B. TECH. (FOOD TECHNOLOGY)

Total Contact Hours = 29 Total Marks = 900 Total Credits = 24

SEMESTER 3rd		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-301	Principles of Food Preservation	3	1	0	40	60	100	**4**
BFOT1-302	Food Chemistry	3	1	0	40	60	100	**4**
BFOT1-303	Food Microbiology	3	1	0	40	60	100	**4**
BFOT1-304	Fluid Flow Operations and Rheology	3	1	0	40	60	100	**4**
BSOS0-F91	Soft Skills-I	0	0	2	60	40	100	**1**
BFOT1-305	Food Chemistry (Lab)	0	0	2	60	40	100	**1**
BFOT1-306	Food Microbiology (Lab)	0	0	2	60	40	100	**1**
BFOT1-307	Training-I	0	0	4	60	40	100	**2**
Departmental Elective –I (Select any one)		3	0	0	40	60	100	**3**
BFOT1-356	Food Hygiene And Plant Sanitation							
BFOT1-357	Industrial Microbiology							
Total		**15**	**4**	**10**	**440**	**460**	**900**	**24**

Total Contact Hours = 25 Total Marks = 800 Total Credits = 22

SEMESTER 4th		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-408	Food Engineering	3	1	0	40	60	100	**4**
BFOT1-409	Fruits and Vegetable Processing Technology	3	1	0	40	60	100	**4**
BFOT1-410	Milk and Milk Products Technology	3	1	0	40	60	100	**4**
BFOT1-411	Technology of Animal Products	3	1	0	40	60	100	**4**
BSOS0-F92	Soft Skills-II	0	0	2	60	40	100	**1**
BFOT1-412	Fruits and Vegetable Processing Technology (Lab)	0	0	2	60	40	100	**1**
BFOT1-413	Milk and Milk Products Technology (Lab)	0	0	2	60	40	100	1
Departmental Elective –II (Select any one)		3	0	0	40	60	100	**3**
BFOT1-458	Biochemical Engineering							
BFOT1-459	Plant Utilities							
Total		**15**	**4**	**6**	**380**	**420**	**800**	**22**

Total Contact Hours = 24 **Total Marks = 900** **Total Credits = 23**

SEMESTER 5th		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-514	Cereals and Pulses Processing Technology	3	1	0	40	60	100	**4**
BFOT1-515	Food Processing Plant Layout and Design	3	1	0	40	60	100	**4**
BFOT1-516	Heat and Mass Transfer	3	1	0	40	60	100	**4**
BSOS0-F93	Soft Skills-III	0	0	2	60	40	100	**1**
BFOT1-517	Cereals and Pulses Processing Technology (Lab)	0	0	2	60	40	100	**1**
BFOT1-518	Heat and Mass Transfer (Lab)	0	0	2	60	40	100	1
BFOT1-519	Training-II	0	0	4	60	40	100	**2**
Departmental Elective – III (Select any one)		3	0	0	40	60	100	**3**
BFOT1-560	Grain Handling and Storage Technology							
BFOT1-561	Technologies of Beverages							
Open Elective – I (Select any one)		3	0	0	40	60	100	**3**
Total		**15**	**3**	**6**	**380**	**420**	**900**	**23**

Total Contact Hours = 25 **Total Marks = 800** **Total Credits = 22**

SEMESTER 6th		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-620	Technologies of bakery and confectionary products	3	1	0	40	60	100	**4**
BFOT1-621	Technology of Fats and Oils	3	1	0	40	60	100	**4**
BSOS0-F94	Soft Skills-IV	0	0	2	60	40	100	**1**
BFOT1-622	Technologies of bakery and confectionary products (Labs)	0	0	2	60	40	100	**1**
BFOT1-623	Technology of Fats and Oils (Labs)	0	0	2	60	40	100	1
Departmental Elective –IV (Select any one)		3	1	0	40	60	100	**4**
BFOT1-662	Food Additives							
BFOT1-663	Food Storage Engineering							
Departmental Elective – V (Select any one)		3	1	0	40	60	100	**4**
BFOT1-664	Waste Management in Food Technology							
BFOT1-665	Health Foods							
Open Elective – II (Select any one)		3	0	0	40	60	100	**3**
Total		**15**	**4**	**6**	**380**	**420**	**800**	**22**

Total Contact Hours = 34 **Total Marks = 800** **Total Credits = 24**

SEMESTER 7th		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-724	Packaging Technology	3	1	0	40	60	100	**4**
BFOT1-725	Spices and Flavour Technology	3	1	0	40	60	100	**4**
BFOT1-726	Packaging Technology (Lab)	0	0	2	60	40	100	**1**
BFOT1-727	Spices and Flavour Technology (Lab)	0	0	2	60	40	100	**1**
BFOT1-728	Training –III	0	0	8	60	40	100	**4**
BFOT1-729	Project-I	0	0	8	60	40	100	4
Departmental Elective – VI (Select any one)		3	0	0	40	60	100	**3**
BFOT1-766	Innovative Techniques In Food Processing							
BFOT1-767	Applications of Enzymes In Food Technology							
Open Elective – III (Select any one)		3	0	0	40	60	100	**3**
Total		**12**	**2**	**20**	**400**	**400**	**800**	**24**

Total Contact Hours = 22 **Total Marks = 400** **Total Credits = 15**

SEMESTER 8th		Contact Hrs..			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOT1-830	Food Analysis & Quality Control	3	1	0	40	60	100	**4**
BFOT1-831	Food Analysis & Quality Control (Lab)	0	0	2	60	40	100	**1**
BFOT1-832	Project-II	0	0	12	60	40	100	**6**
Departmental Elective – VII (Select any one)		3	1	0	40	60	100	**4**
BFOT1-868	Statistical Quality Control							
BFOT1-869	Engineering Properties of Biological Materials							
Total		**6**	**2**	**14**	**200**	**200**	**400**	**15**

Overall

Semester	Marks	Credits
1st	1000	25
2nd	900	25
3rd	900	24
4th	800	22
5th	900	23
6th	800	22
7th	800	24
8th	400	15
Total	**6500**	**180**

PRINCIPLES OF FOOD PRESERVATION

Subject Code: BFOT1-301 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES

To provide the basic knowledge for preservation of food and prevention of food spoilage.

COURSE OUTCOMES

On completion of the course the students are expected to:

1. Be able to know the basics of various food processing and preservation technologies.
2. Be able to acquaint well with principles of different techniques used in processing and preservation of foods.

UNIT-I (11 Hrs.)

Basic Consideration: Aim and objectives of preservation and processing of foods, Constituents of foods: Properties and significance; Nutritive aspects of food constituents; Concept of Water activity, osmosis and diffusion, Food Spoilage**:** Microbial, Physical, Chemical & Miscellaneous; Intermediate moisture Food.

UNIT-II (12 Hrs.)

Preservation of Foods by Low Temperatures: Considerations relating to storage of foods at low temperature, controlled and modified atmosphere storage of foods, freezing process, freezing curve, slow and fast freezing of foods and its consequences, other occurrences associated with freezing of foods. Technological aspects of frozen storage and thawing of foods, freeze concentration

UNIT-III (11 Hrs.)

Preservation of Foods by High Temperature: Basic concepts in thermal destruction of micro-Organisms-D, Z, F, values Heat resistance and thermophiles in micro-organisms. thermal processing of foods: Cooking, blanching, pasteurization and sterilization of foods, canning and spoilages in canned foods.

UNIT- IV (11 Hrs.)

Preservation by Water Removal: Principles, technological aspects and applications of evaporative concentration processes, and membrane processes for food concentrations. Principles, technological aspects and applications of drying and dehydration of foods

Preservation by Chemicals: Use of preservative in foods: chemical and bio preservative including antibiotics, antimicrobial agents.

Recommended Books

1. P.J. Fellows, 'Food Processing Technology Principles & Practices', 3rd Edn., Woodhead Publisher, **2009.**
2. N.N. Potter and J.H. Hotchkiss, 'Food Science', CBS Publishers, **1995.**
3. James M. Jay, M.J. Loessner, D.A. Golden, 'Modern Food Microbiology' 7th Edn, Springer US. **2005.**
4. V. Kyzlink, 'Principles of Food Preservation', Elsevier Press, **1990.**
5. Desrosier & Desrosoer, 'Technology of Food Preservation', CBS Publication, **2006.**

FOOD CHEMISTRY

Subject Code: BFOT1-302 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To develop the knowledge of students in the basic area of Food Chemistry. This course will enable the students to appreciate the similarities and complexities of the chemical components in foods and understanding of the physicochemical properties of foods.

COURSE OUTCOMES:
On completion of the course the students are expected to:
1. Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
2. Be able to understand and identify the non-nutritive components in food, naturally present.

UNIT- I (12 Hrs.)

Introduction: Development of food chemistry and its role in food processing.
Water: Importance of water in foods. Structure of water & ice. Concept of bound & free water and their implications.
Carbohydrates: Nomenclature and classification, structure, physical and chemical properties of carbohydrates – monosaccharide, disaccharides and polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances) and their functions; dietary fiber, changes in carbohydrates during processing**.**

UNIT-II (10 Hrs.)

Proteins: Nomenclature, classification, structure, chemistry and properties of amino acids, peptides, proteins. essential and non- essential amino acids. Changes during processing.

UNIT-III (12 Hrs.)

Lipids: Structure, classification, physical and chemical properties of fatty acids and glycerides, Auto-oxidation, photo oxidation and flavor reversion, Changes in fats & oils during processing.
Vitamins & Minerals: Types, chemistry and functions, source and deficiency diseases. Changes during processing

UNIT-IV (11 Hrs.)

Enzymes: Nomenclature, mechanism of enzyme action, factors affecting enzyme action, enzymes important in foods.
Pigments: Structure and properties of chlorophyll, anthocyanins, tannin, myoglobin and carotenoids, chemical changes during processing

Recommended Books

1. Frank A. Lee, 'Basic Food Chemistry', Springer Publication, **2013.**
2. H.D. Belitz, Werner Grosch, Peter Schieberle, 'Food Chemistry', Springer-Verlag Berlin Heidelberg Publisher, **2009.**
3. L.H. Meyer, L.H. Van Nostrand, 'Food Chemistry', Reinhold Company Publication, New York, London, **1998.**
4. Lehninger, 'Principles of Biochemistry', Palgrave Macmillan Publication, **2004.**

FOOD MICROBIOLOGY

Subject Code: BFOT1-303 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
The course aims to flourish the students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections. This course will also intimate the role of microbes in fermentation, spoilage and food borne diseases.

COURSE OUTCOMES:
On completion of the course the students are expected to:
1. Be able to understand and identify the various microbes associated with foods and food groups.
2. Be able to understand and identify the role of these microbes in food spoilage, food preservation.
3. Understand the role of pathogens in food borne infections.

UNIT-I (11 Hrs.)

Introduction: Importance and historical developments in food microbiology, prokaryotic and eukaryotic cell, morphology, structure, microbiology and reproduction of Bacteria, Yeast, Mold, Actinomycetes and algae. Viruses-structure and replication with particular reference to food borne viruses.

UNIT-II (12 Hrs.)

Microbial growth and death kinetics: Definition, Growth curves (different phases), synchronous growth, doubling/generation time, intrinsic and extrinsic factors, relationship between number of generations and total number of microbes.

Techniques of pure culture: Definition, Serial Dilution, pour plate, streak plate, spread plate, slant, broth and enrichment culture, lyophilization.

UNIT-III (10 Hrs.)

Microorganism in Natural Products: Sources and prevention of contamination; Microbiology of atmosphere, water, influence of aw, milk and milk products; cereals and cereal products; meat and meat products; fish or fish products; poultry and eggs; sugars; spices and salt; canned foods.

UNIT-IV (12 Hrs.)

Food spoilage: Bacterial and fungal food spoilage, food poisoning, food borne infection, food borne intoxication. Toxins produced by staphylococcus, clostridium, aspergillus; bacterial pathogens- salmonella, bacillus, listeria, E. coli, shigella, campylobacter.

Microbial Control: Source of microorganism, Physical and chemical agents used in microbial control, disinfection agents and its dynamics.

Recommended Books

1. Frazier, 'Food Microbiology', 5th Edn. McGraw Hill Education, **2013.**
2. Roger. Y. Stainier, 'General Microbiology', 5th Edn., Macmillan, **1987.**
3. Casida, 'Industrial Microbiology' John Wiley & Sons Inc, New York, **1968.**
4. H.J. Pelczar, 'Microbiology', Tata McGraw Hill Education, **1998.**

FLUID FLOW OPERATIONS AND RHEOLOGY

Subject Code: BFOT1-304 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To perform calculations pertaining to processes and operations and to apply fluid mechanics principles to applied problems.

COURSE OUTCOMES:

On completion of the course the students are expected to:

1. Understand the principles of fluid mechanics and food rheology and their applications in food industry.

UNIT-I (12 Hrs.)

Introduction to fluid, various physical properties of fluid, concept viscosity, units of viscosity, factors affecting the rheological parameters, fluid pressure and its measurement, pressure, manometers, concept of Reynolds's number, types of fluid flow, rate of flow or discharge, derivation of continuity equation, different types of energies of a liquid in motion, pressure energy, kinetic energy, potential head, derivation Bernoulli equation.

UNIT-II (11 Hrs.)

Practical applications of Bernoullies equation, venturimeter, orifice meter, pitot tube, rotameter, loss of head due to friction in viscous flow, Darcy-Weisbach formula; energy losses in pipes; major losses; minor losses; coefficient of friction or fanning friction factor or skin friction factor; drag coefficient; different types of pumps.

UNIT-III (12 Hrs.)

Introduction to Rheology; perfectly elastic (Hookean body), ideal plastic behaviour; ideal viscous behaviour; stress strain diagram of a biomaterial; rheological diagram; concept of apparent viscosity, time independent fluids (no memory fluids); power law (viscous) fluids; pseudo plastic or shear thinning fluids; shear thickening fluids; dilatant fluids; viscoplastic fluids: Bingham plastic (ideal plastic) fluids; non- bingham plastic fluids; Herchel-Bulkley fluids: Time dependent fluids (memory fluids) like thixotropic fluids; antithixotropic (or rheopectic) fluids.

UNIT-IV (10 Hrs.)

Derivation of Hagen-Poiselle equation or theory of capillary viscometer; Stokes law; Viscometry, capillary tube viscometer; Ostwald viscometer; falling sphere resistance method; rotational viscometer; cone and plate type viscometer; circular disc viscometer; oscillatory measurements method; textural profile analysis.

Recommended Books

1. R.K. Bansal, 'A Text book of Fluid Mechanics and Hydraulic Machines', Laxmi Publications (P) Ltd, New Delhi, **2009.**
2. Shiv Kumar, 'Fluid Mechanics', Ane Books Pvt. Ltd, New Delhi, **2010.**
3. K.R. Arora, 'Fluid Mechanics Hydraulic and Hydraulic Machines', Standard Publishers Distributors, New Delhi, **1993.**
4. G.S. Sawhney, 'Fundamentals of Fluid Mechanics', I.K. International Publishing House Pvt. Ltd., New Delhi, **2008.**

FOOD CHEMISTRY LAB.

Subject Code: BFOT1-305 **L T P C**
0 0 2 1

1. Preparation of sample for analysis
2. Determination of acidity/pH of food samples.
3. Preparation of standard solutions.
4. Qualitative tests for the presence of carbohydrates in food samples
5. Qualitative test for the presence of protein in food samples
6. Estimation of sugar in given food sample by Lane and Eynon and Nelson & Somogy method
7. Estimation of lactose in milk sample by titrimetric method
8. Estimation of amount of fat in milk powder by Majonnier's method

9. Estimation of protein by micro-Kjeldhal method
10. Estimation of pectin in fruit (Guava)
11. Determination of saponification value and un-saponifiable matter
12. Determination of vitamin C in food sample.
13. Estimation of phosphatase activity.
14. Estimation of moisture, ash and crude fiber.

FOOD MICROBIOLOGY LAB.

Subject Code: BFOT1-306 **L T P C**
0 0 2 1

1. Working study of various equipment related to Microbiology.
2. Isolation of pure culture using pour plate technique.
3. Isolating pure culture using spread plate technique.
4. Measurement the size of given microbial cell using micrometry.
5. Enumeration total viable count in a culture.
6. To perform Gram staining technique of bacteria.
7. Study the growth curve of microorganisms.
8. Preparation of nutrient broth.
9. Preparation of media with nutrient agar, PDA and special media.
10. Quantitative analysis of food sample by standard plate count (SPC) method
11. Study the quality of milk by methylene blue reductase test.
12. Preparation of curd using starter culture.
13. To perform presumptive test for coliforms in milk.
14. To study the microbial spoilage of given food sample.

FOOD HYGEINE AND PLANT SANITATION

Subject Code: BFOT1-356 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To understand Food safety and hygiene, types of hazards associated with food.

COURSE OUTCOMES:
On completion of the course the students are expected to:
1. This course will enable the emerging food technologists to practice good food handling habits and,
2. Hygiene in food manufacturing plants and surroundings.

UNIT-I (12 Hrs.)

General principles of food hygiene. Personal hygiene. Food handling habits, Sanitation facilities and procedures in food plant operations Sanitary aspects of building and processing equipment. Establishing and maintaining sanitary practices in food plants.

UNIT-II (11 Hrs.)

Safe and effective insect and pest control: Extraneous materials in foods, Principles of Insects and pest control. Physical and chemical control, Food contamination by microorganisms, effective control of micro-organisms, importance in food sanitation, micro-organisms as indicator of sanitary quality.

UNIT-III (10 Hrs.)

Sanitary aspects of water supply: 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-IV (12 Hrs.)

Effective detergency and cleaning practices: Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices. Role of sanitation, general sanitary consideration and sanitary evaluation of food plants. Sanitary aspects of waste disposal.

Recommended Books

1. S. Roday, 'Food Hygiene and Sanitation', Tata McGraw Hill Education, **1998.**
2. Betty C. Hobbs, 'Food Poisoning and Food Hygiene', 2nd Edn., London Publication, **1969.**
3. Gaston and Tiffney, 'Guide to Improve Food Hygiene', Tata McGraw Hill Education.
4. Harry H. Weiser, J. Mountney and Gord, 'Practical Food Microbiology & Technology', **2006.**

INDUSTRIAL MICROBIOLOGY

Subject Code: BFOT1-357 **L T P C** **Duration: 45 Hrs.**

3 1 0 4

COURSE OBJECTIVES:

To Impart knowledge and skills related to process technologies and equipment used for the production of various fermented food products.

COURSE OUTCOMES:

Students completing this course student should be able to:

1. To understand various concepts, principles and procedures involved in the area of fermented food production and enzymes involved in the food production.
2. To familiarize with different fermentor types and their design criteria.

UNIT-I (11 Hrs.)

Economic activities of microorganisms. Propagation of food, food and baker yeasts. Technology of production of alcohol, glycerol, beer and glycerol fermentation.

Production of wine and other alcoholic beverages (Whiskey, rum etc.) activities of lactic acid bacteria and industrial production of lactic acid.

UNIT-II (12 Hrs.)

Activities of acetic acid bacteria and production of vinegar, sorbose and dihydroxyacetone.

Production of dextrons, amino acid fermentation, metabolic controls in industrial fermentation, saccharifying agents - methods of production and uses.

Activities of molds, microbial production of organic acids viz. citric, gluconic, fumaric, itaconic, gibbarellic and kojie acids.

UNIT-III (10 Hrs.)

Microbial production of vitamins B-2 and B-12

Production, Isolation and uses of microbial enzymes, immobilized enzymes and their applications, production of glucose and fructose and starch by enzymatic method.

UNIT-IV (12 Hrs.)

Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances.

Production and isolation of antibacterial antibiotics like penicillin, streptomycin, streptomycin, chloromycetin, tetracyclines, semisynthetic pencillins. antifungal antibiotics.

Recommended Books

1. 'An Introduction to Industrial Microbiology', S. Chand, **2010.**
2. Moo Young, 'Comprehensive Biotechnology', Pergamon Press, New York, **1985.**
3. L.E. Casida, 'Industrial Microbiology', John Wiley & Sons, **2004.**
4. Prescott and Dunn**, '**Industrial Microbiology', Gerald Reed, Globe Bookservices, London.**, 1983.**

5. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton**,** 'Industrial Microbiology: An Introduction', Blackwell Science Ltd., **2001.**

FOOD ENGINEERING

Subject Code: BFOT1-408 **L T P C** **Duration: 45 Hrs...**
3 1 0 4

COURSE OBJECTIVES:
To understand the principles of unit operation as well as to acquaint with fundamentals of food engineering and its process calculations and.

COURSE OUTCOMES:
On completion of the course the students are expected to:
1. To impart basic knowledge of freezing, drying and dehydration, evaporation, extrusion technology and thermal Processing.
2. To understand the basics of designing of food equipment and plant systems.

UNIT-I (11 Hrs.)

Material and Energy Balance: Numerical problems on material and energy balance related to food processing.

Thermal Processing: Microbial inactivation; Derivation and application of equation for determination of thermal process time for cans, calculation of process time for continuous sterilization of liquid foods; factors affecting rate of heat penetration; related numerical problems

UNIT-II (12 Hrs.)

Steam Properties: Properties of wet, saturated and superheated steam, use of steam tables and Mollier diagram.

Evaporation: Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy; related numerical problems.

UNIT-III (11 Hrs.)

Psychrometry: Properties of air-water vapour mixture, psychometric chart, Humidification and dehumidification operations, Application of psychometry to drying; related numerical problems.

Drying and Dehydration: Principles of drying and dehydration, water activity, sorption and desorption isotherms, rates of drying: constant and falling rate periods during convective drying, drying rate constant; freeze drying and spray drying; calculations of freeze drying and spray drying times; related numerical problems.

UNIT-IV (11 Hrs.)

Freezing and Crystallization: Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, different types of freezers and crystallizers.

Fluidization: Mechanism of fluidization, characteristics of gas –solid fluidized systems, pressure drop in fluidized bed, application of fluidization in drying.

Extrusion Technology: Theory, Engineering aspects of single and twin screw extruders, applications of extruders in food processing.

Recommended Books

1. Heldman and Singh, 'Food Process Engineering', Academic Press, **2013.**
2. R.T. Toledo, 'Fundamentals of food Process Engg.', Springer & CB, **2007.**
3. P.G Smith, 'Introduction to Food Process Engineering', Springer US, **2011.**

4. C.J. Geankoplis, 'Transport Processes & Unit Operations', Allyn and Bacon, **1978.**

FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Subject Code: BFOT1-409 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To impart knowledge of different methods of fruits and vegetable processing and to formulate the various value added products.

COURSE OUTCOMES:

On completion of the course the students are expected to:

1. To learn various methods of preservation of fruits and vegetables.
2. To enhance the shelf life of various fruits and vegetables and their products.
3. To develop waste management in fruit & vegetable industry.

UNIT-I (11 Hrs.)

Current status of production and processing of fruits and vegetables. Structural, compositional and nutritional aspects. Post-harvest physiology, handling, losses and conservation of fruits and vegetables.

UNIT-II (12 Hrs.)

Techniques of extension of shelf life of unmodified produce: use of adjuncts, novel packaging, controlled and modified atmosphere storages. Processing for conversion into products and preservation by use of chemical preservatives, chilling & freezing, sterilization & canning, concentration & dehydration and other special techniques.

UNIT-III (10 Hrs.)

Technology of Products: juices & pulps, concentrates & powders, squashes & cordials, nectars, fruit drinks & beverages carbonated and its quality control. Fermented products (Cider, wine, brandy).

UNIT-IV (12 Hrs.)

Jam, Jelly & Marmalades; candied fruits, dried fruits and fruit products (e.g. Aam papads, bars); soup mixes; sauces & ketchups; puree & pastes; chutneys & pickles, Specialty fruit and vegetable products, Waste management in fruits & vegetable industry.

Recommended Books

1. B. Srilakshami, 'Food Science', New Age International, **2003.**
2. N. Shakuntala Manay and M. Shadaksharaswamy, 'Foods: Facts and Principles', 3rd Edn., New Age International (P) Ltd., **2013.**
3. S.R. Mudambi and M.V. Rajagopal, 'Fundamentals of Foods and Nutrition', New Age International, **2001.**
4. Girdhari Lal and G.S. Siddappa and G.L. Tandon, 'Preservation of Fruits and Vegetables', CBS Publications, **1959.**

MILK AND MILK PRODUCTS TECHNOLOGY

Subject Code: BFOT1-410 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To know the basic need and importance of dairy industry and technological aspects of milk and its processing.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To acquaint with techniques and technologies of testing and processing of milk into various products and utilization of byproducts.

UNIT-I (10 Hrs.)

Introduction: Status of Dairy Industry in India. Cooperative Dairying. Operation Floods. Milk: Definition, Composition, Chemical and functional properties of milk components: physicochemical properties of milk protein, aggregation of Casein, micelles, factors affecting milk composition, milk secretion and lactation.

UNIT-II (12 Hrs.)

Fluid Milks: Physicochemical characteristics and factors affecting them. Production, collection, testing quality, cooling, storage, and transportation of liquid milks. Receiving and quality assessing of liquid milk in dairy industry for detection of adulteration, decision for acceptance/rejection, and determination of price of the milk.

Micro-organisms: importance in dairy science and technology. Microbial spoilage of milk.

UNIT-III (12 Hrs.)

Milk Processing Operations: Standardization and/or processing (pasteurization, homogenization, sterilization and UHT processing), storage, packaging and distribution of liquid milks: whole, standardized, toned, double-toned, and skim milk. Recombined, reconstituted, and flavored milks. Effect of processing of milk components and their functional properties.

Cream & Cream characteristics, manufacture of yoghurt and other fermented milk products, Ice cream manufacture, Butter making technology, technology of cheese, processing of evaporated and concentrated milks and dried milk powder.

UNIT-IV (11 Hrs.)

Indigenous Product: Fermented milks (Curd, yogurt etc.) and milk-products (cheeses, butter milk, lassi etc.); other milk products (khoa, casein, whey proteins, lactose etc.); milk and milk product-based sweetmeats (burfi, rasogolla, milk-cake, kalakand, ruberii, etc.)

Milk quality control, sanitation in the dairy plant, adulteration of milk, dairy equipment maintenance and waste disposal.

Recommended Books

1. Sukumar De, 'Outlines of Dairy Technology', Oxford University Press, **1980.**
2. James N. Warner, 'Principles of Dairy Processing', Wiley Publications, New York, **1976.**
3. C.H. Eckles, W.B. Combs and Macy, 'Milk and Milk Products', Tata McGraw Hill, **1957.**
4. Aneja et al, 'Technology of Indian Milk Products', A Dairy India Publication, **2002.**

TECHNOLOGY OF ANIMAL PRODUCTS

Subject Code: BFOT1-411 **L T P C** **Duration: 45 Hrs.**

3 1 0 4

COURSE OBJECTIVES:

To understand the need and importance of meat, egg and fishery industry as well as to study the structure, composition and nutritional quality of animal products.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To understand technology behind preparation of various animal food products and their byproduct utilization.
2. To study slaughtering and processing of various animals.

UNIT-I (11 Hrs.)

Introduction: Scope of meat, poultry and fish industry in India.

Structure and Composition of Muscle and Associated Tissue: Muscle tissue, skeletal muscle, skeletal muscle fiber, myofibrils, myofilaments, smooth muscle, cardiac muscle, epithelial tissue, nervous tissue, Connective tissues, Connective tissue proper, adipose tissue, Muscle bundles and associated connective tissues, Muscle and fiber types, Chemical composition of skeletal muscle.

UNIT-II (11 Hrs.)

Conversion of Muscle to Meat: Homeostasis, Exsanguination, circulatory failure to muscle, postmortem pH decline, rigor mortis, Enzymatic degradation.

Properties of Fresh Meat: Water holding capacity, chemical basis of water holding capacity, color, pigments, Chemical state of pigments.

UNIT-III (10 Hrs.)

Principles of Meat Processing: Curing, meat curing ingredients, methods for incorporation of cure ingredients, chemistry of cured color, comminution, blending and emulsification, Technology of sausages**.**

UNIT-IV (12 Hrs.)

Beef, Mutton and Pork: Slaughtering of cattle, sheep and pig, By products of meat industry**.**

Poultry Dressing and Egg Processing: Stunning, bleeding, scalding, evisceration, packaging and storage, Structure, compositive nutritive value of an egg, Functional properties of egg constituents, Interior quality of eggs and its preservation Egg products.

Fish Processing: Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates, By products of fish Processing industry.

Recommended Books

1. J. Kerry, J. Kerry and D. Ledward, 'Meat Processing Improving Quality', CRC Woodhead Publisher, **2011.**
2. Robert L. Henrickson, 'Meat, Poultry and Seafood Technology', Prentice Hall, New Jersey.
3. B. Panda, 'Poultry Production', **ICAR.**
4. J.C. Forest, E.D. Aberle, H.B. Hedrick W.H., 'Principles of Meat Science', Freeman and Company, **1975.**

FRUITS AND VEGETABLE TECHNOLOGY LAB.

Subject Code: BFOT1- 412 **L T P C**
0 0 2 1

1. Preservation and processing of certain vegetables by drying.
2. Preparation of tomato ketchup and its preservation.
3. Preparation of tomato puree and its preservation.
4. Preparation of pickles.
5. Preparation of jam,
6. Preparation of jelly
7. Preparation of marmalades
8. Preparation of fruit juice, squash and cordial.
9. Processing and Preservation of peas by use of high temperatures (Bottling of Peas).
10. Blanching of a given sample (pea) and assessment of its adequacy.
11. Enzymatic browning of fruits and vegetables and its control.
12. Osmotic dehydration of given sample (Carrot/Grapes).
13. Preparation of amla preserve and dried fruit product (Aam papad, bars)
14. Freezing of fruits and vegetables.
15. Can seaming operations and canning of fruits and vegetables

MILK AND MILK PRODUCTS TECHNOLOGY

Subject Code: BFOT1-413 **L T P C**
0 0 2 1

1. Determination of titrable acidity of milk.
2. Determination of specific gravity of milk & observe effect of water addition on it.
3. Performance of platform tests on given sample of milk.
4. Detection of adulterants and preservatives in milk.
5. Determination of bacteriological quality of milk.
6. Preparation of sterilized flavored milk.
7. Preparation of certain dairy products (Khoya, paneer, curd, yogurt, cream, ice cream, kalakand) and assessment of yield and quality of prepared products.
8. Determination of solubility, dispensability of dried milk powders (spray & drum-dried samples).
9. Determination of fat content of milk
10. Visit to a milk processing plant.

BIOCHEMICAL ENGINEERING

Subject Code: BFOT1-458 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To expose the students in enzyme studies and overview of fermentation processes.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To understand the Enzyme kinetics, Inhibition kinetics, Immobilization
2. To understand the concept of basic fermentation processes and its control systems etc.
3. To get a practical knowledge about running the fermented and its scale – up and modes of operation etc.

UNIT-I (12 Hrs.)

Introduction: Introduction to biochemical engineering, chemical engineering, microbiology, biotechnology and biochemistry.

Cell Growth: Introduction, quantifying cell concentration, growth patterns and kinetics in batch culture, effect of environmental conditions on growth kinetics, heat generation by microbial growth.

UNIT-II (12 Hrs.)

Media Sterilization: Medium formulation, Thermal sterilization, Sterilization by filtration, Design criteria and design equations for sterilization process, Temperature-time profile and design calculations, Methods of air sterilization, Interception, diffusion and combined mechanism

UNIT-III (10 Hrs.)

Enzymes: Introduction, uses and application of enzymes in food industry and biosensors, Biochemical reaction kinetics, Michaelis- Menten type kinetics, Briggs-Halden approach.

UNIT-IV (11 Hrs.)

Fermenter design, control and scale up: Aeration and agitation in fermenter, oxygen supply and demand in microbial processes, oxygen transfer in fermentation, types of spargers, etc.

Recommended Books

1. M.L. Shuler and F. Kargi, 'Bioprocess Engineering: Basic Concepts', Prentice Hall, **2011.**
2. H.C. Vogel and C.L. Todaro, 'Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment', Standard Publishers Distributors, Delhi, **1996.**
3. A.V.N. Swamy, 'Fundamentals of Biochemical Engineering', BS Publications, **2008.**

4. D.G. Rao, 'Introduction to Biochemical Engineering', McGraw Hill Publishing Co. Ltd., **2005.**

PLANT UTILITIES

Subject Code: BFOT1-459 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in food industries.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To understand the theoretical knowledge of steam generators, condensers and gears.
2. To learn the safety measures in steam plants.

UNIT-I (12 Hrs.)

Properties of Steam: Introduction – steam formation – Thermodynamic properties of steam – Sensible heat, latent heat, dryness fraction, wet fraction – superheated steam – steam table, expansion of steam

Steam Generators: Introduction, Classification & Boilers, Water tube, Fire tube type, Vertical tabular boilers, types of fire and water tube boilers, boiler mounting & accessories, Performance of steam generator, Evaporation rate. Performance, boiler efficiency, Factors influencing Boiler efficiency problems.

UNIT-II (12 Hrs.)

Fuels & Combustion: Introduction, solid, liquid & gaseous fuel, Calorific value of fuel, flue gases per kg. of fuel, Minimum Air required per kg. of fuel, Excess Air Problems.

Condensers: The function of a condenser in a Steam Power Plant, Vacuum, Classification, Comparison of Jet & Surface Condensers, Advantages/Disadvantages Mass of Circulating Water required in a condenser, Air Removal.

Fitting, Safety & Maintenance: Selection of size of steam pipes – layout of pipe lines – Energy audit of steam boilers – economy of heat utilization – boiler codes – Indian boiler regulation act – safety in steam plant maintenance.

UNIT-III (11 Hrs.)

Gears: Introduction, Classification of Gears, Parallel Shafts, Spur Gears Spur Rack & Pinion, Helical Gears, Intersecting Shafts, Straight Bevel Gears, Spiral Bevel Gears, Skew Shafts, Crossed Helical Gears, Worm Gear, Hypoid Gears, Gear Terminology, Pitch Circle, Pitch dia, Pitch, Circular Pitch.

UNIT-IV (10 Hrs.)

Lubrication: Introduction, Physical & Chemical Test of Lubricants, Methods of Applying Lubrication, Hand oiling, drop feed cup, ring type of lubrication etc.

Corrosion: Corrosion & its control, General Corrosion, Localized Corrosion, Pitting Corrosion etc. Factors influencing Corrosion, Combating Corrosion, Selection of material.

Recommended Books

1. López-Gómez Gustavo V. Barbosa-Cánovas, 'Food Plant Design' CRC Press, Boca Raton, **2005.**
2. C.P. Mallet, 'Frozen Food Technology', Blackie Academic & Professional an imprint of Chapman & Hall., **1993.**
3. J. Lal & J.M. Shah, 'Theory of Machine', Metropolitan Book & Co. Pvt. Ltd, Delhi-6.
4. S.S. Rattan, 'Theory of Machine', Tata McGraw Hill Publishing Co. Ltd, New Delhi, **2009.**
5. P.L. Ballaney, 'Thermal Engineering', Khanna Publishers, New Delhi-6, **1995.**

CEREALS AND PULSES PROCESSING TECHNOLOGY

Subject Code: BFOT1-514 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To understand and identify the specific processing technologies used for cereals and pulses and the various products derived from these materials.

COURSE OUTCOMES:
On completion of the course the students are expected:
1. To understand the application of scientific principles in the processing technologies specific to the cereal and pulses processing.
2. To study the by- product utilization of various cereals and pulses.

UNIT-I (12 Hrs.)

General introduction to cereals and pulses; Production and utilization trends of various cereals and pulses; Grain classification, structure and composition; Importance of cereals and pulses, Post-harvest quality and quantity losses. Recommended pre-processing practices for handling of cereals and pulses for their safe storage, including control of infestation, National and International quality and grading standards.

UNIT-II (11 Hrs.)

Structure, types, composition, quality characteristics and physicochemical properties of wheat. Cleaning, tempering and conditioning, and milling processes for different wheat's. Turbo-grinding & Air Classification. Blending of flours. Milling equipment and milling products (Dalia, Atta, Semolina and flour). Flour grades and their suitability for baked goods. By-product utilization.

UNIT-III (12 Hrs.)

Structure, types, composition, quality characteristics and physicochemical properties of rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice). By- product (husk and rice bran) utilization.

UNIT-IV (10 Hrs.)

Structure, types and composition of corn. Dry and wet milling of corn. Processed corn products (popped corn, corn flakes etc.) Structure and composition of barley, bajra, jowar and other cereal grains and millets. Malting of barley. Parched and snack products.

Pulses: Anti-nutritional factors and methods of inactivation; pre-treatments; Traditional and modern milling methods and equipment involved.

Recommended Books

1. D.A.V. Dendy & B.J. Dobraszezk, 'Cereals & Cereals Products- Chemistry & Technology', Aspen Publication, **2001.**
2. 'Development in Milling & Baking Technology', AFST (I), CFTRI, Mysore, India.
3. N.N. Potter and J.H. Hotchkiss, 'Food Science', CBS Publishers.
4. N. Shakuntala Manay and M. Shadaksharaswamy, 'Foods: Facts and Principles', 3rd Edn., New Age International (P) Ltd, **2013.**
5. N.L. Kent, 'Technology of Cereals', Pergamon/Woodhead Publishing, **1994.**

FOOD PROCESSING PLANT LAYOUT AND DESIGN

Subject Code: BFOT1-515 **L T P C** **Duration: 45 Hrs...**
3 1 0 4

COURSE OBJECTIVES:
To educate the students regarding selection parameters for the location of food processing industry.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To learn about the design layouts of various food processing industries.

UNIT-I (11 Hrs.)

Introduction: Introduction to plant design and its importance in food processing industries.
Plant Location: Influence of location on plant layout, location factors, location theory and models.

UNIT-II (12 Hrs.)

Plant Layout: Types of manufacturing process, Plant layout problem, objectives and principles of layout; classical types of layout Viz. product layout, process layout and stationary layout; plant layout tools and techniques like process charts, process flow diagram, machine data cards, material movement patterns machine models and sketches, space requirement for machines, work stations and storage, plant layout procedures.
Evaluation of Layouts: Measurement of effectiveness of layout; Layout evaluation by systematic, optimization and mathematical models.

UNIT-III (12 Hrs.)

Network Analysis of Processes: Basic terms, objectives and advantages of Network analysis, various Network techniques like PERT and CPM.
Plant Buildings: Consideration in building design, types of factory buildings, types of building construction; Building materials, drainage, ventilation and illumination in food processing industries.

UNIT-IV (10 Hrs.)

Layout of different industries: Layout of different types of food industries like bread, biscuits, soft drinks, canning, dairy, rice mill and wheat mill.

Recommended Books

1. Farrall Krieger, 'Engineering for Dairy and Food Products', **2006.**
2. Peterse and Timmerhaus and R.E. West, 'Plant Design for Chemical Engg.', 5th Edn. McGraw Hill Education, **2003.**
3. J.M. Moore, 'Plant Layout and Design', Macmillan, **1962.**
4. O.P. Khanna, 'Production Engg. and Industrial Management', Dhanpat Rai Publishing Company.
5. Rase and Barrow, 'Project Engineering of Process Plants', Wiley Publications, **1957.**

HEAT AND MASS TRANSFER

Subject Code: BFOT1-516 **L T P C** **Duration: 45 Hrs...**
3 1 0 4

COURSE OBJECTIVES:
To understand the principles and applications of heat and mass transfer operations.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To understand and apply the principles in heat and mass transfer phenomena.
2. To design heat and mass transfer equipment.

UNIT-I (11 Hrs.)

Heat Transfer: Introduction of heat transfer, importance of heat transfer, modes of heat transfer, thermal conduction in solids, liquids and gases.

Conduction: Fourier's law, thermal conductivity, steady state conduction of heat through a composite solid, cylinder and sphere; Insulation and its purpose, critical thickness of insulation for cylinders and sphere; general heat transfer equation for extended surfaces.

UNIT-II (11 Hrs.)

Convection: Natural and forced convection, Nusselt number, dimensional analysis of free and forced convection, dimensionless numbers used in convective heat transfer, important correlations for free and forced convection.

Radiation: Introduction, reflection, absorption and transmission of radiation, characteristics of black, gray and real bodies in relation to thermal radiation, Stefan Boltzman Law, Kirchoff's Law, Wein's displacement law, Intensity of radiation, radiation exchange between black bodies and diffuse gray surface.

UNIT-III (11 Hrs.)

Heat Exchangers: Overall heat transfer coefficient, fouling factors, log mean temperature, difference for parallel and counter flow, heat exchangers, shell and tube type heat exchangers, effectiveness of parallel and counter flow heat exchangers by general and NTU method.

Evaporators: Types of evaporators -natural circulation evaporators, force circulation evaporators, falling film evaporators, climbing film evaporators, agitated thin-film evaporators and plate evaporators, principles of evaporation and evaporators.

UNIT-IV (12 Hrs.)

Mass Transfer: Introduction to mass transfer, different modes of mass transfer, Mass flux and molar flux for a binary system. Fick's law of diffusion of mass transfer, Derivation of general diffusion mass transfer equation, Molecular diffusion in gases, liquids and solids.

Steady state equimolar counter diffusion, convective mass transfer coefficient, natural and forced convective mass transfer, dimensional analysis for free and forced convective mass transfer, important correlations of convective mass transfer.

Recommended Books

1. A.J. Chapman, 'Heat Transfer', Maxwell Macmillan New York, **1984.**
2. J.P. Holman, 'Heat Transfer', McGraw Hill, New York, **1997.**
3. B.K. Dutta, 'Heat Transfer: Principles and Applications', PHI, New Delhi, **2001.**
4. W.L. Badger & J.T. Bachero, 'Introduction to Chemical Engineering', MacGraw Hill, Singapore, **1995.**
5. Mc Cabe, Smith & Harriot, 'Unit Operation of Chemical Engineering', 7th Edn., McGraw Hill Education, **2005.**

CEREALS AND PULSES PROCESSING TECHNOLOGY LAB.

Subject Code: BFOT1-517 **L T P C**
0 0 2 1

1. Experimental milling of wheat and paddy.
2. Parboiling and Cooking properties of different varieties of rice.
3. Determination of moisture content and ash content of wheat flour.
4. Determination of physical properties of different cereal grains
5. Determination of sedimentation value of the Maida.
6. Determination of alcoholic acidity of the sample of the wheat flour / Maida.
7. To determine the water absorption capacity of the wheat flour / Maida.

8. Determination of adulterant (NaHCO3) in wheat flour/ Maida.
9. Estimation of Protein content of different Cereals and Legumes.
10. Storage studies of cereal and legume grains having different moisture levels.
11. Determination of Gluten content in wheat flour samples.
12. Preparation of expanded & puffed rice from raw and parboiled materials and assessment of quality of products including expansion in volume.
13. Determination of foaming capacity of given flour sample.
14. Determination of dough raising capacity of given flour sample.
15. Traditional and improved pretreatments and its effect on dehusking of some legumes.
16. Determination of dry and wet gluten of a given flour sample.
17. Visit to a working modern roller flour mill and FCI godowns.
18. Visit to working rice mill, collection of samples at various steps of milling and analysis for efficiency of cleaning, shelling, paddy separation, and degree of polish.

HEAT AND MASS TRANSFER LAB.

Subject Code: BFOT1-518 **L T P C**
0 0 2 1

1. Determine the experimental and theoretical value of heat transfer coefficient for natural convection process.
2. Determine the theoretical and experimental value of heat transfer coefficient for forced convection process.
3. Determine the individual thermal conductivities and overall thermal conductivity for composite wall apparatus.
4. Determine the value of surface conductance for given finite geometry shapes (unsteady state heat transfer).
5. Find the emissivity of a given test plate with respect to the black plate.
6. Calculate the heat transfer coefficient for heat transfer in packed bed.
7. Observe boiling phenomena and to determine the heat flux and surface heat transfer coefficient as a function of the temperature excess at constant pressure.
8. Study heat transfer rate, overall heat transfer coefficient and effectiveness of shell and Tube Heat Exchanger.
9. Determine heat transfer from condensing vapors for Dropwise and Flimwise condensation.
10. Study the working principle and operation of an evaporator.

GRAIN HANDLING AND STORAGE TECHNOLOGY

Subject Code: BFOT1-560 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
This course covers fundamentals of grain handling equipment and their storage requirements.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To learn about various storage structures of grains like MAP, CAP etc.
2. To understand modern techniques of infestation, control pesticides.

UNIT-I (11 Hrs.)

Introduction, need for grain storage, principles of grain storage, problems during grain storage.
Stored product pests- insects, rodents, fungi, their nature and occurrence.

UNIT-II (11 Hrs.)

Pest control- Techniques of pesticides application and fumigations Pesticide chemistry, their toxicology and residual analysis Pest control measures and sanitation of mills.

UNIT-III (11 Hrs.)

Grain procurement and handling Modern techniques of infestation control Pesticides and health hazards MAS / CAS, Hypobaric storage.

UNIT-IV (12 Hrs.)

Storage and handling of grain Storage structure- Bag storage, Cover and plinth, CAP storage (Ceiling and Plinth Storage), Silos and large bins -Design of storage structures- Silos flow pattern and problem- Fumigation Processes- Feeding and discharging of silos- conveyors and elevators for grain handling.

Recommended Books

1. Metcalf & Luckemann, 'Introduction of Insect', Wiley Interscience Publications, **1994.**
2. A. Chakraverty, 'Post Harvest Technology of Cereals, Pulses and Oilseeds', Oxford and IBH Publishing Co, Calcutta, **1995.**
3. N.L. Kent and A.D. Evans, 'Technology of Cereals', 4th Edn., Elsevier Science (Pergaman), Oxford, U.K**., 1994.**
4. Samuel A. Matz, 'The Chemistry and Technology Cereals as Food and Feed', CBS Publishers & Distributors Pvt. Ltd., **1996.**

TECHNOLOGIES OF BEVERAGES

Subject Code: BFOT1-561 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVE:

This subject is to impart knowledge and skills of process techniques and equipment used for the production of beverages

COURSE OUTCOMES:

On completion of the course the students are expected:

1. Understand various concepts, principles and procedures involved in processing of beverages.
2. Demonstrate various UNIT operations involved in the food beverage manufacturing.
3. Quality control analysis in various beverages.

UNIT-I (12 Hrs.)

Basic Ingredients in Beverages Beverage-definition-why we drink beverages-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and Nano emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT-II (11 Hrs.)

Beer and Wine Manufacture

Ingredients- Malt- hops- adjuncts- water, yeast. Beer manufacturing process malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and Spoilage. Wine- fermentation-types –red and white. Wine defects and spoilage.

UNIT-III (11 Hrs.)

Carbonated Beverages

Procedures- carbonation equipment-ingredients-preparation of Syrups-Filling system-packaging-containers and closures

Non-Carbonated Beverage

Coffee bean preparation-processing-brewing-decaffeination- instant Coffee-Tea types- black, green and oolong- fruit juices, nectars, quash, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages.

UNIT-IV (12 Hrs.)

Quality Control

Effective application of quality controls- sanitation and hygiene in beverage Industry-Quality of water used in beverages - threshold limits of various ingredients according to PFA, EFSA and FDA – Absolute requirements of Soluble solids and titrable acidity in beverages.

Recommended Books

1. Steen and Ashurst, 'Carbonated Soft Drinks – Formulation and Manufacture', Blackwell Publishing Ltd., **2000.**
2. P.R. Ashurst**, '**Chemistry and Technology of Soft Drink and Fruit Juices', Blackwell Publishing Ltd., **2005.**
3. Charles W. Bamforth, 'Food, Fermentation and Microorganisms', Blackwell Science Publishing Ltd., **2005.**
4. N. Shakuntala Manay and M. Shadaksharaswamy, 'Foods: Facts and Principles', New Age International (P) Ltd., **2013.**

TECHNOLOGIES OF BAKERY AND CONFECTIONARY PRODUCTS

Subject Code: BFOT1-620 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To familiarize with the commercial methods of baking bread and recent advances and to acquaint with the preparation of cakes, toffees, candies and desserts, etc.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To learn microbiological aspects of bakery products, sanitation and hygiene of baking industries.
2. To understand the fundamentals of baking
3. To learn the technologies behind bakery products.
4. To understand industry trends of confectionary and bakery industries

UNIT-I (12 Hrs.)

Introduction: Global status of Bakery and Confectionary industry.

Raw Material for Bakery Products: Essential and optional raw materials for bakery products, Dough development, Methods of dough mixing, Dough chemistry, Rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data.

UNIT-II (11 Hrs.)

Manufacturing of Bakery Products: Detailed description of unit operations for the manufacturing of bakery Products-Bread, Biscuits, Cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking.

UNIT-III (11 Hrs.)

Manufacturing of Confectionary Products: Characteristics and processing of raw material; Technology of manufacturing of toffee, chocolate, fruit drops, hard boiled candies, bars, chewing gums, bubble gums and special confectionary products; colour, flavour and texture of confectionary; standard and regulations.

UNIT-IV (11 Hrs.)

Equipment Used in Bakery and Confectionary Industry: Construction and working of various equipment like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging machines, Rolling and cutting machines project profile of bakery and confectionary unit.

Recommended Books

1. Matz. 'Bakery Technology and Engineering', AVI Publisher.
2. Dendy & Dobraszczyk, Aspen, 'Cereal and Cereal Products', Springer Publication, **2001.**
3. S.B. Arora, 'Hand Book of Bakery Products', SIRI.
4. Karel Kulp and J.G. Ponte, 'Handbook of Cereal Science and Technology', CRC Press, **2000.**
5. N.L. Kent, 'Technology of Cereals', Woodhead Publication, **1994.**
6. W.P. Edwards, 'The Science of Sugar Confectionary', RSC Publishers, **2000.**

TECHNOLOGY OF FATS AND OILS

Subject Code: BFOT1-621 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

To identify the different sources of fats and different testing procedures for fats and oils.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To study the different unit operation involved in processing of oils.
2. To know the products made from fats and oils and their analytical testing.

UNIT-I (11 Hrs...)

Introduction: Importance and functions of fats and oils in foods and health, composition of fats/oils from different animal sources and oilseeds.

Oil Extraction: Different methods of oil extraction, oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oils, Calculations based on the extraction processes.

UNIT-II (11 Hrs.)

Oil/fat Purification: Refining techniques, bleaching, refining losses and deodorization, Batch and continuous refining losses.

Hydrogenation: Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.

UNIT-III (10 Hrs.)

Chemistry of Fats and Oils: Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, effects of ionizing radiation in fats, inter-esterification, reversion.

Technology of Individual Fat Products: Butter, Margarine, Shortening, Lard, Salad, cooking and frying oil.

UNIT-IV (11 Hrs.)

Different Quality Parameters: Peroxide value, Saponification value, Iodine value, acid value, TBA, M value, P-value, Kries value, Adulteration in oils and fats.

Soap processing: Chemistry, physical properties of soap, processing and finishing, different types of soaps, soaps in cosmetics and toiletries.

Recommended Books

1. Michael Bockisch, 'Fats and Oils Handbook', AOCS Press, **1997.**
2. D.P.J. Moran and K.K. Rajah, 'Fats in Food Products', Springer U.S., **1993.**

3. Srinivasan Damodaran, Kirk L. Parkin, Owen R. Fennema, 'Fennema's Food Chemistry', CRC Press, **2011.**
4. L.H. Meyer and L.H. Van Nostrand, 'Food Chemistry by (1998) Reinhold Company Publication, New York, London, **1998.**
5. H.W. Lawson, 'Food Oils and Fats- Technology, Utilization and Nutrition', Springer USA, **1995.**
6. Frank D. Gunstone, 'Vegetable Oils in Food Technology', Composition, Properties and Uses', Blackwell Publishing Ltd., **2011.**

TECHNOLOGIES OF BAKERY AND CONFECTIONARY PRODUCTS LAB.

Subject Code: BFOT1- 620 **L T P C**
0 0 2 1

1. Raw material quality checks on wheat flour.
2. Determination of baking quality of flour for manufacture of bakery products.
3. Preparation of bakery products (Biscuits, cookies, cakes, etc.)
4. Estimation of quality characteristics of bakery products.
5. Preparation of toffee.
6. Preparation of hard boiled candy.
7. Preparation of fudge.
8. Visit to a bakery plant.
9. Visit to a confectionary plant.

TECHNOLOGY OF FATS AND OILS LAB.

Subject Code: BFOT1- 621 **L T P C**
0 0 2 1

1. Experimental expeller processing of oilseeds.
2. Solvent extraction process.
3. Determination of Iodine value of fats and oils sample.
4. Saponification value of fats and oils sample.
5. Estimation of R.M. value, Kirschner, and Polenski value of fats and oils sample.
6. Determination of melting point of fats and oils sample.
7. Determination of peroxide value of fats & oils sample.
8. Adulterants in fats and oils.
9. Imitated dairy products, margarine etc.
10. Production of protein concentrates and isolates.
11. Determination of anti-oxidant-used in oil.

FOOD ADDITIVES

Subject Code: BFOT1-662 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To inculcate the role and activity of chemical and natural food additives theoretically.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To learn the various types of food additives and their functions on food as well as to predict the permissible limit of each additive that could be used in foods.

UNIT-I (11 Hrs.)

Introduction to Food Additives: Definition, Types of additives, Benefits of additives, risk of additives; Consume attitude towards food additives; Food Additive Intake Assessment: Scope and purpose of food additive intake assessment, regulation of maximum levels of food additives, method of estimating dietary intake of additives. Class I and Class II preservatives as per PFA Act. Nutritional Additives: Vitamins, Amino Acids, Fatty Acids, Minerals and trace minerals, dietary supplements.

UNIT-II (11 Hrs.)

Fat Substitutes and Replacers: Introduction, Chemistry, application in foods, toxicology

Food Additives for special dietary purposes: Nutrition, palatability, manufacturing, stabilizers, thickeners, future development. Flavoring Agents and enhancers: Flavors, their nature, creation and production, function of flavors and their utilization, flavor regulations, flavor safety; definition, properties, function of flavor enhancers.

UNIT-III (11 Hrs.)

Sweeteners: Non-nutritive sweeteners, nutritive sweeteners, choice of sweetener

Antioxidants: Oxidation chemistry, mechanisms of oxidation inhibition, natural and synthetic antioxidant, antioxidant and health, toxicology.

Antimicrobial Agents: Introduction, Types of antimicrobial agents.

Emulsifiers: Chemistry, function, mechanism and application; Anti-caking agents, Firming agents.

UNIT-IV (12 Hrs.)

Colorants: Natural and synthetic food colorants, chemistry, sources, analysis, effect on foods applications, safety

Anti-browning Agents: Chemistry of browning reactions in foods, browning inhibitors, special problems in control of enzymatic browning

pH Control Agents and Acidulants: Introduction, mode of action of acids as antimicrobial agents, types of agents, chemical analysis and assay.

Recommended Books

1. A. Larry Branen, P. Michael Davidson, Seppo Salminen, John Thorngate, 'Food Additives', CRC Press, **2001.**
2. Fennema, 'Food Chemistry', 4th Edn. CRC Press, **2007.**
3. H.D. Belitz, Werner Grosch, Peter Schieberle, 'Food Chemistry', Springer-Verlag, Berlin Heidelberg Publisher, **2009.**
4. M.A. Amerine, 'Principles of sensory analysis of Food', 2nd Edn., Academic Press, **1965.**

FOOD STORAGE ENGINEERING

Subject Code: BFOT1-663 **L T P C** **Duration: 45 Hrs.**

3 1 0 4

COURSE OBJECTIVES:

To understand the basic principles and requirements of traditional as well as modern storage techniques in perishable and nonperishable foods and the role of engineering in storage structures and instrumentation for product quality maintenance.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. Good knowledge for the storage structures and instrumentation
2. Commodities quality maintenance and prevention of deterioration and losses.
3. Integration of Science and Engineering practices to increase shelf life of produce.

UNIT-I (12 Hrs.)

Introduction: Purpose and justification of storage of perishable and non-perishable foods, factors influencing shelf life of food materials, engineering properties of biological materials important in design of handling and storage equipment.

Storage Requirements: Storage environment and its interaction with stored product; temperature and moisture migration; storage practices (including fumigation and aeration of stored product); design of aeration systems.

UNIT-II (10 Hrs.)

Mechanical Handling Equipment: Design of handling equipment like bucket elevators, belt, screw and pneumatic conveyors, and fans.

UNIT-III (11 Hrs.)

Storage Structures for Nonperishables: Grain pressure theories- Rankine and Airy theory: Design of bulk storage structures like bins and silos; Design of bag storage structures such as cover and plinth (CAP) and warehouses.

UNIT-IV (12 Hrs.)

Storage Structures for Perishables: Design aspects of ventilated, cold, modified and controlled atmosphere storage systems.

Management Practices: Labeling, record keeping and management of godowns, silos and cold storages; maintenance of buildings and equipment; sanitary conditions in storages.

Recommended Books

1. B.K. Bala, 'Drying and Storage of Cereal Grains', Science Pub., **1997.**
2. S. Vijayaraghavan, 'Grain Storage Engineering and Technology' Batra Book Services, **1993.**
3. 'Handling and Storage of Food Grains in Tropical and Subtropical Areas', Oxford and IBH, **1970.**
4. Volkind and Roslov and Mukhanov, 'Modern Potato and Vegetable Storage', Amrind Publishing Company Pvt. Ltd. New Delhi, **1983.**
5. A. Chakraverty, 'Post Harvest Technology of Cereals, Pulses and Oilseeds', Oxford and IBH Publishing Co, Calcutta, **1995.**
6. Multon., 'Preservation and storage of grains, seeds and their by-products: cereals, oilseeds, pulses and Animal Feed', Lavoisier, New York, USA, **1988.**

WASTE MANAGEMENT IN FOOD TECHNOLOGY

Subject Code: BFOT1-664 **L T P C** **Duration: 45 Hrs.**

3 1 0 4

COURSE OBJECTIVES:

To develop the importance of waste utilization from different food processing industries.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. Understanding the properties of different food industry wastes.
2. Able to recognize and communicate common processes which allow the different food processing waste to be converted into valuable products.

UNIT-I (12 Hrs.)

Waste Utilization from Cereal Food Industries: Different sources of wastes from food industries and their availability in India nature of different waste - 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-II (11 Hrs.)

Utilization of Fruit and Vegetable Wastes: Processes for Waste utilization from fruit and vegetable industries- Distillation for production of alcohol - oil extraction from waste - waste management in sugar mills - citric acid production from fruit waste.

UNIT-III (10 Hrs.)

Fish, Meat and Poultry Waste Utilization: Fish industry by products and waste utilization - meat and poultry waste recycling.

UNIT-IV (12 Hrs.)

Tuber Crops Waste Utilization: Waste from tuber crops - effluent safe disposal- effluent treatment plant- waste recycling plant - feasibility report for food industries using food waste and by products.

Recommended Books

1. P.N. Chereminoff and A.C. Morresi, 'Energy from Solid Wastes', New Tork, Dekker, **1976.**
2. Joshi and Sharma, 'Food Processing Waste Management: Treatment and Utilization Technology', New India Publishing Agency, **2011.**
3. K. Waldron, 'Handbook of Waste Management and Co-Product Recovery in Food Processing', Woodhead Publishing, **2007.**
4. Beagle, 'Rice Husk Conversion to Energy', Rome: Food and Agriculture Organization of the United Nations.

HEALTH FOODS

Subject Code: BFOT1-665 **L T P C** **Duration: 45 Hrs...**
3 1 0 4

COURSE OBJECTIVES:

To understand the role of health and functional foods in health and disease.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. To study the processing of health and functional foods.
2. To gain knowledge about health and functional foods, organic foods and genetically modified foods.

UNIT-I (12 Hrs.)

Definition, status and scope of health and functional foods in India, Definition of nutraceuticals and their importance. Types of health benefits and functional foods and their properties.

UNIT-II (12 Hrs.)

Various food constituents responsible for functional effects: Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods, - Dietetic foods, anti-ageing foods, - Fortified foods, diabetic foods, - Biofedic, prebiotics and probiotic foods.

UNIT-III (10 Hrs.)

Processing of health and functional foods, criteria for selection of raw materials, and their processing. Storage, packaging and labeling of health and functional food.

UNIT-IV (11 Hrs.)

Marketing aspects of health and functional foods. Safety / Legal aspects of health and functional foods. Organic foods and Genetically Modified (GM) foods in relation to health.

Recommended Books

1. R. Chadwick, 'Functional Foods', Springer, **2004.**
2. E.C. Robert Wildman and Wallace, 'Handbook of Nutraceuticals and Functional Foods', CRC Press, **2006.**

3. W. Jeffrey Hurst, 'Methods of Analysis for Functional Foods and Nutraceuticals', 2nd Edn., CRC Press, **2008.**

PACKAGING TECHNOLOGY

Subject Code: BFOT1-724 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:

The course aims to develop the knowledge in the area of packaging of foods and the related technology used as well as to appreciate the application of scientific principles in the packaging of foods.

COURSE OUTCOMES:

On completion of the course the students are expected:

1. The different types of materials and media used for packaging foods.
2. Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, labeling of foods
3. Methods of packaging, shelf life and food factors affecting packaging.

UNIT-I (10 Hrs.)

Introduction: Definitions, Objectives and functions of packaging and packaging materials.

Properties of Packaging Materials: Packaging requirements and selection of packaging materials, properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength.

UNIT-II (11 Hrs.)

Packaging Materials: (a) Paper: pulping, fibrillation and beating, types of papers and their testing methods, cellulosics, paper board. (b) Glass: composition, properties, types of closures, methods of bottle making. (c) Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminium containers, lacquers (d) Plastics: types of plastic films, laminated plastic materials, coextrusion, edible films, biodegradable plastics.

UNIT-III (12 Hrs.)

Barrier Properties of Packaging Materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement.

Packaging equipment and Machinery: Vacuum packaging machine, gas packaging machine, seal and shrink packaging machine, form and fill sealing machine, bottling machines, carton making machines.

UNIT-IV (12 Hrs.)

Food Packaging Systems: Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

Specialized Techniques in Food Packaging: Active packaging system, retortable pouches, aseptic packaging, controlled and modified atmospheric packaging, irradiation in food packaging.

Recommended Books

1. F.A. Paine, 'A Handbook of Food Packaging', Blackie Academic and Professional, London, **1992.**
2. M. Mathlouthi, 'Food Packaging and Preservation', Springer US, **1994**.
3. G.L. Robertson, 'Food Packaging: Principles and Practice', 3rd Edn. CRC Press Taylor and Francis Group, **2013.**
4. S. Sacharow, 'Handbook of Package Materials', AVI Publishing Co. Westport, Conn., **1976.**

SPICES & FLAVOUR TECHNOLOGY

Subject Code: BFOT1-725 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To study about processing of spices, equipment used and value addition and to enrich the knowledge about flavor technology.

COURSE OUTCOMES:
On completion of the course the students are expected:
1. To Identify the different spices and herbs.

To know about various extraction procedures of essential oils and oleoresins from spices

UNIT-I (11 Hrs.)

Introduction: Status and scope of spice and flavour processing industries in India; Spices, Herbs and seasonings: sources, production, selection criteria; flavours: commercially available materials, classification on the basis of origin, physical characteristic.

UNIT-II (12 Hrs.)

Processing Technology of Spices: Chemical composition of spices; processing methods: equipment used in the processing of spices; spice encapsulation; effect of processing on spice quality: contamination of spices with micro-organisms and insects.

Spice Essential Oils: Definition, methods of extraction, isolation, separation equipment.

UNIT-III (10 Hrs.)

Flavour Technology: Essence (flavour) recovery techniques from fruits, spices and herbs along with the equipment used: liquid and Solid flavour production; flavour intensifiers: synthetic flavours; effect of processing on flavour quality.

UNIT IV (12 Hrs.)

Spice Oleoresins: Definition, method of extraction, isolation, separation equipment**.**

Spices and flavour quality evaluation: Criteria for assessment of flavour quality; identification of natural food flavours; methods of flavour evaluation (chemical, instrumental, sensory); PFA standards for flavouring materials and flavours.

Recommended Books

1. G. Reineccius, 'Flavor Chemistry and Technology', CRC Press, Taylor and Francis Group, **2006.**
2. Susheela Raghavan, 'Handbook of Spices, Seasonings and Flavorings', CRC Press, Taylor and Francis Group, **2007.**
3. K. Hirasa and M. Takemasa, 'Spice Science and Technology', CRC Press, Taylor and Francis Group, **1998.**

PACKAGING TECHNOLOGY LAB.

Subject Code: BFOT1-724 **L T P C**
0 0 2 1

1. Determination of physical properties of packaging film.
2. Identification of different packaging materials.
3. Packaging of fresh fruits and vegetables.
4. Estimation of shelf life of packaged foods.
5. Determination of grease resistance of packaging material.
6. Determination of continuity of lacquer coating.
7. Determination of tensile strength and heat sealability of packaging material.

8. Determination of WVTR of packaging material.
9. Determination of water absorption of paperboard and CFB.

SPICES AND FLAVOR TECHNOLOGY LAB.

Subject Code: BFOT1-725 **L T P C**
0 0 2 1

1. Identification and characterization of flavouring compounds of spices.
2. Valuable oil determination. Extraction of oil from clove, pepper, cardamom-chili
3. Extraction of oleoresins-Turmeric, ginger, pepper, clove
4. Detection of adulteration in spices.
5. Study of standard specification of spices
6. Spice analysis.
7. Identification of whole spices
8. Application of spices in processed food products.
9. Visit to spice processing unit.
10. Packaging study of spices
11. Chemical analysis of spices moisture, valuable oil, specific gravity, refractive index, acid value

INNOVATIVE TECHNIQUES IN FOOD PROCESSING

Subject Code: BFOT1-766 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To educate students with the newer and advanced techniques for preservation and processing of foods.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. The need of preserving food substances by non-thermal methods or innovative techniques.

UNIT-I (11 Hrs.)

Membrane technology: Introduction to pressure activated membrane processes: microfiltration, UF, NF and RO and their industrial application. (06 Hrs.) Supercritical fluid extraction: Concept, property of near critical fluids NCF, extraction methods.

UNIT-II (12 Hrs.)

Microwave and radio frequency processing: Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying.
Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

UNIT-III (11 Hrs.)

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

UNIT-IV (11 Hrs.)

Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.
Nanotechnology**:** Principles and applications in foods.

Recommended Books

1. James G. Brennan, Alister S. Grandison, ‘Food Processing Handbook 2nd Edn. Wiley VCH, **2011.**

2. P. Fellows, 'Food Processing Technology', 3rd Edn., Woodhead Publishing.
3. P.J. Fellows, 'Food Processing Technology- Principles and Practice', 2nd Edn., CRC Publications.
4. R.P. Singh and D.R. Heldman, 'Introduction to Food Engineering', Academic Press, **1993.**
5. Barbosa-Canovas, 'Novel Food Processing Technologies', CRC Press, **2004.**

APPLICATIONS OF ENZYMES IN FOOD TECHNOLOGY

Subject Code: BFOT1-767 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
This course focuses on providing detailed knowledge about different enzymes used in food industry and their production methods.

COURSE OUTCOMES:
On completion of the course the students are expected:
1. To know about isolation and purification of enzymes,
2. Understand the concept of enzyme immobilization techniques and the application of enzymes in food industries.

UNIT-I (11 Hrs.)
General properties and classification of enzymes. Co-enzymes, cofactors, enzymes inhibitors. Enzyme kinetics, factors affecting enzyme action Immobilized enzymes. Sources of enzymes and their production.

UNIT-II (12 Hrs.)
Endogeneous enzymes in food quality- color- lipoxynase, chlorophyllase, polyphenol oxidase, texture- Pectic enzymes, Amylases, cellulases, proteases, flavour and aroma-nutritional quality. Role of enzymes in meat tenderization.

UNIT-III (11 Hrs.)
Significance of enzymes in starch industry- high fructose corn syrups, glucose syrups, monohydrate dextrose. Application of amylases, proteases, lipoxidase, lipases and pentosanases in baking industry.

UNIT-IV (11 Hrs.)
Applications of enzymes in milk and milk products Enzymes in fruits and vegetables processing- clarification and debittering. Enzymes in beer and wine making.

Recommended Books
1. G. Reed, 'Enzymes in Food Processing', Academic Press, New York, **1980.**
2. Robert J. Whitehurst and Maarten Van Oor, 'Enzymes in Food Technology', Wiley Blackwell, **2009.**
3. Price and Steven, 'Fundamentals of Enzymology', Oxford Scientific, **1999.**
4. T. Godfrey, S. West, 'Industrial Enzymology', 2nd Edn., Mac Millan Press, London, **1996.**

FOOD ANALYSIS AND QUALITY CONTROL

Subject Code: BFOT1-830 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
This course will flourish the knowledge of various food regulations and techniques with their principles used in food analysis.

COURSE OUTCOMES:
1. To facilitate the understanding of quality control principles and process.
2. To know the methods of selecting appropriate techniques in the analysis of food products.

3. Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.

UNIT-I (12 Hrs.)

Introduction: Quality Control and its importance, functions of quality control departments and quality control laboratories.

Colour: Importance and need of colour determination, methods of colour determination with Spectrophotometer, Colorimeter, Hunter Colour lab, Lovibond Tintometer, Munsell colour and colour difference meter and their applications.

Flavour: Importance of flavour, food flavours, factors affecting food product flavours, measurement of food flavours.

UNIT-II (10 Hrs.)

Kinesthetics and Texture: Food texture, Physical characteristics of food, working of texture measuring instruments such as Texture Analyser, Instron Universal Testing machine, Fruit pressure tester, puncture tester, succulometer, tenderometer, texturometer, maturometer, fibrometer, Texture Profile Analysis (TPA).

UNIT-III (12 Hrs.)

Non Destructive Methods: Near Infrared Spectroscopy (NIR), Nuclear Magnetic Resonance (NMR) and its application, Ultrasonic equipment, conductivity and resistivity meters.

Chromatography: Principle and working of Gas chromatography (GC), High pressure liquid chromatography (HPLC), types of detectors used in GC and HPLC, Thin layer chromatography (TLC), Column Chromatography, chromatographic methods applied as quality control.

UNIT-IV (11 Hrs.)

Sensory Evaluation: Objectives, panel selection, Different test methods and their groups such as difference tests, rating tests, sensitivity tests, Sensory scores, statistical analysis of the data, application of statistical tests such as t-Test, Chi-Square test, F-test, Linear Regression and Correlation Coefficient.

Food Safety and Regulations: Food Safety and Standards Act (2006), Codex Alimentarius, ISO series, HACCP, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Agricultural Practices (GAP), Genetically Modified Foods (GMF).

Recommended Books

1. S. Suzanne Nielsen, 'Food Analysis', Springer, **2010.**
2. A. Kramer and B.A. Twigg, 'Fundamentals of Quality Control for the Food Industry', AVI Publishing Co., Westport, Conn. USA. **1962**
3. S. Ranganna, 'Handbook of Analysis of Fruit and Vegetable', Tata McGraw Hill.
4. Y.H. Hui, 'Handbook of Food Science, Technology and Engineering', CRC Press, Taylor and Francis Group. **2006**
5. R.S. Kirk, R. Sawyer & H. Egan, 'Pearson's Composition and Analysis of Foods', Harlow, Essex, U.K. Longman. **1991.**

FOOD ANALYSIS & QUALITY CONTROL LAB.

Subject Code: BFOT1-831

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0	0	2	1

1. Estimation of moisture content of food sample.
2. Estimation of ash content of food sample.
3. Recognition of threshold concentration of primary taste.
4. Flavor recognition of food sample.
5. Determination of color of food sample using tintometer.
6. Texture analysis of food sample.

7. Detection of adulteration in food sample.
8. Quality control tests in milk.
9. Quality examination of canned food product.
10. Estimation of total phenols in a food sample.
11. Estimation of antioxidant activity of a food sample.
12. Thin layer chromatography of food colors.

STATISTICAL QUALITY CONTROL

Subject Code: BFOT1-868 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To gain knowledge about statistical techniques used in modeling engineering problems.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To know the techniques and types of sampling.
2. To understand design of experiments and process optimization.
3. To learn Six-sigma concept.

UNIT-I (11 Hrs.)

Introduction: The meaning of quality and quality improvement, Statistical methods for quality control and improvement.
Food Quality System: The link between quality and productivity, Quality costs, Legal aspects of quality, implementing quality improvement.
Control Charts for Variables: Statistical basis of the charts, Development and use of x and R, Charts based on standard values, Interpretation of x and R charts, The effect of non-normality on x and R charts.

UNIT-II (12 Hrs.)

Sampling: Population and sampling distributions, Sampling and non-sampling errors, Mean and standard deviation of x, Shape of the sampling distribution of x, Applications of the sampling distribution of x, Population and sample proportions, Mean, standard deviation.
Test Methods: Hypothesis tests, Estimation and hypothesis testing: two populations, Chi-square tests, Analysis of Variance, Simple linear regression, Non-parametric methods.

UNIT-III (11 Hrs.)

Statistical Process Control (SPC) Techniques: SPC for short production runs, Modified and acceptance control charts, SPC with auto correlated process data, Economic design of control charts.
Multivariate Process Monitoring and Control: Description of multivariate data, The Hoteling T2 control chart, The multivariate EWMA (Exponentially Weighted Moving Average) control chart, Latent structure methods.

UNIT-IV (11 Hrs.)

Process Capability Analysis (PCA): PCA using probability plot, Process capability ratios, PCA using a control chart, PCA using designed experiments.
Design of Experiments and Process Optimization: Guidelines for designing experiments, Factorial experiments, the 2k factorial design, Fractional replication of the 2k design, Response surface methods and designs
Six Sigma: Introduction, Six-sigma control chart, Six-sigma quality performance.
Recommended Books

1. Jerome D. Braverman, 'Fundamentals of Statistical Quality Control', Brady and Prentice Hall, **1981.**
2. P.S. Maan. 'Introductory Statistics', John Wiley and Sons, **2010.**

3. D.C. Montgomery, 'Statistical Quality Control', 7th Edn., John Wiley & Sons, **2012.**
4. M. Jaya Chandra, 'Statistical Quality Control', CRC Publisher. **2001.**

ENGINEERING PROPERTIES OF BIOLOGICAL MATERIALS

Subject Code: BFOT1-869 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

COURSE OBJECTIVES:
To understand the different engineering properties of biological materials.
COURSE OUTCOMES:
On completion of the course the students are expected:
1. To acquire the knowledge of engineering properties in the designing of food processing systems and the rheology of food materials.

UNIT-I (11 Hrs.)

Introduction: Physical, Mechanical, Thermal, Electrical and Optical properties of bio-food materials, Effect of temperature on water activity, controlling food water content; Physical characteristics, shape, size, volume, density, porosity and surface area of the food materials. True density of the grains, Angle of repose, Test weight, Co-efficient of external friction, Co-efficient of internal friction, colour of food Materials.

UNIT-II (12 Hrs.)

Basic concept of rheology, Rheological equations and models, viscoelastic characterization of food materials, Rheological properties of food materials; Force-deformities, stress- strain, elastic – plastic, Bulk stress – strain, viscoelastic behaviour; Rheology and texture of food materials.

UNIT-III (10 Hrs...)

Mechanical damage of food materials, causes, Biological and chemical reaction, Damage of food materials under static, impact and vibration; Aero-hydrodynamic characteristics and its application to agricultural products.

UNIT-IV (12 Hrs.)

Basic concepts of friction in food materials, solid friction, rolling resistance, internal friction, angle of repose. Power losses due to friction, Thermal, Electrical and Optical properties of food materials.

Recommended Books

1. Chakravarthy, 'Post Harvest Technology of Cereals and Pulses', Oxford & Ibh Publishing Co. Pvt. Ltd., **2008.**
2. K.P. Sudheer and V. Indra, 'Post Harvest Technology of Horticultural Crops', New India Publishing Agency, **2007.**
3. James Freeman Steffe, 'Rheological Methods in Food Process Engineering', Freeman Press, **1996.**