quality, food safety system, Introduction, Sources of Contamination, Control methods . quality attributes of food- Nutritional , Microbial, Sensory, total quality management, GHP, GMP

#### Unit -2: FOOD SAFETY MANAGEMENT 9 hours

Food Quality Management system, Quality Management Principles, Food laws – HACCP, AOQL, ISO/22000: Food Safety managements system

#### Unit -3: INTERNATIONAL FOOD LAWS AND REGUALTIONS 9 hours

Structure, organization and practical operation of WTO, WHO, FAO, CAC (Codex Alimentarrious Commission), ICGFI.

#### Unit -4: NATIONAL FOOD LAWS AND REGUALTIONS 9 hours

Structure, organization and practical operation of BIS, AGMARK, PFA, FSSAI.

**Unit -5: LABELLING REGULATIONS****9 hours**

Need for labelling, limitations of labelling- safety issues, labelling for irradiated foods, genetically modified foods, nutritional labelling, health claims

**Reference Books:**

1. Ronald S Kirk and Ronald Sawyer., Pearson's Composition and analysis of foods, 9th edition, Wiley, 1991
2. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
3. The Food Safety Information handbook by Cynthia A. Robert, 2009
4. Finley, J., Robinson, S. and Armstrong, D. (Eds.), Food Safety Assessment. American Chemical Society, Washington D.C, 2 nd editions,1992
5. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel Dekker Inc., 2004.