

LIST OF COURSES

Sl. No.	Course Code	Name of the Course	Credits
1	17FP2001	Principles of Food Process Engineering	3:0:0
2	17FP2002	Applied Thermodynamics for Food Engineers	3:1:0
3	17FP2003	Food Chemistry	3:0:0
4	17FP2004	Fluid Mechanics for Food Engineers	3:0:0
5	17FP2005	Food Microbiology	3:0:0
6	17FP2006	Food Microbiology Lab	0:0:2
7	17FP2007	Fluid Mechanics and Heat Transfer Lab	0:0:2
8	17FP2008	Food Analysis Lab –I	0:0:2
9	17FP2009	Food Biochemistry and Nutrition	3:0:0
10	17FP2010	Heat and Mass Transfer	3:0:0
11	17FP2011	Dairy Engineering and Technology	3:0:0
12	17FP2012	Unit Operations in Food Process Engineering - I	3:0:0
13	17FP2013	Fruit and Vegetable Processing Technology	3:0:0
14	17FP2014	Unit Operations in Food Process Engineering and Grain Processing Lab	0:0:2
15	17FP2015	Food Biochemistry Lab	0:0:2
16	17FP2016	Unit Operations in Food Process Engineering - II	3:0:0
17	17FP2017	Refrigeration, Air conditioning and Cold Storage Construction	3:0:0
18	17FP2018	Mechanical Systems for Food Processing	3:0:0
19	17FP2019	Cereals and Pulses Technology	3:0:0
20	17FP2020	Bakery, Beverages and Confectionery Technology	3:0:0
21	17FP2021	Food Safety Regulations	3:0:0
22	17FP2022	Food Enzymology Lab	0:0:2
23	17FP2023	Food Product Technology Lab - I	0:0:2
24	17FP2024	Engineering Properties of Food Materials	3:0:0
25	17FP2025	Engineering Properties of Food Materials Lab	0:0:2
26	17FP2026	Food Engineering and Packaging Lab	0:0:2
27	17FP2027	Food Process Equipment Design	3:0:0
28	17FP2028	Food Analysis Lab – II	0:0:2
29	17FP2029	Computer Aided Food Process Equipment Design Lab	0:0:2
30	17FP2030	Food Additives	3:0:0
31	17FP2031	Plantation Products and Spices Technology	3:0:0
32	17FP2032	Fat and Oil Processing Technology	3:0:0
33	17FP2033	Technology of Meat, Poultry and Fish	3:0:0
34	17FP2034	Drying Technology	3:0:0
35	17FP2035	Food Packaging Technology	3:0:0
36	17FP2036	Storage Engineering	3:0:0
37	17FP2037	Process Economics and Plant Layout Design	3:0:0
38	17FP2038	Non Thermal Techniques of Food Preservation	3:0:0
39	17FP2039	Functional Foods and Nutraceuticals	3:0:0
40	17FP2040	Food Additives Lab	0:0:2
41	17FP2041	Food Product Technology Lab – II	0:0:2
42	17FP2042	Principles of Food Science and Nutrition	3:0:0
43	17FP2043	Processing of Food Commodities	3:0:0
44	17FP2044	Technology of Packaging	3:0:0
45	17FP2045	Nutrition and Food Science	3:0:0

17FP2001 PRINCIPLES OF FOOD PROCESS ENGINEERING

Credits: 3:0:0

Course Objectives:

- To understand the basic principles involved in food process engineering.
- To apply the principles in food processing.
- To perform calculations for basic operations in food processing.

Course Outcomes:

- To enumerate the units and dimensions of various physical quantities.
- To express the laws and theory of gases and vapours.
- To describe the types and properties of fluid flow.

- To calculate the material balance in food processing units.
- To appraise the performance of processing units
- To validate the energy balance involved in food processing operations.

Unit I - DIMENSIONS AND UNIT : Fundamental -derived units. Definitions of some basic physical quantities – Force, momentum, pressure, work and energy, power, heat and enthalpy. Dimensional analysis. Mole – atomical molar mass. Moisture content.-water activity

Unit II - GASES AND VAPORS : Behavior of Gases – Kinetic Theory of gases – Perfect Gas – Gas laws – Ideal gas laws – Real gas- Van der Waal's equation -pure component vapour pressure- partial pressure Dalton's law. Pure component volume-Amagat's law – psychrometry -humidity, relative humidity, saturation humidity –wet and dry bulb temperature-dew point –psychrometric chart reading.

Unit III - FLOW OF FLUIDS : Fluids-Properties, vapor pressure, surface tension, capillary effect, concept of viscosity-types of fluid. Bernoulli equation-fluid flow-laminar, turbulent ; pressure drop in pipes, valves and bends, Orifice meter, Venturimeter , Rotameter, Pitot tube –working principles.

Unit IV - MATERIAL BALANCE : Law of Conservation of mass- Process flow diagram-system boundaries -overall mass balance – component mass balance –basis and tie material- Continuous vs. Batch-Recycle and by pass-unsteady state -mass balance problems on concentration, dehydration, evaporation, crystallization, mixing –solvent extraction –multi stage process.

Unit V - ENERGY BALANCE : Heat capacity – gases – solids – liquids -Latent heat – sensible heat -energy balance for a closed system and open system -total energy balances. Energy balance problems in heat exchangers –Drying.

Text Books

1. Romeo T. Toledo. "Fundamentals of Food Process Engineering". Chapman & Hall, USA, CBS publications, New Delhi, 2000.
2. Smith, PG. "Introduction to Food Process Engineering ", Springer, 2004.

Reference Book

1. Paul Singh R, and Dennis R.Heldman ."Introduction to Food Engineering". Academic Press – Elsevier India Private Ltd. New Delhi, 2004.

17FP2002 APPLIED THERMODYNAMICS FOR FOOD ENGINEERS

Credits: 3:1:0

Course Objectives

- To understand the importance of thermodynamics in food system.
- To apply the concept of statistical thermodynamics for various food system
- To develop an efficient system using thermodynamic principle

Course Outcomes

- To identify the thermodynamic variables that will affect the food processing
- To estimate the effect of various thermodynamic properties on food system
- To solve the problems related to food processing using thermodynamic principles
- To model food system based on thermodynamic properties
- To develop an efficient food processing method
- To predict the bottleneck using the thermodynamic principles

Unit I - FUNDAMENTAL CONCEPTS AND CALCULATION OF THERMODYNAMIC QUANTITIES: Thermodynamic terms, variables, processes and states. First and zeroth law of thermodynamics. State and path function. C_p and C_v . Joule Thomson porous plug experiment. Calculation of thermodynamic quantities - Isothermal expansion, free expansion and adiabatic reversible process.

Unit II - FIRST AND SECOND LAW OF THERMODYNAMICS AND ITS APPLICATION : Steady flow energy equation and its application to steam generator, condenser, nozzles and air compressors. Second law of thermodynamics and its application to refrigerator, heat engine and heat pump. Concept of entropy and calculation of entropy changes.

Unit III - THERMODYNAMIC PROPERTIES OF PURE FLUIDS : Energy properties, Helmholtz and Gibbs free energy, fundamental property relations, Maxwell's equations - Clausius - Clapeyron equations. Differential equation for S, U, H. Gibbs- Helmholtz equation. Fugacity, fugacity coefficient, activity, effect of temperature and pressure on fugacity, determination of fugacity of real gases.

Unit IV - PROPERTIES OF SOLUTIONS : Partial molar properties, concept of chemical potential, fugacity in solutions-Lewis Randall rule, Raoult's law, Henry's law. Activity in solutions- activity coefficients, pressure and temperature effects, Gibbs- Duhem equations.

Unit V - PSYCHROMETRY : Psychrometric properties of air. Psychrometric charts, psychrometric process – sensible heat exchange process, latent heat exchange process, adiabatic mixing, evaporative cooling – problems.

Text Books

1. Narayanan K.V., A Text book of chemical engineering thermodynamics, PHI Learning Private Limited, 2015.
2. Rastogi R.P. and Misra R.R., An Introduction to chemical thermodynamics, Vikas Publishing House Pvt Ltd., 2015.

Reference Books

1. Nag P.K., Engineering Thermodynamics, McGraw Hill Education(India) Private Limited, 2014.
2. Roy Choudhury T., Basic Engineering Thermodynamics, Tata McGraw Hill, 2000
3. Vanwylen and Sontag, Fundamentals of Classical thermodynamics, Wiley Eastern, 2005.

17FP2003 FOOD CHEMISTRY

Credits : 3:0:0

Course Objectives :

- To understand the chemistry of food constituents
- To apply food molecules interaction in developing technologies / processes
- To develop skills for experimenting with food systems and to test various approaches for manipulating the chemical and/or functional properties of foods.

Course Outcomes :

- To name and describe the general chemical structures of the major components of foods (water, proteins, carbohydrates, and lipids) and selected minor components (vitamins and minerals).
- To relate the chemical composition of foods to their functional properties
- To understand, plan, perform and analyse a range of chemical investigations with an emphasis on food analysis
- To give a molecular rationalization for the observed physical properties and reactivity of major food components.
- To predict how changes in overall composition are likely to change the reactivity of individual food components.
- To evaluate and to determine approaches that may be used to control the reactivity of those food components that are likely to impact the overall quality of finished products.

Unit I - WATER AND ICE : Importance of water in foods - Structure of water & ice - concept of bound & free water. Sorption phenomena and sorption isotherms with example. Dispersed systems - gels & emulsion.

Unit II - CHEMISTRY OF CARBOHYDRATES : Nomenclature, classification & structure of carbohydrates, chemical reactions of carbohydrates, physical & chemical properties of sugars, chemistry of polysaccharides, properties and preparation of pectic substances, gums, starch and its hydrolytic products, cellulose, cyclodextrins maltodextrins, HFCS.

Unit III - CHEMISTRY OF LIPIDS : Nomenclature, classification of lipids. Basic Structures and chemistry of fatty acids & glycerides. physical & chemical characteristics of fats & oils Phospholipids, and unsaponifiables, auto oxidation and hydrolysis, antioxidants. Process flow sheet for the manufacture of edible oils (refined and hydrogenated)

Unit IV - CHEMISTRY OF PROTEINS : Nomenclature, classification, structure and chemistry of amino acids, peptides & Proteins. Functional properties of Protein. Isolation, identification & purity of Proteins. Protein denaturation. Enzymes: Introduction, classification & nomenclature of enzymes. Specificity. amylases, pectic enzymes, proteases; glucose oxidases, catalases, peroxidases, lipoxygenases, xanthine oxidases. Immobilized enzyme - One example of working of each enzyme.

Unit V - CHEMISTRY OF VITAMINS AND NATURAL COLOURANTS : Fat-soluble and water soluble vitamins – Choline, carnitine. Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins – Reasons for the loss of vitamins in foods – Overview of natural colourants, sources, chemistry and applications of anthocyanin, betalain, carotenoids and chlorophyll.

Text Books

1. Srinivasan Damodaran, Kirk L. Parkin, Owen R. Fennema. (2007), Fennema's Food Chemistry – 4th Edition, CRC Press, Taylor & Francis group, USA, ISBN- 9780849392726.
2. H.D. Belitz, W. Grosch, P. Schieberle (2009) Food Chemistry – 4th revised and extended edition, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-69933-0

Reference Books

1. John M deMan, (1999) Principles of Food Chemistry – 3rd edition, Springer New York Heidelberg Dordrecht London ISBN 9781461463900 (eBook).
2. N. Michael Eskin. (1990) Biochemistry Of Foods – 2nd Edition Academic Press, USA ISBN 13: [9780122423512](https://www.isbn-international.org/number/9780122423512)
3. David S. Robinson: Food Biochemistry and Nutritional Value Longman Scientific and Technical Publishers, USA (1987)

- Pieter Walstra: Physical Chemistry of Foods Marcel Dekker Publishing, New York (2003) ISBN 9780824793555
- Zdzislaw and E.Sikroski: Chemical and functional Properties of Food Components: 3rd edition, CRC Press, Taylor & Francis group USA (2006), ISBN - ISBN 9780849396755.

17FP2004 FLUID MECHANICS FOR FOOD ENGINEERS

Credits: 3:0:0

Course Objectives:

- To have an in depth knowledge of fluid mechanics.
- To apply fluid mechanics to the area of food engineering.
- To perform basic design calculations for fluid flow in pipes

Course Outcomes:

- To recognize the various properties of fluids.
- To express the units of different properties of fluids.
- To describe the pressure and its measurement.
- To calculate the forces acting on bodies submerged in different positions in liquids.
- To identify the type of flow of fluid.
- To solve problems on fluid flow measurement.

Unit I - PROPERTIES OF FLUIDS : Introduction- Units and Dimensions – Properties of fluids-Density – Specific weight - Specific Volume- Specific gravity- Viscosity-Thermodynamic properties-Compressibility and Bulk modulus- Surface tension and Capillarity -Vapour pressure and cavitation.

Unit II - PRESSURE AND ITS MEASUREMENT : Fluid pressure at a point- Pascal’s law- Pressure variation in a fluid at rest-Absolute, Gauge, Atmospheric and vacuum pressures- Measurement of pressure-Simple manometers-Differential manometers.

Unit III - FLUID STATICS : Hydro static forces on surfaces- Total pressure and centre of pressure- Vertical plane surface submerged in liquid- Horizontal plane surface submerged in liquid- Inclined plane surface submerged in liquid- curved surface submerged in liquid.

Unit IV - BASIC CONCEPTS OF FLUID FLOW AND MEASUREMENT : Kinematics of flow-Types of fluid flow-Rate of flow-continuity equation- continuity equation in three dimensions- velocity and acceleration-velocity potential function and stream function- Dynamics of Fluid flow- Equations of motion- Euler’s equation of motion- Bernoulli’s equation- Practical applications of Bernoulli’s equation – Venturimeter- Orifice meter-Pitot tube.

Unit V - FLOW THROUGH PIPES : Reynolds Experiment- Laminar and turbulent flow- Loss of energy in pipes- Loss of energy due to friction- Minor energy losses-Hydraulic gradient and Total Energy line- Flow through pipes in series- Equivalent pipe-Flow through parallel pipes- Flow through branched pipes-Power transmission through pipes- Water hammer in pipes.

Text Books

- Bansal, R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi, 9th edition, 2011.
- Modi, P.N. and Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi, 2007.

Reference Books

- Som, S.R and Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, 2nd edition, 2007.
- Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines”, S. Chand and Co., New Delhi, 2008.
- Agarwal, S.K., “Fluid Mechanics and Machinery”, Tata Mc Graw Hill Co.New Delhi, 2006.

17FP2005 FOOD MICROBIOLOGY

Credits : 3:0:0

Course Objectives:

- To understand the microorganisms associated with foods and isolation methods of microorganisms from foods.
- To know the methods of preservation of foods.
- To learn the fermentation process and microorganisms involved in the production of fermented foods.

Course Outcomes:

- To name and describe the beneficial and spoilage microorganisms associated with food.
- To understand the growth and methods of isolation of microorganisms from food.

- To enumerate the spoilage factors and the conventional methods of preservation fermentation process and fermented food products.
- To evaluate the role of microorganisms in various foods and water.
- To predict the causative agent and pathogenesis of disease causing foodborne pathogens and their toxins.

Unit I - INTRODUCTION, SCREENING AND ISOLATION OF MICROORGANISMS: Basic of Microbial existence - Micro organisms associated with foods: Bacteria, Molds, Yeast and their importance – Nutritional requirements of bacteria- Factors affecting the growth of bacteria –Growth curve of bacteria - antimicrobial barriers and constituent- .Spoilage and contamination in various food commodities- General Microbiological Methods of enumeration and isolation of bacteria and fungi,-Identification of bacteria and fungi by staining methods.

Unit II - CONVENTIONAL METHODS OF PRESERVATION: Thermal mode of preservation – Pasteurisation ,sterilization and Canning – Heat resistance of microorganisms and their spores – spoilage of canned foods and types of spoiled cans – aseptic packaging - Low-temperature storage. Non-thermal methods of preservation : High pressure processing – Pascatisation - Irradiation – Brief account of microwave, UV and ionizing radiation - Use of chemical preservatives, Natural food preservatives.

Unit III - MICROBIOLOGY OF FERMENTED FOODS: Traditional vegetable fermentation –Sauerkraut - Lactic acid, citric acid, and Acetic acid fermentation - Alcohol production – Beer, wine - Fermentation of oriental food products.

Unit IV - MICROBIOLOGY OF WATER AND FOOD COMMODITIES: Microbiology of water and their importance in processing of foods in industries. MPN of coliforms, Membrane filtration Technique. Microbiology of milk –Phosphatase test. Hetero and homo fermentative Lactic acid bacteria – Yogurt and Cheese fermenting organisms –Aflatoxin producing organisms and their importance in foods.

Unit V - FOOD BORNE PATHOGENS: Food Poisoning and intoxication – food borne diseases – Symptoms of diseases caused by Bacillus spp., Clostridium botulinum, Escherichia coli, Salmonella spp, Staphylococcus aureus, Shigella spp., Hepatitis, Gastroenteritis viruses, Entamoeba histolytica.

Text Book

1. Adams M.R and Moss M.O, “Food Microbiology”, Panima Publishing corporation, New Delhi, 2nd Edition, Third reprint, ISBN-13:9788122410143,978-8122410143, 2007.

Reference Books

1. Sivasankar B, “Food Processing and Preservation”, PHI Learning Private Limited, Eastern Economy Edition, 6th edition, ISBN- 97881203-2086-4, 2009.
2. William C Frazier and Dennis C. Westoff, “Food Microbiology”, Special Edition, Springer, The Mc Graw-Hill Companies, ISBN-9780070667181, 2008.

17FP2006 FOOD MICROBIOLOGY LAB

Credits : 0:0:2

Course Objectives:

- To understand the working principle of microscopes and sterilization techniques.
- To know the preparation of media for the cultivation of microorganisms.
- To identify the isolated strains using staining techniques and biochemical tests.

Course Outcomes:

- Use aseptic technique to properly handle microorganisms to avoid contamination.
- Understand and apply the knowledge to handle microscopes to observe stained microorganisms.
- Enumerate the microorganisms to check the quality characteristics of food.
- Isolate the pure culture from mixed population found in contaminated foods.
- Identify the microorganisms using staining techniques.
- Assess the quality of raw milk by methylene blue reduction test.

List of Experiments

1. Microscopy
2. Sterilization and Disinfection
3. Preparation of culture media.
4. Methods of pure culture techniques for bacteria.
5. Staining techniques - Monochrome staining
6. Gram staining
7. Negative staining,
8. Lacto phenol cotton blue staining for fungi.
9. Hanging drop preparation to observe motility of bacteria
10. Enumeration of microorganisms from water/milk
11. Enumeration of microorganisms from any contaminated food.

12. MPN Test for coliforms.
13. Methylene blue reduction test for assessing the quality of raw milk.
14. Biochemical characterization of bacteria.

17FP2007 FLUID MECHANICS AND HEAT TRANSFER LAB

Credits : 0:0:2

Course Objective:

- To provide extensive knowledge on various flow measuring equipments involved in food industries.
- To equip the students to operate and measurement of the heat transfer equipments.

Course Outcomes:

The students will be able to

- Understand the importance of fluid flow in industrial applications.
- Describe the use of flow measuring devices.
- Demonstrate the loss of energy due to friction in pipes.
- Calculate the losses of energy due to fittings in pipe flow systems.
- Evaluate the required length of pipes for fluid flow.
- Demonstrate the heat transfer equipments and their performance.

List of Experiments

1. Determination of coefficient of discharge of Venturi meter
2. Determination of coefficient of discharge of Orifice meter
3. Calibration of Rotameter
4. Determination of pipe friction and pressure drop due to sudden contraction and expansion during fluid flow
5. Determination of friction loss and pressure drop in Helical coil
6. Determination of Equivalent Length of pipe fittings during fluid flow
7. Determination of pressure drop in annular pipes
8. Pressure drop across Fluidized bed columns
9. Heat transfer studies in a tubular heat exchanger (Parallel and counter flow)
10. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
11. Heat transfer studies of a shell and tube heat exchanger
12. Heat transfer through composite walls

17FP2008 FOOD ANALYSIS LAB - I

Credits : 0:0:2

Course Objectives:

- Demonstrate an ability to assess the most appropriate analytical procedure required for a particular food analysis problem.
- Demonstrate practical knowledge of selected food analysis techniques.

Course outcomes:

Learners who successfully complete this course will be able to:

- Gain knowledge in the terminology used in food analysis
- Understand how food analysis fits into the food industry.
- Learn relevant procedures and equipment
- Gain experience with proximate analysis of foods
- Familiar with precision and accuracy through experiences with components of analysis and reporting results.
- Demonstrate oral and written communication skills to effectively communicate scientific ideas related with food analysis

List of Experiments

1. Estimation of Reducing sugars by Willstatter' Iodometric Titration
2. Estimation of Reducing sugars by Lane and Eynon's method
3. Estimation of Total sugars by Lane and Eynon's method
4. Estimation of Free Fatty Acids in Fats and Oils
5. Saponification Value of Fats and Oils
6. Peroxide Value of Fats and oils
7. Iodine Value of Fats and Oils
8. Estimation of α – Amino Nitrogen by Sorenson's Formol Titration
9. Estimation of Nitrogen by Kjeldhal's Method
10. Estimation of Vitamin C
11. Estimation of iron
12. Estimation of Calcium

13. Qualitative Analysis of Sugars
14. Qualitative Analysis of Amino Acids
15. Identification of Sugars by Paper Chromatography
16. Identification of Aminoacids by Paper Chromatography

17FP2009 FOOD BIOCHEMISTRY AND NUTRITION

Credits : 3:0:0

Course Objectives :

- To understand about metabolic pathways and nutrition
- To apply knowledge on the legal aspects of formulating and labelling functional foods and dietary supplements.
- To develop a food product of high nutritive value

Course Outcomes :

- To describe the structure of ATP and identify the major class of macromolecules to which ATP belongs.
- To list the stages in the catabolism of food molecules and describe what occurs during each stage.
- To describe the biochemistry process, basic concept of human nutrition and the relationship of the consumption of foods to nutritional status and health
- To evaluate the biological functions of foods for health in addition to nutritional values
- To evaluate the potential for adverse events related to dietary supplements
- To apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics (Nutraceuticals and functional foods).

Unit I - METABOLISM OF CARBOHYDRATES: Electron transport chain – glycolysis (EMP) pathway, TCA cycle, gluconeogenesis, Pentose phosphate shunt, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

Unit II - METABOLISM OF FATTY ACIDS AND PROTEINS: Biosynthesis and degradation of fatty acids and cholesterol - Biosyntheses and degradation of amino acids (one example each for sulphur containing, aliphatic, aromatic, heterocyclic, basic and acidic amino acids), peptides and proteins; Biosynthesis and degradation of purines, pyrimidines and nucleic acids, urea cycle.

Unit III - CONCEPTS OF NUTRITION: Basic concept of nutrition – Importance of nutrition and dietetics - Assessment of nutritional status – energy value of carbohydrates, proteins and fats – determination of energy value – balanced diet – Recommended dietary intake – Acceptable dietary intake – Protein efficiency ratio – Net protein utilisation and their determinations – Malnutrition and its problems – Nutrient supplementation & fortification - Nutritional labeling and its importance - Effect of processing on protein quality -carbohydrates in food and dietary fibre.

Unit IV - NUTRITIONAL DISORDERS: 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.

Unit V - SPECIALIZED NUTRITION: Nutrition for specialized purposes – Pediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy. 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.

Text Books

1. Voet D, Voet G, Principles of Biochemistry, 3rd edition, John Wiley and Sons, 2008. ISBN-13: 9780470233962, 978-0470233962.
2. Martin Eastwood, Principles of Human nutrition – 2nd edition. Wiley - Blackwell Publishing, 2003. ISBN: 978-0-632-05811-2

Reference Books

1. Ronald Ross Watson, Functional foods and Nutraceuticals in Cancer Prevention, Ed. Wiley – Blackwell, 2003. ISBN-13: 978-0813818542.
2. Nelson D.L., M.M. Cox, Lehninger Principles of Biochemistry, W.H. Freeman & Company Publications, 2013. ISBN-10: 1-4292-3414-8
3. Tymoczko, J.L., Berg, J.M., Stryer, L. Biochemistry – A short course, 3rd edition. W.H. Freeman. 2009. ISBN-10: 1-4641-2613-5
4. Sunetra Roday., “Food Science and Nutrition – 2nd edition, Oxford Higher Education/Oxford University Press, 2012, ISBN 10: 0198078862

17FP2010 HEAT AND MASS TRANSFER

Credits : 3:0:0

Course Objectives:

- To enable the student to basic study of the phenomena of heat and mass transfer, to develop methodologies for solving food engineering problems
- To understand the information concerning the performance and design of Heat exchangers
- To develop processes with better heat efficiency and economics

Course Outcomes :

- To understand the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems.
- To analyze problems involving steady state heat conduction in simple geometries.
- To evaluate heat transfer coefficients for natural convection.
- To analyze heat exchanger performance by using the method of log mean temperature difference.
- To analyze heat exchanger performance by using the method of heat exchanger effectiveness.
- To understand the influence of radiation in food processing operations.
- To understand basics of diffusion mass transfer and its application in food processing.

Unit I - HEAT TRANSFER – CONDUCTION: Modes of heat transfer – Conduction, Convection and Radiation. Fourier's Law of Heat conduction-Thermal Conductivity for gases, liquids and solids-Thermal diffusivity- Thermal resistance-Steady heat conduction in simple geometries:

Plane wall, hollow cylinder and hollow sphere through solids in series -plane wall and multilayer cylinder. Heat conduction through materials in parallel. Theory of insulation, critical radius of insulation.

Unit II - HEAT TRANSFER – CONVECTION: Convection heat transfer – forced and natural; Evaluation of convection heat transfer coefficient, Dimensionless numbers- Forced convection- Heat Transfer Coefficient for Laminar flow inside a tube -heat transfer coefficient for turbulent flow inside a pipe. – Heat Transfer outside various Geometries in Forced Convection – Flow parallel to flat plate - Natural convection from vertical planes and cylinders –boiling and condensation-mechanisms

Unit III - HEAT TRANSFER – RADIATION: Basics of Radiation heat transfer- Types of surfaces – Kirchoff's Law-radiation from a body and emissivity (Stephan Boltzmann Law) to a small object from surroundings –Planck's Distribution law-Wein's Displacement law- combined Radiation and Convection Heat Transfer.

Unit IV - HEAT EXCHANGERS: Types-Overall Heat Transfer Coefficient-Shell and Tube1-1, 1-2, 2-4 passes –Plate Heat Exchanger-tubular heat exchanger-Parallel Flow and Counter Flow- Cross flow Types-Scraped surface exchangers-Compact Heat exchanger- Heat exchanger Analysis-Log mean Temperature Difference

Unit V - MASS TRANSFER: Physical Origin-Mixture composition-classification-concentration- velocities and fluxes. Fick's law- general equation of mass transfer in stationary media- steady state diffusion- equimolar diffusion-diffusion of water vapour through air-mass transfer coefficient –convective mass transfer

Text Book

1. Rao, D. G, "Fundamentals of Food Engineering", PHI Learning Pvt. Ltd., New Delhi. 2010.

Reference Books

1. McCabe W.L., Smit J.C and Harriott P, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, 7th Edition New York, ISBN-007-424-740-6, 2005.
2. Ballaney, P.L. "Thermal Engineering", Khanna Publishers, New Delhi. 2002
3. R.Palusingh, Dennis R. Heldman "Introduction to food engineering" 5th edition, Academic press 2014

17FP2011 DAIRY ENGINEERING AND TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To understand about milk, milk processing methodologies
- To provide knowledge about the milk processing equipments
- To provide technical know-how about the production of milk products (ice creams, fermented milk products)

Course Outcomes:

- To gain knowledge on milk source and composition
- To understand the various milk processing methods.
- To learn the milk processing equipments.
- To develop an understanding on milk packaging machines

- To demonstrate hands-on skills in manufacturing selected dairy products in a pilot plant setting
- To evaluate the safety and quality factors that determine the acceptability of the dairy products by consumers.

Unit I - DAIRY CHEMISTRY AND MICROBIOLOGY : Introduction - Basic dairy terminology - milk as raw material – composition - nutritive value - Physico-chemical constituents of milk and its constituents – contaminants - microbiology of milk- milk collection - cooling and milk transport - milk reception -Quality control tests - applications of enzymes in dairy industry

Unit II - DAIRY PROCESSING AND EQUIPMENTS : Milk processing equipment – filtration/clarification – Pasteurization – HTST – LTLT - UHT methods - storage tanks - Cream separating Centrifuges - Homogenization – theory - working principle of homogenizers – homogenization efficiency - cream separation – principles – gravity and centrifugal separation – centrifugal separator – parts – construction and working principle – separation efficiency

Unit III - BOTTLE, CAN WASHING AND FILLING EQUIPMENTS : Plant piping – Pumps - Bottle washers- and cappers- can washers-types of can washers-care and maintenance-factors affecting washing operation – Fillers - types of fillers-pouch filling form fill seal machines - aseptic filling - cleaning and sanitization - CIP cleaning- types of CIP systems - Energy use in Dairy plant - sources of energy - cost of energy - Control of energy losses and Energy conservation.

Unit IV - MILK PRODUCT PROCESSING : Butter – method of manufacture – theory of churning - operation of butter churn – over run—batch and continuous methods of butter making. Ghee – methods of manufacture - Cheese – classification – cheddar and cottage cheese - equipments – cheese vats and press-construction details. Ice cream - ingredients – preparation of ice cream mix - freezing – calculation of freezing point and refrigeration - batch and continuous freezers – Special milks - Quality aspects of dairy products.

Unit V - FERMENTED AND DEHYDRATED DAIRY PRODUCTS : Fermented products – Yoghurt – Curd – cultured butter milk Bulgarian butter milk – Kefir – paneer - acidophilus milk etc. - Concept of Probiotics and prebiotic foods – Vacuum Evaporators - drying of milk - drum drier and spray drier - components - construction and working principles.

Text Books

1. Tufail Ahmad, “ Dairy Plant Engineering and Management”, Kitab Mahal Publishers, New Delhi, 2016.
2. Sukumar De, “Outlines of Dairy Technology”, Oxford University Press, New Delhi, 23rd impression, 2006.

Reference Books

1. Farrall,A.W. 1963. Engineering for dairy and food products. John Wiley and Sons, New York.
2. G. Bylund: Dairy Processing Handbook. Tetrapack publishers.
3. Walstra. P et al “ Dairy Technology”Taylor & Francis ISBN-0-203-90999-2, 2005

17FP2012 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING - I

Credits: 3:0:0

Course Objectives:

- To know the various types of equipments used in the food industry.
- To learn the operation and utilization of equipments involved.
- To choose suitable techniques for the food processing operation.

Course Outcomes:

- To define the various unit operations in food processing.
- To compute the moisture content of food materials.
- To describe and demonstrate the various process equipments.
- To evaluate the different operations in food processing.
- To estimate the energy requirement for the different unit operations.
- To develop unit operation system for food processing.

Unit I - DRYING AND DEHYDRATION : Moisture and its measurements - direct and indirect methods – Equilibrium moisture – methods of determination – EMC Models – Henderson ,Kelvin, PET and GAB models – importance of EMC- water activity – psychrometry — 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 II - MECHANICAL SEPARATION : 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 III - EVAPORATION : 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 IV - SIZE REDUCTION: 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 V - MIXING : 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.

Text Books

1. DG Rao, “Fundamentals of Food Engineering” PHI Learning Private Limited, New Delhi.
2. Geankoplis CJ, “Transport Processes and Separation Processes Principles” .Printice Hall India, New Delhi, ISBN-978-81-203-2614-9, 2008
3. Warren,L McCabe, J.C. Smith and Peter Harriot,”Unit Operations of Chemical Engineering “ McGraw Hill International Edition, Singapore, ISBN-007-424740-6, 2005

Reference Book

1. Earle, R.L, “Unit Operations in Food Processing”. Pergamon Press,2nd Edition,UK, 2003

17FP2013 FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To enable the students to understand the processing of fruits and vegetables
- To impart technical knowledge of about how to develop products and preservation
- To understand the methods of dehydration

Course Outcomes:

- To understand the production status and post harvest handling methods of fruits and vegetables
- To learn the methods of processing and preservation of freshly harvested and cut fruits and vegetables.
- To enumerate the processing and preservation of fruits and vegetables by heat treatment.
- To illustrate the production and preservation methods of fruit juices.
- To understand the dehydration methods and design of driers used for drying fruit and vegetables.
- To describe the aseptic technology for product preservation.

Unit I - INTRODUCTION: Production of Fruits and vegetables in India. Cause for heavy losses, Composition of each of the major fruits and vegetables produced in the country- Spoilage factors, Post harvest field operations, Preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. Processing and packaging of cut fruits and vegetables.

Unit II - PRESERVATION OF FRUITS AND VEGETABLES: Canning operations of fruits and Vegetables.-Different filling, closing and sterilization operations- Blanching operations - Batch and Continuous Blanching. Concept of Hurdle technology as applied to fruit and vegetable preservation. Minimal processing. Bottled Products: Preparation of products like Jams, Jellies, Marmalades, Pickles, Puree, Ketchup, Sauce, and Squashes etc. - FSSAI specifications.

Unit III - PROCESSING OF FRUIT JUICES: Common machinery for operations like Peeling, Slicing/Dicing and Pulping. Preparation of specialty products like, Fruit juice concentrates, Fruit Bars and Fruit powders. Clarification of juices -Tomato products – Hot and Cold Break processes. Tomato Deseeding and clarification. Clarification centrifuges – Decanters and desludgers. Fruit juice aroma Recovery and its importance.

Unit IV - DEHYDRATION: Dehydration principles and equipment used for drying –Cabinet tray dryer,Tunnel dryer, Conveyor Belt dryer, Bin dryer, Fluidised bed dryer, Freeze Dryers. Freeze drying Principles. Merits and demerits of Freeze Drying. Preparation of Fruit Powders. Working of Spray Dryer and Drum Dryer. Preparation of Dried slices, Intermediate Moisture Food.

Unit V - ASEPTIC PROCESSING: Aseptic processing and Bulk packing of Fruit juice concentrates. Aseptic heat exchangers for sterilizing and concentrating the product. Aseptic fillers. Tetra pack for small quantities, Dole system and Scholle system for bulk storage in Bag and Boxes and Bag & Drums.Storage of Aseptically packed products.

Text Book

1. Hui Y.H and Others, “Hand Book of Vegetable Preservation and Processing”, Mercel Dekker, New York, 2004

Reference Books

1. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. "Handbook of Post-harvest Technology" Marcel Dekker Press, USA, 2001.
2. L.R.Verma and V.K.Joshi, (2000) Post Harvest Technology of fruits and vegetables. Indus Publishing Co, NewDelhi.
3. P.Fellows, (2000) Food processing Technology: Principles and Practice. Wood Head publishing Limited, Cambridge, England.
4. James G. Brennan, (2006) Food Processing Hand book. Wiley-Ych Verlag GmbH&Co KgaA, Weinheim, Germany

17FP2014 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING AND GRAIN PROCESSING LABORATORY

Credits : 0:0:2

Course Objectives:

- To know the various types of equipments used in the food industry.
- To learn the operation and utilization of equipments involved.
- To choose suitable techniques for the food processing operation.

Course Outcomes:

- To study the various unit operations in food processing.
- To compute the moisture content and drying characteristics of food materials.
- To describe and demonstrate the milling equipments.
- To estimate the energy requirement for the grain milling operations.
- To estimate the mixing properties of flours and grains.
- To evaluate the performance of grain separators and rice mill.

List of Experiments

1. Studies on drying characteristics of vegetables using Cross flow dryer
2. Studies on drying characteristics of vegetables using Through flow dryer
3. Studies on drying characteristics of vegetables using Vibrofluidizer
4. Studies on size reduction of grains using multi mill
5. Studies on size reduction of grains using Disc/Pin mill
6. Studies on mixing properties using Ribbon mixer
7. Studies on mixing properties using Sigma mixer
8. Experiment on Dewatering Centrifuge
9. Studies on cleaning efficiency of specific gravity separator for grains
10. Experiment on milling efficiency using Rubber Roll Sheller
11. Experiment on Plate type pasteurizer
12. Experiment on oil extraction using oil expeller

17FP2015 FOOD BIOCHEMISTRY LAB

Credits : 0:0:2

Course Objectives:

- To gain knowledge of practices for proper literature reviews and evaluation of appropriate methods for analysis.
- To understand proper use of methods of analysis
- To interpret various methodologies for analysis of components in foods.

Course outcomes:

Learners who successfully complete this course will be able to:

- Demonstrate the presence of protein, lipid, carbohydrate and water in food using chemical methods
- Describe various separation and quantification techniques frequently used for food analysis.
- Evaluate proper selection and application of appropriate methods of analysis.
- Aware of how analytical techniques may be used determine food composition and quality
- Work with other students to successfully complete lab experiment
- Apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics

List of Experiments

1. Estimation of sugars by DNS method
2. Estimation of crude fibre
3. Estimation of proteins by the Biuret method
4. Estimation of total free amino acid
5. Estimation of proteins by Lowry's method
6. Estimation of proteins by dye-binding method
7. Estimation of thiamine

8. Estimation of ascorbic acid
9. Estimation of riboflavin
10. Estimation of carotenoids
11. Estimation of cholesterol
12. Estimation of total carbohydrate by anthrone method
13. Qualitative tests for checking of milk and water

17FP2016 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING – II

Credits: 3:0:0

Course Objectives:

- To understand the various unit operations involved in food industry.
- To learn the operation and utilization of equipments involved.
- To choose suitable techniques for the food processing operation.

Course Outcomes:

- To understand the engineering operations that are critical to the food processing operations and industrial growth.
- To define the principles of food processing operations.
- To learn the material and energy balance related to the unit operations.
- To identify the factors affecting unit operations.
- To select suitable unit operations for a specific purpose.
- To appraise the performance of the mass transfer operations in food processing.

Unit I - DISTILLATION : Principles of diffusion and mass transfer -Fick's law – convective Mass transfer – Mass transfer for binary mixtures- definition of Distillation – Flash Distillation — continuous distillation with reflux – combined rectification and stripping- McCabe and Thiele method of determination of no of plates. – Advantages and limitations – distillation equipments – construction and operation – factors influencing the operation.

Unit II - LEACHING AND EXTRACTION : Definitions – Leaching equipment leaching by percolation through stationary solid- moving bed leaching –Dispersed solid – counter current leaching – number of ideal stages. Liquid extraction – Extraction equipment – mixer settlers – packed extraction towers – perforated plate towers – baffle towers – Agitated tower. Pulse column – centrifugal extractor.

Unit III - ABSORPTION AND ADSORPTION : Definition – rate of gas absorption – packing and packed tower for absorption – characteristics of packing- pressure drop and limiting flow rates – principles of absorption – mass balance.

Adsorption – equipment – fixed bed adsorber - pressure swing adsorption – Adsorption from liquids.

Unit IV - CRYSTALLIZATION : Crystallization equilibrium -rate of crystal growth – stage of crystallization – magma- nucleation crystallization equipment. Variations in crystallizers – vacuum crystallizers. Draft tube, baffle crystallizers.

Unit V - MEMBRANE SEPARATION : Micro, Ultra and Nano filtration. Types of membranes. Permeate flux for ultrafiltration – concentration polarization – Application of ultrafiltration, diafiltration – membrane fouling – Separation of gases – porous membrane – Polymer membrane – Membrane structure -flow patterns. – Pervaporation – Reverse Osmosis.

Text Books

1. DG Rao, “ Fundamentals od Food Engineering” PHI Learning Private Limited, New Delhi.

Reference Book

1. Earle, R.L. “Unit Operations in Food Processing”. Pergamon Press,2nd Edition,UK, 2003.
2. Geankoplis, CJ, “Transport Processes and Separation Processes Principles” .Printice Hall India, New Delhi, ISBN-978-81-203-2614-9, 2008.
3. Warren,L McCabe, J.C. Smith and Peter Harriot.”Unit Operations of Chemical Engineering “ McGraw Hill International ,7thEdition ,Singapore, ISBN-007-424740-6, 2005.

17FP2017 REFRIGERATION, AIR CONDITIONING AND COLD STORAGE CONSTRUCTION

Credits: 3:0:0

Course Objectives:

- To enable the students to understand the various concepts behind refrigeration of food.
- To enable students to know about food freezing and equipment involved.
- To enable students to understand various aspects of cold storage.

Course Outcomes:

- To understand refrigeration of food and its operational components.

- To gain knowledge on various forms of food refrigeration in plants, stores and logistics.
- To learn advanced food freezing concepts and techniques.
- To study food safety aspects of chilled foods and frozen foods.
- To comprehend cold chain management in food distribution sector.
- To evaluate the cold storage and packaging of frozen perishable products.

Unit I - PRINCIPLES OF REFRIGERATION: Refrigeration – Ton of refrigeration, refrigeration cycles, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, net refrigerating effect -Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls.

Unit II - COLD STORAGE: Insulation, properties of insulating materials, air diffusion equipment, Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures,

Cooling towers: introduction, Construction and Working; Cold Storage practice, Stacking and handling of materials, Optimum temperatures of storage for different food materials.

Unit III - AIR-CONDITIONING: Psychrometry. Psychrometric Processes. Simple Air Conditioning System – State and Mass Rate of Air. Evaporative, Winter and All Year Air Conditioning Systems. Design Conditions. Load Calculation and Psychrometry of Air Conditioning Systems –Design of Air conditioning apparatus – Transmission and Distribution of Air. Selection of Air Conditioning Systems.

Unit IV - FREEZING AND CHILLING OF FOODS: Freezing equipment, Freezing Time, Freezing Curve, Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to different food sectors. Chilling equipment for liquid foods. Secondary refrigerants, Evaporative cooling and direct expansion techniques in chilling. Chilled foods transport and retail cabinets - Basics of Chilled foods microbiology, Packaging of Chilled foods.

Unit V - COLD CHAIN MANAGEMENT: Supply chain system - Important Factors to consider- logistic supply- Protocols for Domestic, Sea and Airfreight- Traceability and barcode – Product Temperature and Moisture monitoring- Refrigeration systems and Refrigerant types during field chilling, transportation via land, air and sea. Grocery stores and display cases, Home refrigerators - Cooling chain summary - Storage and packaging

Text Book

1. Clive.V.J Dellino, “Cold and Chilled Storage Technology”, Chapman Hall India, 1997.

Reference Books

1. C.P. Arora, “Refrigeration and Air conditioning”, Tata McGraw Hill, 2009.
2. Da-Wen Sun, “Handbook of Frozen Food Processing and Packaging”, CRC Press, 2009.
3. Florkowski W.J, Shewfelt R.L, Brueckner B and Prussia S.E, “Post Harvest Handling and Sytems Approach”, Second edition, Academic Press, 2009.
4. Colin Dennis and Michael Stringer: Chilled Foods – A Comprehensive Guide Brown.M WoodHead Publishing, 2008.

17FP2018 MECHANICAL SYSTEMS FOR FOOD PROCESSING

Credits: 3:0:0

Course Objectives:

- To provide knowledge about types of pumps and their applications.
- To learn about types of power transmission elements, steam generators and chillers.
- To understand the principles of material handling systems.

Course outcomes:

- To understand the working principle of pumps and their applications
- To know about the various power transmission elements and their design.
- To gain knowledge on working principle of boilers and measurement of performance.
- To study the working principle and applications of various mechanical refrigeration systems.
- To learn about the principles and applications of different food chillers and freezers.
- To appraise the construction and working principle of various material handling systems.

Unit I - FOOD PLANT PUMPS: Pumping theory- head developed-Types of pumps-Centrifugal pumps-Reciprocating pumps- piston pump-Rotary gear pumps- vane pumps- and diaphragm pumps-peristaltic pump-construction- working principles and applications (Simple problems).

Unit II - MECHANICAL POWER TRANSMISSION SYSTEMS: Types of shafts-design of shafts-solid and hollow shafts- types of coupling- belt drives-gear drives-chain drives and rope drives-types and materials (Simple problems).

Unit III - STEAM GENERATION AND DISTRIBUTION: Types of Water tube and smoke tube boilers-

Boiler capacity- boiler specification- automatic boilers- Boiler mountings. Performance of steam generators (Simple problems).

Unit IV - REFRIGERATION SYSTEMS: Types of refrigeration systems- VCRs and VARs. Refrigerants, Components of refrigeration systems. Types of Chillers for Solid Foods, Types of Chillers for Liquid Foods, Types of Freezers. (Simple problems).

Unit V - MATERIAL HANDLING IN FOOD PLANTS: Material handling in food plants & Importance, Belt Conveyor, Roller Conveyor, Vibratory Conveyor, Screw Conveyor, Slat Conveyor, Pneumatic Conveyor, Bucket Elevator.

Text Books

1. P.G.Smith, "Introduction to Food Process Engineering", Springer international Edition, 2005
2. R.Paul Singh, Dennis R.Heldman; "Introduction to Food Engineering" (3rd edition), Academic press, Elsevier, 2001.

Reference Books

1. R.K Rajput, "Thermal Engineering", Laxmi Publications, 2008.
2. R.K.Bansal; "Fluid Mechanics and Hydraulic Machines", Laxmi publications (P) Ltd, 2004
3. C.P. Arora, "Refrigeration and Air conditioning", Tata McGraw Hill, 2009.
4. R.S. Khurmi and J.K. Gupta, "A Text Book of Machine Design", Eurasia Publishing House, 2005.

17FP2019 CEREALS AND PULSES TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To create awareness about the processing of major cereals like paddy, maize etc.
- To study the milling techniques of cereals and pulses
- To study about the byproducts obtained during processing along with their uses.

Course Outcomes:

- To gain knowledge about the basic composition and structural parts of food grains.
- To know about paddy processing and rice milling equipment which will help them for developing entrepreneurial skills.
- To apply the knowledge to process food grains into value added products.
- To acquire the skills of processing wheat, maize and corn.
- To develop skills needed in the milling of pulses.
- To study the processing and milling of maize which will promote gainful employment.

Unit I - PADDY PROCESSING : Structure and Composition of paddy – Cleaning of paddy - Pre Cleaners, - Paddy Parboiling Processes. Physico-chemical changes during parboiling – effect of parboiling on cooking qualities - Parboiling methods - Methods of grain drying- LSU, rotary, columnar, recirculatory dryers – By-products of paddy processing - Paddy husk and its uses as husk ash, activated carbon, furfural and other by products – Value added products - Flattened and Puffed Rice.

Unit II - RICE MILLING : Rice milling flow chart - Modern Rice Milling equipments – paddy milling - Dehusking of paddy - Engelberg Huller, Under runner disc shellers, rubber roll sheller and Centrifugal dehusker - Paddy Separators – Satake and Schule Designs – Rice Polishers - Cone polishers and other types - Bran and Broken separators - Rice mill yields and loss due to broken at different stages of milling – milling efficiency - Use of Rice Bran in Edible oil Industry.

Unit III - WHEAT MILLING : Structure and composition of wheat – flow chart for wheat milling – milling process - equipments used in wheat milling – parboiling of wheat – bulgur wheat – products and by products of wheat.

Unit IV - PROCESSING OF MAIZE/CORN : Structure and composition of maize – milling methods - Pre-cleaning - cleaning equipment - degermination and dehusking - Dry milling of maize – wet milling – flow chart - Products of milling – Flour – Semolina - Brewers' grits etc and their applications - Bran and Fibre separation - Gluten and Starch Separation - Equipment used - Starch conversion into other value added products – Acid Hydrolysis, Enzyme Hydrolysis, Isomerization processes - Processing for Dextrose, Malto Dextrin and other products - Extraction and refining of Corn oil in brief.

Unit V - MILLING OF PULSES : Structure and composition – need for pulse milling – Unit operations of pulse milling – domestic and commercial scale pulse milling methods – Dry and wet milling, CFTRI, CIAE, Jadavpur methods - Process flow chart – Pulse milling machineries - dehusking in Pulse Pearler - splitting of pulses in Pulse splitter - Mini dhal mill - working principle - advantages and disadvantages – pulse milling efficiency - Grinding of split pulses - pulse flour products - their applications and equipments used.

Text Books

1. KM. Sahay and KK. Singh. Unit operations of Agricultural Processing, Vikash Publishing house PVT Ltd. Delhi, 2014.

- Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 2014.

Reference Books

- Samuel A .Matz: “The Chemistry and Technology of Cereals as Food and Feed”, Chapman and Hall, 1992.
- Bernard Godon and Claude Willm, “Primary Processing of Cereals” Berns and Noble Publishers, 1994.
- Karel Kulp and Joseph P Pante, “Handbook of Cereal Science and Technology”, Mercel Dekkar, USA, 2000.

17FP2020 BAKERY, BEVERAGES AND CONFECTIONERY TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To provide know how on the machinery and process involved in the baking and confectionery process
- To understand the various types of sugar and its grades
- To know the process and machinery involved in the manufacture of beverages.

Course Outcomes:

- To gain knowledge on the ingredients, process and machinery involved in bakery and confectionery and beverage technology.
- To understand the importance and effect of quality of raw materials on the final products\
- To apply the knowledge gained in formulating new types of products
- To critically analyze the process for maintaining and improving the quality of the final product
- To evaluate the steps involved in the process and improve existing technologies or develop newer technologies
- To design and create newer process and products that are better economically, nutritionally or technologically.

Unit I - LABORATORY TESTING OF WHEAT GRAIN QUALITY: Moisture tests, Grain hardness testing. Visco graph, Amylograph, Farinograph. Dough mixers, Dividers, rounders, Proofing, moulding, Ovens, Slicers, Packaging materials and equipment, Sanitation and safety.

Unit II - MATERIALS OF BAKING : Bread manufacturing process – Straight dough fermentation, Sponge and dough, Biscuit-Types of biscuit dough – Developed dough, short dough, semi-sweet, enzyme modified dough and batters- importance of the consistency of the dough- Cake – Flour specification – ingredients – manufacturing process – types of chemically aerated goods.

Unit III - SUGAR MANUFACTURE : Energy and material balance of cane sugar process. Extraction of juice, extraction yields, drying and uses of Bagasse, Purification of juices-juice filtration and chemical purification, Clarification stages, Lime addition, pH control, Treatment of clarified juice, evaporation –multiple effect evaporators, Vacuum pans, Crystallization, Washing of sugar crystals and centrifugal separation/dewatering of sugar and other related processes. Sugar Refining, Sugar analysis, Sugar recovery – improvement, Sugar balance, energy conservation, Sugar plant sanitation.

Unit IV - MANUFACTURE OF ALCOHOLIC AND CARBONATED BEVERAGES : Manufacture of beer, wine and champagne - Quality characteristics, Manufacture of distilled beverages including whisky, brandy, rum and gin – Quality aspects

Manufacture of sugar-free, sugarless, carbonated beverages - quality aspects

Unit V - CONFECTIONERY TECHNOLOGY: Types of Confectionery, raw materials and processing of toffee, chocolates, fruit drops, hard boiled candies. Additives for Confectioneries. Equipments used in Confectionery manufacture.

Text Book

- Samuel A. Matz, “Bakery Technology and Engineering”, Chapman & Hall, 3rd Edition, 1992.

Reference Books

- Bakery Products – Science and Technology, Ed., Y.H. Hui, Blackwell Publishing, 2006. ISBN-13: 978-0-8138-0187-2
- Sumnu SG and Sahin S. Food Engineering aspects of Baking sweet goods. CRC Press,2008. ISBN 978- 1- 4200- 5274- 9
- Hunsigi G. Production of Sugarcane Theory and Practice, Springer Verlag, 1993. e-ISBN-13: 978-3-642-78133-9
- Varnam A.H. & Sutherland J.P. BEVERAGES - *Technology, Chemistry and Microbiology*, Springer-Science+Business Media, B.V., 1994. ISBN 978-1-4615-2508-0 (eBook)
- Lees R and Jackson EB. Sugar Confectionery and Chocolate Manufacture, Chapman and Hall Pub.,1992. e-ISBN-13: 978-1-4684-1495-0
- Edwards, W .P. The Science of Sugar Confectionery, RSC Publishing, UK., 2000. ISBN 0-8 5404-593-7

17FP2021 FOOD SAFETY REGULATIONS

Credits: 3:0:0

Course Objectives:

- To study importance of Food Safety
- To understand the regulating authorities for food safety world over

Course Outcomes:

- To understand the regulations followed in various food industries.
- To define the food labeling patterns.
- To apply the knowledge in food industries.
- To analyze the safety operations involved in food systems.
- To evaluate the steps involved in the process operations in food industries.
- To prepare HACCP standards for food industries.

Unit I - FOOD REGULATIONS: World Trade order – Functioning and responsibilities of the WTO - Codex Alimentarius –History, operations of Codex alimentarius, Responsibilities – Codex standards and Maximum residue limits – Current Issues under consideration – SPS (Sanitary and phytosanitary measures) agreement. World Health Organisation – History and mandate – Operations and responsibilities – ICGFI – Functions and responsibilities. Concept of Six Sigma

Unit II - FOOD AUTHORITY IN INDIA: Food safety and Standards Act – organizational chart – role of individual authority –principles to be followed –Provisions as to articles of food –imported items – Responsibilities of the food business operator – Liability of manufacturers, packers, wholesalers, distributors and sellers –Enforcement of the act – Licensing and registration of food business – Food safety officer and their powers – Analysis of food – regulations regarding labs involved in food analysis – Offences and penalties – Adjudication and food safety appellate tribunal – Laws relating to Food Processing Industries in India - FPO, MMPO, PFA, AGMARK, Essential Commodities Act, BIS

Unit III - FOOD LABELING : Need for labeling – Developing labeling standards at the world level – Limitations of labeling safety issues – Labeling regarding methods of processing – Irradiated products – Products derived from modern biotechnology – organic produce - Genetically modified foods – EU rules on nutritional labeling – US rules on nutritional labeling – Health claims – Approach of US and EU

Unit IV - MICROBIOLOGICAL FOOD SAFETY : Concept of HACCP – Assembling the team – Product description – Describing the product's intended use – Establishing a process flow diagram – on site confirmation - Listing potential hazards and control measures - Determination of critical points – decision tree for CCPs- Establishing monitoring procedures- establishing corrective actions – establishing verification Procedures

Unit V - SAFETY ASPECTS OF WATER: Safety aspects of drinking water (microbiological and chemical) - the epidemiological triangle diseases caused by drinking of contaminated water , bottled water – setting of guideline values (microbiological and chemical) – risks and advantages of chlorination of water-Bottled water – origin of water- nutritional and physiological aspect – safety aspects – microbiological and chemical quality – Regulations for bottled water – EU, US and India

Text Books

1. Kees A. van der Heijden and Sanford Miller, “International Food Safety Handbook: Science, International Regulation, and Control”, Published by CRC Press, ISBN 0824793544, 9780824793548, 1999.
2. Guide to the Food Safety and Standards Act, Tax-mann Allied Services Pvt. Ltd., ISBN 10-8174968288, 2006.

Reference Book

1. Mehta R. and George J., “Food Safety Regulation Concerns And Trade- The Developing Country Perspective”, Published by Macmillan India Ltd., New Delhi. ISBN 1403925046, 9781403925046, 2005.

17FP2022 FOOD ENZYMOLOGY LAB

Credits : 0:0:2

Course Objective:

- To study the characteristics of various enzymes applicable in food industries.

Course Outcome:

- The students will be able to have a clear knowledge about enzymes
- The students will be able to understand the importance of each of the factors that affect enzyme activity
- The students will be able to apply the same to maximize enzyme action
- The students will be able to analyze when a problem arises and give a suitable and logical solution

- The students will be able to evaluate enzymes from different sources and select the right one depending on the type of food / condition
- The students would be able to make appropriate decision of evaluation and characterization when it comes to newer source of enzymes

List of experiments

1. Estimation of reducing sugars by dinitrosalicylic acid
2. Estimation of amylase activity
3. Effect of pH on amylase activity
4. Effect of temperature on amylase activity
5. Effect of substrate concentration on amylase activity
6. Effect of enzyme concentration on amylase activity
7. Determination of total and specific activity of amylase
8. Estimation of protein by Lowry's method
9. Estimation of protease activity
10. Effect of pH on protease activity
11. Effect of temperature on protease activity
12. Effect of substrate concentration on protease activity
13. Effect of enzyme concentration on protease activity
14. Determination of total and specific activity of protease
15. Studies on enzyme immobilisation

17FP2023 FOOD PRODUCT TECHNOLOGY LAB - I

Credits : 0:0:2

List of Experiments

1. Preparation of RTS beverage
2. Preparation of squash
3. Preparation of cordial
4. Preparation of Jam and jellies
5. Preparation of marmalade
6. Preparation of ketchup
7. Preparation of basic bread
8. Preparation of French bread
9. Preparation of sweet atta biscuit
10. Preparation of butter scotch cookies
11. Preparation of sweet biscuits
12. Preparation of salt biscuits

17FP2024 ENGINEERING PROPERTIES OF FOOD MATERIALS

Credits: 3:0:0

Course Objectives:

- To study about the different methods of determining the quality and properties of different foods
- To gain knowledge of engineering properties during processing, packing, storage and transport.
- To impart knowledge about electrical properties of food and its applications in food engineering

Course Outcomes:

- To understand Engineering properties of food materials.
- To identify the structure and chemical composition of foods.
- To determine the physical properties of food materials.
- To calculate the water activity, food stability sorption and desorption isotherm of food materials.
- To study the difference between Newtonian and non-Newtonian fluids.
- To examine the thermal properties, electrical and magnetic properties of food.
- To measure the aero- and hydrodynamic characteristics and the application of frictional properties in grain handling, processing and conveying.

Unit I - PHYSICAL PROPERTIES OF FOODS: Methods of estimation of Shape, Size, volume, density, porosity and surface area, sphericity, roundness specific gravity. Frictional properties-coefficient of friction, Storage and flow pattern of agricultural crops

Unit II - RHEOLOGICAL PROPERTIES OF FOODS: Definition – classification – Newton's law of viscosity – momentum-diffusivity-kinematic viscosity – viscous fluids – Newtonian and Non Newtonian fluids- Viscosity Measurements-Viscometers of different types and their applications-Texture measuring instruments-Hardness and brittleness of Food materials.

Unit III - THERMAL PROPERTIES OF FOODS: Definitions of Heat capacity, specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient, Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity, DTA, TGA, DSC.

Unit IV - AERODYNAMIC AND HYDRODYNAMIC PROPERTIES OF FOODS: Drag and lift coefficient, terminal velocity and their application in the handling and separation of food materials. Water activity- measurement-vapor pressure method –freezing point depression method- Effect of temperature, and pressure on water activity-moisture sorption isotherms- models-Henderson, PET and GAB models.

Unit V - ELECTRICAL PROPERTIES OF FOODS: Dielectric properties-dielectric constants-, Dielectric measurements-Ionic Interaction-Dipolar rotation. Effect of moisture, temperature and pressure on dielectric properties. Microwave heating-Infrared and Ohmic heating, Irradiation

Text Books

1. Serpil Sahin and Servet Gulum Sumnu “Physical Properties of Foods”, Springer,USA, 2006.
2. Nuri N. Mohsenin: “Thermal Properties of Food & Agricultural materials”, Gordon and Reach science publishers, 1970.

Reference Books

1. Rao, M.A and S.S.H. Rizvi:”Engineering Properties of Foods”, MerceL Dekker inc. New York, 1998.
2. Lewis M.J, “Physical properties of foods and food processing systems” Woodhead publishing Cambridge, UK, 1990.
3. ReyonD Jewitt and others: “Physical properties of foods “Allied science publishers, 1983.
4. Shafiur Rehman: Food Properties Hand book CRC press inc. New York, 1995.
5. Micha Peleg and Edward B. Bagley, “Physical Properties of Foods” AVI publishing company inc, Westport USA, 1983.
6. Kachru R.P.and R.K. Gupta, “Physico – Chemical Constituents and Engineering Properties of Food crops”, Scientific publishers, Jodhpur.

17FP2025 ENGINEERING PROPERTIES OF FOOD MATERIALS LAB

Credits : 0:0:2

List of Experiments

1. Determination of viscosity of liquid food materials
2. Determination of surface area of grains by using planimeter.
3. Determination of porosity of food grains.
4. Determination of specific gravity, specific volume and density of foods.
5. Determination of friction.
6. Determination of sphericity, roundness of food grains.
7. Measurement of terminal velocity of food particles.
8. Measurement of angle of repose
9. Determination of hardness of grains.
10. Estimation of moisture content of food grains, fruits and vegetables.
11. Calculation of specific heat of food materials.
12. Calculation of thermal conductivity of food materials.
13. Determination of rehydration characteristics of dried foods.

17FP2026 FOOD ENGINEERING AND PACKAGING LAB

Credits : 0:0:2

List of Experiments

1. Characterization of Dehydrated Products- Extruded Products
2. Characterization of Dehydrated Products-Extruded Ready-To-Cook and flaked Products.
3. Determination of Particle Size-Sieve Analysis
4. Determination of The Overall Heat Transfer Coefficient Of Plate Heat Exchanger – Co-Current Flow
5. Determination of The Overall Heat Transfer Coefficient Of Plate Heat Exchanger - Counter Current Flow
6. Determination of efficiency of a distillation column
7. Kinetics of Anthocyanin extraction
8. Kinetics of Anthocyanin degradation
9. Determination of viscosity by Ostwald’s viscometer
10. Determination of the migration characteristics of the given material – acid as stimulant
11. Determination of the migration characteristics of the given material – alcohol as stimulant
12. Determination of the Water Vapour Transmission rate of the given packaging material.

17FP2027 FOOD PROCESS EQUIPMENT DESIGN

Credits: 3:0:0

Course Objectives

- To enable the student to design and develop equipments used in Food Processing operations.
- Identify and discuss critical design of typical processing equipment.
- Understand the relationship between process design and Safety

Course Outcomes

- To identify the factors that will affect the design of equipments
- To classify the variables based on various properties
- To interpret the relation between various process variables
- To select the critical variables for the design of equipments
- To develop a conceptual design model
- To assess the validity of the conceptual model

Unit I - BASIC DESIGN CONSIDERATIONS AND MATERIALS OF CONSTRUCTION : Basic considerations in process equipment design. Materials of construction – mechanical properties and materials. Design considerations - stresses created due to static and dynamic loads. Process flow diagrams (PFD) – symbols used in PFD.

Unit II - DESIGN OF PRESSURE VESSELS : Design conditions and stresses – design stress, design criteria, corrosion allowance. Design of a shell and its components – cylindrical and spherical shells, head, nozzles and flange thickness. Vessels subjected to internal pressure and combined loading – cylindrical shell and spherical shell, stresses induced in vessel. Vessels subjected to external pressure. Optimum proportions of a vessel and optimum vessel size.

Unit III - DESIGN OF STORAGE VESSELS AND REACTION VESSELS : Storage of fluids – storage of volatile, non-volatile liquids and storage of gases. Design of rectangular tanks – with and without stiffeners. Design of tanks – bottom and shell design and self-supporting roof design. Classification of reaction vessels, heating system. Design considerations – jacket design, coil and channel design.

Unit IV - DESIGN OF HEAT EXCHANGERS AND EVAPORATORS : Types of heat exchangers – double pipe heat exchangers, shell and tube heat exchangers, and special types of heat exchangers. Design of shell and tube heat exchanger. Design of calendria type evaporators.

Unit V - DESIGN OF DRYERS AND MIXERS : Types of agitators. Power requirements for agitation. Design of agitation system components – shaft design and agitator design. Design of tray dryers.

Text Books

1. Shrikant D Dawande. “Process design of equipments”. Central Techno Publications, ISBN: 81-89178-14-8, Nagpur, 2005.
2. Mahajani V.V and Umarji S.B. “Joshi’s process equipment design”. Trinity Press. ISBN: 978-93-5138-091-1, New Delhi, 2014.

Reference Books

1. Singh & Heldman.”Introduction to Food Engineering”. Academic Press – Elsevier India Private Ltd. ISBN: 978-0-1240-1675-0 New Delhi, 2013
2. Jasim Ahmed, Mohammad Shafuir Rahman “Handbook of Food Process Design, 2 volume Set” Wiley-Blackwell, ISBN: 978-1-4443-3011-3, April 2012.
3. Rajesh Mehta and J. George “Food Safety Regulation Concerns and Trade- The Developing Country Perspective,” Published by Macmillan India Ltd., New Delhi. 2005
4. Miguel A. Galan, Eva Martin del Valle. “Chemical Engineering: Trends and Developments” John Wiley & Sons, ISBN: 978-0-470-02498-0, 2005.
5. Maroulis Z.B. and Saravacos G.D. “Food Process Design”, Marcel Dekker Inc. ISBN- 0824743113, 2003.

17FP2028 FOOD ANALYSIS LAB - II

Credits : 0:0:2

Course Objective:

- To determine the quality of Food commodities
- To interpret the genuineness of the products based on the quality

Course Outcome:

- The students will have a knowledge of the quality parameters of different types of food products
- The students will be able to classify food products based on their quality
- The students would be able to interpret results and decide on the quality

- The students would be able to compare two brands of the same product and decide the best one based on the quality
- The students will be able to evaluate newer products based on quality
- The students will be able to design and develop newer and better methods of analysis for improving the quality of a Food Product

List of Experiments:

Sugar rich products like Jams, Squashes, Marmalades, Sugar and Jaggery

1. Analysis of total sugars
2. Determination of pectin
3. Determination of acidity
4. Determination of total fruit solids
5. Determination of Calcium
6. Estimation of Ascorbic acid

Bakery Products including wheat

7. Determination of gluten content
8. Determination of alcoholic acidity
9. Determination of maltose equivalent
10. Estimation of total nitrogen content by Kjeldahl method

Meat and meat products

11. Determination of Extract release volume
12. Determination of swelling ratio
13. Determination of TMA

Milk and Milk products

14. Determination of Fat content by Gerber method
15. Determination of lactose content by Lactometer

Plantation Products including Tea, Coffee and Cocoa

16. Determination of Total extractives
17. Determination of Tannin content
18. Determination of Caffeine

Vitamins, Minerals and Colourants

19. Estimation of anthocyanins
20. Estimation of Chlorophyll
21. Determination of Iron

17FP2029 COMPUTER AIDED FOOD PROCESS EQUIPMENT DESIGN LAB

Credits : 0:0:2

Course Objectives

- Design of plants using computing software.
- Simulating process environment virtually.
- Understanding relational database and design specific unit operations.

Course Outcomes:

- Provide the student with a good understanding of computer aided design principles and practice.
- Learn effective approaches to building up knowledge about a process through simulation.
- Acquire the skills needed to design a chemical plant using ANSYS FLUENT.

List of Experiments:

1. Basic concept of simulation and CFD
2. Introduction to GAMBIT
3. Introduction to FLUENT
4. Heat transfer through laminar flow
5. Heat transfer through Turbulent flow.
6. Simulation of flow past sphere.
7. 2 dimensional heat flow analysis
8. 3 Dimensional heat flow analysis
9. Conjugate heat transfer study
10. Heat transfer through fluid.

17FP2030 FOOD ADDITIVES

Credits: 3:0:0

Course Objectives:

- To understand the Chemistry of the additives added to food
- To know the limits of addition as prescribed by FAO/WHO and PFA
- To develop newer additives with improved safety standards.

Course Outcomes:

- To know about importance of additives in maintaining or improving food quality.
- To learn about the development of various instant premixes by addition of preservatives within the permissible limits.
- To understand the applications of food additives and how to study the toxicity of food additives.
- To study the importance of additives in maintaining or improving food quality.
- To identify and design newer products, with better quality using additives which are economical and safe.
- To describe the properties, levels of addition and toxicity data of various food additives.

Unit I - INTRODUCTION : Food additives - definition and classification, food safety levels as per the specifications, safety evaluation of additives – determination of acute and chronic toxicity - NOEL, ADI, LD50 value, PFA regulations, GRAS status.

Unit II - ACIDULANTS:Types, chemical properties, levels of additions in individual products, toxicity data of Acidulants – Preservatives – Emulsifiers and gums - Antioxidants

Unit III - HUMECTANTS:Types, chemical properties, levels of additions in individual products, toxicity data of Dough conditioners - flour improvers – Humectants

Unit IV - FAT SUBSTITUTES AND REPLACERS: Types, chemical properties, levels of additions in individual products, toxicity data of Colourants – Natural and artificial, Flavourants, Flavour enhancers, Fat substitutes and replacers

Unit V - NUTRITIONAL ADDITIVES:Types, chemical properties, levels of additions in individual products, toxicity data of Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives

Text book

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.

Reference Book

1. Newton, D.E. Food Chemistry. An Imprint of Infobase Publications, New York. 2007.

17FP2031 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To study about the various methods of processing tea products.
- To demonstrate a basic knowledge on process of coffee, and cocoa.
- To develop an awareness of various processing procedure for major spices & minor spices.

Course Outcomes:

- To define the different unit operations and its equipments involved in coffee, tea and cocoa processing
- To gain knowledge in processing of plantation crops and spices and also its value added products.
- To outline ways in which quality loss can be minimised during preparation and processing
- To develop value added products from plantation products and spices
- To demonstrate appropriate technique for the extraction of spice oil and oleoresin with quality standards
- To acquire a confident to get placement in any kind of cereals and spices industry with minimum post harvest losses and maximum benefit to the industry.

Unit I - CHEMISTRY AND TECHNOLOGY OF COFFEE : Coffee – Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the manufacture of coffee powder – Instant coffee, technology – Chicory chemistry - Quality grading of coffee.

Unit II - CHEMISTRY AND TECHNOLOGY OF TEA : Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process – Green tea manufacture – Instant tea manufacture – Grading of tea.

Unit III - CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS : Occurrence – Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa

bean – cocoa powder – cocoa liquor manufacture Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates.

Unit IV - CHEMISTRY AND TECHNOLOGY OF MAJOR SPICES : Pepper, Cardamom, ginger, Chilli, mint, and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Enzymatic synthesis of flavor identicals - Quality control of major spices.

Unit V - CHEMISTRY AND TECHNOLOGY OF MINOR SPICES : Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove Vanilla, Coconut, Areca nut, Oil palm and Cashew - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Quality control of minor spices

Text Books

1. Peter, K.V. Hand book of herbs and spices. Volume 2. Wood head publishing Ltd., 2004. eBook ISBN: 9780857095688
2. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V., Ramaswamy, H.S. Handbook of post harvest technology – cereals, fruits, vegetables, tea and spices. Marcel Dekker Inc., New York (Special Indian Reprint). 2010. ISBN 13: [9780824705145](#)

Reference Books

1. Tainter, D.R. Grenis, A.T. Spices and Seasonings – A food technology hand book. 2nd edition. John Wiley and Sons, Inc., Canada. 2001. ISBN: 978-0-471-35575-5
2. Salunkhe, D.K. and Kadam S.S. Ed. 1998. Hand book of Vegetable Science and Technology, Marcel Dekker, New York, USA. ISBN: 0824701054
3. Minifie Bernard W. Chocolate, Cocoa and Confectionery Technology, 3rd Edition, Aspen Publication, 1999. ISBN: 9780834213012
4. Handbook on Spices, National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi 2004. ISBN: 8178330946
5. Banerjee B. 2002. Tea Production and Processing – 3rd edition, Oxford & IBH Publishing Co.Pvt.Ltd., New Delhi.

17FP2032 FAT AND OIL PROCESSING TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To understand the physical and chemical properties of fats and oils.
- To study the extraction and refining processes of various oils and fats.
- To learn the packaging, quality standards of fats and oils.

Course Outcomes:

- To enumerate the importance of fats and oils.
- To describe the manufacturing process of oils and fats.
- To apply knowledge on manufacture of designer fats.
- To appraise the quality attributes of oils and fats.
- To design suitable packaging materials.
- To invent methods for industrial applications of oils and fats.

Unit I - PHYSICAL AND CHEMICAL PROPERTIES : Fats and oils – formation – functions of oil in human body - fatty acids – double bonds and their position in oil – Geneva type classification - sources of vegetable oils – production status-oil content – coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil – physical and chemical properties of fats and oils - chemical reactions of oil – hydrolysis – hydrogenation, oxidation and polymerization.

Unit II - EXTRACTION METHODS : Oil extraction methods –mechanical expression – ghani , power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance-solvent extraction process – steps involved, batch and continuous-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils – palm oil, virgin coconut oil – extraction process.

Unit III - REFINING OF OILS : Refining of oils – objectives – characterization - degumming – Zeneath process – deacidification process – continuous acid refining-bleaching of oil – continuous bleaching process – decolourising agents-deodorization process winterization processes-hydrogenation of oil –selectivity – catalyst – batch type hydrogenation – regeneration of catalyst-vanaspati, ghee and margarine – production process-partial sterilization, emulsification, chilling, kneading and rolling, incorporation of salt, colouring substances-production of special fats – butter – types - production and storage.

Unit IV - PACKAGING OF EDIBLE OILS : Packaging of edible oils – requirements – types – timplate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches – packaging for Vanaspati and ghee 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.

Unit V - INDUSTRIAL APPLICATIONS AND QUALITY STANDARDS : Industrial applications of fats and oils – quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards – site selection for oil extraction plant- safety aspects- HACCP standards in oil industries.

Text books

1. Harry Lawson, “Food oils and Fats - Technology, Utilization and Nutrition”, CBS Publishers and Distributors, New Delhi, 1997.
2. Gunstone F.D., “Oils and Fats in Food Industry”, Blackwell Publishing, United Kingdom, ISBN – 13: 9781405171212, 2008.

Reference book

1. Gunstone F.D., “Vegetable Oils in Food Technology: Composition, Properties and Uses”, 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681, 2011.

17FP2033 TECHNOLOGY OF MEAT, POULTRY AND FISH

Credits: 3:0:0

Course Objectives:

- To understand about the composition and nutritive value of meat, poultry and fish
- To know about processing technology of meat, poultry and fish
- To understand the HACCP and GMP of meat plant.

Course Outcomes:

- To enumerate the composition and role of microorganisms in meat.
- To understand the slaughtering, carcass processing methods and equipments used for processing meat.
- To apply the technological ideas in preparation of various types of meat products and design of equipments used for processing meat.
- To understand the HACCP and GMP of meat processing
- To evaluate the processing of poultry meat, meat products and egg products.
- To predict the role of microorganisms in spoilage, biochemistry, preservation and fishery products

Unit I - CHEMISTRY AND MICROBIOLOGY OF MEAT: Meat composition from different sources; Definitions and measurements, Explanation of muscle structure and compositions and its modifiers, White and Red Meat, Description of animal fat and its modifiers, description of bone and its modifiers; Post mortem muscle chemistry, Meat colour, flavors of meat products, meat microbiology and safety.

Unit II - SLAUGHTERING AND CARCASS PROCESSING: Modern abattoirs and some features, Ante mortem handling and welfare of animals, design of handling facilities, Hoisting rail and traveling pulley system, and stunning methods, stunning pen, slaughtering equipment, Washing area, Sticking, bleeding, dressing, Beef/Sheep and Pig Dressing operations, Offal handling and inspection, Inedible by products: Carcass processing equipment, Operational factors affecting meat quality, effects of processing on meat tenderization; meat processing equipment, electrical gadgets and manual gadgets; Typical lay outs.

Unit III - MEAT PRODUCTS: Canned meat, Frozen meat, Cooked and Refrigerated meat, Dried and preserved meat, Cured meat, Prepared meat products, Production methods for Intermediate moisture and dried meat products, Different kinds of sausages – Equipment used for all the process operations; Meat plant hygiene, Good manufacturing practice and HACCP.

Unit IV - PROCESSING OF POULTRY PRODUCTS: Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Plant sanitation; Poultry meat processing operations in detail along with equipment used – Defeathering, bleeding, Scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

Unit V - FISH AND OTHER MARINE PRODUCTS PROCESSING: Commercially important marine products from India, Basic biochemistry, spoilage factors of fish, field refrigeration and icing practice, merits and demerits, Use of dry ice and liquid nitrogen as preservation elements, use of Refrigerated Sea Water (RSW) for preservation, Changes during storage in RSW and CSW; Freeze preservation; freezing of prawn and shrimp, weighing, filling and glazing, Individual quick freezing - relative merits and demerits, Canning operations, Salting and drying of fish, pickling and preparation of fish protein concentrate and fish oil.

Text Book

1. Hui, Y.H., Nip, W.K., Rogers, R.W., “Meat Science and Applications”. Marcel Dekkar Inc. New York, 2001.

Reference Books

1. Joseph Kerry, John Kerry and David Ledwood, “Meat Processing”, Woodhead Publishing Limited, CRC Press, 2002.
2. Balachandran, K.K, “Post Harvest Technology of Fish and Fish Products”, Daya Publishing House, New Delhi, 2001.

3. Mead G, "Poultry meat processing and quality", Woodhead Publishing Limited, 2004.

17FP2034 DRYING TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To understand the basic theory of drying and its significance in food systems
- To understand the importance of drying as a method of food processing
- To learn about the relative advantages / disadvantages of each method of drying

Course Outcomes:

- To gain knowledge on drying principles and psychrometric chart
- To apply the principles to solve problem on drying
- To understand different types of dryers for different food materials
- To design dryers for different types of foods
- To assess the concept behind industrial dryers
- To evaluate the dryer performance

Unit I - THEORY OF DRYING: Principles of drying – Fundamentals of air-water mixtures – Psychrometric chart – Problems based on psychrometry – Drying curves – constant and falling rate period - Heat and mass transfer in dryers – moisture content in foods – determination of moisture content and its measurement - methods of determination - Equilibrium moisture content – methods of determination – EMC models

Unit II - DRYING METHODS : Selection of dryers – design of dryers - Conduction drying – convection drying – Pneumatic or fluidized bed drying – natural air drying – heated air drying – recirculatory dryer (non mixing type) – LSU dryer (continuous mixing type) – Baffle dryer - Radiation drying – Sun drying and infrared drying – Dielectric drying – chemical drying -Thin layer and deep bed drying - dryer performance

Unit III - DRUM DRYER, FOAM MAT DRYER AND FREEZE DRYER : Drum driers - Types of Drum Dryers - Principles of Operation of the Drum Dryer – rotary dryers Cabinet drying – vacuum tray dryers - Foam Mat Drying- Principles- Equipments- Factors affecting Foam mat drying – Freeze dryers - Fundamentals of freeze drying – Freezing – Primary drying stage – secondary drying stage -Changes during freeze drying – Condensation, defrosting – Industrial freeze driers.

Unit IV - FLUIDIZED BED DRYER, SPRAY DRYER, OSMOTIC DRYING : Fluidized bed dryer – Spouted bed dryer - spray drying of foods - Principles of Spray Drying Processes – Atomizers and nozzles - Reconstitution of powders – Foam spray drying - Osmotic dehydration – Principles – Factors affecting osmosis- Equipment used.

Unit V - RADIATION AND DIELECTRIC DRYERS : Infrared drying – principles - microwave drying of foods – dielectric concepts – construction and working – Radio Frequency drying – principles – working - Flash Dryers - Design of Flash Dryers - Materials Dried in Flash Dryers.

Text Books

1. Arun S. Mujumdar, "Handbook of Industrial Drying", CHIPS, 3rd Edition, 2006.
2. Chakraverty. A. " Post Harvest Technology of Cereals, Pulses and Oil seeds", Oxford and IBH Publishing Co.Pvt. Ltd. New Delhi, 2014.

Reference Books

1. Paul Singh, R and Dennis R. Heldman.. Introduction to Food Engineering Academic Press, 2001
2. Hui Y. H.,"Food Drying Science and Technology, Microbiology, Chemistry, Application", CHIPS, 2008.
3. Loesecke,H. W. V, "Drying & Dehydration of Foods", Published by Agrobios, 2005.

17FP2035 FOOD PACKAGING TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To study about the functions of packaging along with the influence of various factors on food.
- To know about the different packaging materials, their manufacturing process and equipment.
- To study about the various methods of packaging to improve the shelf life of the products.

Course Outcomes:

- To understand the need and functions of packaging as a solution to various factors affecting food.
- To gain knowledge on shelf life of food and various methods of estimating it.
- To explain the different packaging materials, their manufacturing process and equipment involved.
- To know about the various closures and sealing mechanisms for different packaging materials.
- To select the different printing and labelling methods and legislative requirements.
- To devise innovations in food packaging and their applications.

Unit I - INTRODUCTION TO FOOD PACKAGING: Functions of packaging, Effect of environmental factors - light, Oxygen, Moisture, Temperature, mechanical forces and biological factors on quality of food. Estimation of shelf life. General Approach, analysis of storage requirement, accelerated storage studies: Vacuum and Inert Gas Packaging: Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.

Unit II - METAL CANS AS PACKAGING: Metallic can types - Tin cans and Aluminum cans. Specialty of Open top sanitary cans, Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Basics of Canning operations – Can Reformer, Flanger, Seaming, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles.

Unit III - FLEXIBLE FILMS PACKAGING: Formation of Films and pouches, Plastics used and their Specific applications - Polyethylene (LDPE and HDPE), Cellulose, Polypropylene (PP), Polyesters, Polyvinylidene Chloride (PVDC - Diofan, Ixan and Saran), Polyvinyl chloride, Copolymers their applications. Co-extruded films and Laminates. Rigid and Semi rigid plastic packaging – fabrication methods – Thermo forming, Blow moulding, Injection moulding, Extrusion – Retort pouch packaging. Laminated Paper board Cartons, Fibre Board and Corrugated Card Board packaging and their applications.

Unit IV - FILLING AND SEALING OPERATIONS FOR VARIOUS TYPES OF PACKAGES: Closing and sealing of Rigid plastic containers. Filling and sealing of Flexible plastic containers, Seal types-Bead seals, Lap Seals and Fin seals –Differences and advantages, Hot wire sealing, hot bar sealing and impulse sealing – differences and relative advantages, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements. Filling and Sealing of pouches, pouch from fill seal machines.

Unit V - INNOVATIONS IN FOOD PACKAGING: Aseptic Packaging. Active packaging, Moisture control, CO₂ and Oxygen scavenging. Modified atmosphere packaging – principles, applications. Permeability of gases in packs. Antimicrobial Packaging, Edible packaging films and coating. Packaging for non-thermal food processing. Intelligent Packaging – Time-temperature indicators, RFID, Tamper evident packaging.

Text Book

1. Coles, R., Dowell, D.M., Kirwan, J, Food Packaging Technology, Black Well Publishing Ltd., 2009

Reference Books

1. Gordon L. Robertson. Food Packaging Principles & Practice, CRC Press, 2013.
2. Kit L Yam and Dong Sun Lee, Emerging Food Packaging Technologies: Principles and Practice, Woodhead Publishing Ltd, 2012.
3. Jung H. Han, Innovations in Food Packaging, Academic Press, 2014.
4. Scott A. Morris, Food and package engineering, Wiley-Blackwell Publishing, 2011.
5. Takashi Kadoya, Food Packaging, Academic Press, Inc, 1990.

17FP2036 STORAGE ENGINEERING

Credits : 3:0:0

Course Objectives :

- To enable the student to understand: The need for effective and scientific storage of food commodities.
- To provide an opportunity for students to develop skills in evaluating storage structures and also to design structures for various perishable commodities.

Course Outcomes :

- To recognize the need for adaptation of scientific storage methodologies for food commodities.
- To distinguish between traditional storage structures and modern storage structures.
- To design and construct modified storage structure based on the requirement on the farm.
- To calculate the amount of CO₂ & O₂ that can be permissible in systems that require a manipulation of the storage structures in terms of atmospheric conditions.
- To criticize, evaluate and judge the efficiency of commercial storage structures.
- To modify structures and environments to better fit the needs of commodities and consumer alike.

Unit I - PHYSICO - CHEMICAL AND THERMAL PROPERTIES OF GRAINS: Grain dimensions, bulk density, true density, porosity, coefficient of friction, angle of repose, thermal conductivity and aerodynamic properties. Psychrometry: humidity, % relative humidity, humid heat, deterioration index, wet bulb temperature, use of psychrometric charts.

Unit II - INSECTS AND PESTS: Types, extent of losses during storage, causes and control measures, Insecticides- principles, scope of application in warehouses; requirements, group of active ingredients, choice, toxicity, resistance, application techniques, Fumigants - chemicals, areas of application, choice, toxicity, application rates, exposure time and resistance. Rodenticides - Types and effectiveness and limitations, important moulds and bacteria involved in spoilage of grains; effect on physico- chemical and sensory quality of grains; mycotoxins.

Unit III - GRAIN STORAGE STRUCTURES: Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations - pressure distribution in storage bins.

Unit IV - GRAIN STORAGE THEORY: Principles, moisture movement during bulk storage of grains, methods of aeration, various theories, Physical, chemical, microbiological and sensory changes occurring during storage.

Unit V - CONTROLLED ATMOSPHERE STORAGE: Air tight, controlled atmosphere and modified atmospheric storage; differences, principles, optimization of storage gas composition, rate of supply, control systems for oxygen and carbon dioxide- their effect on microbes and limitations.

Text Book

1. Sahay K.M and K.K.Singh. "Unit Operations of Agricultural Processing" Vikas Publications, New Delhi, ISBN-81-259-1142-1, 2007.

Reference Book

1. Shejbal, J. (ed) 1980. Controlled atmosphere storage of grains. Elsevier Scientific Publishing Co. London

17FP2037 PROCESS ECONOMICS AND PLANT LAYOUT DESIGN

Credits: 3:0:0

Course Objectives :

- To enable the students understand various concepts of economics of food plant.
- To understand the processes involved in layout design.
- To understand the development and design consideration and cost estimation in food industry.

Course Outcomes :

- To gain knowledge on the various factors involved in setting up a Food Processing Industry.
- To understand the process of food plant layout design.
- To apply their knowledge to design projects for setting up a Food Processing Industry.
- To analyse the problems involved in deciding the level of manufacture of a food product
- To evaluate the options involved and decide on the right choice based on the economics of the system
- To develop own industry or plan turn-key projects based on the request from customers

Unit I - FOOD PROCESS DESIGN DEVELOPMENT: Technical feasibility survey of Food Industry, process development, Food Process flow sheets – Hygienic food process design - equipment design and specifications – Computed-aided process design – Principles of spread-sheet aided process design (Basic concepts only)

Unit II - PLANT LAYOUT: Marketability of the product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, Government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Plant Layout based on process and product. Richard Muther's Simple Systematic Plant Layout.

Unit III - PROJECT EVALUATION AND COST ESTIMATION: Capital investments – fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investments. Methods of Cost estimation – Cost Indices.

Unit IV - PRODUCT COST AND PLANT OVERHEADS: Manufacturing costs – Direct production costs(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitability - Application to a Food Processing plant e.g. Tomato processing - Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc. Depreciation, Amortization and methods of determining the same. Introduction to Food Safety Management System.

Unit V - PROFITABILITY ANALYSIS: Return on original investment, interest rate of return, accounting for uncertainty and variations and future developments. Cash flow diagram and its importance - Optimization techniques – Linear and Dynamics programming, Optimization strategies.

Text Book

1. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, ISBN-007-124044-6, 2004 .

Reference Books

1. Rudd D F and Watson C C, Strategy of Process Engineering, John Wiley & Sons Inc, ISBN-978-0471744559, 2013
2. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113, 2003.
3. Towler G and Sinnott R.K. Chemical Engineering design principles, practice and Economics of Plant and Process. 2nd Edition. Elsevier, ISBN-9780080966595, 2012

- Rudd and Watson, Strategy of Process Engineering, Wiley and Sons, 1987
- Baasel W.D. Preliminary chemical engineering plant design, van Nostrand Reinhold, 2nd Edition, 1990
- Heldman D.R. and Lund D B. Hand Book of Food Engineering, 2nd edition, CRC Press, Taylor and Francis Group, 2007

17FP2038 NON THERMAL TECHNIQUES OF FOOD PRESERVATION

Credits: 3:0:0

Course Objectives:

- To impart understanding about different Emerging technology in Food Processing.
- To enable the students to apply the knowledge in real time Food Processing Innovations.
- To innovate new technologies or hurdle combinations for unexplored realms of food processing.

Course Outcomes:

- To know the emerging technologies applied to food processing
- To understand the relative advantages and disadvantages of emerging technologies over existing technologies
- To visualize the equipment used and process stages of emerging technologies
- To apply the non thermal technologies as alternative food processing methods
- To identify the potential of newer technologies for commercialization
- To develop strategies for applying the technologies to wide range of food

Unit I - HIGH PRESSURE PROCESSING OF FOODS: Principles – applications to food systems – effect on quality – textural, nutritional and Microbiological quality – factors affecting the quality – modelling of high pressure processes – High Pressure Freezing, Principles and Applications

Unit II - RADIATION PROCESSING OF FOODS : Principle, Types of radiation sources. Biological effects of irradiation, Irradiation of Foods–Gamma Irradiation, X-Ray Irradiation, UV Irradiation–Combined treatments. Applications and Limitations.

Unit III - OSMOTIC DEHYDRATION OF FOODS: Principle – Mechanism of osmotic dehydration – Effect of process parameters on mass transfer – Methods to increase the rate of mass transfer – Applications – Limitations of osmotic Dehydration – Management of osmotic solutions

Unit IV - OHMIC AND ULTRASOUND PROCESSING OF FOODS: Principle of ultrasound – Fundamentals – Ultrasound as a processing and preservation aid – Effect on properties of foods Basics of ohmic heating – Electrical conductivity - generic configurations- treatment of products

Unit V - PULSED LIGHT AND HURDLE TECHNOLOGY: Basics of hurdle technology – Mechanism Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived antimicrobials – Antimicrobial enzymes – bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle)

PULSED ELECTRIC FIELD PROCESSING OF FOODS: Principles – Mechanism of action – PEF treatment systems – Main processing parameters – PEF Technology – Equipments – Mechanism of microbial and enzyme inactivation- safety aspects– Processing of liquid foods using PEF – Process models – Comparison of High pressure processing and PEF – Enzymatic Inactivation by PEF, Examples – Microbiological and chemical safety of PEF foods

Text Book

- Da-wen Sun: Emerging Technologies for Food Processing, Elsevier Academic Press and Marcel Dekker Inc, 2014.

Reference Books

- Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food stability safety and quality, Kluwer Academics / Plenum Publishers, 2002.
- Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Novel Food Processing Technologies (Food Science and Technology Series), CRC Press, 2004.

17FP2039 FUNCTIONAL FOODS AND NUTRACEUTICALS

Credits: 3:0:0

Course Objectives:

- To understand the basics of nutraceuticals and functional foods
- To study the significance of nutraceuticals and their role in disease prevention
- To hypothesize the safety and efficacy of individual nutraceuticals and functional foods products,
- To emphasize regulatory issues that influences the development and commercialization of nutraceuticals and functional foods in global markets
- To identify new strategies for marketing of traditionally known nutraceuticals

Course Outcomes:

- To understand the meaning of functional foods and nutraceuticals.
- To recognize the structures of the major bioactive food constituents that are being incorporated into functional foods.
- To describe current state of the knowledge with regards to the application of functional foods for risk reduction of chronic diseases.
- To evaluate critically the methods for extraction and identification of nutraceutically significant molecules.
- To distinguish functional food products that are nutritionally logical, technically feasible, and that also are in compliance with FDA regulatory guidelines.
- To reorganize the issues related to development and commercialization of nutraceuticals and functional foods products.

Unit I - NUTRACEUTICALS-HISTORICAL, TECHNOLOGICAL ASPECTS AND CLASSIFICATIONS: 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 - Mechanism of action - chemical nature.

Unit II - FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS: 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 III - OMEGA-3 FATTY ACIDS AND CLA: 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 IV - LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS: 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 V - HERBS AS FUNCTIONAL FOODS, STABILITY, TESTING AND MARKETING ISSUES FOR NUTRACEUTICALS AND FUNCTIONAL FOODS: 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.

Text Books

1. Wildman, R.E.C. (2001) "Handbook of Nutraceuticals and Functional Foods", CRC Press LLC. ISBN-0849387345.
2. Schmidl, M.K. and T.P. Labuza. (2000). Essentials of Functional Foods. Aspen Publishers, inc., Gaithersburg, MD. ISBN 978-0-8342-1261-9

Reference Book

1. Tomris Altug. (2003). Introduction to Toxicology and Food. CRC Press, Boca Raton, FL. ISBN 9780849314568
2. Stanley T. Omaye . (2004). Food and Nutritional Toxicology CRC Press, Boca Raton, London. eBook ISBN: 978-0-203-48530-9
3. Ho, C.T. and Q.Y. Zheng. (2001). Quality Management of Nutraceuticals. ACS Symposium Series 803, ACS, Washington DC. eISBN: 9780841218840
4. M.A.Eskin, S. Tamir S. (2006) Dictionary of Nutraceuticals and Functional Foods. CRC Press. ISBN 0849315727

17FP2040 FOOD ADDITIVES LAB**Credits : 0:0:2****Course Objectives**

- To understand the Chemistry of the additives added to food
- To understand the importance of additives in maintaining or improving food quality To develop newer additives with improved safety standards.

Course Outcomes

- To know about the importance of additives in maintaining or improving food quality.

- To learn the chemistry of the additives added to a food.
- To express their knowledge on development of various instant premixes by addition of preservatives within the permissible limits.
- To understand the properties, levels of addition and toxicity data of various food additives.
- To demonstrate various applications of food additives and how to study the toxicity of food additives

List of Experiments

1. Estimation of Sulphur-Di-Oxide
2. Estimation of Sodium Benzoate
3. Estimation of Sorbic Acid
4. Estimation of Butylated hydroxyl toluene
5. Estimation of Propyl Gallate
6. Estimation of Ascorbic Acid
7. Estimation of Iron
8. Estimation of Copper
9. Determination of Saccharin
10. Estimation of curcumin in turmeric
11. Estimation of capsaicin
12. Estimation of iodine in Iodised salt
13. Estimation of salt in pickled products
14. Estimation of baking powder.

17FP2041 FOOD PRODUCT TECHNOLOGY LAB - II

Credits : 0:0:2

List of Experiments

1. Preparation of Rasagulla
2. Preparation of Sandesh
3. Preparation of Paneer
4. Preparation of Kalakhand
5. Preparation of Peda
6. Preparation of Gulab Jamun
7. Preparation of Bread and Butter Pickle
8. Preparation of Hot and Sour Tomato Pickle
9. Preparation of Chilly and Ginger Pickle
10. Preparation of Soanpadi
11. Preparation of Mysorepak
12. Preparation of Gummies
13. Preparation of aerated confectionery

17FP2042 PRINCIPLES OF FOOD SCIENCE AND NUTRITION

Credits: 3:0:0

Course objectives:

- To understand the fundamentals of bio molecules
- To impart basic knowledge on the methods of analysis of fats and oils
- To know the food additives and microbes associated with food

Course outcomes:

- To enumerate and describe the fundamentals of food constituents and quality analysis.
- To understand the types of food additives and their importance in food.
- To examine the role of microorganisms associated with food and their importance in fermentation
- To predict the role of food borne diseases and intoxication
- To enumerate the factors responsible for spoilage of various foods.
- To understand the methods of preservation of foods.

Unit I - FUNDAMENTALS OF FOOD CONSTITUENTS: Introduction to Proximate constituents of food - Carbohydrates – Classification – Simple & complex, mono-, di-, oligo- and polysaccharides; Important reaction of carbohydrates –Caramelisation, Maillard. Fats – classification – Analysis of Fats and oils – Saponification value, Iodine value, Acid value, Acetyl value, Peroxide value – Principles and Importance of the analytical methods, Vitamins – Fat and water-soluble – nutritional significance

Unit II - FOOD ADDITIVES: Introduction to food additives - Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

Unit III - MICROORGANISMS ASSOCIATED WITH FOOD: Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; Oriental fermented foods and, Production of Sauerkraut, Wine, Lactic acid and single cell protein.-examples and their applications

Unit IV - FOOD BORNE DISEASES AND INTOXICATION: food intoxications and poisonings – *Bacillus* spp., *Clostridium botulinum*, *Staphylococcus aureus*, Hepatitis, Gastroenteritis viruses, *Entamoeba histolytica*. Food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

Unit V - FOOD PRESERVATION: Principles involved in the use of sterilization, pasteurization and blanching, thermal death point - methods of determination of thermal death time (Graphical, mathematical) – D, Z and F values – Importance of 12 D concept, Time – Temperature indicators - Canning; frozen storage-freezing methods, factors affecting quality of frozen foods; irradiation preservation of foods.

Text Books

1. Coultate T.P “Food – The Chemistry of its Components”, 2nd Edition. Royal Society, London, 1992.
2. Sivasanker, B, “Food Processing and Preservation”, Prentice-Hall of India Pvt. Ltd. New Delhi, ISBN-9788120320864, 2002.

Reference Books

1. Frazier W.C. and D.C. Westhoff, “Food Microbiology”, 4th Ed., McGraw-Hill Book Co., New York, ISBN_9780070667181,2008.
2. Adams M.R and Moss M.O, “Food Microbiology”, Panima Publishing corporation, New Delhi, 2nd Edition, Third reprint, ISBN-13:9788122410143,978-8122410143, 2007.

17FP2043 PROCESSING OF FOOD COMMODITIES

Credits: 3:0:0

Course Objectives:

- To study various processing methods for various food materials like fruits & vegetables, dairy products, cereals, meat, poultry, fish and bakery products .
- To study various innovative food processing techniques.

Course Outcomes:

- To understand the basics of food processing.
- To know the various processing technologies involved in fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products.
- To learn the basics on microbiology of food products.
- To describe the process of manufacture of various food products.
- To recognize various methods of preservation of food.
- To express the possible arena of entrepreneurial activity related to food products.

Unit I - CEREAL, PULSES AND OIL SEEDS TECHNOLOGY: Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

Unit II - FRUITS AND VEGETABLE PROCESSING: Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

Unit III - DAIRY PROCESSING : Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardised, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenisers and pumps - Method of manufacture of dairy products - Icecream, Cheese, Paneer, Yoghurt - Pasteurisation and microorganisms involved in spoilage of milk.

Unit IV - MEAT, POULTRY AND FISH PROCESSING: Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing .

Unit V - PLANTATION PRODUCT TECHNOLOGY: Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

Text Books

1. Srivastava, R.P. and Kumar, S.: Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow (2nd Edition 1998).
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press, USA (2001)
3. James Harper W. and Carl W. Hall: Dairy Technology and Engineering AVI Publishing, Westport, USA (1976)

4. Karel Kulp and Joseph P Pante: Hand Book Of Cereal Science and Technology Marcel Dekkar USA (2000)
5. Samuel Matz: The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall (1992)

17FP2044 TECHNOLOGY OF PACKAGING

Credits: 3:0:0

Course Objectives:

- To provide knowledge on packaging and packaging materials.
- To understand the working of various packaging methods.
- To enable the students to understand applications of various packaging materials in food industry.

Course Outcomes:

- To understand food quality and need food packaging.
- To classify food packaging design strategies and framework.
- To explain the manufacturing process of various packaging materials.
- To select common methods of sealing of various food packaging materials.
- To apply the knowledge on advance food packaging methods and their applications in industry.
- To adapt the principle and need for testing of packaging materials.

Unit I - INTRODUCTION TO FOOD PACKAGING: Packaging developments—historical perspective. Food supply and the protective role of packaging. Definition of basic functions of packaging. Packaging strategy – Packaging design and development framework. Levels of Packaging. Food Package Environments. Factors affecting product quality and shelf life –Physical, Chemical and Biological processes.

Unit II - METAL AND GLASS FOOD PACKAGING MATERIALS: Metal cans - Raw materials for can-making. Container Making process – Three piece cans and Two piece cans – End-making processes. Protective and Decorative Coatings. Glass as Food Packaging Material – Types of Glasses and Composition – Glass Container Nomenclature – Glass and Container Manufacturing.

Unit III - PLASTIC AND PAPER FOOD PACKAGING MATERIALS: Plastics used in Food Packaging and their Specific applications – Polymers and Copolymers. Plastic Manufacturing - Extrusion and Calendaring. Extrusion – Monolayer – Cast and Blow film processes. Orientation of Films. Coextrusion. Coating and Lamination of Plastic Films. Rigid Plastic Packaging Manufacture. Paper Manufacturing Process. Types of Paper and applications. Laminated Paper board – Folding Cartons, Beverage Cartons and Molded Pulp Containers. Corrugated Fibre Board and Fibre Drum packaging.

Unit IV - FILLING AND SEALING OF VARIOUS TYPES OF PACKAGES: Closures for Glass and Plastic Containers. Sealing of Plastic Films. Heat Sealing and Types of Seal. Induction, Dielectric, and Ultrasonic sealing. Peelable Seals. Types of Pouch. Form fill Seal Equipment – Vertical and Horizontal.

Unit V - ADVANCED PACKAGING METHODS AND TESTING OF MATERIALS: Vacuum and Inert Gas Packaging. Retort pouch packaging. Active packaging and Modified atmosphere packaging – principles and applications. Aseptic Packaging – principles and applications. Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.

Text Book

1. Coles, R., Dowell, D.M., Kirwan, J, Food Packaging Technology, Black Well Publishing Ltd., 2009.

Reference Books

1. Gordon L. Robertson. Food Packaging Principles & Practice, CRC Press, 2013.
2. Scott A. Morris, Food and package engineering, Wiley-Blackwell Publishing, 2011.
3. Takashi Kadoya, Food Packaging, Academic Press, Inc, 1990.

17FP2045 NUTRITION AND FOOD SCIENCE

Credits: 3:0:0

Course Objectives:

- To learn the nutrients required for health, and their sources in diets.
- To learn how nutrients in foods affect and are affected by metabolic functions of the human body.
- To learn how variability among research results leads to consumer perceptions of changing or conflicting recommendations for dietary practices from the nutrition community.

Course Outcomes:

- To understand the basis in the area of nutritional assessment in health and disease
- To evaluate the biological functions of foods for health in addition to nutritional values
- To judge the potential for adverse events related to dietary supplements
- To identify which nutrients are sources of energy for the body and how an excess or a deficiency of energy can affect the body.
- To formulate nutrition therapy for chronic disease

- To compare the various types of nutrition research with respect to type and reliability of information produced.

Unit I - HUMAN NUTRITION : Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

Unit II - BIOMOLECULES : Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins,

Unit III - VITAMINS : Physiological role, bio-availability, requirements, sources and deficiency of Fat soluble Vitamins: Vitamin A, Vitamin D, E & K. *f* Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, Vitamin B6.

Unit IV - MINERALS : Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. *f* Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

Unit V - RECENT TRENDS IN NUTRITION : Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

Text Books

1. Gordon M. Wardlaw – 2004. Perspectives in Nutrition, 6th edition, WCB McGraw-Hill Publishers, Boston (ISBN 007-244212-3)
2. Shubhangini A. Joshi -1992. “Nutrition and Dietetics”Tata Mc Grow- Hill publishing Company Ltd, New Delhi.
3. Srilakshmi. B – 2016. “Nutrition Science”, 5th edition, New Age International (P) Ltd, Publishers, Chennai

Reference books

1. Ronald Ross Watson, Functional foods and Nutraceuticals in Cancer Prevention, Ed. Wiley – Blackwell, 2003. ISBN-13: 978-0813818542.
2. Nelson D.L., M.M. Cox, Lehninger Principles of Biochemistry, W.H. Freeman & Company Publications, 2013. ISBN-10: 1-4292-3414-8
3. Tymoczko, J.L., Berg, J.M., Stryer, L. Biochemistry – A short course, 3rd edition. W.H. Freeman. 2009. ISBN-10: 1-4641-2613-5
4. Sunetra Roday., “Food Science and Nutrition – 2nd edition, Oxford Higher Education/Oxford University Press, 2012, ISBN 10: 0198078862

LIST OF COURSES

Sl.No	Course Code	Name of the Course		Credits
1	15FP3001	Stability and Shelf Life Testing of Foods		3:0:0
2	15FP3002	Technology of Fresh Cut Fruits and Vegetables		3:0:0
3	16FP1001	Basics of Food Science and Technology		3:0:0
4	16FP2001	Food and Nutrition Security of GM Crops		3:0:0
5	16FP2002	Post Harvest Technology of Foods		3:0:0
6	16FP2003	Mechanization and Post Harvest Technology Lab		0:0:2
REVISED VERSION COURSES				
1	14FP3017	1.1	Food Industry Waste Management	3:0:0
2	14FP3024	1.1	Food Processing and Biotechnology	3:0:0
3	14FP3025	1.1	Advances in Processing of Horticultural Products	3:0:0

15FP3001 STABILITY AND SHELF LIFE TESTING OF FOODS

Credit: 3:0:0

Course Objectives:

- To enable the student to know the importance of sorption isotherms in stability of Food products.
- To provide knowledge on methods of shelf life testing of Food products
- To make the students acquire knowledge on effect of packaging materials on the shelf life of products

Course Outcomes:

- The students would be able to develop skills on determining the shelf life of new products
- The students would apply their knowledge in developing newer and cost-effective packaging materials for improved quality of processed products
- The students would be able to develop foods that are wholesome and safe

Factors affecting shelf life and spoilage – Physical, chemical and microbial – Methods used to predict microbial stability – Sorption isotherms - The glass transition approach – Temperature and food stability – Arrhenius model – the Q10 concept – Shelf life testing and indices – Modelling shelf life – Predictive models and their application to certain foods – Software systems – Sensory evaluation methods of shelf life testing - Accelerated shelf life testing – Predicting packaging characteristics for shelf life improvement – Practical application of shelf life testing of fruits and vegetables, dry mixes, high fat foods, dairy and confectionery products.

Text books

1. Kilcast D and P Subramaniam. The Stability And Shelf-Life Of Food. Woodhead Publishing Ltd. 2000. ISBN 1 85573 500 8.
2. Kilcast D and P Subramaniam. Food and Beverage Stability and Shelf Life. Woodhead Publishing Ltd. 2011. ISBN-13: 978-1845697013
3. R. Steele. Understanding and Measuring the Shelf-life of Food. Woodhead Publishing Ltd. 2004. ISBN 1 85573 732 9.

15FP3002 TECHNOLOGY OF FRESH CUT FRUITS AND VEGETABLES

Credit: 3:0:0

Course Objectives:

- To enable the student to know about importance of fresh cut fruits and vegetables.
- To provide knowledge on processing & preservation techniques of the same
- To make the students acquire knowledge on fruit and vegetable processing

Course Outcomes:

- The students would be able to develop skills on cut fruits and vegetables preservation techniques.
- The students would apply their knowledge in developing newer and cost-effective strategies of fruit and vegetable preservation
- The students would be able to develop foods that are wholesome and safe

Course Description:

Fresh-cut Produce: Tracks and Trends – Regulatory issues - Quality Parameters – Safety aspects – Physiology of fresh cut produce – Enzymatic effects of flavor and texture – Microbiology of fresh cut produce – Microbial enzymes associated with fresh cut produce – Preservative treatments – Packaging and Modified atmosphere packaging of fresh cut produce – Flavour and aroma of fresh cut produce – Sensory quality evaluation of fresh cut produce

Reference Books

1. Olusola Laminkanra. Fresh-Cut Fruits And Vegetables – Science, Technology and Market. CRC Press LLC, 2002. ISBN 1-58716-030-7.
2. Robert Soliva – Fortuny, Advances in Fresh-cut Fruits and Vegetables Processing. CRC Press, 2010. ISBN 978 – 1 – 4200 – 7121 – 4.
3. Brody A L, Zhuang, H, Han, J H. Modified Atmosphere Packaging for Fresh-Cut Fruits and Vegetables. Blackwell Publishing Ltd. 2011. ISBN 978-0-8138-1274-8

16FP1001 BASICS OF FOOD SCIENCE AND TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To understand about nutrition and its importance
- To impart knowledge of Food Safety and its scope in quality control of foods
- To study the basic knowledge about food processing and preservation techniques

Course Outcomes:

- To get exposure about nutrition and nutritive value of different food sources
- To develop skills to identify and examine the food- borne microorganisms
- Apply knowledge about various processing methods in Food Industries

Description:

Basic constituents of foods, Carbohydrates, Fats, Proteins, Vitamins, aminoacids, Sugars – simple, complex, Practical importance of sugars, Complex sugars (starch, cellulose), Maillard reaction, Frying, Vitamins and minerals importance. Calculation of BMR,PER,NPU - Basics of ADI, RDA, RDI - **Nutritional disorders** - Effect of processing on nutrients - **Role of microorganism** in food processing and preservation - Role of microorganism in food spoilage - Food borne illness and intoxication - Food quality analysis - Role of microorganism in health promotion – Blanching – Pasteurization & Sterilization – Canning – Drying - Retort Pouching - Refrigeration and Freezing - Hurdle Technology - Minimal Processing - Cut Fruits and vegetables - Irradiation - Emerging / Novel non-thermal technologies

Reference Books

1. Potter, Norman N., Hotchkiss, Joseph H. (1995), Food Science, Fifth Edition, ISBN 978-1-4615-4985-7
2. William C. Frazier and Dennis C. Westhoff, "Food Microbiology" Tata Mcgraw – Hill Ltd., New Delhi, Fourth Edition, ISBN – 9780070667181.
3. P. Fellows, (2000) Food Processing Technology: Principles and Practice. Wood Head Publishing Limited, Cambridge, England.
4. Srilakshmi, B. (2003), Food Science, Fifth Edition, New Age International (P) Publishers Ltd., Chennai, ISBN 13: 9788122427240

16FP2001 FOOD AND NUTRITION SECURITY OF GM CROPS

Credits: 3:0:0

Course Objectives:

- To provide foundation in Food safety regulations
- To create awareness on the importance of GM crops
- To develop basic knowledge on techniques in nutrition security of GM crops.

Course Outcomes:

- The student would acquire knowledge on International food safety regulations.
- The student acquires knowledge in current research achievements in the field of nutritional safety of GM crops

Description:

International aspects of the quality and safety of Foods derived from modern Biotechnology, Application of ELISA for detection of Toxins in food, Biosensors for food quality Assessment, Malnutrition, consequences, causes, prevention and control. Applied community nutrition. Food safety and food faddism. safety testing for toxicity, allergenicity, anti nutritional effects. Native toxins and toxins produce during storage, health hazards.

References Books

1. Matin Qaim, *Genetically Modified Crops and Agricultural Development*, Palgrave Macmillan US, 2016.
2. Watson and Preedy, *Genetically Modified Organisms in Food: Production, Safety, Regulation and Public Health*, Academic Press, 2015.
3. Roland Norer. *Genetic Technology and Food Safety*, International Congress of Comparative Law, Springer, 2016.
4. Tutelyan, Victor. *Genetically Modified Food Sources Safety Assessment and Control*. Amsterdam: Elsevier/Academic Press, 2013.
5. Carter, Colin Andre, Giancarlo Moschini, and Ian M. Sheldon. *Genetically Modified Food and Global Welfare*. Bingley, UK: Emerald, 2011.
6. Lawrence, Geoffrey, Kristen Lyons, and Tabatha Wallington. *Food Security, Nutrition and Sustainability*. Sterling, VA: EARTHSCAN, 2010.
7. Stahl, Ulf, Ute E. B. Donalies, Elke Nevoigt, and D. B. Archer. *Food Biotechnology*. Berlin: Springer, 2008.
8. Bielecki, Stanisław, J. Tramper, and Jacek Polak. *Food Biotechnology*. Amsterdam: Elsevier, 2000.
9. Ti rre - pe , sta o F., and sta o . Barbosa- no as. *Food Science and Food Biotechnology*. Boca Raton, Fla: CRC Press, 2003.

16FP2002 POST-HARVEST TECHNOLOGY OF FOODS

Credits: 3:0:0

Course Objectives:

- To study the principles of Post-Harvest technology
- To provide knowledge on food processing techniques

Course Outcomes:

- The student get knowledge on Post-Harvest techniques of food crops
- The student become aware on research in post harvest crop management

Description:

Classification, chemical composition and nutritional values of food grains (cereals including millets, legumes and pulses). Anti-nutritional factors in food-methods for their removal- aflatoxins and their removal. Contamination, processing and preservation of food products: bakery, fruits and vegetables, meat, fish and poultry, dairy. Thermal and Non-thermal methods of food preservation: Principles and applications-Canning, evaporation, drying, freezing, irradiation and HPP. Post harvest technology of cereals and pulses, fruits and vegetables, milk and milk products, meat, fish and poultry, plantation products and spices.

References Books

1. Florkowski, Wojciech J., and Robert L. Shewfelt. *Postharvest Handling A Systems Approach*. Amsterdam: Elsevier/Academic Press, 2009.
2. Rees, Debbie, Graham Farrell, and J. E. Orchard. *Crop Post-Harvest Science and Technology : Perishables*. Hoboken: Wiley-Blackwell, 2012.
3. Chakraverty, Amalendu. *Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. New York: Marcel Dekker, 2003.
4. Golob, P. *Crop Post-Harvest Science and Technology*. Oxford, UK: Blackwell Science, 2002.
5. Ahmad, Mohammad Shamsheer, and Mohammed Wasim Siddiqui. *Postharvest Quality Assurance of Fruits: Practical Approaches for Developing Countries*. 2015.
6. Simson, Sharon Pastor, and Martha C. Straus. *Post-Harvest Technology of Horticultural Crops*. Jaipur, India: Oxford Book Co, 2010.

16FP2003 MECHANIZATION AND POST-HARVEST TECHNOLOGY LAB

Credits: 0:0:2

Co-requisite: 16FP2002 Post Harvest Technology of Foods

Course Objectives:

- To expose the students to the importance of post harvest technology
- To expose the students to food preservation techniques

Course Outcomes:

- The student would acquire knowledge on Post-Harvest techniques
- The student would know about the techniques in food preservation
- The student would be able to develop different kinds of food products

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

14FP3017 FOOD INDUSTRY WASTE MANAGEMENT

Credit 3:0:0

(Version 1.1)

Course Objectives

- To enable the student, understand the extent of wastes produced in a food industry and its environmental effects
- To enable the student, understand the nature of food wastes and methods of treatment
- To enable the student, know the importance of waste utilization in Food industries

Course Outcomes

- Students will attain knowledge about various legalizations on food industry and its environmental impact
- Students will attain knowledge about the methods of managing food wastes
- Students will gain knowledge on the methods for utilization of food wastes
- Students will gain knowledge on getting value-added products from wastes

Sources of Food Industry Wastes – BOD and COD – Characterization, and Composition of Food Industry Wastes. Environmental Management Systems for Food Industries – ISO14000 for Food Industries – Legislations pertaining to Environmental Interaction of Food Industries – Key drivers for waste management and co-product recovery in Food Processing–Strategies to be followed for optimizing manufacturing to minimize wastes – Key issues and technologies for Food waste separation and Co-product recovery – Methods of solid and liquid waste treatment – Impact of water footprint and rehabilitation of Food industry waste water – Waste water treatment – Unit operations in waste water treatment – Waste management in specific food industries–Methods to obtain value-added products from wastes from specific food industries.

Reference Books

1. Kosseva M and C Webb, Food Industry Wastes, Assessment and Recuperation of Commodities, Academic Press, 2013. ISBN: 978-0-12-391921-2
2. Panda H. The Complete Book on Managing Food Processing Industry Waste, Asia Pacific Business Press Inc, 2011. ISBN: 9788178331454.
3. Waldron K.W., Handbook of waste management and co-product recovery in food processing (Volume 1), Woodhead Publishing Ltd., 2007. ISBN - 1 84569 025 7
4. Arvanitoyannis I., Waste Management for the Food Industries, Academic Press, 2007. ISBN: 978-0-12- 373654-3.
5. Vasso Oreopoulou, Utilization of By-Products and Treatment of Waste in the Food Industry, Springer Science, 2007. ISBN-13: 978-0387-33511-7.
6. Wang L.K. , Y-T Hung, H H. Lo and C Yapijakis, Waste Treatment in the Food Processing Industry, CRC Press, 2005. ISBN 9781420037128.

14FP3024 FOOD PROCESSING AND BIOTECHNOLOGY

Credit 3:0:0

(Version 1.1)

Course Objectives:

- To provide knowledge about the chemistry and microbial aspects of food.
- To teach the various processing methods of foods.
- To equip knowledge with the various equipments for processing of foods.

Course Outcomes:

- The student will gain knowledge about the chemistry and microbial aspects of food.
- The student will have the knowledge of various processing techniques and related equipments.
- The students will be able to develop new products with improved quality.

Food Chemistry -Constituents of food – Enzymatic and Non-enzymatic browning - Food additives: intentional and non-intentional and their functions; Enzymes in food processing. **Food Microbiology** - food fermentation; Food borne diseases – infections and intoxications, food spoilage – causes and prevention. **Thermal and non-thermal methods of food preservation** : Principles and Applications in Food System - Technology of Manufacture of **Food Products**- Bakery and confectionery , vegetable and fruit products, Plantation products and spices, Milk and Milk products , edible oils and fats; meat, poultry and fish products.

Reference Books

1. Saravacos GD and Maroulis ZB, Food Process Engineering Operations, Taylor and Francis group, 2011. ISBN 9781420083538.
2. Campbell-Platt, G. Food Science and Technology, Wiley-Blackwell, 2009. ISBN: 978-0-632-06421-2.
3. Damodaran S, Parkin KL, Fennema OR, Fennema's Food Chemistry, CRC Press/Taylor & Francis, 2008
4. Adams MR and Moss MO, Food Microbiology, 3rd ed. RSC Publishing, 2008. ISBN 978-0-854042845.

14FP3025 ADVANCES IN PROCESSING OF HORTICULTURAL PRODUCTS

Credit 3:0:0

(Version 1.1)

Course Objectives:

- To enable the student to know about post harvest technology of fruits and vegetables.
- To provide knowledge on processing & preservation techniques of fruits and vegetables.
- To make the students acquire knowledge on fruit and vegetable processing

Course Outcomes:

- The students would be able to develop skills on various preservation techniques.
- The students would apply their knowledge in developing newer and cost-effective strategies of food preservation.
- The students would be able to develop foods that are wholesome and safe.

Importance of post harvest technology of fruits and vegetables -Post harvest handling- Physiology -Fruit ripening - Spoilage -Deteriorative factors and their control. Minimal processing: Cut fruits and vegetables. Hurdle technology: Osmotic dehydration, Canning, Technology of value addition and preservation – beverages and preserves. Thermal methods of preservation- Freezing- methods, freeze concentration, freeze drying, pre-cooling and chilling techniques. Drying and dehydration methods- Different types of dryers- components and working - Foam mat drying, spray drying. Non-thermal preservation - Emerging preservation techniques- Microwave heating – Radiation preservation –Ohmic heating -High pressure processing - Aseptic processing. Packaging and storage: storage systems for horticultural products -Cold storage - Modified and Control Atmosphere Storage.

Reference Books

1. Rodrigues FS and Fernandes AN. Advances in Fruit Processing Technologies, CRC Press, Taylor and Francis group, 2012. ISBN 978 – 1 – 4398- 5152 – 4.
2. Hui Y.H. Handbook of Fruits and Fruit Processing. Blackwell Publishing, 2006. ISBN 13: 978 – 0 – 8138- 1981-5.
3. W Jongen. Fruit and Vegetable Processing: Improving Quality, Woodhead Publishing Ltd., England. 2002. ISBN 185573548.
4. Shafiur Rahman. Handbook of Food Preservation. Replika Press Pvt. Ltd. India.2006.

LIST OF SUBJECTS

Subject Code	Name of the Subject	Credits
14FP2001	Principles of Food Process Engineering	3:0:0
14FP2002	Food Chemistry	3:0:0
14FP2003	Fluid Mechanics and Heat Transfer Lab	0:0:2
14FP2004	Food Analysis Lab –I	0:0:2
14FP2005	Heat and Mass Transfer	3:0:0
14FP2006	Dairy Engineering and Technology	3:0:0
14FP2007	Unit Operations in Food Process Engineering - I	3:0:0
14FP2008	Fruit and Vegetable Processing Technology	3:0:0
14FP2009	Unit Operations in Food Process Engineering and Grain Processing Lab	0:0:2
14FP2010	Unit Operations in Food Process Engineering - II	3:0:0
14FP2011	Refrigeration, Air conditioning and Cold Storage	3:0:0
14FP2012	Food Packaging Technology	3:0:0
14FP2013	Storage Engineering	3:0:0
14FP2014	Enzymology Lab	0:0:2
14FP2015	Food Product Technology Lab - I	0:0:2
14FP2016	Physical Properties of Food Materials	3:0:0
14FP2017	Supply Chain Management	3:0:0
14FP2018	Food Safety Regulations	3:0:0
14FP2019	Engineering Properties of Food Materials Lab	0:0:2
14FP2020	Food Engineering and Packaging Lab	0:0:2
14FP2021	Food Process Equipment Design	3:0:0
14FP2022	Food Analysis Lab – II	0:0:2
14FP2023	Computer Aided Food Process Equipment Design Lab	0:0:2
14FP2024	Mechanical Systems for Food Processing	3:0:0
14FP2025	Cereals and Pulses Technology	3:0:0
14FP2026	Plantation Products and Spices Technology	3:0:0
14FP2027	Food Additives	3:0:0
14FP2028	Fat and Oil Processing Technology	3:0:0
14FP2029	Technology of Meat, Poultry and Fish	3:0:0
14FP2030	Bakery and Confectionery Technology	3:0:0
14FP2031	Drying Technology	3:0:0
14FP2032	Process Economics and Plant Layout Design	3:0:0
14FP2033	Food Additives Lab	0:0:2
14FP2034	Food Product Technology Lab - II	0:0:2
14FP2035	Food Preservation Principles	3:0:0
14FP2036	Processing of Food Commodities	3:0:0
14FP2037	Technology of Packaging	3:0:0
14FP2038	Functional Foods and Nutraceuticals	3:0:0
14FP2039	Material Science for Food Engineers	3:0:0
14FP2040	Food Industry Waste Management	3:0:0
14FP2041	Emerging Technologies in Food Process Engineering	3:0:0
14FP2042	Computational Fluid Dynamics Lab	0:0:2
14FP3001	Separation Processes in Food Engineering	3:0:0
14FP3002	Mass Transfer Processes in Food Engineering	3:0:0
14FP3003	Technology of Food Flavourants and Colourants	3:0:0
14FP3004	Food Plant Layout and Design	3:0:0
14FP3005	Instrumental Techniques for Food Quality and Safety	3:0:0
14FP3006	Storage Engineering of Grains	3:0:0
14FP3007	Food Laws and Safety Regulations	3:0:0

14FP3008	Logistics and Distribution Management in Food Industry	3:0:0
14FP3009	Food Analysis Lab	0:0:2
14FP3010	Food Engineering and Transport Processes Lab	0:0:2
14FP3011	Food Product Technology Lab	0:0:2
14FP3012	Advances in Dairy, Meat and Fish Processing	3:0:0
14FP3013	Advances in Food Microbiology	3:0:0
14FP3014	Advances in Processing of Cereals, Pulses and Oil seeds	3:0:0
14FP3015	Advances in Processing of Horticulture, Spices and Plantation Products	3:0:0
14FP3016	Milling and Bakery Technology	3:0:0
14FP3017	Food Industry Waste Management	3:0:0
14FP3018	Refrigeration and Cold storage Engineering	3:0:0
14FP3019	Advances in Food Process Engineering	3:0:0
14FP3020	Engineering Properties of Food	3:0:0
14FP3021	Design of Food Processing Equipments	3:0:0
14FP3022	Advances in Packaging and Handling of Foods	3:0:0
14FP3023	Food Material Science	3:0:0
14FP3024	Food Processing and Biotechnology	3:0:0
14FP3025	Advances in Processing of Horticulture Products	3:0:0
14FP3026	Food Analysis and Agro biotechnology Lab	0:0:4

14FP2001 PRINCIPLES OF FOOD PROCESS ENGINEERING

Credits: 3:0:0

Course Objectives

- To enable the students to solve problems in Food Engineering process of value addition and quality improvement.
- To impart knowledge on the principles of Food Process Engineering and its importance for the Food Industry.
- To make the student to understand units and dimensions, ability to solve engineering problems related to food processing, and familiarization with some food processing unit operations.

Course Outcomes

- The students understand the principles in formulating solutions to solve problems in food industry.
- The students understood the importance of Food Process Engineering as one of the major pillars of Food Science and Technology discipline.
- The students acquired the required skills in dealing with units and dimensions, solving problems of Food Process Engineering.

Dimensions and unit - Force, momentum, pressure, work and energy, power, heat and enthalpy. Dimensional analysis. Mole – atomical molar mass. Gases and vapors: Behavior of Gases – Gas laws – Van der Waal's equation -Amagat's law – psychrometry. Flow of fluids: Fluids-Properties - concept of viscosity-types of fluid. Bernoulli equation-fluid flow- pressure drop due to fittings, flow measurement principles- Material Balance : Process flow diagram-system boundaries - Continuous vs. Batch-Recycle and by pass-unsteady state -mass balance problems. Energy Balance: Heat capacity -energy balance for a closed system and open system Energy balance problems in heat exchangers –Drying.

Reference Books

1. Albert Ibarz, Gustavo V. Barbosa-Canovas, "Unit Operations in Food Engineering". 2nd Edition, Taylor & Francis, 2014.
2. Smith, PG. "Introduction to Food Process Engineering", 2nd Edition, Springer, 2011.
3. Paul Singh R, and Dennis R.Heldman "Introduction to Food Engineering" 4th Edition. Academic Press – Elsevier India Private Ltd. New Delhi, 2008.
4. Chapman & Hall, USA, CBS publications, New Delhi, 2007.

5. Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine, "Fundamentals of Heat and Mass Transfer", Published by Wiley; 6th edition, 2006.

14FP2002 FOOD CHEMISTRY

Credits: 3:0:0

Course Objectives

- To enable the students understand the chemistry and importance of water, carbohydrates, lipids, proteins and vitamins
- To impart knowledge on the methods of manufacture of oils and the methods of determining the quality of oils and fats
- To understand the role of vitamins in human nutrition and the effect of various processing methods in maintaining the vitamin content in foods.

Course Outcomes

- The students understood the importance of various food constituents, and their role in a food.
- The students understood the chemical changes that takes place during food processing
- The students understood to develop a basic idea in new food product development

Structure of water & ice - Sorption isotherms – Dispersed systems – Carbohydrates: nomenclature, classification, structures and physical & chemical properties - Process flow sheet for the maltodextrin and cyclodextrin production - Lipids: Classification, basic structures and properties - Auto oxidation and hydrolysis - Proteins: Nomenclature, classification, structure and chemistry of proteins and amino acids- Isolation, identification & purification - Enzymes: Classification, nomenclature and functions of enzymes – Specificity – Immobilization - Importance of enzymes in food industry –Vitamins and minerals: Fat and water-soluble vitamins -RDA – Bioavailability – Effect of processing

Reference Books

1. De Man J.M., "Principles of Food Chemistry", Springer, 3rd Edn., ISBN 978-1-4614- 6389-4, 2013
2. Belitz, H.D., Grosch, W., Schieberle, P. Food Chemistry. 4th and Revised and Extended Edition, Springer Verlag, Germany, ISBN 978-3-540-69933-0, 2009.
3. Damodaran S., Parkin K. and Fennema O.R., "Fennema's Food Chemistry", CRC Press, ISBN 0849392721, 9780849392726, 2008.
4. Vaclavik V.A. and Christian E.W., "Essentials of Food Science", Springer, 3rd Edn., ISBN 978-0-387-69939-4, 2008.

14FP2003 FLUID MECHANICS AND HEAT TRANSFER LAB

Credits: 0:0:2

Co Requisite: 14CE2003- Mechanics of Fluids

Course Objectives

- To enable the students to understand the means of pressure loss in fluid dynamics
- To enable the students to understand the means of heat losses in food systems

Course Outcomes

- Students would be able to develop systems that minimize pressure losses in flow systems
- Students would be able to judge the efficiency of a system and develop suitable technologies

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2004 FOOD ANALYSIS LAB – 1

Credits: 0:0:2

Co Requisite: 14FP2002-Food Chemistry

Course Objectives

- To train the student to analyse food components
- To make the students aware of the standards of food quality

Course Outcomes

- Students would be able to assess the quality of the food
- Students would be able to develop newer methods of food analysis

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2005 HEAT AND MASS TRANSFER

Credits: 3:0:0

Course Objectives

- To enable the student to understand the basics of fluid mechanics and thermal flow
- To understand the Importance of thermal fluid sciences in processing of food
- To develop processes with better heat efficiency and economics

Course Outcomes

- Learn to design heat exchangers for food processing
- Learn to design cold storage for food preservation
- Learn to Select suitable processing equipment

Modes of heat transfer-Fourier's law of heat conduction-Heat conduction through simple geometry-Theory of insulation, critical radius of insulation-Forced and natural convection. Boiling and condensation-mechanisms-Radiation heat transfer-Heat exchangers-overall heat transfer coefficient- log mean temperature difference in Shell and tube heat exchanger and double pipe heat exchanger. Heat exchanger Analysis-Fick's law- mass transfer and coefficient –convective mass transfer.

Reference Books

1. Incropera F.P. Fundamentals Of Heat And Mass Transfer. 7th Edition, John Wiley. ISBN 13-978-0470-0297-9, 2011.
2. M. Thirumaleshwar; Fundamentals of heat and mass transfer-Sai print-O-pak. Ltd, 2009
3. Geankoplis CJ, "Transport Processes and Separation Processes Principles" .Prentice 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 Edition, Singapore, ISBN-007-424740-6, 2005
5. Yunus A.Cengel, Robert H.Turner.," Fundamentals of Thermal Fluid Science", Tata McGraw Hill,New Delhi, 2005.

14FP2006 DAIRY ENGINEERING AND TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To understand about milk, milk processing methodologies
- To provide knowledge about the processing equipments
- To provide technical know-how about the production of milk products.

Course Outcomes

- The students learn the technology of milk and its processing methods.
- The students gain knowledge about the various milk processing equipments.
- The students understand the production of various milk products.

Dairy Chemistry and Microbiology- Classification of milk - Milk transport and storage in dairy plants-Applications of enzymes in dairy industry - Dairy Processing Equipments- Milk processing - Milk Chillers, Ice Cream Freezers. Vacuum Evaporators, Spray and Drum Dryers, Product instantizing equipment. Packaging of milk -Manufacture of dairy products- Butter, Ghee, paneer, Khoa, Milk powder,ice cream- Fermented dairy products– Yoghurt, Curd, acidophilus milk etc.- Concept of Probiotic and prebiotic foods, Energy use in Dairy plant, sources of energy, cost of energy, Control of energy losses and Energy conservation.

Reference Books

1. Trevor J.Britz & Richard K.Robinson “Advanced Dairy Science and Technology” Blackwell Publishing Ltd. 2008.
2. Sukumar De, “Outlines of Dairy Technology”, Oxford University Press, New Delhi, 23rd impression, 2006.
3. Garret Smit G, “Dairy Processing”, Woodhead Publishing Limited, England. 2005.
4. Edger Spreer, “Milk and Dairy Product Technology” Marcel Dekkar Inc. New York, USA, 2005.
5. Walstra. P et al “ Dairy Technology”Taylor & Francis ISBN-0-203-90999-2, 2005

14FP2007 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING –I

Credits: 3:0:0

Prerequisite: 14FP2001 Principles of Food Process Engineering

Course Objectives

- To understand the principle involved in food processing engineering
- To the principle and working of various processing equipments
- To know the methods of product recovery

Course Outcomes

- The students understand the operation of equipment
- The students know various factors affecting food processing equipments
- The students learn to select suitable processing equipment

Agitation and mixing agitated vessels, mixing and blending of miscible liquids, mixing index and effectiveness of mixing. Types of evaporators, single and multiple effect evaporators. Evaporator capacity, multiple effect evaporator – methods of feeding. Moisture and its measurements. Drying rate – Mechanical Drying. Types fixed – and Fluidized Bed. Filtration – types of filtration, constant pressure filtration and constant volume filtration and filtration aids. Principles of comminution. Energy and power requirements. Size reduction equipments.

Reference Books

1. Zeki Berk, “Food Process engineering and technology”. ISBN- 978-0-12-373660-4 Elsevier, 2009,
2. Fellows, P. Food Processing Technology. CRC Press 2009
3. Geankoplis CJ, “Transport Processes and Separation Processes Principles” .Printice Hall India, New Delhi, ISBN-978-81-203-2614-9, 2008
4. Sahay, K. M. & K. K. Singh. Unit Operations of Agricultural Processing (II revised) Vikas Publishing House Pvt. Ltd., New Delhi. 2007.
5. Richardson, J.F, J. H. Harker & J. R. Backhurst. Coulson & Richardson’s Chemical Engineering – Vol. 2. Elsevier Publications. 2006.
6. Warren,L McCabe, J.C. Smith and Peter Harriot,”Unit Operations of Chemical Engineering “ McGraw Hill International Edition, Singapore, ISBN-007-424740-6, 2005

14FP2008 FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To know the status of fruit and vegetable production in India with importance to losses.
- To study the canning of fruits and vegetables and to impart knowledge about the various products.
- To study the various methods of drying of fruits and vegetables.

Course Outcomes

- Students have attained knowledge on various preservation treatments and operations involved in processing.
- Students have attained knowledge on the various preparation of the products and its standard specifications.
- The students are enabled to apply their knowledge on various technological advancements in the field of product development.

Production and composition of Fruits and vegetables in India, Spoilage factors, Post harvest field operations, preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. General methods of preservation of whole fruits/Vegetables and processed fruits and vegetables. Canning of fruit and vegetables, Preparation of products like Jams, Jellies, Marmalades, Pickles, Puree, Ketchup, Sauce, Squashes etc. – FSSAI specifications. Blanching operations, Processing of fruit juices, Concentrates, Fruit Bars and Fruit powders. Clarification of juices, Minimal processing, Dehydration, Reverse osmosis, Aseptic processing-Basic concepts and principles.

Reference Books

1. Nirmal K. Sinha, “Hand Book of Vegetable and Vegetable Processing”, 978-0-8138-1541-1, Wiley-BlackWell 2011
2. Fellows P. J. “Food processing technology principles and practice”.3rd Edition Published by Woodhead Publishing Limited, Cambridge, England, 2009.
3. John, P Jacob. “A handbook on post harvest management of fruits and vegetables” ISBN- 71-7035-532-X, Daya Publication, 2008.
4. M. Shafiur Rahman,” Handbook of Food Preservation”, Second Edition, ISBN-13:978-1-5-7444-606,2007
5. Srivastava, R.P. and Kumar S, “Fruit and Vegetable Preservation: Principles and Practices”, International Book Distributing Co. Lucknow 2006.

14FP2009 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING AND GRAIN PROCESSING LAB

Credits: 0:0:2

Co Requisite: 14FP2007-Unit Operations in Food Process Engineering-I

Course Objectives

- To understand the principle involved in food processing engineering
- To the principle and working of various processing equipments
- To know the methods of product recovery of different equipments

Course Outcomes

- Students can learn the material and energy balance related to the unit operations
- Students can understand the factors affecting unit operations
- Students can select suitable unit operations for a specific purpose

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2010 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING – II

Credits: 3:0:0

Prerequisite: 14FP2001 Principles of Food Process Engineering

Course Objectives

- To understand the role of unit operations in food processing engineering
- To know the working principle of various equipments
- To know the methods of product recovery

Course Outcomes

- Students can learn the material and energy balance related to the unit operations
- Students can understand the factors affecting unit operations
- Students can select suitable unit operations for a specific purpose

Principles of diffusion. Distillation – flash Distillation, rectification and stripping. Distillation equipments. Calculation of theoretical plates. Leaching and liquid liquid extraction. Liquid liquid equilibria and solid liquid equilibria. Extraction equipments. Absorption – packing and packed tower for absorption. Adsorption equipment. Crystallization and crystallization equipment. Membrane separation. Types of membranes. Separation of gases. Pervaporation and Reverse Osmosis

Reference Books

1. George D. Saravacos, Zacharias B. Maroulis” Food processing engineering operation “Taylor and Francis, 2011.
2. Geankoplis CJ, “Transport Processes and Separation Processes Principles” .Printice Hall India, New Delhi, ISBN-978-81-203-2614-9, 2008
3. Maria Margarida Cortez Vieira, Peter Ho, “Experiments in Unit Operations and Processing of Foods”, ISBN 978-0387-33513-1, Springer, 2008.
4. Sahay, K. M. & K. K. Singh. Unit Operations of Agricultural Processing (II revised) Vikas Publishing House Pvt. Ltd., New Delhi, 2007.
5. Richardson, J.F, J. H. Harker & J. R. Backhurst. Coulson & Richardson’s Chemical Engineering – Vol. 2. Elsevier Publications, 2006.
6. Warren, L McCabe, J.C. Smith and Peter Harriot, ”Unit Operations of Chemical Engineering “ McGraw Hill International Edition, Singapore, ISBN-007-424740-6, 2005.

14FP2011 REFRIGERATION, AIRCONDITIONING AND COLD STORAGE

Credits: 3:0:0

Prerequisite: 14FP2005 Heat and Mass Transfer

Course Objectives

- To enable the students to understand the various concepts behind refrigeration and air conditioning.
- To enable the students to solve simple problems in refrigeration and air conditioning.
- To enable the students to understand the various concepts behind cold storage construction, design, maintenance, and applications in food industry.

Course Outcomes

- The students are knowledgeable to construct refrigeration and air conditioning.
- The students will be able to solve problems on refrigeration and air conditioning and design cold storage for food applications.
- The students will be able to apply their knowledge on cold storage of perishable products.

Refrigeration – Basic concepts and Psychrometrics, Air conditioning – Cold Storage Design And Construction - Cooling load estimation, prefabricated cold storage systems and mobile refrigeration systems. Freezer Storages - Pre-cooling and pre freezing - Freezer types. Chilling equipment for liquid foods. Secondary refrigerants and direct

expansion techniques in chilling. Chilled foods transport and display cabinets - Chilled foods microbiology, Packaging of Chilled foods - Design considerations for chillers and chilled Storages. Evaporative cooling.

Reference Books

1. Ibrahim Dincer and Mehmet Kanoglu, “Refrigeration Systems and Applications”, 2nd Edition, John Wiley and Sons Publication, ISBN-9780470747407, 2010.
2. Florkowski W.J, Shewfelt R.L, Brueckner B and Prussia S.E, “Post Harvest Handling and Sytems Approach”, Second edition, Academic Press, USA, ISBN- 9780123741127, 2009.
3. Martyn Brown, “Chilled foods – A Comprehensive Guide”, 3rd edition, WoodHead publishing, ISBN-9781845692438, 2008.
4. Ahmadul Ameen, “Refrigeration and Air Conditioning”, Prentice Hall of India, New Delhi, ISBN-8788120326712, 2006.

14FP2012 FOOD PACKAGING TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To study about the functions of packaging along with the influence of various factors on food.
- To know about the different packaging materials like cans, bottles, flexible films etc.
- To study about the various methods of packaging and the equipments used for packaging.

Course Outcomes

- Students will attain knowledge about the testing of various packaging materials and also suitability of packaging materials with respect to the products.
- Students understand the designing of various storage structures and theories related to it.
- Students are updated of the recent technological advancements in the field of Food Packaging.

Introduction to Food packaging, Effect of environmental factors in packaging, testing of packaging materials, Shelf Life Estimation, Vacuum Packaging, Manufacturing of Metal cans, glass containers, plastic containers and pouches, paper and paperboard. Properties of plastics, .Filling and sealing of Flexible plastic containers, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements Extrusion – Retort pouch packaging, Active packaging, Moisture control, CO₂ and Oxygen scavenging, Modified atmosphere packaging – principles, applications.

Reference Books

1. Gordon L. Robertson, “Food Packaging and Shelf life –A Practical Guide”, CRC Press, ISBN-9781420078442, 2010.
2. Coles, R., Dowell, D.M., Kirwan, J. “Food Packaging Technology”, Wiley-Blackwell Publishing Ltd, ISBN-9781405147712, 2009.
3. Chiellini, E., “Environmentally Compatible Food Packaging”, Wood Head Publishing Ltd and CRC press, ISBN-9781845691943, 2008.

14FP2013 STORAGE ENGINEERING

Credits: 3:0:0

Course Objectives

- To expose the students to the large scale handling and storage mechanism of grains.
- To make the students understand the engineering operations involved in control of physical, chemical and biological spoilage during storage of grains.

- To impart knowledge on design of storage structures.

Course Outcomes

- The students have understood the various spoilage factors of grains during storage.
- The students have gained knowledge on the various aspects of storage of grains and storage structures.
- The students can apply their technical know-how in designing and layout of grain storage structures.

Introduction about the importance of storage, Physico - chemical and thermal properties of grains, Effect of moisture content and drying on storage of grains, Grain storage principles, changes occurring during storage, types of storage structures, theory of storage – Rankine and Janssen theories, design of storage structures, Extent of losses during storage, types of pests and insects, their effect on quality of grains and control measures, Controlled and modified atmosphere storage.

Reference Books

1. Donald B. Brooker F.W. Bakker-Arkema Carl W. Hall “Drying and Storage of Grains and Oil Seeds” – AVI Book, ISBN-9780870551611, 2013.
2. Sahay K.M and K.K.Singh. “Unit Operations of Agricultural Processing” Vikas Publications, New Delhi, ISBN-81-259-1142-1, 2009.
3. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, ISBN-8120402898, 9788120402898. 2009.

14FP2014 ENZYMOLOGY LAB

Credits: 0:0:2

Co Requisite: 14FP2002-Food Chemistry & 14BT2001 Basics of Biochemistry

Course Objectives

- To understand the importance of enzymes in foods.
- To know the application of various enzymes in foods.

Course Outcomes

- The students learn about different enzymes.
- The students apply their knowledge of incorporating enzymes in foods and their actions in foods

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2015 FOOD PRODUCT TECHNOLOGY LAB – I

Credits: 0:0:2

Co Requisite: 14FP2008-Fruit and Vegetable Processing Technology

Course Objectives

- To understand the ingredients needed for preparations of food products.
- To calculate the quantity of ingredients for preparations of food products.

Course Outcomes

- The students are able to list the various ingredients needed for preparations of food products.
- The students are able to calculate the quantity of ingredients for preparations of food products.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2016 PHYSICAL PROPERTIES OF FOOD MATERIALS

Credits: 3:0:0

Course Objectives

- To study about the different engineering properties of foods.
- To study the methods of determining the quality and properties of different foods.
- To gain knowledge and apply engineering properties in the design of processing, transport and storage equipments.

Course Outcomes

- The students have gained knowledge of engineering properties of food materials.
- The students have gained skills measurement techniques of engineering properties of foods.
- The students have acquired technical know-how on the design of processing, transport and storage structures.

Physical Properties of Foods: Methods of estimation of physical characteristics - Frictional properties-Rheological Properties - Viscosity and Texture measurement techniques-Hardness and brittleness testing - Thermal Properties – concepts and measurement techniques - Aerodynamic and Hydrodynamic Properties- Drag and lift coefficient, terminal velocity and their application in the handling and separation of food materials- Sorption isotherms – Models

Reference Books

1. Jasim Ahmed and Mohammad Shafi ur Rahman, Handbook of Food Process Design, Blackwell Publishing Ltd, ISBN-9781444330113,2012.
2. Serpil Sahin and Servet Gulum Sumnu “Physical Properties of Foods”, Springer,USA, ISBN-9780387308081 2006.
3. Rao, M.A and S.S.H. Rizvi:”Engineering Properties of Foods”, Marcel Dekker inc. New York, ISBN-97841824753283, 2005.

14FP2017 SUPPLY CHAIN MANAGEMENT

Credits: 3:0:0

Course Objectives

- To understand the fundamentals of supply chain management
- To learn the importance of supply chain management in Food preservation
- To learn about the opportunities available in the country

Course Outcomes

- The students have gained skills on methods to improve supply chain management
- The students are able to develop newer and cost-effective strategies
- The students are able to develop better quality systems.

Supply chain management – Basic concepts – Global supply chain operation - Planning and sourcing – Lean supply management and Six sigma quality– Agile supply management - Making and delivering – Coordination and use of Technology – Supply chain metrics – Opportunities – Developing a supply chain system – Relationship and integration – Third Party logistics in Supply chain – Sustainable supply chain management – Outsourcing – Internationalisation of the supply chain and retailing - Temperature controlled supply chains – Future perspectives

Reference Books:

1. Sanders N.R., Supply chain management: A global perspective, Wiley Publications, ISBN-0470141174, 9780470141175,2011.
2. Scott C., H Lundgren, and P Thompson. Guide to Supply Chain Management, Springer Verlag, ISBN: 978-3-642-17675-3, 2011.

14FP2018 FOOD SAFETY REGULATIONS

Credits: 3:0:0

Course Objectives

- To create awareness about the importance of Food Safety.
- To impart knowledge about the Regulating authorities for food safety world over.
- To provide knowledge on HACCP in food industries.

Course Outcomes

- The students have gained knowledge on importance of food safety.
- The students have acquired sufficient knowledge about the regulations and authorizes for food safety.
- The students have developed their skills in the safety aspects to be implemented in food industries.

Food Regulations World Trade order – Functioning and responsibilities of the WTO - Codex Alimentarius –Current Issues under consideration – SPS (Sanitary and phytosanitary measures) agreement. World Health Organisation – ICGFI – Functions and responsibilities. Concept of Six Sigma – FSSAI – Organisational chart and role of individual authority – Enforcement of the act – Food safety officers and their powers – Regulations pertaining to Food analysis labs - Offences and penalties – Adjudication and Food safety appellate tribunal – Food labelling – Safety issues – Labelling of GM foods – Approach of US and EU – HACCP and Food safety – Effluent treatment and laws governing the same.

Reference Books:

1. Craig VanGrasstek, The History and Future of the World Trade Organization., WTO Publications, , ISBN-13: 978-9287038715, 2013.
2. Guide to the Food Safety and Standards Act, Tax-mann Allied Services Pvt. Ltd., ISBN 10-8174968288, 2006.
3. Mehta R. and George J., “Food Safety Regulation Concerns And Trade- The Developing Country Perspective”, Published by Macmillan India Ltd., New Delhi. ISBN 1403925046, 9781403925046, 2005.
4. Enhancing participation in Codex Activities: FAO/WHO training package, ISBN 92 5 1052778, 2005.

14FP2019 ENGINEERING PROPERTIES OF FOOD MATERIALS LAB

Credits: 0:0:2

Co Requisite: 14FP2010-Unit Operations in Food Process Engineering – II & 14FP2016- Physical Properties of Food Materials

Course Objectives

- To study about the different engineering properties of foods.
- To study the methods of determining the quality and properties of different foods.
- To gain knowledge and apply engineering properties in the design of processing, transport and storage equipments.

Course Outcomes

- The students have gained knowledge of engineering properties of food materials.
- The students have gained skills measurement techniques of engineering properties of foods.
- The students have acquired technical know-how on the design of processing, transport and storage structures.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2020 FOOD ENGINEERING AND PACKAGING LAB

Credits: 0:0:2

Co Requisite: 14FP2012- Food Packaging Technology

Course Objectives

- To understand the principle and working of various food engineering operations and machinery.
- To provide knowledge on packaging and packaging materials.

Course Outcomes

- To students are able to operate food processing machinery and find the efficiency.
- The students will get exposure about packaging, packaging materials and packaging methods.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2021 FOOD PROCESS EQUIPMENT DESIGN

Credits: 3:0:0

Prerequisite: 14FP2007 Unit Operations in Food Process Engineering -I
14FP2010 Unit Operations In Food Process Engineering-II

Course Objectives

- To enable the student to design and develop equipments used in Food Processing operations.
- Identify and discuss critical design of typical processing equipment.
- Understand the relationship between process design and Safety

Course Outcomes

- The students will gain technical know-how about the material requirements and design of various equipments needed in Food industries.
- The students will understand the practical applications of basic design engineering principles.
- The students will understand the content and applications of process flow diagrams, (PFDs) and piping and instrument diagrams (P&IDs).

Materials: Metals and non-metals, design of pressure vessels- Numerical problem and design of pressure vessel. Storage Vessels: Design of storage vessels – Rectangular Tank with and without stiffeners – shell design. Reaction Vessels: Design of Reaction vessels – materials -classification – jackets. Heat Exchangers: Design of Heat exchangers – types – materials – Evaporator: Materials of construction – types – design-consideration – Design of agitators – power requirements. Dryers: Types - General considerations – Design of Tray dryer- Equipment Ancillaries – Piping system – Flow control devices.

Reference Books

1. Singh & Heldman.”Introduction to Food Engineering”. Academic Press – Elsevier India Private Ltd. ISBN: 978- 0- 1240- 1675- 0 New Delhi, 2013
2. Jasim Ahmed, Mohammad Shafuir Rahman “Handbook of Food Process Design, 2 volume Set” Wiley-Blackwell, ISBN: 978-1-4443-3011-3, April 2012.
3. Rajesh Mehta and J. George “Food Safety Regulation Concerns and Trade- The Developing Country Perspective,” Published by Macmillan India Ltd., New Delhi. 2005
4. Miguel A. Galan, Eva Martin del Valle. “Chemical Engineering: Trends and Developments” John Wiley & Sons, ISBN: 978-0-470-02498-0, 2005.
5. Maroulis Z.B. and Saravacos G.D. “Food Process Design”, Marcel Dekker Inc. ISBN- 0824743113, 2003.

14FP2022 FOOD ANALYSIS LAB-II

Credits: 0:0:2

Co Requisite: 14FP2006 Dairy Engineering and Technology

Course Objectives

- To train the student to analyse food components
- To make the students aware of the standards of food quality

Course Outcomes

- Students would be able to assess the quality of the food
- Students would be able to develop newer methods of food analysis

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2023 COMPUTER AIDED FOOD PROCESS EQUIPMENT DESIGN LAB

Credits: 0:0:2

Co Requisite : 14FP2021-Food Process Equipment Design

Course Objectives

- Design of plants using computing software.
- Simulating process environment virtually.
- Understanding relational database and design specific unit operations.

Course Outcomes

- The students have understood computer aided design principles and practice.
- The students have learnt the effective approaches to building up knowledge about a process through simulation.
- The students have acquired the skills needed to design a chemical plant using ASPEN HYSYS.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2024 MECHANICAL SYSTEMS FOR FOOD PROCESSING

Credits: 3:0:0

Course Objectives

- To provide knowledge about types of pumps and their applications.
- To learn about types of power transmission elements, steam generators, chillers, refrigeration and material handling systems.
- To enable the students to solve simple problems in mechanical systems.

Course Outcomes

- The students have understood the working principle of pumps and their applications.
- The students have understood the various power transmission elements and working principle of boilers, refrigeration and material handling systems.
- The students have acquired knowledge to solve simple problems in pumps, power transmission systems and refrigeration systems.

Pumping theory- head developed-Types of pumps-Centrifugal pumps- Reciprocating pumps- Rotary gear pumps- vane pumps- and diaphragm pumps-construction- working principles and applications. Mechanical power

transmission systems: shafts-solid and hollow shafts- types of coupling- belt drives-gear drives-chain drives and rope drives. Chilled water and ice production. Material handling. Types of elevators-Design configuration-power requirement and applications- handling of wet products- SS and plastic conveyors and elevators.

Reference Books:

1. Albert Ibarz and Gustavo V. Barbosa - Canovas, "Introduction to Food Process Engineering", Taylor & Francis, ISBN 1439809186, 9781439809181, 2013.
2. R.Paul Singh and Dennis R. Heldman, "Introduction to Food Engineering", 5th edition, Academic press, Elsevier, ISBN: 978 – 0- 12- 398530- 9, 2013.
3. Sadhu Singh, "Handbook of Mechanical Engineering", S.Chand & Company Ltd, New Delhi, 2011.
4. V.B.Bhandari, "Design of Machine Elements", 3rd edition, Tata McGraw- Hill Publishing private Limited, 2010.
5. R K Rajput, "Fluid Mechanics and Hydraulic Machines", S. Chand & Co, ISBN: 8121916666, 9788121916660, 2008.

14FP2025 CEREALS AND PULSES TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To create awareness and knowledge about the processing of major cereals like paddy, maize, pulses etc.
- To study the storage and handling techniques of cereals.
- To study about the byproducts obtained during processing along with their uses.

Course Outcomes

- The students have understood the Paddy Processing and Rice milling equipment which will help them for developing entrepreneurial skills.
- The students have developed skills in the milling and processing of pulses, maize.
- The students have learnt the grain storage and handling processes including the spoilage and problems associated with different methods of storage, which will enable them to promote protective measures against rodents and pests.

Paddy processing-Parboiling process-Methods of grain drying-Products and byproducts of paddy processing-Rice milling- Dehusking process-Modern rice mills and their components-Rice Mill yields and loss due to broken at different stages of milling-Milling of pulses-Traditional milling process-Modern milling process-Machinery and equipment employed-Pulse flour products-Dry milling of maize-wet milling of maize and corn-value added products-Grain storage and handling.

Reference Books

1. Jan A. Delcour and R. Carl Hoseney, "Principles of Cereal Science and Technology," ISBN: 1891127632, 9781891127632, AACC International, 2010.
2. P. S. Kendurkar, "Post-Harvest Technology and Value Addition in Cereals, Pulses and Oilseeds" Indian Society of Agricultural Biochemists, Indian Society of Agricultural Biochemists, 2008
3. Amalendu Chakraverty, "Post-Harvest Technology of Cereals, Pulses and Oilseeds", 3rd Edn., Oxford and IBH Publishing Company Pvt. Limited, 2006
4. Amalendu Chakraverty, Arun S. Mujumdar, Hosahalli S. Ramaswamy, "Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices" CRC Press, 2003.

14FP2026 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To understand about Coffee, its processing techniques and coffee products.
- To learn the different types of tea, its manufacturing techniques and quality parameters.

- To learn Cocoa, its processing and chocolate manufacturing technology.
- To know the processing and chemistry of major and minor spices.

Course Outcomes

- The students have understood the processing steps involved for different plantation products and spices.
- The students will apply their knowledge in processing industries related to plantation crops and spices.
- The students will gain skills on identifying the quality aspects of plantation crops and spices.

Coffee: Occurrence – chemical constituents – Harvesting and Technology of coffee and related products - Chicory chemistry – Quality grading of coffee. Tea: Occurrence – harvesting and Technology of various types of tea – Grading of tea. Cocoa and Cocoa Products: Occurrence Chemistry – Processing of cocoa and related products - Chemistry and technology of chocolate manufacture – Quality control of chocolates. Chemistry and Technology of Major & minor Spices: Chemistry of the volatiles –Enzymatic synthesis of flavour identical – Quality control- Synthesis of volatiles using micro-organisms, plant suspension cultures.

Reference Books

1. K.V. Peter, “Handbook of herbs & spices”, Volume2, ISBN: 0857095684, 9780857095688, Elsevier, 2012.
2. Chi-Tang Ho, Jen-Kun Lin, Fereidoon Shahidi. “Tea and Tea Products: Chemistry and Health-Promoting Properties, Nutraceutical Science and Technology”, CRC Press, 2008.
3. Susheela Raghavan, “Handbook Seasoning, Spices & Flavoring”, Second Edition, CRC Press, Publication, 2006.
4. Amalendu Chakraverty, Arun S. Mujumdar, G. S. Vijaya Raghavan & Hosahalli S. Ramaswamy: “Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices”, CRC Press, 2003.

14FP2027 FOOD ADDITIVES

Credits: 3:0:0

Course Objectives

- To understand the Chemistry of the additives added to food
- To understand the importance of additives in maintaining or improving food quality
- To Know the limits of addition as prescribed by FAO/WHO and PFA
- Develop newer additives with improved safety standards.

Course Outcomes

- The Students acquire knowledge about importance of additives in maintaining or improving food quality.
- The students are able to apply their knowledge on development of various instant premixes by addition of preservatives within the permissible limits.
- The Students understand about the properties, levels of addition and toxicity data of various food additives.

Food additives - definition and classification, food safety levels as per the specifications, safety evaluation of additives – determination of acute and chronic toxicity- NOEL, ADI, LD50 value, PFA regulations, GRAS status. Acidulants, Preservatives, Emulsifiers and gums, Antioxidants, Humectants, Dough conditioners, flour improvers, Fat substitutes and replacers, Colourants, Flavourants, Flavour enhancers, Nutritional additives, Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents : Types, chemical properties, levels of additions in individual products and toxicity data

Reference Books

1. H.-D. Belitz, Werner Grosch, Peter Schieberle. “Food Chemistry” Springer, ISBN: 3540699333, 9783540699330, 2009.
2. S.N.Mahindru. “Food additives”. APH Publishing, ISBN: 8131304183, 9788131304181, 2009.
3. Damodaran S., Parkin K. and Fennema O.R., “Fennema’s Food Chemistry”, CRC Press, ISBN 0849392721,, 2008.
4. Thomas Furia “Handbook of Food additives” CRC Press LLC, 2003

- Francisco D-V and Octavio P-L., “Natural Colorants for Food and Nutraceutical Uses”, CRC Press LLC, 2003.

14FP2028 FAT AND OIL PROCESSING TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To understand the physical and chemical properties of fats and oils
- To study the extraction and refining processes
- To learn the packaging, quality standards of fats and oils.

Course Outcomes

- The students have understood to appreciate the importance of fats and oils and their manufacture.
- The students can develop technology for manufacture of designer fats.
- The students can develop newer methods of analysis of oils and fats.

Physical and chemical properties of fats and oils - sources of vegetable oils - chemical reactions of oil – Oil extraction methods –mechanical expression - principle of operation and maintenance-solvent extraction process – batch and continuous-continuous -production of special oils –extraction process. Refining of oils - Production methods of vanaspati, ghee, butter and margarine colouring substances. Packaging of edible oils, vanaspati and ghee. Changes during storage of oil. Non edible oils– production and processing. Industrial applications of fats and oils – quality regulations - manufacture of soap, candle, paints and varnishes - ISI and Agmark standards –oil extraction plant- safety aspects- HACCP standards in oil industries.

Reference books

1. Gunstone F.D., “Vegetable Oils in Food Technology: Composition, Properties and Uses”, 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681, 2011.
2. Gunstone F.D., “Oils and Fats in Food Industry”, Blackwell Publishing, United Kingdom, ISBN – 13: 9781405171212, 2008.

14FP2029 TECHNOLOGY OF MEAT, POULTRY AND FISH

Credits: 3:0:0

Course Objectives

- To understand about the composition, nutritive value of meat, poultry and fish
- To know about processing technology of meat, poultry and fish
- To learn the technology of meat products and eggs

Course Outcomes

- The student will be able to understand about the composition of meat, poultry and fish,
- The student will have knowledge on the processing of meat, poultry and fish and their by products.
- The students will have knowledge about meat plant sanitation, hygiene and standards.

Meat composition- muscle structure and compositions- Post mortem muscle chemistry. Meat color, flavors of meat products, meat microbiology and safety. Slaughtering and carcass processing-Modern abattoirs- Carcass processing equipment, meat processing equipment. Meat Products. Meat plant hygiene, Good manufacturing practice and HACCP. Processing of Poultry Products. Spoilage factors. Plant sanitation; Poultry meat processing operations. Packaging of poultry products. Fish and other marine products processing. Basic biochemistry, spoilage factors of fish, field refrigeration and icing practice, Freeze preservation. Canning operations, Salting and drying of fish.

Reference Books

1. Leo M.L. Nollet, Fidel Toldra, “Advance Technologies for Meat Processing”, Woodhead Publishing Limited, CRC Press, ISBN: 1420017314, 9781420017311, 2006.

2. Mead G, "Poultry meat processing and quality", Woodhead Publishing Limited, CRC Press, ISBN: 18555737272, 9781855737273, 2004.
3. Hui, Y.H., Nip, W.K. and Rogers, R.W, "Meat Science and Applications". Marcel Dekkar Inc. New York, ISBN: 0203908082, 9780203908082, 2001.
4. Balachandran, K.K, "Post-Harvest Technology of Fish and Fish Products", Daya Publishing House, New Delhi, ISBN: 8170352371, 9788170352372, 2001.

14FP2030 BAKERY AND CONFECTIONERY TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To provide know how on the machinery and process involved in the baking process
- To understand the various types of sugar and its grades
- To know the confectionery product manufacture

Course Outcomes

- The students have gained knowledge on the ingredients of baking.
- The students have gained knowledge of the process and machinery involved in bakery and confectionery technology.
- The students have acquired experience of entrepreneur skills of bakery

Testing of Flour For Grains and flour for bakery applications – Bakery equipments – Sanitation and safety aspects- Bread manufacturing process – Process for the manufacture of cakes and biscuits – Importance of consistency of the dough and batter – Importance of the type of flour involved in the manufacture – Quality aspects of baked products - Process for the manufacture of cane sugar – Equipments involved in sugar manufacture - Sugar Refining – Quality standards for sugar - Sugar plant sanitation – Technology for the manufacture of Alcoholic and Non-alcoholic beverages – Quality aspects – Confectionery Technology – Types of confectionery – Additives and Equipments used in Confectionery manufacture – Quality aspects.

Reference Books

1. Stanley Cauvain and Linda S. Young, "Technology of Bread making", Springer, ISBN: 038785657, 9780387385655, 2007.
2. Leo M.L. Nollet, Fidel Toldra, "Advance Technologies for Meat Processing", Woodhead Publishing Limited, CRC Press, ISBN: 1420017314, 9781420017311, 2006.

14FP2031 DRYING TECHNOLOGY

Credits: 3:0:0

Course Objectives

- To understand the basic theory of drying and its significance in food systems
- To understand the importance of drying as a method of food processing
- To learn about the relative advantages / disadvantages of each method of drying

Course Outcomes

- The students have understood the theory of drying.
- The students have understood the principle and working of various types of dryers.
- The students are able to apply their knowledge on drying technology in various food industries.

Principles of drying –pyschrometry – Drying curves –Heat and mass transfer in dryers. Drying models - Water content in foods and its determination – Drying methods and types of dryers- Types of Feeding –Fundamentals of freeze drying – Freezing – Primary drying stage – secondary drying stage -Changes during freeze drying – Condensation, defrosting – Industrial freeze driers. Fundamentals of microwave and dielectric drying - Equipment for microwave and dielectric heating and drying. Fluidized bed drying– Effect of operating parameters –

conventional and modified fluidized bed dryer – Pneumatic / Flash dryers - Basic Operation Principle and Applications of Flash Dryers - Design of Flash Dryers - Materials Dried in Flash Dryers.

Reference Books

1. Singh and Heldman, "Introduction to Food Engineering" Academic Press, ISBN 9780123985309, 2013
2. Sahay K.M and K.K.Singh. "Unit Operations of Agricultural Processing" Vikas Publications, New Delhi, ISBN-81-259-1142-1, 2009.
3. Hui Y. H.,"Food Drying Science and Technology, Microbiology, Chemistry, Application", CHIPS, 2008.
4. Arun S. Mujumdar, "Handbook of Industrial Drying", CHIPS, 3rd Edition, 2006.
5. Loesecke,H. W. V, "Drying & Dehydration of Foods", Published by Agrobios, 2005.
6. Donald B. Brooker F.W. Bakker-Arkema Carl W. Hall "Drying and Storage of Grains and Oil Seeds" – AVI Book, ISBN 0- 442-20515-5,2002

14FP2032 PROCESS ECONOMICS AND PLANT LAYOUT DESIGN

Credits: 3:0:0

Course Objectives

- To enable the students understand the various concepts of economics of food plant.
- To understand the processes involved in layout design.
- To understand the development and design consideration and cost estimation in food industry.

Course Outcomes

- The students will gain knowledge on the various aspects of economics involved in Food Processing Industry.
- The students will understand the process of food plant layout design.
- The students will be able to apply their knowledge to design projects for setting up a Food Processing Industry.

Technical feasibility survey of Food Industry, process development, Food Process flow sheets – Hygienic food process design - equipment design and specifications – Plant layout – Factors to be considered while deciding the plant layout - Process and Product layout – Project evaluation and Cost estimations – Process profitability Application to a Food Plant - Plant Overheads - Profitability Analysis: Optimization techniques – Linear and Dynamics programming, Optimization strategies.

Reference Books

1. Dale F.Rudd and Charles Churchill Watson, Strategy of Process Engineering, John Wiley & Sons Inc, ISBN-978-0471744559, 2013
2. Gavin Towler, R.K. Sinnott, Chemical Engineering design principles, practice and Economics of Plant and Process. 2nd Edition. Elsevier, ISBN-9780080966595, 2012
3. Jasmin Ahmed, Mohammad Shafuir Rahman, Hand Book of Food Process Design, 2 Volume Set, Wiley Black Well, ISBN-978-1-4443-3011-3, 2012

14FP2033 FOOD ADDITIVES LAB

Credits: 0:0:2

Co Requisite: 14FP2027-Food Additives

Course Objectives

- To understand the Chemistry of the additives added to food
- To understand the importance of additives in maintaining or improving food quality
- To develop newer additives with improved safety standards.

Course Outcomes

- The students acquire knowledge about importance of additives in maintaining or improving food quality.
- The students are able to apply their knowledge on development of various instant premixes by addition of preservatives within the permissible limits.
- The students understand about the properties, levels of addition and toxicity data of various food additives.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2034 FOOD PRODUCT TECHNOLOGY LAB – II

Credits: 0:0:2

Co Requisite: 14FP2006-Dairy Engineering and Technology &
14FP2026-Plantation Products and Spices Technology

Course Objectives

- To understand the ingredients needed for preparations of food products.
- To calculate the quantity of ingredients for preparations of food products.

Course Outcomes

- The students are able to list the various ingredients needed for preparations of food products.
- The students are able to calculate the quantity of ingredients for preparations of food products.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP2035 FOOD PRESERVATION PRINCIPLES

Credits: 3:0:0

Course Objectives

- To understand the fundamentals of bio molecules
- To impart basic knowledge on the methods of analysis of fats and oils
- To learn about the food borne diseases , food poisoning and food preservation principle

Course Outcomes

- The students gain knowledge on the fundamentals of food constituents.
- The students get skills on various principles of food processing.
- The students acquire knowledge of various preservation techniques.

Fundamentals of food constituents: Carbohydrates – Classification - Analysis of Fats and oils -Vitamins–Fat–nutritional significance. Food additives: Classification, intentional and non- intentional additives, food colorants – natural and artificial; food flavors. Microorganisms associated with food-fermented foods and food chemicals, single cell protein. Food borne diseases- factors responsible for spoilage of vegetable, fruit, meat, poultry, beverage. Food preservation-Sterilization, pasteurization and blanching, thermal death point– Canning; frozen storage-freezing methods, factors affecting quality of frozen foods.

Reference Books

1. Tom Coultate , Food the Chemistry of its Components 5th Edition, RSC Publishing, ISBN: 978-0-85404-111-4, 2009
2. Frazier W.C. and D.C. Westhoff, “Food Microbiology”, 4th Ed., McGraw-Hill Book Co., New York, ISBN-9780070667181,2008
3. Neelam Khetarpaul, Food Processing and Preservation, Daya Publishing House, ISBN-81-7035-4135-418-8, 2005.

4. James M. Jay, Martin J. Loessner, David A. Golden, Modern Food Microbiology, 7th Edition, Springer Science and Business Media Inc, ISBN-0-387-23180-3, 2005

14FP2036 PROCESSING OF FOOD COMMODITIES

Credits: 3:0:0

Course Objectives

- To impart knowledge on the basics of food processing
- To study various processing methods for various food materials like fruits & vegetables, dairy products, cereals, meat, poultry, fish and bakery products .
- To study various innovative food processing techniques

Course Outcomes

- Students will have a know-how on the various processing technologies involving fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products
- Students have acquired basic knowledge on microbiology of food products
- Students will have an overview of the possible arena of entrepreneurial activity related to food products.

Technology of Rice, Pulse milling and Wheat milling-Oil extraction-Methods of manufacture of bread-Fruits and vegetable processing - Preservation treatments-Basics of Canning, Minimal processing and Hurdle technology. Processing of fruit juices. Dairy processing-manufacture of milk and milk products - Meat, poultry and fish processing and their products- Processing of Plantation products -Processing of Tea, Coffee and Cocoa and chocolate Processing of spices-. Pepper, cardamom, ginger, vanilla and turmeric.

Reference Books

1. Srivastava, R.P. and Kumar, Sanjeev: Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co (3rd Edition 2006).
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press, USA (2001)
3. W. James Harper and Carl W. Hall: Dairy Technology and Engineering AVI Publishing, Westport, USA (1976)
4. Karel Kulp and Joseph P Pante:Hand Book Of Cereal Science and Technology Mercel Dekkar USA (2000)
5. Samuel Matz: The Chemistry and Technology of Cereals as Food and Feed, Chapman & Hall (1992)

14FP2037 TECHNOLOGY OF PACKAGING

Credits: 3:0:0

Course Objectives

- To provide knowledge on packaging and packaging materials.
- To understand the working of various packaging material manufacturing methods.
- To enable the students to understand the interaction of food items with packaging materials and packaging material testing.

Course Outcomes

- The students will get exposure about packaging, packaging materials and packaging methods.
- The students will develop knowledge on manufacturing of packaging materials and testing.
- The students will be familiar about the food distribution chain and sustainable packaging.

Packaging functions, strategy, design, need and environmental effects. Properties of packaging media. Effect of environmental factors and biological factors on quality of food products. Vacuum and Inert Gas Packaging. Metal cans for packaging. Glass in food packaging. Flexible films, co-extruded films and Laminates in packaging. Rigid and Semi rigid plastic-Retort pouch. Paper and Paperboard. Filling and sealing. Interaction of food and packaging material: Active and Modified atmosphere packaging. Speciality packages. Tests for packaging materials.

Reference Books

1. M.L.Rooney, "Active Food Packaging", Blackie Academic & Professional Publisher, London, 2012.
2. Coles, R., Dowell, D.M., Kirwan, J. "Food Packaging Technology", Black Well Publishing Ltd., 2009.
3. Chiellini, E., "Environmentally Compatible Food Packaging", Wood Head Publishing Ltd., 2008.
4. Gordon L. Robertson, "Food Packaging Principles & Practice", CRC Press, 2006.
5. NIIR Board, "Food Packaging Technology Handbook", National Institute of Industrial Research, New Delhi, 2004.

14FP2038 FUNCTIONAL FOODS AND NUTRACEUTICALS

Credits: 3:0:0

Course Objectives

- To understand the basics of nutraceuticals and functional foods
- To study the significance of nutraceuticals and their role in disease prevention
- To identify new strategies for marketing of traditionally known nutraceuticals

Course Outcomes

- The students have understood the importance of Functional food for preventive therapy.
- The students have learnt methods for extraction of nutraceuticals
- The students have learnt methods for identification nutraceutically significant molecules..

Teleology and Organization models for nutraceuticals – Classification of Nutraceuticals - Flavonoids And Carotenoids As Antioxidants and anti cancer agents- Omega-3 Fatty Acids and Cardiac Arrhythmias, Glycemic control and rheumatoid arthritis – CLA as a nutraceutical – Mechanism - Potential health benefits and adverse effects of CLA – Lycopene, Garlic, Olive oil, and Nuts as functional Foods – Probiotics and Prebiotics – Herbs as functional Foods - Kinetic modelling of chemical reactions – Accelerated shelf life testing – Regulatory and marketing issues for nutraceuticals

Reference Books

1. Aluko R.E., Functional Foods and Nutraceuticals, Springer, 2012. ISBN 978-1-4614-3480-1.
2. D Bagchi, F C. Lau, D K. Ghosh, Biotechnology in Functional Foods and Nutraceuticals, CRC Press, 2010. ISBN 9781420087116.
3. John Shi, Functional Food Ingredients and Nutraceuticals: Processing Technologies, CRC Press, Taylor and Francis Group, 2007. ISBN: 0 – 8493 – 2441 – 6.
4. Wildman, R.E.C., "Handbook of Nutraceuticals and Functional Foods", II edition, CRC Press LLC. 2006. ISBN--10: 0849364094.
5. Hasler C M., Regulation of Functional Foods and Nutraceuticals: A Global Perspective, IFT Press, Blackwell Publishing, 2005. ISBN: 9780813811772.

14FP2039 MATERIAL SCIENCE FOR FOOD ENGINEERS

Credits 3:0:0

Course Objectives

- To enable students understand the basics of material science
- To enable them understand the importance of it in food equipment design
- To enable students understand the current trends in developing food grade materials

Course Outcomes

- The Students will attain knowledge about designing of food grade equipments
- The Students will be able to develop newer materials for food use
- The Students will be able to develop cost-effective methods of developing food-grade materials

Properties of Crystals and Solids : Classification of Engineering materials –Crystal geometry– Structure determination by X-ray Diffraction- Crystalline and Non-crystalline states – Inorganic solids – Metals and Alloys - Imperfection in Crystals and Phase diagram – Iron-Iron carbide systems and applications – Fick’s second law of diffusion and its importance in alloy manufacture – Phase transformations and its applications –Manufacture and properties of different types of steel – Basics of SS Fabrication – Deformations – Creep, Fatigue, and Fracture – Oxidation and Corrosion and methods of protection

Reference Books

1. Khanna O.P., “A Textbook of Material Science and Metallurgy”, Dhanpat Rai Publications, 2013.
2. Rajput R.K., Fundamentals of Materials Science, S.K. Kataria and Sons, 2011.
3. Mittemeijer, Eric J., Fundamentals of Materials Science, Springer Publications, 2011.
4. Khurmi R. S. & R.S. Sedha, Materials Science, S. Chand and Co., 2008.
5. Raghavan V.. “Materials Science and Engineering -A First course”, Fifth Edition, Prentice – Hall of India Private Ltd., New Delhi. 2008.

14FP2040 FOOD INDUSTRY WASTE MANAGEMENT

Credits 3:0:0

Course Objectives

- To enable the student understand the extent of wastes produced in a food industry and its environmental effects
- To enable the student understand the nature of food wastes and methods of treatment
- To enable the student know the importance of waste utilization in Food industries

Course Outcomes

- Students will attain knowledge about the methods of managing food wastes
- Students will gain knowledge on the methods for utilization of food wastes.
- Students will gain knowledge on getting value-added products from wastes

Legislations pertaining to Food waste disposal - Key drivers for waste management and co-product recovery in Food Processing – Strategies to be followed for optimizing manufacturing to minimize wastes – Key issues and technologies for Food waste separation and Co-product recovery – Methods of solid and liquid waste treatment – Impact of water footprint and rehabilitation of Food industry waste water - Waste management in specific food industries – Methods to obtain value-added products from wastes.

Reference Books

1. Kosseva M and C Webb, Food Industry Wastes, Assessment and Recuperation of Commodities, Academic Press, 2013. ISBN: 978-0-12-391921-2
2. Panda H. The Complete Book on Managing Food Processing Industry Waste, Asia Pacific Business Press Inc, 2011. ISBN: 9788178331454
3. Waldron K.W., Handbook of waste management and co-product recovery in food processing (Volume 1), Woodhead Publishing Ltd., 2007. ISBN - 1 84569 025 7
4. Arvanitoyannis I., Waste Management for the Food Industries, Academic Press, 2007. ISBN: 978-0-12-373654-3.
5. Wang L.K., Y-T Hung, H H. Lo and C Yapijakis, Waste Treatment in the Food Processing Industry, CRC Press, 2005. ISBN 9781420037128

14FP2041 EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING

Credits: 3:0:0

Course Objectives

- To study about the concepts and principles of various techniques such as High Intensity Pulse Techniques, Light Pulses and emerging aspects in food process engineering.

- To learn about the equipments used and working principle for the emerging aspects in food process engineering.
- To know the various applications of the new technologies in food process engineering.

Course Outcomes

- Students are updated of the recent technological advancements in the field of Food Technology.
- Students are appraised of the alternate technologies in Thermal Processing of foods.
- The students are able to apply their knowledge on various technological advancements in the field of Food Technology.

Introduction to High Pressure Processing of foods, effect on textural, nutritional and Microbiological quality of foods. Application in the food systems. High Pressure Freezing, Principles, Working and Applications. Pulsed Electric Field processing of foods Principles – Mechanism of action – PEF treatment systems. Principle and Mechanism of osmotic dehydration– Applications. Principle of ultrasound. Basics of ohmic heating-equipment-applications. Hurdle technology- Basics, mechanism, applications and effect of hurdles in foods.

Reference Books

1. Shafiur Rahman. 2007. Handbook of food preservation. Published by Taylor & Francis Group, LLC.
2. Da-Wen Sun. 2005. Emerging technologies for food processing. Elsevier Academic Press, California.
3. Fellows P. J. 2000. Food processing technology principles and practice. Published by Woodhead Publishing Limited, Cambridge, England.
4. Da-wen Sun: Emerging Technologies for Food Processing, Elsevier Academic Press Marcel Dekker Inc. NY (1995)
5. G.W. Gould. 1995. New Methods of Food Preservation. Published by Blackie Academic and Professional, UK.

14FP2042 COMPUTATIONAL FLUID DYNAMICS LAB

Credits: 0:0:2

Co Requisite : 14CE2003- Mechanics of Fluids & 14FP2021-Food Process Equipment Design

Course Objectives

- To make students to understand the flow and heat transfer analysis in engineering problems of practical interest.
- To enable students to study different fluid flows and developing a better intuition of fluid mechanics.
- To enable students to understand the process of developing a geometrical model of the flow, applying appropriate boundary conditions, specifying solution parameters, and visualizing the results.

Course Outcomes

- The students get technical knowledge in the actual implementation of CFD methods The emphasis on the use of CFD as a virtual fluid laboratory.
- The students understand the process of developing a geometrical model of the flow, applying appropriate boundary conditions, specifying solution parameters, and visualizing the results.
- The students have an appreciation for the factors limiting the accuracy of CFD solutions.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP3001 SEPARATION PROCESSES IN FOOD ENGINEERING

Credits: 3:0:0

Course Objectives:

- To enable the students understand the concepts of separation of solids and liquids in food engineering application.
- To understand the principle behind various separation process equipments.
- To provide knowledge to the students about the working and application of various separation equipments.

Course Outcomes:

- Students will be able to apply their knowledge on separation techniques.
- Students will be able to select suitable separation equipments needed for food industries.
- Students will be able to operate various separation equipments.

Basic principles of fluid flow-devices to measure pressures-types of flow-simple mass balance - continuity equation-pressure drop due to friction-flow in packed beds; Mechanical separation-screens – sedimentation- Filtration-equipments for filtration and sedimentation; Centrifugal separation- Basic equations. Different types of centrifuges - advantages and applications; Filtration by membrane systems- Reverse Osmosis (RO), Nano filtration (NF), Diafiltration, Ultra filtration (UF) and Micro filtration (MF), Membrane Configuration -, membrane materials-Adsorption and Diffusion-Basics of absorption- Diffusion of gases in liquid and solid foods, Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components

Reference Books

1. Geankoplis C.J., “Transport process and separation process principles”, PHI learning private limited, New Delhi, 4th edition, ISBN-978-81-203-2614-9, 2008.
2. McCabe, W.L., Smith, J.C., and Harriott, P., “Unit operations of chemical engineering”. McGrawhill Intl. Edition, Singapore, 7th edn. ISBN-007-424740-6, 2005.
3. Coulson J.M., Richardson J.F., Bachurst J.R., and J.H. Harker – “Coulson & Richardson's Chemical Engineering – Vol. 2 Particle Technology and Separation Processes”, Butterworth & Heinemann - Elsevier science Ltd., Fifth Edition, ISBN 0750644451, 2002.
4. Ramaswamy H.S. and Markotte M., “Food Processing Principles and Applications”, CRC Press Ltd. ISBN-1-58716-008-0, 2006.

14FP3002 MASS TRANSFER PROCESSES IN FOOD ENGINEERING

Credit 3:0:0

Course Objectives:

- To understand the need of mass transfer process in food industries
- To understand the principle behind various mass transfer process
- To know the operation of various mass transfer equipments

Course Outcomes:

- The students can understand the application of various mass transfer processes in food industries
- The student can select suitable mass transfer operation for a specific need
- The students can design various mass transfer equipments for food processing equipments

Energy balance and material balance for various mass transfer processes. Vapour liquid equilibrium, simple batch and steam distillation. Single and multiple effect evaporator - mode of operation and methods of feeding. Thermo and mechanical systems in evaporators. Solid liquid and liquid liquid extraction. Super critical fluid extraction. Super critical fluid state, Properties of Super critical CO₂, Density, Viscosity, Volatility. Applications; extraction of Fatty acids, oleoresins and essential oils; Relative advantages, limitations and economics.

Text Books:

1. Geankoplis C.J., "Transport process and separation process principles", PHI learning private limited, New Delhi, 4th edition, ISBN-978:81-203-2614-9, 2008.
2. Ramaswamy H.S. and Markotte M., "Food Processing Principles and Applications", CRC Press Ltd. ISBN-1-58716-008-0, 2006.
3. McCabe, W.L., Smith, J.C., and Harriott, P., "Unit operations of chemical engineering". McGrawhill Intl. Edition, Singapore, 7th edn. ISBN-007-424740-6, 2005.
4. Coulson J.M., Richardson J.F., Bachurst J.R., and J.H. Harker – "Coulson & Richardson's Chemical Engineering – Vol. 2 Particle Technology and Separation Processes", Butterworth & Heinemann - Elsevier science Ltd., Fifth Edition, ISBN 0750644451, 2002.

14FP3003 TECHNOLOGY OF FOOD FLAVOURANTS AND COLOURANTS**Credits: 3:0:0****Course Objectives:**

- To enable the student to understand the basics of foods flavours and colours
- To enable the student to learn the Chemistry & technology of natural flavours, pigments

Course Outcomes:

- To develop methods for stabilization of natural colorants
- To develop aroma chemicals
- To develop techniques for analysis of colorants and aroma chemicals

Basics of flavours and colours: Olfactory perception of flavour and taste – Theories of olfaction - Molecular structure and activity relationships of taste-Chemicals causing pungency, astringency, cooling effect - Regulations, Toxicology and Safety aspects. Technology of natural flavours: Classification – Alliaceous flavours - Bittering agents, Coffee and Cocoa, Fruit flavours. Evolution of flavours during processing – Essential oils and oleoresins - Chemistry and Technology of Chlorophyll and carotenoids - Haems and bilins, annatto, saffron, turmeric- - Anthocyanins and betalains - Microbial and cell suspensions in the synthesis of colours and flavours- Technology for the production of dried colourants and flavorants - Analysis of flavours and colours: Total component analysis - Head space analysis –Solid phase micro extraction - E-Nose technology - Tristimulus colorimetry.

Reference Books

1. Socaciu C., "Food Colorants - Chemical and Functional Properties", CRC Press, Taylor and Francis group, LLC, ISBN No. 9780849393570, 2008.
2. Reineccius G. and Heath H.B., "Flavor Chemistry and Technology" , Taylor and Francis group, CRC Press, II Edition, 2006.
3. Rowe D.J., "Chemistry and Technology of Flavors and Fragrances", Blackwell Publishing Ltd., U.K., ISBN No. 1405114509, 2005.
4. Marsili R., "Techniques for Analyzing Food Aroma", Marcel Dekker Inc., 1997
5. Francisco D-V and Octavio P-L., "Natural Colorants for Food and Nutraceutical Uses", CRC Press LLC, 2003.
6. Lauro G.J., "Natural Food Colorants", Marcel Dekker Inc., 2000.

14FP3004 FOOD PLANT LAYOUT AND DESIGN**Credits: 3:0:0****Course Objectives:**

- To enable the student to understand the various factors involved in the site selection and design of food plant layout.
- To enable the students learn the concept of preparing cost estimate and economics.
- To understand the importance HACCP and food safety laws governing food industries.

Course Outcomes:

On completion of the course, and exposed to

- The student will gain knowledge to design and setting up of new food processing plant as Entrepreneur and/or consultant.
- The student can prepare cost estimate and economic analysis of food industry.
- The student can implement the food safety standards in food industries.

Consideration for location of food processing plants- Site selection-Product Capacity– Storage of Raw materials and Product - Waste Disposal, Utilities – other requirements - water, electricity, labor, transportation facilities, refrigeration, boiler- laboratory - Plans for Future Expansion. Plant layout- different types. Flow process charts. Machine flow diagrams. Selection of processing and handling machines. Plant utilities - Raw material requirements. Application of system design and principles. Layout plans for different machines and utilities. Plant specifications and cost estimates, plant profile. Process plant sanitation and hygiene. Economics-Cost of Producing a Product-Capital - Elementary Profitability Measures.

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. R.K. Sinnot. “Coulson and Richardsons Chemical Engineering” Vo. 6., 4th Edition, Elsevier Publication. 2005.
3. Max S. Peters and Klaus D. Timmerhaus and Ronald West. “Plant Design and Economics For Chemical Engineers”, 5th Edition, Tata Mc-Graw Hill Education. 2003.
4. T.C. Robberts. “Food Plant Engineering Systems”. CRC Press. 2002.

14FP3005 INSTRUMENTAL TECHNIQUES FOR FOOD QUALITY AND SAFETY

Credit: 3:0:0

Course Objectives

- To understand the importance of analytical techniques for quality control
- To know the appropriate analytical method for specific purpose
- To apply the principles of instrumentation in food processing industries

Course Outcomes

- The students can understand the working principle of various instruments
- The students can do various qualitative and quantitative analyses
- The knowledge gained can be used for food quality control

Chromatography principles. High performance liquid chromatography, Gas chromatograph - column efficiency, types of detectors – FID, TCD, ECD, MSD. FTIR Spectroscopy. Atomic Absorption Spectroscopy and Atomic Emission Spectrometry (AES). ICP – Mass spectrometry - Atomic Fluorescence Spectrometry (AFS). The NMR Phenomenon – Types of information provided by NMR spectra – Instrumental and Experimental Considerations – Solid state NMR – application of NMR to Food analysis. Application of GC/MS, LC/MS / FAB/MS / MS/MS and linked scan techniques for food analyze.

Reference Books:

1. Semih ötles. Methods of analysis of food components and additives, 2012 second edition. CRC Press, Taylor and Francis group
2. Yolando Pico, Chemical analysis of food techniques and applications, 2012 Elsevier publications
3. Rouessac F. and Rouessac A. Chemical Analysis: Modern Instrumentation Methods and Techniques, 2007, 2nd Edition, John Wiley and Sons. Ltd. England. ISBN: 978-0-470-85903-2

14FP3006 STORAGE ENGINEERING OF GRAINS

Credits : 3:0:0

Course Objectives

- To enable the students to understand the various concepts of food storage, post harvest loss and prevention of such losses.
- To impart knowledge on the design aspects of storage structures
- To provide knowledge on modern storage methods

Course Outcomes

- The students will be able to know all the operation in food storage and post harvest handling.
- The food loss prevention can help to meet the food demand.
- The quality of the products can be maintained and make available during off season.

Storage of grains, Biochemical changes during storage, Storage Capacity estimate models-Storage factors affecting losses, Bag & bulk storage, Pressure distribution theories, Rodent control, method of stacking - preventive method, bio-engineering properties of stored products, Structural and thermal design of storage structures. Air distribution systems, CA & MA storage, Storage of dehydrated products, Food spoilage and prevention.

Reference Books

1. K.M. Sahay and K.K. Singh; Unit operations of Agricultural Processing, Vikash Publishing house, 2008.
2. Judith A. Evans, Frozen Food Science and Technology, Blackwell Publishing Ltd, 2008.
3. Y. H. Hui and others, Handbook of Frozen Foods, Marcel Dekker, Inc, 2004.
4. Jelle Hayma, The storage of tropical agricultural products, Agromisa Foundation, Wageningen, 2003.
5. David J. Walker and Graham Farrell, Food Storage Manual, Natural Resources Institute, 2003.
6. T.P.Ojha & A.M.Michael, Principles of Agricultural Engineering Vol-I, 2003, Jain Brothers, New Delhi.
7. P.Fellows, Food processing Technology: Principles and Practice, 2000, CRC, Wood Head Publishing Ltd.

14FP3007 FOOD LAWS AND SAFETY REGULATIONS

Credit: 3:0:0

Course Objectives

- To enable the students to understand the basics of food safety and regulations governing the same, the world over.
- To make the students to understand the role of individual personnel of the regulatory authority
- To enable to understand food safety management systems

Course Outcomes

- Students will be able to develop Protocols based on GMP for Food Processing Industries
- Develop new innovative norms and Ensure implementation of adequate safety regulations and control.
- Students will be able to run risk analysis based upon data and statistics obtained from production lines.

Structure, organization and practical operation of international intergovernmental food regulation bodies such as World Trade order - Codex Alimentarius -World Health Organization. Regulatory affairs - International Food Regulatory Affairs - Risk Analysis- Food and Health- Farm to Fork Regulation of the Food Chain- Regulating authority for food safety in India and its role - Food labelling –Standards at the world level for processed food, irradiated foods, genetically modified foods – EU & US approach to nutritional labelling and Health claims. General concepts of HACCP and ISO 22000. Safety aspects of drinking water and Indian regulations for bottled water.

Reference Books

1. The History and Future of the World Trade Organization, WTO Publications 2013, Craig Van Grastek, ISBN-13: 978-9287038715
2. Guide to the Food Safety and Standards Act. Tax-mann allied Services Pvt. Ltd., ISBN – 10 – 8174968288. 2006.

3. Rajesh Mehta and J. George - Food Safety Regulation Concerns and Trade- The Developing Country Perspective. Published by Macmillan India Ltd., New Delhi. 2005
4. Enhancing participation in Codex Activities : FAO/WHO training package, 2005, ISBN 92 5 1052778

14FP3008 LOGISTICS AND DISTRIBUTION MANAGEMENT IN FOOD INDUSTRY

Credits 3:0:0

Course objectives

- To understand the fundamentals of supply chain management
- To learn the importance of supply chain management in Food preservation
- To learn about the opportunities available in the country

Course outcomes

- Will able to develop skills on methods to improve supply chain management
- Will be able to develop newer and cost-effective strategies for logistics
- Will be able to help the consumer to get quality food.

Supply chain management – Basic concepts – Global supply chain operation - Planning and sourcing – Lean supply management and Six sigma quality– Agile supply management - Making and delivering – Coordination and use of Technology – Supply chain metrics – Opportunities – Developing a supply chain system – Relationship and integration – Third Party logistics in Supply chain – Sustainable supply chain management – Outsourcing – Internationalisation of the supply chain and retailing - Temperature controlled supply chains – Future perspectives

Reference Books

1. Sanders N.R., Supply chain management: A global perspective, Wiley Publications, 2012.
2. Scott C., H Lundgren, and P Thompson. Guide to Supply Chain Management, Springer Verlag, 2011. ISBN: 978-3-642-17675-3
3. Bourlakis, M.A., and P W. H. Weightman, Food Supply Chain Management, Blackwell Publishing Ltd. 2004. ISBN: 1-4051- 0168-7.
4. Michael H. Hugos, “Essentials of Supply chain management”, John Wiley and Sons, 2003. ISBN 0-471-23517-2
5. Eastham J., L Sharples and S D Ball, Food Supply chain Management – Issues for the Hospitality and retail sector, Reed Elsevier PLC group. 2001. ISBN: 0 7506 4762 0.

14FP3009 FOOD ANALYSIS LAB

Credits: 0:0:2

Course Objectives

- To train the student to analyse food components
- To make the students aware of the standards of food quality

Course Outcomes

- Students would be able to assess the quality of the food
- Students would be able to develop newer methods of food analysis

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP3010 FOOD ENGINEERING AND TRANSPORT PROCESSES LAB

Credits: 0:0:2

Course Objectives

- To enable the students to understand the principle and operation of food machinery.
- To enable the students to understand the means of pressure loss in fluid dynamics
- To enable the students to understand the means of heat losses in food systems

Course Outcomes

- Students would be able to apply the fundamental knowledge of operation of machinery and evaluate the performance.
- Students would be able to develop systems that minimize pressure losses in flow systems
- Students would be able to judge the efficiency of a system and develop suitable technologies

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP3011 FOOD PRODUCT TECHNOLOGY LAB

Credits: 0:0:2

Course Objectives

- To understand the ingredients needed for preparations of food products.
- To calculate the quantity of ingredients for preparations of food products.

Course Outcomes

- The students are able to list the various ingredients needed for preparations of food products.
- The students are able to calculate the quantity of ingredients for preparations of food products.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14FP3012 ADVANCES IN DAIRY, MEAT AND FISH PROCESSING

Credits: 3:0:0

Course Objectives

- To understand about the composition, nutritive value of meat, poultry and fish
- To know about processing technology of meat, poultry and fish
- To learn the value addition and packaging of meat, fish and poultry products

Course Outcomes

- The student will be able to understand to process meat, poultry and fish.
- The students will be able to learn hygienic and mechanised processing.
- The students will be able to prepare various value added products.

Introduction, Basic dairy terminology- Dairy Products technology- Quality aspects - Dairy Processing Equipments- Plant piping, Pumps. Energy use in Dairy plant.

Meat composition - Explanation of muscle structure and compositions - Description of animal fat and its modifiers. Description of bone and its modifiers. Post mortem muscle chemistry. Meat color, flavors of meat products, meat microbiology and safety. Slaughtering and carcass processing. Meat Products. Good manufacturing practice and HACCP. Poultry Processing - Fish and other marine products processing.

Reference Books

1. Leo M. L. Nollet, "Handbook of Meat, Poultry and Seafood Quality", Blackwell Publishing, 2007.
2. Garret Smit. G., Dairy Processing. Woodhead Publishing Limited, England. 2005.
3. Mead G, "Poultry meat processing and quality", Woodhead Publishing Limited, 2004.
4. National Institute of Industrial Research, Modern Technology of Milk processing and Dairy products, II Edition, NIIR Publications, India, 2004
5. Joseph Kerry, John Kerry and David Ledwood, "Meat Processing", Woodhead Publishing Limited, CRC Press, 2002.
6. Sukumar De. Outlines of Dairy Technology, Oxford University Press. 2001. ISBN: 9780195611946
7. Hui, Y.H., Nip, W.K., Rogers, R.W, "Meat Science and Applications". Marcel Dekkar Inc. New York,2001.
8. Balachandran, K.K, "Post Harvest Technology of Fish and Fish Products", Daya Publishing House, New Delhi, 2001.

14FP3013 ADVANCES IN FOOD MICROBIOLOGY

Credits: 3:0:0

Course Objectives

To enable the student to understand:

- The interaction between food and microbes
- The uses of microbes in the development of food products
- Importance of microbiology in relation to sanitation.

Course Outcomes

On completion of the course, the student will gain knowledge and exposed to

- Various microorganisms involved in food and food product spoilage
- The multifarious role in different types of food fermentations
- Preservation techniques and control measures employed in the promotion and production of microbiologically safe food

Food and microorganisms: factors affecting growth of microorganisms - food preservation and spoilage food – thermal and non thermal mode of preservation – Microbiology of various types of foods – Meat, fish, poultry, dairy products, fruits and vegetables, cereals and pulses, enteral nutrient solution – Indicators of food quality and safety– HACCP and food safety- food and enzyme produced by microorganism -Food borne diseases – Gastroenteritis, Staphylococcal infections, Botulism, Listeriosis, Salmonellosis, Shigellosis – Mycotoxins

Text Books

1. William C Frazier and Dennis C. Westoff, "Food Microbiology", Special Edition, Springer, The Mc Graw-Hill Companies, ISBN-9780070667181, 2008.
2. Adams M.R and Moss M.O, "Food Microbiology", Panima Publishing corporation, New Delhi, 2nd Edition, Third reprint, ISBN-13:9788122410143,978-8122410143, 2007.

14FP3014 ADVANCES IN PROCESSING OF CEREALS, PULSES AND OIL SEEDS

Credits: 3:0:0

Course Objectives

- To understand the structure and composition of cereals and pulses.
- To know the techniques involved in milling of cereals and pulses.
- To understand the extraction and refining of oil from oil seeds.

Course Outcomes

On completion of the course, the student will gain knowledge.

- Various techniques and equipments used to process cereals and pulses.
- Value added products developed from cereals and pulses.
- Different storage structures and protection of stored grains.

Structure, composition and quality characteristics of cereals and pulses- Machinery used for milling cereals and pulses-Parboiling of rice – Processing of maize - Nixtamalisation – Processing of Pulses - Products and by products of cereals and pulses-Extraction and refining of oil from oil seed-Techniques involved in milling and drying of cereals and pulses- Quality gradation in rice, corn, and pulses.

Reference Books

1. P. S. Kendurkar, Post-Harvest Technology and Value Addition in Cereals, Pulses and Oilseeds Indian Society of Agricultural Biochemists, Indian Society of Agricultural Biochemists, 2008
2. Amalendu Chakraverty, Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Edn., Oxford and IBH Publishing Company Pvt. Limited, 2006
3. Amalendu Chakraverty, Arun S. Mujumdar, Hosahalli S. Ramaswamy Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices CRC Press, 22-Jan-2003
4. Amalendu Chakraverty, R. Paul Singh: Postharvest technology: cereals, pulses, fruits and vegetables Science Publishers, 2001
5. Karel Kulp and Joseph P Pante, “Handbook of Cereal Science and Technology”, Mercel Dekkar, USA, 2000.

14FP3015 ADVANCES IN PROCESSING OF HORTICULTURE, SPICES AND PLANTATION PRODUCTS

Credit: 3:0:0

Course Objectives

- To enable the student to know about post harvest technology of fruits and vegetables.
- To provide knowledge on processing & preservation techniques of fruits and vegetables
- To provide knowledge on processing plantation and spice crops.

Course Outcomes

- The students acquire knowledge on fruit and vegetable processing.
- The students apply their knowledge of processing methods in food industries
- Students will be able to understand the processing steps involved for different plantation products and spices.

Importance of post harvest technology of fruits and vegetables -post harvest handling- Physiology -Spoilage - Principles and methods of preservation - Canning -Minimal processing -Hurdle technology - Quick freezing preservation- Drying and dehydration methods -Osmotic dehydration- Foam mat drying -Freeze drying - Intermediate moisture foods –Sensory evaluation of fruits, vegetables and their products.

Chemistry and Technology of Coffee– Production of coffee powder-Chicory chemistry - Quality grading. Tea - types of tea -Technology of Cocoa and Cocoa Products- Major Spices– Oleoresins and essential oils –Chemistry of the volatiles –Enzymatic synthesis of flavor identicals - Quality control. Processing of Minor Spices.

Reference Books

1. Chakraverty, A., Mujumdar, A.S., Raghavan, G.S.V., Ramaswamy, H.S. Handbook of post harvest technology – cereals, fruits, vegetables, tea and spices. Marcel Dekker Inc., New York (Special Indian Reprint). 2010.
2. Srivastava, R.P. and Sanjeev kumar. Fruit and vegetable preservation. Principles and practices. International book Distributing Co., Lucknow. 2002. ISBN:8185860742
3. Peter, K.V. Hand book of herbs and spices. Volume 2. Woodhead publishing Ltd., 2004Tainter, D.R. Grenis, A.T. Spices and Seasonings – A food technology hand book. 2nd edition. John Wiley and Sons, Inc., Canada. 2001.
4. Shafiur Rahman. Handbook of Food Preservation. Replika Press Pvt. Ltd. India.2006.

5. Verma, L.R and Joshi, V.K. Post harvest technology of fruits & vegetables (Vol I & II). Indus publishing company, New Delhi.2000.

14FP3016 MILLING AND BAKERY TECHNOLOGY

Credit: 3:0:0

Course objectives

To enable the students to understand

- Quality tests for wheat
- Importance of wheat quality on the quality of the products
- Milling and its importance in product manufacture

Course outcomes

- The students would be able to use the knowledge in developing new products
- The students would be able to use suitable machinery for minimising / altering the quality of wheat during milling
- The students would be able to develop newer standards for baked products

Laboratory testing of Wheat grain Quality – Testing of dough - Viscoamylograph, Farinograph - Wheat milling Flow sheet and Machinery involved - wheat products and wheat by-products - Bakery Equipment and Engineering - Bulk handling of ingredients, Weighing equipment, Dough mixers, Dividers, rounders, Proofing, moulding, Ovens, Slicers, Packaging materials and equipment, Sanitation and safety -Bread manufacturing processes – Biscuit- Types of biscuit doughs –importance of the consistency of the dough- Cake – Flour specification – ingredients – manufacturing process – types of chemically aerated goods - Types of Confectionery - raw materials and processing of toffee, chocolates, fruit drops, hard boiled candies

Reference Books

1. Sumnu S.G. and Sahin S. Food Engineering aspects of baking sweet goods, CRC Press, Taylor and Francis Group, 2008.
2. Hui Y.H., Bakery Products: Science and Technology, Blackwell Publishing, 2006. ISBN 13:978-0-8138-0187-2.
3. Cauvain S.P. and Young L.S., Baked Products: Science, Technology and Practice, Blackwell Publishing, 2006.ISBN-13: 978-1-4051-2702-8
4. Kulp K. and Ponte Jr. Joseph G, Handbook of Cereal Science and Technology, Second Edition, Revised and Expanded, Marcel Dekker Inc. 2000. ISBN 0-8247-8297-1.

14FP3017 FOOD INDUSTRY WASTE MANAGEMENT

Credits : 3:0:0

Course Objectives

- To enable the student understand the extent of wastes produced in a food industry and its environmental effects
- To enable the student understand the nature of food wastes and methods of treatment
- To enable the student know the importance of waste utilization in Food industries

Course Outcomes

- Students will attain knowledge about the methods of managing food wastes
- Students will gain knowledge on the methods for utilization of food wastes.
- Students will gain knowledge on getting value-added products from wastes

Legislations pertaining to Food waste disposal - Key drivers for waste management and co-product recovery in Food Processing – Strategies to be followed for optimizing manufacturing to minimize wastes – Key issues and technologies for Food waste separation and Co-product recovery – Methods of solid and liquid waste treatment –

Impact of water footprint and rehabilitation of Food industry waste water - Waste management in specific food industries – Methods to obtain value-added products from wastes.

Reference Books

1. Kosseva M and C Webb, Food Industry Wastes, Assessment and Recuperation of Commodities, Academic Press, 2013. ISBN: 978-0-12-391921-2
2. Panda H. The Complete Book on Managing Food Processing Industry Waste, Asia Pacific Business Press Inc, 2011. ISBN: 9788178331454.
3. Waldron K.W., Handbook of waste management and co-product recovery in food processing (Volume 1), Woodhead Publishing Ltd., 2007. ISBN - 1 84569 025 7
4. Arvanitoyannis I., Waste Management for the Food Industries, Academic Press, 2007. ISBN: 978-0-12-373654-3.
5. Wang L.K. , Y-T Hung, H H. Lo and C Yapijakis, Waste Treatment in the Food Processing Industry, CRC Press, 2005. ISBN 9781420037128

14FP3018 REFRIGERATION AND COLD STORAGE ENGINEERING

Credits : 3:0:0

Course Objectives

- To enable the students to understand the various concepts behind refrigeration and storage construction.
- To study the various refrigeration systems.
- To understand the shelf life enhancement under refrigerated condition.

Course Outcomes

- The students will be able to apply their knowledge on cold storage of perishable products.
- The students will be able to design refrigeration and cold storage systems.
- The students will be able to understand the controlling of microbial activity and maintain freshness of the products.

Refrigeration cycles, Refrigerants and Equipments- COP -Atmospheric air and its properties, Psychometrics, Cold Storage- construction, design, prefabricated systems. Freezer storage, pre-cooling and pre freezing. Cold storage practice, stacking and handling of materials, optimum temperatures for foods. Storages- operation and maintenance. Chilled foods- equipment, Secondary refrigerants, direct expansion, transport and display cabinets - microbiology, packaging - Hygienic design considerations for chillers and chilled Storages- Evaporative cooling and its applications. Freezing equipment, Freezing rates, ice crystals, quick freezing, cryogenic Freezing, freezing of different foods.

Reference Books

1. Da-Wen Sun, Hand book of Frozen Food Processing and Packaging, Second Edition, CRC Press, Taylor and Francis Group, 2012. ISBN 978 – 1 – 4398- 3604 – 0
2. C.P. Mallet, Frozen Food Technology, Springer London, Limited, 2012. ISBN 1461365767, 9781461365761
3. William C. Whitman, William M. Johnson, John A. Tomczyk, and Eugene Silberstein Refrigeration and Air Conditioning Technology, Sixth Edition, Delmar, Cengage Learning, 2009.
4. Judith A. Evans, Frozen Food Science and Technology, Blackwell Publishing Ltd, 2008.

14FP3019 ADVANCES IN FOOD PROCESS ENGINEERING

Credits: 3:0:0

Course Objectives

- To enable the students to study & understand the various preservation methods foods.
- To enable the student to understand the emerging technologies applied to food processing.
- To strategize the applications in a wide range of food systems.

Course Outcomes

- The students will be able to conserve and minimize the losses in food produce.
- The students will be able to apply the know how in maintaining food security.
- The students will be able to develop newer technologies for food preservation.

Thermo bacteriology of foods – Understanding freeze concentration - membrane process -ultra filtration and Reverse osmosis. Minimal Processing of Foods with thermal methods- Spray drying – Ohmic heating - Microwave processing – Equipment. Application of Biosensors and Biocatalysts in Food. Non thermal methods- its applications - Application of light pulses in sterilization of foods and packaging materials – High pressure processing- Insight on technologies like osmotic dehydration - freeze drying - Food irradiation - advantages and applications. - Super critical fluid extraction – Aseptic processing in foods - extrusion cooking – equipment.

Reference Books

1. James G.Brennen., “ Food Processing Hand Book”, Wiley – VCH Verlag GmbH, 2006.
2. Sun D-W, “Emerging Technologies for Food Processing”, Published by Academic Press, 2005.
3. Ohlsson T. and Bengtsson N., “Minimal Processing Technologies in the Food Industry”, Published by Woodhead Publishing Ltd.,ISBN No. 0849312078, England, 2002.
4. P Richardson, Campden and Chorleywood., “Thermal Technologies in Food Processing” Food Research Association, UK, Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, CB1 6AH, England, 2001.
5. Guy R. “Extrusion cooking – Technologies and Applications” Woodhead Publishing Ltd., CRC Press LLC, England, 2000.
6. Gould G.W., “New Methods Of Food Preservation”, Aspen Publishers, Great Britain, ISBN No. 0834213419, 1999.

14FP3020 ENGINEERING PROPERTIES OF FOOD

Credits: 3:0:0

Course Objectives

- To learn the Engineering properties food and related biomaterials
- To understand the importance in developing new products
- To understand the significance of engineering properties in deciding the sequence of unit operations during processing, handling and storage.

Course Outcomes

- The students will understand the science and engineering concepts for characterizing the thermo-physical behaviour of foods and related biomaterials.
- The students will know the basic principles needed to select and operate instruments and equipments.
- The students will know to design and develop newer and cost effective technologies.

Mechanical properties of foods: compression and shear, deformation testing ,non-destructive methods. Mechanical damage to fruits and vegetables, grains and seeds: failure criteria, external force during handling, detection and evaluation damage. Rheological properties of liquid foods - measurement and applications. Textural Properties: Instruments for measurement of consistency, hardness, firmness, brittleness - Dielectric properties- loss factor, dielectric constant - Gas exchange properties of fruits and vegetables: respiration and fermentation, gas diffusion and applications. Electromagnetic properties- Non destructive methods of testing - optical instruments, colour and colour spaces, NIR spectroscopy.

Reference Books

1. Ludger Figura and Arthur Teixeira. Food Physics-Physical Properties-Measurement and Applications, Springer 2007 .ISBN : 0-12-119062-5
2. Rao MA, Rizvi SSH and Datta AK, Engineering Properties of Foods .Taylor & Francis/CRC press 2005

3. Malcolm Bourne .Food Texture and Viscosity Concept and Measurement .API -2002 ISBN : 978-3-540-34191-8

14FP3021 DESIGN OF FOOD PROCESSING EQUIPMENTS

Credit 3:0:0

Course Objectives

- To know the importance of process equipment design in processing industries.
- To know the factors influencing the process equipment design
- To have knowledge about the materials of construction of the process equipments

Course Outcomes

- The students can design the process equipment for food processing
- The students can calculate the capital cost for food process plant
- The students can calculate the cost of production of the product

Materials of construction, design of pressure vessels, cylindrical shell, internal and external pressure. Design of storage vessels. Rectangular tank without stiffeners and with stiffeners. Design of reaction vessels and its classification. Design of vessel shell with half coil, design of vessel shell with jacket. Design of Heat exchangers - design pressure and design temperature- shell design and tube heat exchanger design. Design of evaporators – types and design consideration. Design of driers - design of tray dryer, rotary dryer.

Reference Books

1. James R. Couper, W. Roy Penney, James R Fair, Stanley M. Wales. Chemical Process Equipment Selection and Design, third edition 2012, Elsevier publications.
2. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113, 2003.
3. Coulson ,J.M. and Richardson,J.F. “Chemical Engineering “ Butterworth-Heinemnn Elsevier, ISBN-0750644451, 2002.

14FP3022 ADVANCES IN PACKAGING AND HANDLING OF FOODS

Credit 3:0:0

Course Objectives

- To study about the functions of packaging along with the influence of various factors on food.
- To know about the different packaging materials like cans, bottles, flexible films etc.
- To study about the various methods of packaging and the equipments used for packaging.

Course Outcomes

- Students will attain knowledge about the testing of various packaging materials and also suitability of packaging materials with respect to the products.
- Students understand the designing of various storage structures and theories related to it.
- Students are updated of the recent technological advancements in the field of Food Packaging.

Importance of packaging - Fundamentals of packaging - Packaging materials and their properties, suitability and costs. Manufacture of packaging materials- Metals, Glass, Plastic- Flexible, semi-rigid, rigid - Paper and paperboard. Filling and sealing in food packaging - Types of Packaging – Active, MAP, CA, Intelligent, Retort pouch, vacuum, inert gas - Labelling and Printing. Tests for Packaging materials. Importance of material handling, electro-mechanical material handling-bulk conveying equipment (belt/chain/drag, screw/auger conveyors, pneumatic conveyors, bucket elevators etc) - Handling of wet products.

Reference Books

1. K.M. Sahay and K.K. Singh; Unit operations of Agricultural Processing, Vikash Publishing house, 2008.

2. K. L. Yam, D.S. Lee and L. Piergiovanni, Hand Book of Food Packaging, CRC Press, 2006
3. G. L. Robertson, Food Packaging: Principles and Practices, 2nd ed, CRC, 2005
4. R.Coles, D.McDowell and M. J. Kirwan, Food Packaging Technology, CRC Press, 2003
5. R. Ahvenainen, Novel Food Packaging Techniques, Woodhead Publishing, 2003
6. T.C.Robberts: Food Plant Engineering Systems, CRC Press Ltd. Washington, USA, 2002.
7. R.Paul Singh, Dennis R.Heldman; "Introduction to Food Engineering" (3rd edition), Academic press, Elsevier, 2001.

14FP3023 FOOD MATERIAL SCIENCE

Credits: 3:0:0

Course Objectives

- To enable students understand the importance of food polymers
- To make the students understand the interaction of food constituents in maintaining the texture and structure of a food
- To enable the students understand the effect of various methods of processing on the structure and texture of food materials

Course Outcomes

Students would be able

- To develop new products which are nutritional and cost effective
- To predict their behaviour during storage
- To develop cheaper sources of raw materials for a product

Basics of theory of glass transitions –Key elements of the food polymer science approach –Models – the dynamics map –water as a plasticizer - Crystallisation – gelation mechanism –Mechanism of gel formation in food systems– Basic Theories of gelation – mechanical properties of cured gels –Foods as composite materials –solid foams and sponges – Fibrous structures – Reinforcement by solid particles and fibers –Cellular structures of fruits and vegetables - Emulsions – Types of food emulsions –Measurement of particle size and size distributions in emulsions - Factors affecting stability of emulsions – Structures of adsorbed layers on the surfaces of emulsion droplets - Protein stabilized emulsions and foams -Mechanism of Maillard Reaction – Factors influencing Maillard reaction – Type of amino acid, pH, type of sugar, solvent state, sugar – amine ratio, Advanced glycosylation products - - Kinetics of Maillard browning

Reference Books

1. Aguilera J.M. and Lillford P.J., "Food Materials Science – Principles and Practice, Springer, ISBL 978-0-387-71946-7, 2008.
2. Schwartzberg H.G., and Hartel R.W., "Physical Chemistry of Foods", Marcel Dekker Inc., New York, ISBN No. 0824786939, 1992.
3. Friberg S., Larsson K. and Sjoblom S. "Food Emulsions" Marcel Dekker Inc., Fourth Edition, ISBN No. 0824746961, 2004.
4. Damodaran S., Parkin K. and Fennema O.R., "Fennema's Food Chemistry", CRC Press, ISBN No. 0849392721, 9780849392726, 2008.
5. Belitz H-D., Grosch W. and Schieberle P., "Food Chemistry"- Springer Verlag, Berlin Heidelberg, Germany, III Revised Edition, ISBN No. 3540408177, 2004.

14FP3024 FOOD PROCESSING AND BIOTECHNOLOGY

Credit 3:0:0

Course Objectives

- To provide knowledge about the chemistry and microbial aspects of food.
- To teach the various processing methods of foods.

- To equip knowledge with the various equipments for processing of foods.

Course Outcomes

- The student will gain knowledge about the chemistry and microbial aspects of food.
- The student will have the know-how of various processing methods of foods and the related equipments for processing of foods.

Food Chemistry-Constituent of food – contribution to texture, flavour and organoleptic properties of food; food additives – intentional and non-intentional and their functions; enzymes in food processing. Food Microbiology - Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases – infections and intoxications, food spoilage – causes. Food Processing-Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing. Food Preservation- Use of high temperatures – sterilization, pasteurization, blanching, aseptic canning; frozen storage – freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods. Manufacture of Food Products- Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

Reference Books

1. Saravacos GD and Maroulis ZB, Food Process Engineering Operations, Taylor and Francis group, 2011. ISBN 9781420083538.
2. Campbell-Platt, G. Food Science and Technology, Wiley-Blackwell, 2009. ISBN: 978-0-632-06421-2.
3. Damodaran S, Parkin KL, Fennema OR, Fennema's Food Chemistry, CRC Press/Taylor & Francis, 2008
4. Adams MR and Moss MO, Food Microbiology, 3rd ed. RSC Publishing, 2008. ISBN 978-0- 854042845.

14FP3025 ADVANCES IN PROCESSING OF HORTICULTURE PRODUCTS

Credit: 3:0:0

Course Objectives:

- To enable the student to know about post harvest technology of fruits and vegetables.
- To provide knowledge on processing & preservation techniques of fruits and vegetables
- To make the students acquire knowledge on fruit and vegetable processing

Course Outcomes:

- The students would be able to develop skills on various preservation techniques.
- The students would apply their knowledge in developing newer and cost-effective strategies of food preservation
- The students would be able to develop foods that are wholesome and safe

Importance of post harvest technology of fruits and vegetables -post harvest handling- Physiology -Fruit ripening - Spoilage -Deteriorative factors and their control - Principles and methods of preservation -Pre-treatments - Commercial canning -Minimal processing -Hurdle technology -Thermal and non-thermal preservation - Quick freezing preservation- Drying and dehydration methods- Different types of dryers- components and working- Osmotic dehydration- Foam mat drying -Freeze drying - Emerging preservation techniques- Microwave heating – Radiation preservation - Intermediate moisture foods –Ohmic heating -High pressure processing -Sensory evaluation of fruits, vegetables and their products - Packaging and storage- packaging materials-Aseptic packaging -Storage systems of fruits and vegetables and their products -Cold storage - Modified and Control Atmosphere Storage.

Reference Books

1. Rodrigues FS and Fernandes AN. Advances in Fruit Processing Technologies, CRC Press, Taylor and Francis group, 2012. ISBN 978 – 1 – 4398- 5152 – 4.
2. Hui Y.H. Handbook of Fruits and Fruit Processing. Blackwell Publishing, 2006. ISBN 13: 978 – 0 – 8138-1981-5.

3. W Jongen. Fruit and Vegetable Processing: Improving Quality, Woodhead Publishing Ltd., England. 2002. ISBN 185573548.
4. Shafiur Rahman. Handbook of Food Preservation. Replika Press Pvt. Ltd. India.2006.

14FP3026 FOOD ANALYSIS AND AGRO BIOTECHNOLOGY LAB

Credits : 0:0:4

Course Objectives

- To understand about the analysis of food products
- To know about the standards of analysis.
- To learn the biotechnology aspects of foods

Course Outcomes

- The student will be able to understand the analysis methods of food products.
- The students will be able to apply their knowledge in research centres.
- The students will be able to prepare standards for analytical methods.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.