ADDITIONAL SUBJECTS

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FP224 FOODREFRIGERATION AND COLD STORAGE CONSTRUCTION

Credit : 3:0:0

Unit I Principles of Refrigeration
Refrigeration cycles, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Ozone Depletion Potentials, Green house Potential Refrigerants, use of non polluting refrigerants, net refrigerating effect, ton of refrigeration - Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls. Atmospheric air and its properties, Psychometrics, Energy considerations

Unit II Cold Storage Design and Construction
Small and large commercial storages, Cold Room temperatures, Insulation, properties of insulating materials, air diffusion equipment, Doors and other openings. Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures, insulation of freezer rooms: Pre-cooling and
pre freezing. Cold Storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials-meat and poultry products, marine products, fruits and vegetables, spices and food grains

**Unit III Operation and maintenance - Controlled atmosphere and modified atmosphere storages**
Operation and maintenance, Cleanliness, defrosting practices, preventive maintenance, safety measures
Controlled atmosphere and Modified atmosphere storages
Principles and basics of their construction

**Unit IV Chilling of Foods**

**Unit V Freezing of foods**
Freezing equipment, Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Blast freezers, Contact Plate Freezers, conveyorized quick freezers, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables.

**Text/Reference Books**
FP225 FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Credit : 3:0:0

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

Unit I Introduction
Production of Fruits and vegetables in India., Composition of each of the major fruits and vegetables produced in the country - Mangoes, Pineapple, Guava, Papaya, Grapes among fruits - Beans, Carrot, Tomatoes, Potato, Onion, Brinjal among Vegetables. Cause for heavy losses. Spoilage factors, Post harvest field operations, including methods to reduce the post harvest losses, General methods of preservation of fruits and vegetables.

Unit II Canning of Fruits and Vegetables
Reception, sorting and Storage operations for fruit and vegetables. Preparation of fruits and vegetables for canning. – Washing, peeling, grating, slicing dicing, deseeding, blanching - Importance of Blanching operations - Batch and Continuous Blanching.- Hot water and Steam Blanching.- Canning operations – precautions in canning operations, Spoilage of canned foods. Common machinery for operations like Peeling, Slicing/Dicing, Pulping, Grating and canning process.

Unit III Fruit and vegetable products
Juice and pulp extraction – various extractors used including Hydraulic Press - Hot and Cold Break process - Clarification - Clarification centrifuges – Decanters and desludgers. Preparation and packaging of pulps, Jams, Jellies, Marmalades, Squashes Pickles, Puree, Ketchup, Sauce - Different types Glass and Plastic Containers, Large capacity storage containers in plastic, in plastic and SS containers. Different filling, closing and sterilization operations. Different preservatives used for long and short-term storage

Specialty products - Fruit Bars , Fruit juice concentrates – methods of concentration - evaporators used for concentration of fruit juices and pulp - Tubular, Plate and scraped surface evaporators and Fruit Powders - Preparation of Fruit material for powder production - Working of Spray Dryer and Drum Dryer - Fruit juice aroma Recovery and its importance. Brief on Aroma Recovery equipment.

Unit IV Dehydration
Unit V Aseptic and other methods of processing

Aseptic processing and Bulk packing of Fruit juice concentrates, Pulps and Puree - Brief information on Asepticity and how it is strictly maintained in the plant - Aseptic heat exchangers for sterilizing and concentrating the product - Aseptic fillers. Different system of filling practiced. Tetra pack for small quantities - Dole system and Scholle system for bulk storage in Bag & Boxes and Bag & Drums. - Storage of Aseptically packed products.

Minimal Processing and packaging of vegetables, Brief study of Hurdle technology as applied to Vegetable and Fruit processing.

Text Books

Reference Books

FP226 DAIRY TECHNOLOGY

Credit : 3:0:0

Objectives
To enable the student to understand
- The basic composition and properties of milk.
- Study the processing of milk with the use of equipments.
- To know about the manufacture of different dairy products and the equipments used.
- To impart the knowledge on fermented dairy products.
Unit I Dairy Chemistry and Microbiology
Introduction, Milk - composition, food and nutritive value, physico-chemical properties. Buying and collection of milk – transportation of milk – milk reception – contaminants - Milk reception in dairies, Quality and Quantity tests at reception - Applications of enzymes in dairy industry

Unit II Milk Processing

Unit III Manufacture of Dairy Products
Manufacture of Cream, Butter, Ghee, Milk powder, Cheese – Types and Defects in cheese. Quality aspects of these products. Equipments used for manufacture of each product like Butter churn, ghee boiler, Spray and Drum Dryers, Product instantizing equipment etc.

Unit IV Manufacture of Ice Cream and other Dairy Products
Manufacture of Ice cream – Chemistry and technology – Microbiology of ice cream - Quality aspects. Manufacture of paneer, Toned Milk, Sweetened Condensed milk, Khoa. Extraction of casein from milk – properties - composition and industrial uses. Production of lactose and whey

Unit V Fermented dairy products

Text books

Reference Books

FP227 CEREALS AND PULSES TECHNOLOGY

Credit : 3:0:0

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

Unit I Paddy Processing:
Paddy Varieties - Their Composition and Quality characteristics. Curing of Paddy. Parboiling Processes, Cold Water soaking and Hot water soaking processes, Paddy Dryer - LSU Dryer. By Products of Paddy Processing - Paddy husk and its uses as boiler fuel, husk ash, activated carbon, furfural and other by products. Production of Flattened Rice and Puffed Rice from Paddy

Unit II Rice Milling:

Unit III Milling of Pulses:

Unit IV Milling and Processing of Maize:
Dry milling of maize: Storage and drying, Pre-cleaning, cleaning equipment, Degermination and Dehusking, Roller milling, Sifting, Purifying, Aspiration, Pneumatics in a maize mill.
Products of milling - Flour, Semolina, Brewers’ grits etc and their applications. Wet milling of Maize and corn: Modern methods of processing, Cleaning, Steeping, Degermination, Bran and Fibre separation, Gluten and Starch Separation., Equipment needed for Degermination, Debraning and starch separation. 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 Grain Storage and Handling:**
Bulk Storage in silos and large Bins - Problems of Silo storage, Construction of Silos - concrete and Metal Silos, Physical load and mechanical strength of Silos, Silo flow problems, Relative merits and demerits of Silo storage to Bag Storage, Relative Costs of Silo and Bag Storage. Conveyors and Elevators for feeding and discharging into Silos. In silo Aeration and Drying, Problems of Dust Explosion in Grain Storages, Quality Changes of Grains during storages and remedial measures to prevent unwanted quality changes.

**Text Books**

**Reference Books**

**FP228 SUGAR AND CONFECTIONERY TECHNOLOGY**

**Credit : 3:0:0**

**Objectives:**

Department of Food Processing Engineering
1. To study the methods of manufacturing of sugar and other allied products.
2. To study about the machineries involved in confectionery manufacturing.

**Unit I Introduction**

**Unit II Sugar production processes**
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 III: Technology of Chocolate manufacturing**
Ingredients and their role as food additives in chocolate manufacturing. Machineries involved in the process of manufacturing chocolates.

**Unit IV: Technology of Confectionery manufacture**
General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweets – Ingredients, Methods of manufacture – Types – Center – filled, lollipops, coextruded products. Manufacture of gums and jellies – Quality aspects

**Unit V: Manufacture of Miscellaneous Products**
Caramel, Toffee and fudge – Liquorice paste and aerated confectionery, Lozenges, sugar pannings and Chewing gum, Countlines - Quality aspects

**Text Books**

**Reference Books**
FP229 FOOD PACKAGING TECHNOLOGY

Credit : 3:0:0

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 to improve the shelf life of the products.
- To learn about the equipments used for packaging.

Unit I : Introduction to Food Packaging
Protection of Food products - major role of food packaging - Functions of packaging, Effect of environmental factors like Light, Oxygen, Moisture, Temperature and mechanical forces and biological factors on food quality and shelf life, Need for protective packaging. Estimating the Shelf life requirement of food products for packaging - accelerated storage studies etc. Tests on packaging materials - Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.

Unit II : Metal Cans and Glass Bottles as Packaging
Merits and demerits, Metallic can types employed, Tin cans and Aluminum cans, relative merits and demerits, specialty of Open top sanitary cans (OTS), Lacquers and their use, Three piece cans and Two piece cans, Aerosol Cans, Relative merits and demerits. Basics of Canning operations, Can closures. Glass jars and Bottles in food packaging, Design features and applications, Sterilization of bottles, advantages and problems, Bottle and jar closures, different types of caps and liners used.

Unit III : Flexible Films Packaging

Unit IV : Filling and Sealing Operations for various types of packages.
Can double seam - can seam formation and defects- terminology, Metal caps for bottles and jars – Crown corks, lug caps, Twist off lid and ROPP caps, Description and applications. 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.
Unit V: Interaction of Food Material with Packaging Material
Active packaging, Moisture control, CO₂ and Oxygen scavenging, Modified atmosphere packaging – principles, applications. Vacuum and Inert Gas Packaging.

Text Books
2. Donald Downing: Complete Course in Canning (3 Volumes) CTI Publications inc, USA (1996)

Reference Books
4. Shirly V. Vangrade and Morgy Woodburn: Food Preservation and Safety Surabhi Publications, Jaipur India

FP230 FOOD CHEMISTRY

Objectives
To enable the student to understand:
- Chemistry of the constituents forming a food
- Interaction between constituents and its effect on food quality
- Importance of these interactions in developing Technologies / Processes

Unit I: Water and ice
Importance of water in foods. Structure of water & ice. Concept of bound & free water & their implications. Sorption Phenomena and Sorption isotherms, examples – Dispersed systems – some basic considerations

Chemistry of Carbohydrates: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars

Unit II: Chemistry of Polysaccharides
Chemistry, properties and preparation of Pectic substances, gums & polysaccharides, Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins

Unit III: Chemistry of Lipids
Definition & classification of lipids. Basic Structures, Chemistry of fatty acids & glycerides. Components of Fatty acids, Phospholipids, and unsaponifiables, Auto oxidation and hydrolysis, Physical & chemical characteristics of fats & oils, hydrogenated fats,
shortening agents, confectionary fats etc. Rancidity of fats & oils, and its prevention, antioxidants. Process flow sheet for the manufacture of edible oils (refined and hydrogenated)

**Unit IV : Chemistry of Proteins**

**Unit V : Chemistry of Vitamins**
Summary of vitamin stability – Toxicity and sources of vitamins – Bioavailability of vitamins – Reasons for the loss of vitamins in foods – Fat-soluble and water soluble vitamins – Choline, carnitine

**Text Books:**

**Reference Books**

**FP231 ANALYSIS OF FOOD PRODUCTS OF ANIMAL ORIGIN LAB**

Credit: 0:0:2

12 experiments will be notified by the HOD from time to time
FP232 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credit:3:0:0

Objectives
To enable the students to understand
1. Basics of plantation and spice products
2. Techniques in processing these products
3. Developing new Technology.

Unit I : Chemistry and Technology of Coffee

Unit II : Tea – Chemistry and Technology

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 and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identicals - Quality control

Unit V : Chemistry and Technology of Minor Spices
Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Quality control

Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

Text Books / Reference books
FP233 MILLING AND BAKERY TECHNOLOGY

Credit: 3:0:0

Objectives
To enable the students to understand
1. Lab tests done in industries
2. Milling process in wheat
3. Wheat and wheat products

Unit I: Fundamentals of Market Analysis for Wheat and Wheat Products
Laboratory testing of Wheat grain Quality, Moisture tests, Grain hardness testing. Testing, Visco graph, Amylograph, Ferinograph.

Unit II: Outline of the Wheat Milling Process
Wheat milling Flow sheet, explanation of steps in milling operations of milling-Cleaning, Sifters, Destoners, Roller milling – Break rolls, fluted rolls and plane rollers, purifier, plan sifter; Pneumatic conveying, wheat products and wheat by-products.

Unit III: 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.

Unit IV: Baked Products

Unit V: Confectionery Technology
Types of Confectionery, raw materials and processing of toffee, chocolates, fruit drops, hard boiled candies

Text/Reference Books

1. Association of Operative Millers Cereal Millers Hand Book: Burgess Publishing company, USA 1963
Objectives
To enable the student to understand:
1. Chemistry of the additives added to a food
2. Importance of additives in maintaining or improving food quality
3. Know the limits of addition as prescribed by FAO/WHO and PFA
4. Develop newer additives with improved safety standards

Unit I Introduction
Food additives definition – Determination of the limit for addition – NOEL – Toxicity data – Method of determining toxicity – LD50, carcinogenicity, teratogenicity – PFA, FDA, FPO regulations – GRAS additives

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

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

Unit IV
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
Types, chemical properties, levels of additions in individual products, toxicity data Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives

Text book
2. Handbook of Food additives by Thomas Furia,
FP235 RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS

Credit: 3:0:0

Objectives:
1. To study the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
2. To study the effect of radiation as a processing and preservation method
3. To study the importance and safety issues of the irradiated foods

Unit I Basics of Radiation Chemistry
Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.

Unit II Radiation Chemistry of Food Components
Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

Unit III Microwaves In Food Processing
Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.

Unit IV Infra red Radiation
Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.

Unit V Radio Frequency Heating Principles
RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

Text Books

Reference Books
FP236 PROTEIN CHEMISTRY AND TECHNOLOGY

Credit : 3:0:0

Objectives
To enable the student to understand:
1. Chemistry of the protein found in food
2. Importance of proteins in modifying the textural properties of food systems
3. Importance of protein engineering in improving the nutritional and functional properties of food
4. Develop newer technologies and sources of proteins

Unit I  Basics of amino acids and protein chemistry
Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.
Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

Unit II  Protein Architecture
Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup
Secondary structure: Alpha, beta and loop structures and methods to determine (Basics only)
Basics of Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites
Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

Unit III  Protein Engineering
Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, de novo protein design.
Unit IV Basics of the Properties of Food proteins – Animal and Marine sources
Caseins and Whey proteins
Caseins – Heterogeneity and Molecular properties – caseins micelles – Mechanism of stabilization – Structure models – Structure of whey proteins and improvement of functionality
Muscle proteins – Structure and functionality – Application of muscle proteins in foods
Sea weed proteins – Protein content and functionality, digestibility of algal proteins – applications to food systems

Unit V Basics of the properties of Food proteins – Plant sources
Composition, Properties and functional properties of soya, rapeseed, peanut.
Leaf as a protein source – Basic and Food applications of rubisco

Text Books

Reference Books

FP237 ENGINEERING PROPERTIES OF FOODS
Credit : 3:0:0

Objectives:
1. To study the various engineering properties of food materials under different conditions.
2. To study about the different methods of determining the quality and properties of different foods

Unit I : Physical Properties of Foods
Methods of estimation of - Shape, size, volume, density, porosity and surface area.

Unit II : Rheological Properties of Foods
Rheological Classification and models, Static tests for solid foods, Creep, relaxation, Dynamic testing of solid foods, stress and strain in solid foods, stress-strain diagram, visco-
elastic fluids, measurement methods, Viscometers and Rheometers of different design and their applications, texture measuring instruments, Hardness and brittleness of food materials.

**Unit III : Thermal Properties of Foods**
Definitions - specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity;

**Unit IV : Aerodynamic and hydrodynamic properties of Foods**
Drag coefficient, terminal velocity and their application in the handling and separation of food materials.

**Unit V: Electrical properties of foods**
Dielectric properties, electric energy transmission properties, Electro-magnetic field effects, Dielectric measurements, Polar solvents, Ionic solutions.

**Text Books**

**Reference Books**

**FP238 EMERGING TECHNOLOGIES IN FOOD PROCESSING**

**Credit:** 4:0:0

**Objectives**
To enable the student to understand:
1. Emerging / alternative technologies applied to food processing
2. Relative advantages / disadvantages over existing technologies
3. Economics and commercialization of newer technologies
4. Strategies for applying the same to a 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 – modeling of high pressure processes – High Pressure Freezing, Principles and Applications

**Unit II Pulsed electric field processing of Foods**

**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 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)

**Text Books**

**Reference Books**
4. Pulsed electric field technology for the food industry: Fundamentals & applications (Food engineering series) RASO J., HEINZ V, 2006
5. Ohmic Heating: A Value-added Food Processing Tool Marybeth Lima, Tuoxiu Zhong and N. Rao Lakkakula

FP239 FOOD DEHYDRATION TECHNOLOGY

Credit: 4:0:0

Objectives
To enable the student to understand:
1. Basic theory of drying and its significance in food systems
2. Importance of drying as a method of food processing
3. Relative advantages / disadvantages of each method of drying
4. Economics and commercialization of technologies
5. Develop strategies for applying the same to a wide range of food

Unit I Basics of dehydration
Theories of drying – constant and falling rate period - diffusion theory, capillary theory, evaporation – condensation theory, Luikov, Philip and De Vries theory
Water content in foods and its determination – Theoretical and empirical models for determining water activity

Unit II Cabinet, Vacuum and Drum drying of Foods
Fundamentals of cabinet drying – Mass and Heat balances in dryers (batch and continuous) (simple problems only) – description of batch and continuous dryers – Application in Food industry – Vacuum and Drum driers

Unit III Spray drying of Foods

Department of Food Processing Engineering
Fundamentals – Nozzles, Rotary atomizers and two fluid feeds- Interaction of droplets with air- Drying of droplets with soluble and insoluble solids – Microstructure of spray dried products – Reconstitution – Foam spray drying – Applications in the Food industry

Unit IV Freeze drying of Foods
Fundamentals of freeze drying – Freezing and drying steps – Combined heat and mass transfer (only theory) – Structural changes and volatile retention during freeze drying – Freeze dehydration related processes: prefreezing, preconcentration, condensation, defrosting – Industrial freeze driers – Atmospheric freeze drying - Applications in food industry

Unit V Fluidised bed drying, Microwave drying and Extrusion o Foods
Fluidised bed drying – Batch and Continuous dryers – Pneumatic dryers
Extrusion cooking – Single and Twin-screw extruders
Packaging of dehydrated products

Text Books

Reference Books

FP240 PROCESSING OF FOOD COMMODITIES
Credit: 3:0:0

Objectives:
1) To study various processing methods for various food materials like fruits & vegetables, dairy products, cereals, meat, poultry, fish and bakery products
2) To study various innovative food processing techniques

Unit I Fruits and vegetable processing
Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Canning of Fruits and Vegetables, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic and other methods of processing.

Unit II Dairy processing
Basic dairy terminology, composition, Quality and Quantity tests at reception, dairy Processing Equipments, various dairy Products, Packaging of milk in bottles and sachets.

Unit III Milling and bakery Technology
Fundamentals of Market Analysis for Wheat and Wheat Products, Laboratory testing of Wheat grain Quality, Moisture tests, Outline of the Wheat Milling Process, equipments
**Unit IV Meat, Fish and Poultry processing**


**Unit V Cereal technology**

Paddy Processing - Varieties, their Composition and Quality characteristics, Curing of Paddy, Parboiling Processes, By Products. Rice milling and equipments, Milling of Pulses, Grain Storage and Handling.

**Text Books**


**FP241 ANALYSIS OF FOOD LAB – 1**

Credit 0:0:2

12 experiments will be notified by the HOD from time to time

**FP242 ANALYSIS OF FOOD LAB – 2**

Credit 0:0:2

12 experiments will be notified by the HOD from time to time

**FP243 ANALYSIS OF FOOD PRODUCTS LAB – 1**

Credit 0:0:2

12 experiments will be notified by the HOD from time to time

**FP244 FOOD ANALYSIS LAB**

Credit 0:0:2

12 experiments will be notified by the HOD from time to time

**FP245 FOOD PRODUCT TECHNOLOGY LAB - 1**

Credit 0:0:2

12 experiments will be notified by the HOD from time to time
FP246 ENZYMOLGY LAB
Credit 0:0:2
12 experiments will be notified by the HOD from time to time

FP247 ANALYSIS OF FOOD PRODUCTS OF PLANT ORIGIN LAB
Credit 0:0:2
12 experiments will be notified by the HOD from time to time

FP248 FOOD PRODUCT TECHNOLOGY LAB - 2
Credit 0:0:2
12 experiments will be notified by the HOD from time to time
SCHOOL OF FOOD SCIENCES

AND

TECHNOLOGY
### ADDITIONAL SUBJECTS

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FP 318 ADVANCES IN FOOD ENGINEERING – I

Credit : 4:0:0

Unit – I Heat preservation of foods
Heat preservation of foods - thermo bacteriology, process calculation and selection - low
temperature preservation - microbiological aspects, cooling and cold storage - physical methods
of preservation - freeze concentration - membrane process - ultra filtration, reverse osmosis

Unit – II Hurdle technology
Hurdle technology - principles and applications - hurdle effect in fermented food, shelf stable
products, intermediate moisture foods- total quality of foods - optimal range of hurdles and
potential safety - application of hurdle technology - fruit and vegetable preservation, dairy
products and meat

Unit- III Irradiation, Microwave and High pressure processing
Food irradiation - advantages and applications, Equipment Microwave processing – equipments
interaction with food materials, material properties, effect of microorganisms, High pressure
processing – Principles -equipment, processing and effect on microorganisms.

Unit-IV Ultrasound and Electrical resistance processing
Application of heat and ultrasound - inactivation of microorganisms and enzymes,
Ohmic heating - models- treatment of products

Unit-V Aseptic processing and Extrusion
Advances in aseptic processing and packaging - processes, design of process, Commercial
sterilization, Preventive measures for contamination.
Extrusion cooking - recent developments, methods, equipment, and design criteria of extruders.

Text Books
1. Emerging Technologies for Food Processing, Da-Wen Sun, Contributor Da-Wen Sun,
   Published by Academic Press, 2005.

Reference Books
1. Novel Food Processing Technologies, Ed., Barbosa-Canovas, G.V.; Tapia M.S.; Pilar
   5333-7 (hardback) 978-0-203-99727-7 (electronic).
2. Food Processing Operations Modeling Design and Analysis, Irudayaraj J.M. Second
   (hardback) 978-0-8247-4516-5 (electronic)
FP 319 ENGINEERING PROPERTIES OF FOOD MATERIALS

Credits : 4:0:0

Unit I Physical Properties

Unit II Rheological Properties

Unit III Textural Properties
Texture of food materials - Measurement methods - imitative and empirical tests - dynamic test. Firmness and Hardness - different methods of measurements on various produce and foods - dynamic hardness. Physical damage on food - causes - Detection and evaluation Static and dynamic resistance to mechanical damage – Compression, Impact and Vibration damage

Unit IV Thermal Properties
Thermal properties - specific heat - determination - methods for solids and slurries Determination of thermal conductivity - steady state and unsteady state methods. Thermal diffusivity - determination - relationship among specific heat, thermal conductivity, bulk density and thermal diffusivity - effect of moisture content on thermal properties.

Unit V Electrical and Aerodynamic properties
Electrical properties - resistance, capacitance - uses - Dielectric loss factor - method of determination. A.C. conductivity and dielectric constant - determination - Q meter. Effect of moisture content on electrical properties - energy absorption from high frequency electric field. Aerodynamic properties - lift and drag - drag coefficient - friction drag - pressure drag -
terminal velocity - importance - spherical bodies and non-spherical bodies - Reynold’s number relationship - separation of foreign materials - pneumatic handling and transportation - applications.

Text Books

Reference Books.

FP320 TRANSPORT PROCESSES IN FOOD ENGINEERING

Credits: 4:0:0
Unit I Introduction & Momentum transfer

Unit II Unsteady State Heat Transfer
Unsteady State Heat Transfer-Derivation in basic equation- unsteady state heat conduction in various geometries- Numerical finite difference methods for unsteady state conduction-differential equation of energy change- boundary layer flow and turbulence in heat transfer - Applications specific to food systems

Unit III Unsteady state diffusion mass transfer
Unsteady state diffusion mass transfer– Convective mass transfer coefficients- mass transfer coefficient for various geometries- molecular diffusion plus convection- numerical methods for unsteady state molecular diffusion- dimensional analysis in mass transfer - Applications specific to food systems

Unit IV Applications to drying
Predicted transfer coefficients for constant and falling rate drying period- combined conduction, radiation & convection heat transfer in constant rate period- drying in falling rate period by
diffusion- continuous counter current drying- derivation of equation for freeze drying - Applications specific to food systems

**Unit V Applications to unsteady state thermal processing**
Unsteady state thermal processing of biological materials- mass transfer between phases- estimation of mass transfer coefficients for packed towers- heat effects and temperature variations in absorption - Applications specific to food systems

**Text Book**

**Reference Books**

**FP 321 ADVANCES IN FOOD ENGINEERING – II**

**Credits : 4:0:0**

**Unit-I Minimal Processing of Foods**

*Minimal Processing of Foods with thermal methods and non thermal methods- safety criteria in minimally processed foods- Minimal processing in practice- fruits & vegetables-seafood- effect on enzymatic and textural properties- quality changes- packaging and storage conditions- Future developments* 

**Unit-II High Intensity Electrical Pulse Technique**

*High-intensity electric pulse technique- Processing systems- design of static chambers- continuous chambers- other chamber designs- generation of different voltage waveforms- oscillation magnetic fields for food processing- generation of magnetic fields - inactivation of microorganisms*

**Unit- III Advanced Methods of Preservation Extraction**

*Application of pulses of light in sterilization of foods and packaging materials - Extraction and distillation process – Super critical fluid extraction - Energy calculation process*

**Unit-IV Recent Developments in drying Technology.**

*Recent developments on design and practice of spray drying - drying behavior of droplets – Instantisation Techniques - Recent advances in Foam mat drying, osmotic dehydration, heat pump drying and freeze drying - Energy requirements for different methods of dehydration*
Unit-V Enzymes and Biosensors
Food Enzymes -Sources-Types- Processes and Production methods- Enzymatic Synthesis of food additives and flavours - Biosensors- types-application of biosensors in food industry

Text Books.
1. Emerging Technologies for Food Processing, Da-Wen Sun, Published by Academic Press, 2005

Reference Books.
1. Trends in Food Engineering, Jorge E. Lozano, Cristina Anon, Efren Parada-Arias, Gustavo V. Barbosa-Canovas, Contributor Jorge E. Lozano, Published by CRC Press, 2000

FP 322 FOOD PACKAGING AND STORAGE ENGINEERING

Credits : 4:0:0

Unit I Introduction
Importance of packaging, packaging materials, their selection, form and testing – paper boards, plastic films, laminates, metals, glasses, retort pouches - storage of dehydrated products

Unit II Packaging for different types of foods
Package for different individual groups of foods like dehydrated foods, liquid foods, frozen foods, processed (cooked) foods – vacuum packaging of fruits and vegetables – equipment and method – packaging equipment for solid, semi – solid and liquid food. Types of fillers – filler for glass bottle, pouches.

Unit III Form-fill- seal process and Shrink wrapping
Form fill seal equipment, sealing equipment, labelling, capping, canning, and cartooning equipment – shrink wrapping.

Unit IV Grain storage engineering
Storage of grains – biochemical changes during storage – production, distribution and storage capacity estimate models – ecology, storage factors affecting losses, storage requirements, bag and bulk storage – pressure distribution – theories – rat proof godowns and rodent control –
method of stacking – preventive method, bio-engineering properties of stored products – function, structural and thermal design of structures.

Unit V Cold storage, Controlled and Modified atmosphere storage
Cold storage, Controlled and Modified atmosphere storage – effects of nitrogen, oxygen, and carbon–dioxide on storage of durable and perishable commodities Determination of cooling load.

Text Book

Reference Books

FP323 TECHNOLOGY OF FOOD FLAVOURANTS AND COLOURANTS

Credits : 4:0:0

Unit I – Basics of flavours and colours

Unit II – Chemistry and Technology of Natural flavours
Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours. Evolution of flavours during processing – enzymatic development, effect of roasting, cooking, frying on flavour developments- Essential oils and oleoresins – Extraction – Super critical fluid extraction - Continuous and semi-continuous methods- Effect of types of solvents used. Liquid
and dry flavour production - Staling of flavours. Microbial and cell suspensions in the synthesis of flavours

**Unit III – Chemistry and Technology of natural pigments**
Chlorophyll and chlorophyll derivatives, Haems and bilins, Carotenoids, annatto, Crocetin, Curcumin- Stability to pH, temperature and other processing conditions - Technology for the production of dried colourants - Caramel colour. Microbial and cell suspensions in the synthesis of colours.

**Unit IV - Chemistry and Technology of natural pigments**
Anthocyanins and betalains, Less common colourants – Acylated β-ring substituted anthocyanins, Monascus, Cochineal and related pigments, Stability to pH, temperature and other processing conditions. Technology for the production of dried colourants.

**Unit V – Techniques of analysis of flavours and colours**
Total component analysis– Basics and methods – Recent developments. Head space analysis – static and dynamic methods – basic principles – method and developments - Solid phase micro extraction of aroma components - E nose technology. Tristimulus colorimetry – Basics and application to foods.

**Text books**
1. Flavor Chemistry and Technology, By Gary Reineccius, Henry B. Heath, 2nd Edn., Taylor and Francis group, CRC Press, 2006

**Reference Books**

**Credits: 4:0:0**

**09FP201 FOOD ENGINEERING OPERATIONS**

**Objectives:**
To enable the student to understand
1. The importance of unit operations in biological systems engineering
2. Applications of various unit operations in food industries.
UNIT –I Cleaning & Grading:

UNIT- II Mixing & Forming

UNIT –III Size Reduction
Principles of size reduction - size reduction procedures - energy used in grinding - kicks law, rittingers law, bonds law, work index, new surface formed by grinding( shape factors) - grinding equipment - crushers, hammer mills, fixed head mills, plate mills, ball mills, roller mills, cutters. Sieving - particle size analysis.

UNIT-IV Blanching, frying, peeling & enrobing

UNIT-V Cold operations
Freezing – Theory- Ice crystal formation-solute concentration- volume changes- calculation of freezing time- equipment- cooled air freezers, cooled liquid freezers and cooled surface freezers, & cryogenic freezers- changes in foods. Freeze concentration-theory- equipment - effect on foods.

Textbooks:

Reference books:

09FP202 DRYING TECHNOLOGY

Credit: 4:0:0
Objectives:
To enable the student to understand:
1. Basic theory of drying and its significance in food systems
2. Importance of drying as a method of food processing
3. Relative advantages / disadvantages of each method of drying

UNIT I Theory of Drying

UNIT II Drum drying, Foam Mat Drying & Osmotic dehydration of Foods

UNIT III Spray drying of Foods
Principles of Spray Drying Processes – Atomization - Drop Size and Size Distribution Wheel Atomizers - Pressure Nozzles - Pneumatic Nozzles - Chamber Design - Chamber Shape - Air-Droplet Contact Systems - Powder and Air Discharge Systems - Ancillary Equipment - Fans - Powder Separators – Reconstitution of powders – Foam spray drying

UNIT IV Freeze drying and Microwave drying of Foods

UNIT V Fluidized bed and Pneumatic drying

Text Books

Reference Books
2. Loesekte,H. W. V., 2005. Drying & Dehydration of Foods, Published by Agrobios (India)

**09FP203 FAT AND OIL PROCESSING TECHNOLOGY**

**Credits: 4:0:0**

**Objectives:**
To enable the students to understand
1. Physical and chemical properties of fats and oils
2. Extraction and refining processes

**UNIT I: Physical and chemical properties**

**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**

**UNIT IV: Packaging of edible oils**

**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
   Westport, Connecticut.

Reference books

09FP204 SPICES AND PLANTATION CROP TECHNOLOGY

Credit : 4:0:0

Objectives:
To enable the student to understand
1. The importance and different basic unit operations in processing of spices
2. Processing methods of plantation crops.

UNIT I: Importance of spices
Spices – production and importance – pepper, cardamom, chilli, turmeric, ginger, clove, nutmeg and other minor spices – stage of harvesting and harvesting methods – threshing, shelling, decortication of spices - methods – merits and demerits

UNIT II: Cleaning, grading and packaging of spices
Processing of spices – drying - traditional and mechanical drying – cleaning, grading and grinding – construction and operation of different mills – cryogenic grinding, packaging and storage of spices

UNIT III: Processing of spices
Processing of major and minor spices – pepper, cardamom, chilli, turmeric, ginger, clove, nutmeg, – quality analysis of spices- processes involved in the manufacture of oleoresins and essential oils.

UNIT IV: Processing of coconut, oilpalm, arecanut and cashew

UNIT V : Processing of coffee, tea, cocoa and vanilla
Processing of coffee, tea, cocoa and vanilla – methods, process and equipment – value added products – packaging and storage

Text books

References:

09FP205 FOOD SAFETY REGULATIONS AND CONTROL

Credits: 4:0:0

Objectives:
To enable the student to understand
1. Importance of Food Safety
2. Regulating authorities for food safety world over

UNIT-1: 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

UNIT 2 - Food authority in India


UNIT 3 - Food labeling

Karunya University

UNIT 4 -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 5 - 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:
2. The Food Safety and Standards Act 2006

Reference Book:
1. Food Safety Regulation Concerns And Trade- The Developing Country Perspective, Ed. By Rajesh Mehta And J. George, Published by Macmillan India Ltd., New Delhi. 2005

Credits: 4:0:0

Objectives:
To enable the student to understand
1. The importance of separation process.
2. Size reduction and mixing operations in industries
3. Develop processes with better efficiency and economics

Unit –I  Mechanical & Centrifugal Separation:
Sedimentation-gravity sedimentation- sedimentation of solid particles in gas media. Particle velocity and basics of centrifugal separation. Different types of centrifuges- basket, tubular bowl, decanting, disc bowl, desludging bowl centrifuge, nozzle centrifuge.

**Unit- II Filtration**
Rates of filtration- filter cake resistance- equation for flow through filter- constant rate filter- constant pressure filtration- filter cake compressibility- filtration equipment- plate and frame filter press- rotary filters-centrifugal filters

**Unit –III Membrane separation**
Osmotic pressure- cross flow microfiltration- ultra filtration- reverse osmosis- rate of flow through membrane – vanthoff equation- diffusion equation- Sherwood number-schmidt number- membrane equipment- membrane fouling-

**Unit-IV Mixing**
Characteristics of mixtures- measurement of mixing-particle mixing- rates of mixing, energy input in mixing, liquid mixing- power number, Froude number- mixing equipment- liquid mixtures, powder and particle mixtures, dough and paste mixtures

**Unit-V Size Reduction**
Grinding and cutting- energy used in grinding- Kicks law, Rittingers law, Bonds law, work index, new surface formed by grinding( shape factors)- grinding equipment- crushers, hammer mills, fixed head mills, plate mills, roller mills, cutters. Sieving- particle size analysis.

**Textbooks:**

**Reference book:**

**09FP301 ADVANCES IN FOOD MICROBIOLOGY**

**Credit: 4:0:0**

**Objectives:** To enable the student to understand:

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

**UNIT I: Food and Microorganisms**

UNIT II Microbiology of preservation
General concepts about molds, bacteria and yeasts. Effect of high temperature on microbes – TDT, D value, Z value, 12D concept, calculation of process time. Effect of low temperature, radiation, drying on microbes.

UNIT III: Food fermentation
Manufacture, spoilage and defects of Bread, malt beverages, wines, vinegar, fermented vegetables, fermented dairy products, oriental fermented foods.

UNIT IV: Foods and enzymes from microorganisms
General principles of culture maintenance and preparation for food fermentation – Single cell protein – Fats from microbes – production of amino acids - production of other substances added to food - production of enzymes.

UNIT V: Microbiology in Food Sanitation
Bacteriology of water supplies - Sewage and waste treatment and disposal – Microbiology of the food product - Good Manufacturing Practices (GMP) – Hazard Analysis and Critical Control Points (HACCP).

Text Book

Reference Book

09FP302 KINETICS OF FOOD SYSTEMS

Objectives
1) To enable students understand the physical chemistry and kinetics of food systems
2) To make the students understand the interaction of food constituents in maintaining the texture and structure of a food

UNIT 1: Glass Transitions in Foods
Basics of theory of glass transitions – crystalline and amorphous polymers, - difference, Glass transition temperature, crystallite melting point, Crystal melting point – Key elements of the food polymer science approach – Fringed micelle structural model – the dynamics map – Effect of
molecular weight on Tg – Plasticizer – water as a plasticizer - Crystallisation – gelation mechanism – Polymer crystallization kinetics theory - Importance in food systems

UNIT 2: Physical Chemistry of Food Gels & gelling
Nature of the gel state – Mechanism of gel formation in food systems – point cross linking, extended junction zone formation, particle association and spinodal decomposition – gel network types. Basic Theories of gelation – Flory –Stockmayer theory – percolation theory, diffusion – limited aggregation model - mechanical properties of cured gels – Small deformation studies – differentiation between strong and weak gels - frequency dependence, strain dependence and temperature dependence of viscoelastic modulus – Large deformation studies – failure envelopes

UNIT 3: Generation of Engineered Gel Structures

UNIT 4: Structures & Properties Of Food Emulsions
General aspects of emulsions – Types of food emulsions – Oil in water, water in oil, water in oil in water- Measurement of particle size and size distributions in emulsions - Factors affecting stability of emulsions – Structures of adsorbed layers on the surfaces of emulsion droplets - Importance of interfacial layer – Protein stabilized emulsions and foams

UNIT 5: Kinetics of Non-enzymatic browning
Introduction –Mechanism of Maillard Reaction – Factors influencing Maillard reaction – Type of amino acid, pH, type of sugar, solvent state, sugar – amine ratio, temperature, Fluorescence (pH and Temperature interactions)- Kinetics of Maillard browning

Text Books

1. Physical Chemistry of Foods – by Henry G. Schwartzberg and Richard W. Hartel, Marcel Dekker Inc. USA. 1992

Reference Books


09FP303 ENGINEERING PROPERTIES OF FOOD MATERIALS

Credits – 4:0:0

Objectives
1) To enable students to understand the different engineering properties of food materials.
2) To make the students to acquire knowledge of engineering properties in the designing of food processing systems.

UNIT I : Physical Properties

UNIT II : Rheological Properties

UNIT III : Textural Properties

UNIT IV: Thermal Properties

UNIT V: Electrical and Aerodynamic properties
Text Books:

Reference Books:

09FP304 TRANSPORT PROCESSES IN FOOD ENGINEERING

Credits – 4:0:0

Objectives
1) To enable the students to understand the systems of Heat transfer in food applications.
2) To enable the students to understand the systems of Mass transfer in food applications.

UNIT I : Introduction

UNIT II : Unsteady state heat transfer
Unsteady State Heat Transfer-Derivation in basic equation- unsteady state heat conduction in various geometries- Numerical finite difference methods for unsteady state conduction- differential equation of energy change- boundary layer flow and turbulence in heat transfer.

UNIT III : Unsteady state Mass Transfer
Unsteady state diffusion mass transfer– Convective mass transfer coefficients- mass transfer coefficient for various geometries- molecular diffusion plus convection- numerical methods for unsteady state molecular diffusion- dimensional analysis in mass transfer.

UNIT IV : Drying Process
Predicted transfer coefficients for constant and falling rate drying period- combined conduction, radiation & convection heat transfer in constant rate period- drying in falling rate period by diffusion- continuous counter current drying- derivation of equation for freeze drying.

UNIT V : Contact Equilibrium Process
Unsteady state thermal processing & biological materials- mass transfer between phases- estimation of mass transfer coefficients for packed towers- heat effects and temperature variations in sorption phenomenon.
Text Books:

Reference Books:

09FP305 FOOD ENGINEERING

Credits: 4:0:0

Objectives:
To enable the students to study & understand the
1. Heat preservation methods.
2. Aseptic Packaging of processed foods

UNIT – I: Preservation Aspects
Heat preservation of foods - thermo bacteriology, process calculation and selection - low temperature preservation - microbiological aspects, cooling and cold storage - physical methods of preservation - freeze concentration - membrane process - ultrafiltration, Reverse osmosis

UNIT-II: Minimal Processing
Minimal Processing of Foods with thermal methods and non thermal methods- safety criteria in minimally processed foods- Minimal processing in practice- fruits & vegetables-seafood- effect on enzymatic and texture property- quality changes- packaging and storage conditions- Future developments

UNIT- III: Osmotic, Heat Pump & Freeze Drying
Application of light pulses in sterilization of foods and packaging materials- Foam mat drying - osmotic dehydration – heat pump drying - freeze drying - recent advances in freeze drying

UNIT-IV : Spray Drying
Recent developments on design and practice of spray drying - drying behavior of droplets - flash evaporation - extraction and distillation process - energy calculation process - energy requirements in different methods of dehydration - super critical fluid extraction

UNIT-V Aseptic Packaging & Extrusion
Advances in aseptic processing and packaging - processes, design of process, decontamination of packaging - extrusion cooking - recent developments, methods, equipment, and design criteria of extruders.

Text Books:
1. Emerging Technologies for Food Processing, Da-Wen Sun, Contributor Da-Wen Sun, Published by Academic Press, 2005
2. Minimal Processing Technologies in the Food Industry, Thomas Ohlsson, Nils Bengtsson, Thomas Ohlsson Ohlsson, Knovel (Firm, Knovel (Firm), Thomas Ohlsson, Nils Bengtsson, Published by Woodhead Publishing, 2002

Reference Books.

09FP306 EMERGING TRENDS IN FOOD PROCESS ENGINEERING

Credits: 4:0:0

Objectives:
To enable the student to understand
1. High Intensity Pulse Techniques, Light Pulses,
2. Food irradiation, high pressure processing and biocatalysts.

UNIT –I: Hurdle Technology
Hurdle technology - principles and applications - hurdle effect in fermented food, shelf stable products, intermediate moisture foods- total quality of foods - optimal range of hurdles and potential safety - application of hurdle technology - fruit preservation, dairy products and meat

UNIT-II Light Pulse Technique
High-intensity pulse technique- Processing systems- design of static chambers- continuous chambers- other chamber designs- generation of different voltage waveforms- oscillation magnetic fields for food processing- generation of magnetic fields - mechanisms of inactivation of microorganisms in food preservation.

UNIT-III: Ohmic Heating
Application of heat and ultrasound - inactivation of microorganisms and enzymes - electrical resistance heating of food - ohmic heating, heating models- treatment of products - high voltage pulse technique - Elsteril process, influence on microorganisms, food ingredients - decontamination of packaging - decontamination of microorganisms by surface treatment

UNIT- IV: Food Irradiation & High Pressure Processing
Food irradiation - advantages and applications, microwave processing - interaction with food materials, material properties, effect of microorganisms, microwave equipment – high pressure processing – Principles - equipment, processing and effect on microorganisms.

UNIT-V: Biocatalysts Biocatalysts- Sources-Types- Processes in Food Industry- Enzymatic Synthesis of Food Additives – Biocatalysis using enzymes-flavours & fragrance - Biosensors- types-application of biosensors to food industry requirements- Development of Biosensors-
Text Books:


Reference Books

09FP307 FOOD PACKAGING AND STORAGE ENGINEERING

Credits: 4:0:0

Objectives:
To enable the students to understand
1. Different packaging techniques
2. Different Storage techniques

UNIT I: Packaging – Importance & Materials
Importance of packaging & packaging materials, form and testing – paper boards- tensile, tearing, bursting, water absorption, plastic films & laminates - test for tensile strength, bursting strength, tear strength, permeability (water vapor & gas), stretch, metals, glasses & retort pouches.

UNIT II: Selection of Packages
Migration characteristics, Package for different individual groups of foods like dehydrated, liquid, frozen & processed foods–vacuum packaging of fruits & vegetables–equipment & method– packaging equipment for solid, semi–solid &liquid food. Types of filling machines – glass bottle, pouches.

UNIT III Packaging methods

UNIT IV: Storage Engineering

UNIT V Cold, MA & CA Storages

Text Books:

Reference Books

09FP308 TECHNOLOGY OF FOOD FLAVOURANTS & COLOURANTS

Credits – 4:0:0

Objectives:
To enable the student to understand
1. Basics of foods flavors and colours
2. Chemistry & technology of natural flavours, pigments

UNIT 1 – Basics of flavours and colours

UNIT 2 – Technology of Natural flavours
Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours. Evolution of flavours during processing – enzymatic development, effect of roasting, cooking, frying on flavour developments- Essential oils and oleoresins – Extraction – Super critical fluid extraction - Continuous and semi-continuous methods- Effect of types of solvents used. Liquid and dry flavour production - Staling of flavours. Microbial and cell suspensions in the synthesis of flavours

UNIT 3 – Chlorophyll & Carotenoids
Chlorophyll and chlorophyll derivatives, Haems and bilins, Carotenoids, annatto, saffron, turmeric- Stability to pH, temperature and other processing conditions - Technology for the
production of dried colourants - Caramel colour. Microbial and cell suspensions in the synthesis of colours.

UNIT 4 - Anthocyanins & Flavonoids
Anthocyanins and betalains, Less common colourants – Acylated β-ring substituted anthocyanins, Monascus, cochineal and related pigments, Stability to pH, temperature and other processing conditions. Technology for the production of dried colourants.

UNIT 5 – Analysis of flavours and colours
Total component analysis– Basics and methods – Recent developments. Head space analysis – static and dynamic methods – basic principles – method and developments - Solid phase micro extraction of aroma components - E nose technology. Tristimulus colorimetry – Basics and application to foods

Text Books :
1. Flavor Chemistry and Technology, By Gary Reineccius, Henry B. Heath, 2nd Edn., Taylor and Francis group, CRC Press, 2006

Reference Books

09FP309 FOOD ANALYSIS LAB

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time

List of Experiments:
1. Analysis of Jam – Moisture and Total sugars
2. Analysis of Jam – Fiber and Ash
3. Analysis of milk – Determination of fat content by Gerber’s method
5. Analysis of Coffee – Determination of caffeine content
6. Analysis of tea – Total extractives in tea
7. Analysis of tea – Tannin content of tea
8. Kinetics of bi-phasic (solid-liquid) extraction of natural colours – anthocyanins
9. Kinetics of bi-phasic (liquid-liquid) extraction of natural colours – carotenoids
10. Kinetics of degradation of colours
11. Column chromatographic separation of colours
12. Kinetics of Maillard browning
13. Sensory analysis
14. Estimation of iron content
15. Estimation of copper

**09FP310 FOOD MICROBIOLOGY LAB**

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time

*List of Experiments:*

1. Experiment on Microscopy
2. Experiment on sterilization and disinfection
3. Experiment on isolation of microorganisms by pure culture technique
4. Experiment on monochrome staining & gram staining
5. Experiment on negative staining & spore staining
6. Experiment on Hanging drop technique
7. Experiment on isolation of MO from spoiled food
8. Experiment on isolation of MO from air
9. Experiment on water quality analysis
10. Experiment on Lactophenol cotton blue staining
11. Experiment on methylene blue reduction test, phosphate test for milk samples
12. Experiment on biochemical test (TSI, catalase, oxidase, hydrogen peroxide)
13. Experiment on production of wine
14. Experiment on production on enzyme amylase
15. Experiment on phenol coefficient test.

**09FP311 FOOD ENGINEERING LAB**

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time.

*List of Experiments:*

1. Experiment on Vacuum shelf drier
2. Experiment on plate pasteurizer
3. Experiment on tubular pasteurizer
4. Experiment on vibro fluidizer
5. Experiment on Fluidized bed drier
6. Experiment on Spray drier
7. Experiment on Freeze drier
8. Experiment on canning of vegetables
9. Experiment on canning of fruits
10. Experiment on twin screw extruder
11. Experiment on Sigma mixer
12. Experiment on retort pouch sterilizing unit
13. Experiment on bottling of fruit juices
14. Experiment on bottling of vegetable products
15. Experiment on vacuum packaging

09FP312 FRUIT AND VEGETABLE PROCESS ENGINEERING
Credits: 4:0:0

Objectives:
To enable the student to know about
1. Post harvest technology of fruits and vegetables
2. Processing & preservation techniques of fruits and vegetables

Unit-I Concepts of fruit and vegetable processing
Importance of post harvest technology of fruits and vegetables -post harvest handling and physiology of fruits and vegetables -Fruit ripening – changes during ripening-recommended ripening conditions for fruits – sources of ethylene for ripening – ethylene reactions with O₂ and CO₂. Spoilage of fruits and vegetables and their processed products -Deteriorative factors and their control – enzymatic changes, chemical changes, physical, changes and biological changes

Unit-II Preservation techniques
Biochemistry of fruits-implication on processing- Principles and methods of preservation of fruits and vegetables-Pre-treatments- blanching – methods-Commercial canning of fruits and vegetables-Minimal processing of fruits and vegetables-merits and demerits-Hurdle technology – applications Thermal and non-thermal preservation of fruits and vegetables - Quick freezing preservation of fruits and vegetables – principle – advantages

Unit-III Drying & dehydration

Unit-IV Emerging preservation techniques

Unit-V Packaging and storage
attributes – tests--Storage systems of fruits and vegetables and their products – recommended storage -conditions for selected fruits and vegetables-Cold storage of fruits and vegetables – cooling load calculation – design of cold storage – cost economics of cold storage-Modified & Control Atmosphere Storage of fruits & vegetables.

Text Books:

Reference Books
2. The Completer Technology Book on Processing, Dehydration, canning, Preservation of Fruits & Vegetables by NIIR Board, New Delhi
3. Loesecke. 2001. Drying and dehydration of foods. Agrobios (India), Jodhpur

09FP313 FOOD PRODUCT TECHNOLOGY & PACKAGING LAB

Credits: 0:0:2
12 experiments will be notified by the HOD from time to time

LIST OF EXPERIMENTS

S.No.
1. Preparation and calculation of material balance of on khoa- and chhana – based traditional dairy products
2. Preparation of traditional aerated confectionery
3. Preparation of traditional products from legumes
4. Determination of quality parameters of premixes
5. Determination of water vapour transmission rate of the given packaging material - polythene
6. Estimation of water vapour transmission rate of the given packaging material - polypropylene
7. Determination of migration characteristics of packaging materials using different simulants - alcohol as a simulant
8. Determination of migration characteristics of packaging materials using different simulants - acid as simulant
9. Determination of continuity of tin coating in cans by thiocyanate test for porosity
10. Estimation of thermal shock resistance of glass bottles
11. Determination of grease resistance of papers used in food industry – butter paper & toffee wraps
12. Determination of half value (hvp) of products stored in ldpe (low density polyethylene) films by direct weighing method & break down method
13. Estimation of half value (hvp) of products stored in hdpe (high density polyethylene) films by direct weighing method & break down method
14. Determination of bacterial counts of polymer – packed foods during storage
15. Determination of coliforms and fungal counts of polymer – packed foods during storage

09FP314 TRANSPORT PROCESSES IN FOOD ENGINEERING LAB

Credits: 0:0:2
12 experiments will be notified by the HOD from time to time

S.No. LIST OF EXPERIMENTS
1. Drying studies using through flow dryer – drying rate and drying curve
2. Determination of overall heat-transfer co-efficient of a tubular pasteuriser
3. Determination of crushing efficiency of sugar cane crusher
4. Performance evaluation of an extruder
5. Calibration of rota meter
6. Determination of heat transfer through composite walls
7. Determination of pressure losses in pipes due to sudden enlargement and contraction.
8. Calibration of venturi meter and orifice meter
9. Determination of friction coefficient in annular pipe
10. Determination of overall heat transfer coefficient in shell and tube heat exchanger
11. Determination of aerodynamic properties using fluidised bed column
12. Determination of mixing index of a mixer – sigma, ribbon, planetary mixers
13. Determination of mass transfer coefficient using Fick’s law
14. Determination of enthalpy balances in single effect evaporator
15. Determination of mass transfer rate in leaching / extraction

09FP315 – FOOD ENZYMOCYLOGY LAB

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time

Sr. No. LIST OF EXPERIMENTS

1. Estimation of reducing sugars by dinitrosalicylic acid method
2. Estimation of proteins by the hartree-lowry method
3. Amylases - optimisation of ph & temperature
4. Optimisation of enzyme-substrate ratio and determination of michaelis–menten kinetics
5. Time study / enzyme kinetics of amylases
6. Optimisation of ph and temperature of protease
7. Optimisation of enzyme-substrate ratio and determination of michaelis–menten kinetics - protease
8. Time study / enzyme kinetics of protease
9. Characterisation of activity of crude amylase
10. Characterisation of activity of crude protease
11. Techniques of enzyme immobilization
12. Michaelis – menten kinetics and half-life of immobilized enzymes -
13. Qualtitative tests for presence of enzymes – catalase, peroxidase and urease
14. Tests for cellulase activity
15. Test for phosphatase activity in milk
ADDITIONAL SUBJECTS

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<th>Subject Name</th>
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<td>Processing of Food Commodities</td>
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<td>09FP213</td>
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<tr>
<td>09FP218</td>
<td>Processing of Food Lab – 2</td>
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10FP201 PROCESSING OF FOOD COMMODITIES

Credits: 3:0:0

Objectives:
1) To study various processing methods for various food materials like fruits & vegetables, dairy products, cereals, meat, poultry, fish and bakery products
2) To study various innovative food processing techniques

Outcomes:
1) Students to acquire knowledge on the basics of food processing
2) Students will have a know-how on the various processing technologies involving fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products
3) Students to acquire basic knowledge on microbiology of food products
4) Students will have an overview of 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

Unit IV Meat, Fish and Poultry 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

09FP213 PROCESSING OF FOOD LAB -1

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time

Objectives
To make the students
  a) Understand the basics of fruit and vegetable processing
  b) Know the process of manufacture of fruit and vegetable products
  c) Understand the importance of mass and material balances

Outcome
  a) Know the process of manufacture of processed fruits and vegetables
  b) Understand the Laws and standards governing the product.

List of Experiments:
1. Preparation of syrups
2. Preparation of Grape squash
3. Preparation of orange squash
4. Preparation of pineapple RTS
5. Preparation of lime cordial
6. Preparation of mango jam
7. Preparation of mixed fruit jam
8. Preparation of Jellies
9. Preparation of marmalades
10. Preparation of fruit bars
11. Preparation of tomato ketchup
12. Preparation of Pumpkin sauce
13. Vinegar – salt – oil pickles
14. Preparation of gummies, fondants and fudges
15. Preparation of toffees.
09FP218 PROCESSING OF FOOD LAB -2

Credits: 0:0:2

12 experiments will be notified by the HOD from time to time

Objectives
To make the students
  a) Understand the basics of bakery products processing
  b) Know the process of manufacture of bakery products
  c) Understand the importance of mass and material balances

Outcome –
  a) Know the process of manufacture of bakery products
  b) Understand the Laws and standards governing the product.

List of Experiments:

1. Preparation of whole wheat bread
2. Preparation of multigrain bread
3. Preparation of bun
4. Preparation of puffs
5. Preparation of doughnuts
6. Preparation of Hard dough biscuits
7. Preparation of soft dough biscuits
8. Preparation of multigrain biscuits
9. Preparation of high fiber biscuits
10. Preparation of cookies
11. Preparation of rusks
12. Preparation of angel cake
13. Preparation of pound cake
14. Preparation of eggless cake
15. Preparation of puddings
SCHOOL OF FOOD SCIENCE & TECHNOLOGY
NEW SUBJECTS

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<tr>
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<td>10FP302</td>
<td>Instrumental Techniques of Food Analysis</td>
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<td>10FP303</td>
<td>Food Biochemistry and Nutrition</td>
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<tr>
<td>10FP304</td>
<td>Advances in Food and Water Microbiology</td>
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10FP301 FOOD SAFETY REGULATIONS AND CONTROL

Credit : 3:1:0

Objectives
1) To enable the students to understand the basics of food safety and regulations governing the same, the world over
2) To make the students to understand the role of individual personnel of the regulatory authority

Outcome
Students will be able to develop - (a) protocols based on GMP for Food Processing Industries (b) develop new innovative norms and (c) ensure implementation of adequate safety regulations and control.

Unit I: Structure, Organization and practical operation of International / Intergovernmental Food regulation bodies
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 Organization – History and mandate – Operations and responsibilities – ICGFI – Functions and responsibilities.

Unit II : Regulating authority of Food safety in India and its role

Unit III: Food labeling – Regulations
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: General aspects of 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: ISO 22000 Regulations

Text Books

Reference Book
Rajesh Mehta and J. George - Food Safety Regulation Concerns and Trade- The Developing Country Perspective, 2005, Published by Macmillan India Ltd., New Delhi.

10FP302 INSTRUMENTAL TECHNIQUES OF FOOD ANALYSIS

Credit : 3:1:0

Objectives
1) To enable the students to understand the basics of various techniques available for the analysis of a food commodity
2) To make the students appreciate the instruments for analysis and their advancements till date

Outcome
Students will be able to – (a) apply the instrumental techniques learnt towards the analysis of food materials and (b) develop / improve methods of analysis with improved sensitivity and reproducibility

Unit I: Basic concepts in chromatography - Chromatogram, distribution coefficient, retention volume, capacity factor, Gaussian profile, theoretical plates, selectivity, resolution, kinetic processes – Physical forces and interactions – Ionic interactions, van der Waals
forces, hydrogen bonding, charge transfer – Modes of separation – Adsorption, Partition, Ion-exchange, size-exclusion

**High performance liquid chromatography** – Basic principles – Mobile phase – Instrumentation – Injector, Column, Pump, detector. Types of detector – advantages of HPLC over other techniques – Applications of HPLC to food analysis

**Unit II: Gas Chromatography and FTIR Spectroscopy**
Principles – Definitions, terms relating to Retention of analytes, column efficiency, sample component separation- Theory of Gas chromatography – Instrumentation – Carrier gas source, inlet system, columns, types of detectors – FID, TCD, ECD, MSD – application of GC to food analysis

**FTIR Spectroscopy**
Principles of Infrared spectroscopy – Instrumentation- Data handling Techniques, Spectral ratioing, co-adding, Baseline correction, peak measurements, measurement of overlapping bands, smoothing and interpolation, spectral subtraction – quantitative analysis- Sampling methods, transmission cells, attenuated total reflectance – Applications in foods

**Unit III: Atomic absorption spectroscopy**
Introduction to AAS – Components of an AA spectrometer – Overview, Light sources, Nebuliser / Atomiser assemblies, Nebulisers, flames, optics, detectors, support gases, AAS measurements- approaches to improving the S/N ratio – Interferences – Chemical, Physical, Ionisation, Background and spectral – Calibration techniques – External standards and Standard additions – Minimising uncertainties – Atomisation techniques

**Atomic emission spectrometry (AES) - ICP** – Mass spectrometry - **Atomic Fluorescence Spectrometry (AFS)** - Trace metal determinations in Biological samples

**Unit IV: Nuclear Magnetic Resonance spectroscopy**
Electromagnetic spectrum – The NMR Phenomenon – Types of information provided by NMR spectra – Instrumental and Experimental Considerations – Solid state NMR – application of NMR to Food analysis

**Unit V: Mass spectrometry**
Process – Ionisation techniques – Instrumentation – Linked scanning technqiues – application of MS in Food Science – application of GC/MS, LC/MS / FAB/MS / MS/MS and linked scan techniques

**Capillary electrophoresis**
Instrumentation and components – Modes of CE – Capillary zone electrophoresis, Micellar electrokinetic chromatography (MECK), Capillary gel electrophoresis (CGE), Capillary isoelectric focusing (CIEF), Capillary Isotachophoresis (CITP) – Applications of CE in analysis of food substances

**Text book:**

**Reference Books:**
2. David L. B. Wetzel, George Charalambous, 1998. Instrumental Methods of Food and Beverage Analysis, Elsevier Science BV.

10FP303 FOOD BIOCHEMISTRY AND NUTRITION

Credit : 3:1:0

Objectives
1) To enable students understand the basics of food biochemistry and nutrition
2) To make the students appreciate the importance of nutrition and enable them to develop new products of high nutritive value

Outcome
Students will be able to apply their knowledge in Food Biochemistry and nutrition in designing new range of products with improved nutritional characteristics (Nutraceuticals, probiotics etc.)

Unit I:
Electron transport chain - glycolysis, TCA cycle, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof Pathway (EMP), urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

Unit II:
Biosyntheses and degradation of fatty acids, and cholesterol - Biosynthesises 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.

Unit III:

Unit IV:
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, phytoallexins, phytates

Unit V:
Nutrition for specialized purposes – Pediatric nutrition – geriatric nutrition – Sports nutrition – Nutrition during pregnancy - Functional foods

Text Books:

Reference Books:

10FP304 ADVANCES IN FOOD AND WATER MICROBIOLOGY

CREDITS- 4:0:0

Objectives
1) To enable students to understand the basics of microbiology and its importance in food and water
2) To study their impact on health and diseases transmitted
3) To recycle waste and appreciate the importance of anaerobic digestion in relation to energy

Outcome
Students demonstrate their ability to – (a) identify and solve problems related to Food and Water Microbiology and (b) develop ways for ensuring a microbially safe product in Food Industries

UNIT I: Food and Microorganisms
General concepts about bacteria, molds and yeasts -Factors affecting the growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure – combined effects of factors affecting growth

Unit II: Microbiology of water
Soft and hard water – its implications in Food processing industry- Definition of potable water, contaminated water and polluted water – Diseases transmitted through water – cholera, typhoid, dysentery (Amoebic / Bacillary) – coliforms and its importance – MPN count of coliforms – Permissible limits in drinking water – Advantages and disadvantages of chlorination of water

Unit III: Food spoilage and defects
Classification- Food infections – bacterial and other types; Food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for food spoilage – spoilage of canned foods

**Unit IV: Foods and Enzymes from microorganisms**
General principles of culture maintenance and preparation for food fermentation – single cell protein – fats from microbes – production of amino acids – production of other substances added to food – production of enzymes

**Unit V: Microbiology in Food Sanitation**
Bacteriology of water supplies – sewage and waste treatment and disposal – Anaerobic digestion pathways in relation to biogas output – Good Manufacturing Practices (GMP) – Hazard Analysis and Critical Control Points (HACCP)

**Text Books**

**Reference Books**
SCHOOL OF FOOD SCIENCES AND TECHNOLOGY
## ADDITIONAL SUBJECTS

<table>
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<tr>
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<th>Name Of The Subject</th>
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<td>Food Microbiology</td>
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<td>2. 11FP202</td>
<td>Process Engineering Calculations</td>
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<td>4. 11FP204</td>
<td>Principles of Fluid Mechanics and Heat Transfer</td>
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<td>6. 11FP206</td>
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<td>7. 11FP207</td>
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<td>8. 11FP208</td>
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<td>10. 11FP210</td>
<td>Technology of Meat, Fish and Poultry Processing</td>
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<td>11. 11FP211</td>
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<td>12. 11FP212</td>
<td>Food Chemistry</td>
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<td>13. 11FP213</td>
<td>Food Additives</td>
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<td>14. 11FP214</td>
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<td>15. 11FP215</td>
<td>Cereal &amp; Pulses Technology</td>
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<td>Milling and Bakery Technology</td>
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<td>21. 11FP221</td>
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<td>26. 11FP226</td>
<td>Analysis of Food Products of Plant Origin Lab</td>
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<td>Analysis of Food Products of Animal Origin Lab</td>
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<td>29. 11FP229</td>
<td>Food Refrigeration &amp; Cold Storage Construction</td>
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<td>Radiation Preservation and Processing Techniques</td>
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### 11FP201 FOOD MICROBIOLOGY

**Credits:** 3:0:0

**Course Objectives:**
To enable the students to understand
- Isolation methodology of microorganisms
- Methods of preservation of foods
Karunya University School of Food Sciences and Technology

• Microorganisms of food commodities of plant and animal origin
• Food borne diseases and microorganisms

Course Outcome:
On successful completion of the subject, students will get exposure to
• How to isolate microorganisms and how to utilize microorganism as sources of food
• How to utilize microorganism to produce fermented foods
• How to utilize microorganisms in food industries

Unit I: Introduction, screening and isolation of microorganisms


Unit II: Conventional methods of preservation

Thermal mode of preservation – Pasteurisation and appertization – determination of D and Z values – spoilage of canned foods – aseptic packaging - Low-temperature storage

Non-thermal methods of preservation: High pressure processing – Pascalisation - Irradiation – Brief account of microwave, UV and ionizing radiation - Use of chemical preservatives, Natural food preservatives - Microbiological quality control and HACCP

Unit III: Microbiology of Fermented products

Traditional vegetable fermentation – Sauerkraut - Lactic acid, citric acid, and mixed acid fermentations - Alcohol production – Fermentation of oriental food products.

Unit IV: Microbiology of Food commodities of animal / marine origin

Microbiology of water and their importance of processing of foods in industries. Microbiology of milk – Hetero and homo fermentative Lactic acid bacteria – Yogurt and Cheese fermenting organisms - Importance of aflatoxin in canned foods.

Unit V : Food borne pathogens

Food Poisoning and intoxication – food borne diseases – Symptoms, prevention and treatment of Bacillus spp., Clostridium botulinum, Escherichia coli, Salmonella, Staphylococcus aureus, Shigella spp., Hepatatis, Gastroenteritis viruses, Entamoeba histolytica and Entamoeba coli.

Text Book:

Reference Books:
11FP202 FOOD PROCESS ENGINEERING CALCULATIONS

Credit: 4:0:0
Course Objective:
- To enable the students to understand the process engineering calculations in food industries

Course Outcome:
- On completion of the syllabus, the students will be able to develop skill and other engineering knowledge relating to various process engineering calculations essentially required for the food engineers to function effectively.

Unit I: Basics of Food Engineering Calculations
System of measurements; SI system of measurement; Units and Dimensions, Fundamental and derived units, Mole units – Mole, atomic mass and molar mass, Solids, liquids and solutions – important physical properties of solutions

Unit II: Gas Vapour Mixtures and its behavior in Food systems

Unit III: Material Balances of unit operations in Food systems
Material balances – basic principles, law of conservation of mass, process flow diagram, system boundaries, total mass balance, component mass balance. Material balance of food processes involving Distillation, Absorption and Stripping, Extraction and leaching.

Unit IV: Material Balances of unit operations in Food systems
Material balance of food processes involving drying, evaporation and concentration by non-thermal processes involving membrane separations

Unit V: Energy Balances
Concept and units – Heat capacity – Sensible heat changes in gases at constant pressure – Sensible heat changes in liquids – Latent heat - calculations of enthalpy changes, general balance without reactions, heats of solution and mixing.

Text Book:

Reference Books:

**11FP203 FOOD MICROBIOLOGY LAB**

**Credits:** 0:0:2

**Course Objective:**
- To study the various microorganisms associated with food.

**Course Outcome:**
- The students to learn various methods of isolation, characterization and screening of bacteria, fungi and other related organisms which will help them to develop skills to monitor various food processing operations in food industries.

**List of Experiments**

1. Study of morphology of bacteria and fungi
2. Methods of Sterilization of glass wares and culture media for microbiological work
3. Preparation of nutrient broth and nutrient agar
4. Monochrome staining
5. Differential staining – Gram staining
6. Negative Staining, Lacto phenol cotton blue staining
7. Methods of pure culture techniques for bacteria
8. Hanging drop preparation to observe motility of bacteria
9. Enumeration and isolation of bacteria and fungi from water / milk
10. Enumeration and isolation of bacteria and fungi from any contaminated food
11. IMViC tests
12. Methylene blue reduction test in milk
13. Phenol Coefficient test for disinfectants

**11FP204 PRINCIPLES OF FLUID MECHANICS AND HEAT TRANSFER**

**Credits:** 4:0:0

**Course Objectives**

To enable the student to understand:

1. Basics of Fluid mechanics and thermal flow
2. Importance of thermal fluid sciences in processing of food
3. Develop processes with better heat efficiency and economics

**Course Outcome:**

On successful completion of the subject, the students will be able to apply their knowledge on thermal fluid sciences in processing of food.

**Unit I: Introduction to Fluid Mechanics**

Fluids – Properties, vapor pressure, surface tension, capillary effect; Types of fluids. Bernoulli equation; fluid flow – laminar, turbulent; pressure drops in pipes, valves and bends. Orifice meter, Venturi meter, Rotameter, Pitot tube – working principles
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Unit II: Introduction to thermodynamics
Thermodynamic system and Control volume, thermodynamic properties, thermodynamic equilibrium, thermodynamic process, Zeroth law of thermodynamics, concept of work and heat transfer. First law of thermodynamics – closed and open system, Carnot cycle - Second law of thermodynamics.

Unit III- Steam and Properties of Steam
Properties of steam – Phase transformation at constant pressure – PVT data – Steam tables – wet and super-heated steam, entropy of water, steam and super-heated steam – Constant pressure, constant volume processes – Adiabatic process- Isothermal and polytropic processes – boilers and their types

Unit IV: Heat Transfer – Conduction

Unit V – Heat Transfer – Convection and Radiation
Convection heat transfer – forced and natural; Evaluation of convection heat transfer coefficient, turbulent flow over a flat plate, Forced convection inside tubes, heat transfer coefficient for Laminar flow in a tube with constant heat flux and constant wall temperature. Basics of Radiation heat transfer.

Text Book:

Reference Books:
3. 11FP205 FOOD BIOCHEMISTRY AND NUTRITION

Credits: 3:0:0

Course Objectives:
To enable the students to understand
- Biochemical cycles
- Biosynthesis of macromolecules
- Nutrition and its importance
- Anti-nutritional factors
- Specialized nutrition

Course Outcome:
- On successful completion of the subject, students will get exposure about Nutrition and its importance, nutrition for different group people, nutritive values of different food sources.

Unit I: Carbohydrate metabolism
Electron transport chain, Glycolysis – Embden Meyerhof Pathway (EMP), Pentose phosphate shunt, TCA cycle, gluconeogenesis, urea cycle, inter connections of pathways, metabolic regulation, Bioenergetics – respiratory chain ATP cycle, energy rich compounds.

Unit II: Protein and Fatty acid Metabolism
Biosynthesis and degradation of - fatty acids (saturated and unsaturated), and cholesterol; amino acids (glycine, tyrosine, cysteine, histidine), peptides and proteins; Purines (adenine, thymine), pyrimidines (guanine and cytosine) and nucleic acids (DNA and RNA).

Unit III: Concepts of Nutrition

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, and phytates

Unit V: Specialized Nutrition

Text Book

Reference Books:

11FP206 FLUID MECHANICS AND HEAT TRANSFER LAB

Credits: 0:0:2

Course Objective
- To study the various chemical engineering parameters through practical exercise

Course Outcome
- On completion of the course, the students will be able to develop skills needed to analyse various chemical engineering parameters and study heat transfer, exchanger, pressure drop, etc which will enable them to carry out different chemical engineering operations connected with food industry
List of Experiments

1) Determination of pipe friction and pressure drop under sudden contraction and expansion during fluid flow
2) Determination of Equivalent Length of pipe fittings during fluid flow
3) Determination of Pressure drop in Helical coil
4) Determination of Pressure drop in annular pipes
5) Calibration of Venturi meter and rotameter /
6) Calibration of Orifice meter
7) Pressure drop across Packed-bed columns
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
13) Filtration studies using a leaf filter
14) Heat transfer studies of a long tube evaporator
15) Determination of particle size distribution using a gyratory sieve shaker

11FP207 FOOD BIOCHEMISTRY LAB

Credits: 0:0:2

Course Objective
- To study the biochemical properties of food commodities

Course Outcome
- On completion of the course, the students will be able to develop skills needed to analyse various biochemical constituents of food

List of Experiments

1. Estimation of sugars by DNS method
2. Estimation of sugars by Phenol - Sulfuric acid / Anthrone- Sulfuric acid methods
3. Estimation of proteins by the Biuret method
4. Estimation of proteins by microkjeldahl’s method
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. Qualitative tests for checking of milk and water
13. Qualitative test for checking of blanching
Credits: 4:0:0

Course Objective
- To enable the students to understand the concepts and applications of distillation, evaporation, separation and super critical fluid extraction processes.

Course Outcome
- On completion of the syllabus, the students will be able to apply their knowledge on distillation, evaporation, separation and super critical fluid extraction processes in various food industries.

Unit I: Introduction
Basic principles of food processing, Conservation of mass and energy, Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

Unit II: Distillation
Distillation, Steam distillation, applications and equipment – determination of height equivalent of theoretical plate (HETP) – McCabe-Thiele method – reflux ratio. Molecular distillation, theory and examples. Mass transfer phenomenon applied to food systems.

Unit III: Evaporation
Needs, basic principles, Calculations, Single and multiple effect evaporation, Heat economy – enthalpy balances for evaporators, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit IV: Contact Equilibrium Separation Processes
Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction, with food application examples, Crystallization.

Unit V: Leaching and Extraction
Leaching – Leaching equipments – principles of continuous and countercurrent leaching. Liquid extraction – extraction equipment – principles of extraction. Special extraction techniques – supercritical fluid extraction. Applications; extraction of Fatty acids, oleoresins and essential oils; Relative advantages, limitations and economics. Mechanical extraction – Expellers, screw press, filter press.

Text Book:

Reference Books:
11FP209 FOOD ENGINEERING AND PACKAGING LAB

Credits: 0:0:2

Course Objectives:
- To enable the students to understand the principles of food engineering and packaging.
- To enable the students to understand about the working methodology behind instruments used for food engineering and packaging applications.

Course Outcome:
- On completion of the subject, students will be able to apply their knowledge on food engineering and packaging in various food industries.

List of Experiments

1. Characteristics of dehydrated products
2. Characteristics of flaked products
3. Water vapor transmission rate of different packaging materials
4. Determination of migration characteristics of packaging materials
5. Efficiency of a scraped surface heat exchanger
6. Studies on milling characteristics of cereals
7. Determination of viscosity of given fluid using Ostwald viscometer
8. Determination of mixing index of a sigma mixer
9. Determination of overall heat transfer coefficient in tubular pasteurizer
10. Study of the drying characteristics of a cross flow drier
11. Determination of washing efficiency of a continuous washer for root crops
12. Determination of tensile strength of given packaging material
13. Determination of bursting strength of given packaging material
14. Determination of efficiency of extraction using Bollmon extractor
15. Determination of efficiency of rotary flash evaporator
16. Gas transmission rates test on flexible films
17.

11FP210 TECHNOLOGY OF MEAT, POULTRY AND FISH PROCESSING

Credits: 3:0:0

Course Objectives:
To enable the students to understand about
- Composition, nutritive value of meat, poultry and fish
- Processing technology of meat, poultry and fish
- Meat products, eggs

Course Outcome:
- On completion of the course, the student will be able to understand about how to process meat, poultry and fish, preparation of different types of products from meat, poultry and fish

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, Product export and its sustenance, 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, in pack freezing, relative merits and demerits, Canning operations, Salting and drying of fish, pickling and preparation of fish protein concentrate, fish oil and other by products.

Text Book

Reference Books
**Credits: 4:0:0**

**Course Objective**

- To enable the students to understand the various concepts of economics, process development, design consideration and cost estimation in food industry.

**Course Outcome**

- On completion of the subject, the students will be able to apply their knowledge on plant design and process development in various food industries.

**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  General design Consideration**

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.

**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. 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

**Unit IV Plant overheads**

Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc

**Unit V Profitability Analysis**

Return on original investment, interest rate of return, accounting for uncertainty and variations and future developments. Optimization techniques – Linear and Dynamics programming, Optimization strategies.

**Text Book**


**Reference Books**

11FP212 FOOD CHEMISTRY

Credits: 3:0:0

Course Objectives:
To enable the students to understand the chemistry and importance of water, carbohydrates, lipids, proteins and vitamins

- The importance of water and its role in structure and texture maintenance
- The role of sugars in colour and flavor development and polysaccharides in texture
- The importance of proteins in health and their role in food
- The methods of manufacture of oils and the methods of determining the quality of oils and fats
- The role of vitamins in human nutrition and the effect of various processing methods in maintaining the vitamin content in foods.

Course Outcome:
On successful completion of the subject, students will get exposure to

- The importance of water and its role in structure and texture maintenance
- The role of sugars in color and flavor development and polysaccharides in texture
- The importance of proteins in health and their role in food
- The methods of manufacture of oils and the methods of determining the quality of oils and fats
- The role of vitamins in human nutrition and the effect of various processing methods in maintaining the vitamin content in foods.

Unit I: Water and ice
Importance of water in foods. Structure of water & ice. Bound & free water, water activity ($a_w$) and their implications. Sorption Phenomena and Sorption isotherms, examples – Dispersed systems – some basic considerations

Chemistry of Carbohydrates: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars

Unit II: Chemistry of Polysaccharides
Chemistry, properties of Pectins, gums. Starch and its hydrolytic products, maltodextrins, Cellulose, Cyclodextrins, dietary fiber – soluble and detergent fiber.

Unit III: Chemistry of Lipids

Unit IV: Chemistry of Proteins

Unit V: Chemistry of Vitamins
Fat soluble and water soluble vitamins – chemistry, their sources, functions, bioavailability. Reasons for loss of vitamins in food.

Text Book:

Reference Books:

11FP213 FOOD ADDITIVES

Credits: 3:0:0

Course Objectives:
To enable the students to understand
- About food additives and determination of toxicity
- Types and chemical properties of preservatives, emulsifiers, and antioxidants
- Types and chemical properties of humectants, enzymes and starches
- Types and chemical properties of flavorants, fat substitutes
- Types and chemical properties of sweeteners, chelating agents, and anti-browning agents,

Course Outcome:
On successful completion of the subject, students will get exposure to
- Applications of food additives and how to study the toxicity of 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
Types, chemical properties, levels of additions in individual products, toxicity data of Acidulants – Preservatives – Emulsifiers and gums - Antioxidants

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

Unit IV
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
Types, chemical properties, levels of additions in individual products, toxicity data of
Sweeteners – Natural and synthetic, Chelating agents, antibrowning agents, Nutritional additives

Text book

Reference Book:
2007.

11FP214 FRUIT AND VEGETABLE TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To enable the students to understand
- Fruits and vegetables of India
- Thermal processing of fruits and vegetables
- Fruit juices
- Methods of dehydration
- Aseptic and non-thermal processing of fruits and vegetables

Course Outcome:
On successful completion of the subject, students will get exposure to
- Processing of fruits and vegetables, preparation of juices and other products from
  fruits and vegetables

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. General methods of preservation of
whole fruits/Vegetables and processed fruits and vegetables. Processing and packaging of cut
fruits and vegetables.

Unit II Canning of Fruits and Vegetables
Washing, peeling, grating, slicing dicing, deseeding. Juice and pulp extraction and clarification.
Bottled Products: Preparation of products like Jams, Jellies, Marmalades, Pickles, Puree, Ketchup, Sauce, Squashes etc. - FPO specifications. Bulk preparation and storage. Different
filling, closing and sterilization operations.

Canning of Vegetables. Precautions - Blanching operations - Batch and Continuous Blanching. Concept of Hurdle technology as applied to fruit and vegetable preservation.

Unit III Processing of fruit juices
Common machinery for operations like Peeling, Slicing/Dicing, Pulping, Grating, Hydraulic
Pressing and Clarification.

Preparation of specialty products like, Fruit juice concentrates, Fruit Bars and Fruit powders.

Academic Information
Unit IV Dehydration

Unit V Aseptic and other methods of processing
Aseptic processing and Bulk packing of Fruit juice concentrates, Pulps and Puree Brief information on Asepticity and how it is strictly maintained in the plant. Aseptic heat exchangers for sterilizing and concentrating the product. Aseptic fillers. Different system of filling practiced. 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.

Minimal processing – Basic concepts, Reverse osmosis

Text Book

Reference Books

11FP215 CEREAL AND PULSES TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To enable the students to understand
- Processing of paddy
- Processing of rice, millets, pulses
- Storage of cereals

Course Outcome:
- On successful completion of the subject, students will get exposure about Processing of cereals, and how to store it.

Unit I Paddy Processing and Byproducts Utilization:
Unit II Rice Milling:

Unit III Milling of Pulses:
Traditional milling process, merits and demerits, Drying of legumes, Sun drying, Pre-cleaning, Pitting, Oil application, conditioning, Dehusking and splitting, Machinery and equipment employed, mass balance, losses during milling; Modern milling process, Mechanical hot air drying and conditioning, Dehusking in Pulse Pearler, Water conditioning, splitting of pulses in Pulse splitter, Grinding of split pulses, pulse flour products, their applications, equipment used.

Unit IV Milling and Processing of Maize:
Pre-cleaning, cleaning equipment, Degermination and Dehusking, Roller milling, Sifting, Purifying, Aspiration, Pneumatics in a maize mill. Products of milling-Flour, Semolina, Brewers’ grits etc. and their applications. Dry and Wet Milling Processes. Gluten and Starch Separation, extraction process; Equipments needed for Degermination, Debranning and starch separation - 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 Grain Storage and Handling:
Bag Storage - structure design, Cover and Plinth Storage Structures, Dunnage, Materials for Dunnage, Pallets, Protection against rodents and pests. Fumigation Processes for bag storage piles, Bulk Storage in silos and large Bins; Construction of Silos, Physical load and mechanical strength of Silos, concrete and Metal Silos. In silo Aeration and Drying, Problems of Dust Explosion in Grain Storages, Quality Changes of Grains during storages and remedial measures to prevent unwanted quality changes.

Text Book:

Reference Books:

11FP216 SUGAR AND CONFECTIONERY TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To enable the students to understand about
- Sugarcane and its cultivation and processing
- Sugar production methodology
- Alcoholic beverages
- Carbonated beverages
Course Outcome:
• On successful completion of the subject, students will get exposure about Sugarcane and how to utilize sugarcane products in food industry, manufacturing of alcoholic beverages, confectionery products.

Unit I Introduction

Unit II Sugar production process details:
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 III: Technology of Alcoholic Beverages
Manufacture of beer, wine and champagne - Quality characteristics
Manufacture of distilled beverages including whisky, brandy, rum and gin – Quality aspects

Unit IV: Technology of Carbonated Beverages and Confectionery
Manufacture of carbonated beverages – quality aspects – Manufacture of sugar-free, sugar-less carbonated beverages.
Confectionery manufacture
General technical aspects of industrial sugar confectionery manufacture, Manufacture of high boiled sweets – Ingredients, Methods of manufacture – Types – Center filled, lollipops, coextruded products. Manufacturing technology of gums and jellies – Quality aspects

Unit V: Manufacture of Miscellaneous Products
Caramel, Toffee and fudge – Liquorice paste and aerated confectionery, Lozenges, sugar pannings and Chewing gum, Countlines - Quality aspects

Text Book

Reference Books

11FP217 DAIRY TECHNOLOGY

Credits: 3:0:0

Objectives:
To enable the students to understand about
• Milk, milk processing methodologies, milk products (ice creams, fermented milk products)

Outcome: On successful completion of the subject, students will get exposure about
• Milk and how it get processed using various thermal processing methods, fermented and non-fermented products produced utilizing milk as a major substrate.

Unit I Dairy Chemistry and Microbiology
Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests, Quality and Quantity tests at reception, Cell count and other tests, Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases – Dietary recommendations – Applications of enzymes in dairy industry

Unit II Dairy Processing Equipments

Unit III Manufacture of Dairy Products
Cheese – Types of cheese, Defects in cheese, Manufacture of paneer, Different types of processed milk, Khoa, Milk powder – Quality aspects

Unit IV Manufacture of Ice Cream and other Dairy Products
Manufacture of Ice cream – Chemistry and technology –Microbiology of ice cream - Quality aspects
Manufacture of Butter, Ghee – Grading of butter - Quality aspects
Extraction of casein from milk, properties, composition and industrial uses
Production of lactose and whey

Unit V Fermented dairy products
Fermented products – Yoghurt, Curd, acidophilus milk etc.- Concept of Probiotics and prebiotic foods, Energy use in Dairy plant, sources of energy, cost of energy, Control of energy losses and Energy conservation.

Text Book

Reference Books

11FP218 FOOD PACKAGING TECHNOLOGY

Credits: 3:0:0

Course Objective
To enable the students to understand about
• Packaging and packaging materials, interaction of food items with packaging materials

Course Outcome
• On successful completion of the subject, students will get exposure about how to package the food items using different techniques, how to use cans and films for packaging and its properties, how food items are interacting with packaging materials.

Unit I : Introduction to Food Packaging:

Unit II : Metal Cans as Packaging

Unit III : Flexible Films Packaging

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 : Interaction of Food Material with Packaging Material

Text Book

Reference Books
11FP219 MILLING AND BAKERY TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To enable the students to understand about
- Wheat and its processing, market value of wheat products
- Bakery technology, instruments used in bakery technology
- Types of biscuits and its manufacturing technology

Course Outcome:
- On successful completion of the subject, students will get exposure about how to process wheat and how to produce different products using wheat flour

Unit I: Fundamentals of Market Analysis for Wheat and Wheat Products:
Laboratory testing of Wheat grain Quality, Moisture tests, Grain hardness testing. Testing of wheat flour for bread making and Chapathi making, Visco graph, Amylograph, Farinograph and other tests and their significance in bread manufacture.

Unit II: Outline of the Wheat Milling Process
Wheat milling Flow sheet, explanation of steps in milling operations of milling; Cleaning, Sifters, Destoners, Wet Washing, Roller milling – Break rolls, fluted rolls and plane rollers and their applications, Sifting and purifying, plan sifters; Extraction, milling for Atta, Semolina of different particle size, Maida and other products. Pneumatic conveying of products, By products of wheat mill, Grits and Bran, Extruded macaroni products from Wheat semolina.

Unit III: Bakery Equipment and Engineering
Bulk handling of ingredients, Weighing and metering equipment, Dough mixing and mixers, Dividing, rounding, sheeting, and laminating, Fermentation enclosures and brew equipment, Forming and molding bread-like products, Forming cookies, crackers and other products, Ovens and baking, Fryers and frying, Pans, pan handling equipment, and Slicers, Applicators for adjuncts, Packaging materials and equipment; Preservation methods, Computerization in plant and laboratory, Sanitation and safety.

Unit IV: Baking Technology
Bread manufacturing process – Straight dough fermentation, Sponge and dough, Accelerated processing, Chorley wood bread process, Dough retarding and freezing – Specialty fermented goods- Part-baked breads, Yeast laminated products, Ingredients for baking.

Unit V: Biscuits and Cake Manufacture
Biscuits – Ingredients and flour specification - Types of biscuit doughs – Developed doughs, short doughs, semi-sweet, enzyme modified doughs and batters- importance of the consistency of the dough – Layered Products (Wafers).
Cake manufacture – Flour specification – ingredients – manufacturing process – types of chemically aerated goods

Text Book
Karunya University
School of Food Sciences and Technology

Reference Books

11FP220 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credits: 3:0:0

Course Objectives:
To enable the students to understand about
• Coffee and its processing techniques, instant coffee, and quality grading
• Different types of tea and its manufacturing techniques, instant tea, quality parameters of tea
• Cocoa and its processing, chocolate manufacturing technology
• Processing and chemistry of major spices
• Processing and chemistry of minor spices

Course Outcome:
• On completion of the subject, students will be able to understand the processing steps involved for different plantation products and spices.

Unit I : Chemistry and Technology of Coffee

Unit II : Tea – Chemistry and Technology

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

Unit V : Chemistry and Technology of Minor Spices
Cumin, Coriander, Cinnamon, fenugreek, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – Quality control
Synthesis of volatiles using micro-organisms, plant suspension cultures.
Text Book

Reference Books

11FP221 ENGINEERING PROPERTIES OF FOOD MATERIALS

Credits: 3:0:0

Course Objectives:
• To study the various engineering properties of food materials under different conditions.
• To study about the different methods of determining the quality and properties of different foods

Course Outcome:
• On completion of the subject, the students will be able to design food processing equipments and gain knowledge on process development of new food products.

Unit I: Physical Properties and frictional properties of Foods
Methods of estimation of - Shape, size, volume, density, porosity, surface area, moisture content, equilibrium moisture content, water activity. Sorption Isotherm and its determination. Friction, Static and kinetic friction, and angle of repose. Mechanical properties

Unit II: Rheological Properties of Foods

Unit III: Thermal Properties of Foods
Definitions - specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity;

Unit IV: Aerodynamic and hydrodynamic properties of Foods
Drag and lift coefficient, friction drag, pressure drag, terminal velocity and their application in the handling and separation of foreign materials, pneumatic handling and transportation.

Unit V: Electrical properties of foods
Dielectric properties – resistance and capacitance, dielectric constant and loss factor, electric energy transmission properties, Electro-magnetic field effects, Dielectric measurements, Polar solvents, Ionic solutions.
Text Book

Reference Books

11FP222 ANALYSIS OF FOOD LAB – 1
Credits: 0:0:2
Course Objective:
- To learn about analysis of various food components.

Course Outcome:
- The students will develop practical skill in analyzing various food components available in various food materials.

List of experiments
1. Analysis of Honey for total and reducing sugars
2. Analysis of Milk – Lactose and Fructose content
3. Analysis of Fat content of edible oil seeds.
4. Analysis of Wheat flour
5. Analysis of Ghee & Butter – Reichert Meissel and Polenske Values
6. Analysis of Ghee & Butter – Baryta number
7. Analysis of caffeine in Coffee
8. Analysis of alcohol content in Beer
9. Analysis of instant premixes
10. Analysis of spices – Pepper & Ginger
11. Determination of Biological Oxygen Demand
12. Determination of chemical oxygen demand

11FP223 ANALYSIS OF FOOD LAB– 2
Credits: 0:0:2
Course Objective:
- To learn about analysis of various food components.

Course Outcome:
- The students will develop practical skill in analyzing various food components available in various food materials.

List of experiments (food additives)
1. Determination of moisture content in butter
2. Determination of sodium chloride in dried fish
3. Estimation of pectic substances in fruit based product
4. Estimation of total sugar and reducing sugar
5. Estimation of free fatty acid content in milk powder
6. Estimation of benzoic acid
7. Estimation of curcumin content in turmeric
8. Estimation of acid insoluble ash in cereal products
9. Estimation of salt in butter
10. Estimation of saccharin in beverages
11. Estimation of free sulphur di oxide in fruit products
12. Estimation of caffeine

11FP224 FOOD PRODUCT TECHNOLOGY LAB – 1

Credits: 0:0:2

Course Objective
- To study about the technology behind various food products.

Course Outcome
- On completion of the subject, the students will be able to develop new food products based on the knowledge gained.

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
13. Preparation of angel cake
14. Preparation of pound cake
15. Preparation of sponge cake
16. Preparation of rusks

11FP225 ENZYMEOLOGY LAB

Credits: 0:0:2

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

Course Outcome
- On completion of the subject, the students will be able to estimate the enzyme activity and to characterize the enzymes applicable in food industries.

List of experiments

Academic Information
11FP226 ANALYSIS OF FOOD PRODUCTS OF PLANT ORIGIN LAB

Credits: 0:0:2

Course Objective

- To enable the students to develop practical skills to analyse various constituents in food products based on plants.

Course Outcome

- On completion of the subject, students will be able to analyse the biomolecules present in food products based on plants.

Experiments

1. Analysis of total sugars in jam
2. Analysis of reducing sugars in jam
3. Determination of acidity in fruit juices
4. Determination of total fruit solids in sauces
5. Determination of pectin content of jam
6. Determination of total ash in jaggery
7. Estimation of lycopene in tomato
8. Estimation of carotenes in a fruit
9. Estimation of anthocyanins and chlorophyll in a plant product
10. Estimation of saccharin and ascorbic acid in fruit beverage
11. Estimation of polyphenol in a plant product
12. Estimation of sulphur dioxide in fruit beverage
13. Estimation of iron and copper in a plant product
14. Analysis of tannins in black tea

11FP227 ANALYSIS OF FOOD PRODUCTS OF ANIMAL ORIGIN LAB

Credits: 0:0:2

Course Objective
To enable the students to develop practical skills to analyse various constituents in food products based on animals.

**Course Outcome**
- On completion of the subject, students will be able to analyse the biomolecules present in food products based on animals.

**Experiments**
1. Estimation of fat in milk
2. Determination of alpha-amino acid content by Sorensons Formal titration
3. Estimation of curcumin in turmeric
4. Estimation of cholesterol
5. Estimation of salt in dried fish
6. Estimation of saponification value of an oil
7. Estimation of iodine value of butter
8. Determination of moisture content of spices
9. Determination of total volatile oil by Clavenger apparatus
10. Analysis of total extractives and ash content of tea
11. Determination of caffeine content of coffee
12. Determination of Scoville’s index of capsaicin

**11FP228 FOOD PRODUCT TECHNOLOGY LAB –II**

**Credits:** 0:0:2

**Course Objective**
- To enable the students to understand the technology behind the manufacturing of various food products.

**Course Outcome**
- On completion of the subject, the students will be able to develop the food products based on their knowledge gained.

**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 Soanpapdi
11. Preparation of Mysorepakk
12. Preparation of Gummies
13. Preparation of aerated confectionery

**11FP229 FOOD REFRIGERATION AND COLD STORAGE CONSTRUCTION**
Credits: 3:0:0

Objective
- To enable the students to understand the various concepts behind refrigeration and storage construction.

Course Outcome
- On completion of the subject, the students will be able to apply their knowledge on cold storage of perishable products.

Unit I Principles of Refrigeration

Unit II Cold Storage Design and Construction

Unit III Operation and maintenance - Controlled atmosphere and modified atmosphere storages
Operation and maintenance, Cleanliness, defrosting practices, preventive maintenance, safety Measures. Controlled atmosphere and Modified atmosphere storages. Principles and basics of their construction. Concept of cold chain supply.

Unit IV Chilling of Foods

Unit V Freezing of foods
Freezing equipment. Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Blast freezers, Contact Plate Freezers, conveyorized quick freezers, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables.

Text Book

Reference Books
2. J.S.Pruthi: Quick Freezing Preservation of Foods (2 Volumes) Allied Publishers,
11FP230 RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS

Credit: 3:0:0

Course Objectives:
- To study the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
- To study the effect of radiation as a processing and preservation method.
- To study the importance and safety issues of the irradiated foods.

Course Outcome
- On completion of the subject, the students will gain knowledge about irradiation and safety measures to be followed and its application in food industries.

Unit I Basics of Radiation Chemistry
Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation. Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.

Unit II Radiation Chemistry of Food Components
Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

Unit III Microwaves In Food Processing
Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.

Unit IV Infra red Radiation
Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.

Unit V Radio Frequency Heating Principles
RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

Text Book

Reference Books
11FP231 EMERGING TECHNOLOGIES IN FOOD PROCESSING

Credits: 3:0:0

Course Objectives
To enable the student to understand:
- Emerging / alternative technologies applied to food processing
- Relative advantages / disadvantages over existing technologies
- Economics and commercialization of newer technologies
- Strategies for applying the same to a wide range of food

Course Outcome
- On completion of the subject, the students will be able to apply their knowledge on high pressure processing, pulsed electric processing of food, irradiation and hurdle technology in various food industries

Unit I High pressure processing of Foods
Principles – applications to food systems – effect on quality – textural, nutritional and microbiological quality – factors affecting the quality – modeling of high pressure processes – High Pressure Freezing, Principles and Applications

Unit II Pulsed electric field processing of Foods

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 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)

Text Book
Karunya University
School of Food Sciences and Technology

Reference Books
1. Handbook of Food Preservation. M. Shafiar Rahman. Published by Marcel Dekker, Inc.
NY. 2006
2. Emerging Technologies for Food Processing. Da-Wen Sun. Published by Elsevier

11FP232 ECONOMICS AND FOOD INDUSTRY MANAGEMENT

Credits: 4:0:0

Course Objective
- To enable the students to understand the concepts of economics and management activities of a food industry.

Course Outcome
- On completion of the subject, the students will be able to apply their knowledge to become a food industry entrepreneur.

Unit I Profiles of Food Processing Industries in India
Industrial production and growth rate in food processing sector, Opportunities and Threats; Entrepreneurship; Concept/meaning, Need, Competencies/qualities of an entrepreneur; Entrepreneurial Support System; District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC), Khadi Village and Industries Commission (KVIC), other relevant institutions/organizations/NGOs at State level

Market Survey and Opportunity Identification (Business Planning)
How to start a small scale industry, Procedures for registration of small scale industry, List of items reserved for exclusive manufacture in small scale industry, Assessment of demand and supply in potential areas of growth, Considerations in product selection, Data collection for setting up small ventures, Project Report Preparation, Preliminary Project Report, Techno-Economic feasibility report
Project Viability, Managerial Aspects of Small Business

Unit II Principles of Management

Unit III Factory Act and Payment of Wages Act
Environmental considerations, Concept of ecology and environment, Factors contributing to Air, Water, Noise pollution, Air, water and noise pollution standards and control; Personal Protection Equipment (PPEs) for safety at work places, Human relations and performance in organization, Industrial Relations and Disputes

Unit IV Preparation of Financial Statements
Classification of accounts, double book entry: Financial analysis, Significance and limitations of financial statements, Financial statement analysis, Ratio analysis, Profitability, Solvency and
activity ratios, Fund flow statements, Working capital and changes in working capital, preparation of cash flow statements, Significance of fund flow and cash flow statements.

Unit V Project and Product Costing
Elements of costing, preparation of cost sheets, Budgeting and budgetary controls, Product costing, Break even and sensitivity analysis, rates of returns. Capital costing, pay back periods, discounted cash flow analysis, Depreciation analysis. Related financial skills

Text Book

Reference Books

11FP301 MASS TRANSFER PROCESSES IN FOOD ENGINEERING

Credits: 4:0:0

Course Objective:
- To enable the student to understand the importance of mass transfer processes in food engineering applications.

Course Outcome
- On completion of the syllabus, the students will be able to apply their knowledge on distillation, evaporation, separation and super critical fluid extraction processes in various food industries.

Unit I: Basic Principles of separation processes
Basic principles of food processing SI system of basics units, Conservation of mass and materials balances, energy and heat units, conservation of energy and heat balances Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

Unit II: Vapor liquid separation processes
Vapor- liquid equilibrium relations, single stage equilibrium contact for vapor liquid system, relative volatility of vapor liquid system Distillation, Steam distillation, applications and equipment, Mass transfer phenomenon applied to food systems

Unit III: Evaporation
Needs, basic principles, Single and multiple effect evaporation, Heat economy, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit IV: Gas liquid Separation Processes
Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction, with food application examples
Unit V: Extraction and Leaching
Mechanical extraction – Expellers, screw press, filter press.
Liquid-liquid extraction, liquid-solid extraction, phase diagram determination of extraction steps by McCabe-Thiele method.
Super critical Fluid extraction - Super critical Fluid State, Properties of Super critical CO2, Density, Viscosity, Volatility etc. Supercritical Phase Equilibria, Solubility, SCFE systems and components, Applications; extraction of Fatty acids, oleoresins and essential oils; Relative advantages, limitations and economics

Text Books

Reference Books

11FP302 SEPARATION PROCESSES IN FOOD ENGINEERING

Credits: 4:0:0
Course Objectives
- To enable the students to understand the concepts of separation of solids and liquids in the food engineering application.

Course Outcome:
- On completion of the subject, the students will be able to apply their knowledge on filtration technique, design of centrifuge, RO system in the food industries.

Unit I: Basic principles of fluid flow
Pressure head in fluids-devices to measure pressures- U tube manometer- Pitot tube, types of flow-laminar-turbulent, simple mass balance and continuity equation, pressure drop due to friction, drag coefficient, flow in packed beds.

Unit II: Mechanical Separations
Mechanical separation-screeners - sedimentation, gravity sedimentation, Sedimentation of solid particles in gas media, stokes law,
Filtration, constant volume filtration, Constant pressure filtration, Industrial applications and equipments for Filtration and Sedimentation

Unit III: Separation by centrifuge
Centrifugal separation-Sedimentation, filtration centrifuges, Basic equations. Different types of centrifuges – Basket, Tubular Bowl, Decanting, Disk bowl, Desludging (Self Cleaning) Bowl
Centrifuges, Nozzle centrifuges. Importance of balancing of rotating masses, feed and discharge arrangement in each case. Specific characteristics, advantages and applications.

**Unit IV: Filtration by membrane systems**
Definitions; Reverse Osmosis (RO), Nano filtration (NF), Diafiltration, Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.

**Unit V: Adsorption and Diffusion**
Basics of adsorption, Diffusion of gases in liquid and solid foods, Moisture transfer in foods, Diffusion in porous foods, Inter-phase moisture transport. Diffusion of aroma components Applications of diffusion and migration in food packaging

**Text Books**

**Reference Books**
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</table>
12FP201 PRINCIPLES OF FOOD PROCESS ENGINEERING

Credits: 3:1:0

Course Objective:
- To enable the students to solve problems in Food Engineering process of value addition and quality improvement.

Course Outcome:
- To utilize the principles in formulating solutions to solve problems in food industry.

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

Unit III

Unit IV

Unit V

Text Books

Reference Book
12FP202 THERMODYNAMICS

Credits: 4:0:0

Course Objective:
- To enable the student to solve problems in Food engineering process of value addition and quality improvement.

Course Outcome:
- To utilize the principles in formulating a solution to a problem in food industry.

Unit I

Unit II

Unit III

Unit IV

Unit V
PROPERTIES OF PURE SUBSTANCE : Phases of a pure substance -phase change – properties diagram – T- V diagram -PV diagram -solid phase on process diagram -PT diagram – PVT surface. equation of state and departure function, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria

Text Book
1. Radhakrishna E, “Fundamental Engineering Thermo Dynamics”, Printice Hall of India, New Delhi,2005
12FP203 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 will be able to
- understand the importance of various food constituents, and their role in a food
- develop a basic idea in New Food Product development
- understand the importance of Packaging materials

Unit I
WATER AND ICE: Importance of water in foods. Structure of water & ice. Bound & free water, water activity ($a_w$) and their implications. Sorption Phenomena and Sorption isotherms, examples – Dispersed systems – some basic considerations

CHEMISTRY OF CARBOHYDRATES: Nomenclature Classification & structure of carbohydrates, Chemical reactions of carbohydrates. Physical & chemical properties of sugars

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12FP204 FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Credits: 3:0:0

Course Objectives:
- To enable the students to understand the thermal processing of fruits and vegetables
- To impart technical know-how on the preparation of fruit juices
- To understand the methods of dehydration

Course Outcome:
- The students will get exposure to the processing of fruits and vegetables, preparation of juices and other products from fruits and vegetables

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. General methods of preservation of whole fruits/Vegetables and processed fruits and vegetables. Processing and packaging of cut fruits and vegetables.

Unit II
operations. Canning of Vegetables. Precautions - Blanching operations - Batch and Continuous Blanching. Concept of Hurdle technology as applied to fruit and vegetable preservation.

Unit III

Unit IV

Unit V
**ASEPTIC AND OTHER METHODS OF PROCESSING:** Aseptic processing and Bulk packing of Fruit juice concentrates, Pulps and Puree Brief information on Asepticity and how it is strictly maintained in the plant. Aseptic heat exchangers for sterilizing and concentrating the product. Aseptic fillers. Different system of filling practiced. 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. Minimal processing – Basic concepts, Reverse osmosis.

Text Book

Reference Books

**12FP205 FOOD MICROBIOLOGY**

Credits: 3:0:0

Course Objectives:
- To understand the isolation methodology of microorganisms.
- To know the methods of preservation of foods.
- To identify the microorganisms of food commodities of plant and animal origin.
- To learn about Food borne diseases and microorganisms.

Course Outcomes:
• To isolate microorganisms and how to utilize microorganism as sources of food.
• To utilize microorganism to produce fermented foods.
• To utilize microorganisms in food industries.

Unit I

Unit II

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

Unit IV
MICROBIOLOGY OF WATER AND FOOD COMMODITIES: Microbiology of water and their importance of processing of foods in industries. MPN of coliforms Microbiology of milk – Hetero and homo fermentative Lactic acid bacteria – Yogurt and Cheese fermenting organisms –Aflatoxin producing organisms and their importance in canned 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, Staphylococcus aureus, Shigella spp., Hepatatis, Gastroenteritis viruses, Entamoeba histolytica and Entamoeba coli.

Text Book

Reference Books
Credits: 0:0:2

List of Experiments
1. Estimation of Reducing sugars by Willstatter’s 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 \( \alpha \) – Amino Nitrogen by Sorenson’s Formol Titration
9. Estimation of Nitrogen by Kjeldhal’s Method
10. Qualitative Analysis of Sugars
11. Qualitative Analysis of Amino Acids
12. Identification of Sugars by Paper Chromatography
13. Identification of Aminoacids by Paper Chromatography

12FP207 FOOD MICROBIOLOGY LAB

Credits: 0:0:2

List of Experiments
1. Study of morphology of bacteria and fungi
2. Methods of sterilization of a) Glass wares using hot air oven and b) culture media foe microbiological work using autoclave and pressure cooker
3. Preparation of nutrient broth and nutrient agar
4. Monochrome staining
5. Differential staining-Gram staining
6. Negative staining, Lacto phenol cotton blue staining
7. Methods of pure culture techniques for bacteria
8. Hanging drop preparation to observe motility of bacteria
9. Enumeration and isolation of bacteria and fungi from water/milk
10. Enumeration and isolation of bacteria and fungai from any contaminated food
11. MPN Test for coliforms
12. IMVIC Tests
13. Metylene blue reduction test in milk

12FP208 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 storage and handling techniques of cereals.
- To gain knowledge on processing and milling of pulses.
- To study about the by products obtained during processing along with their uses.

Course Outcomes:
- To know about Paddy Processing and Rice milling equipment which will help them for developing entrepreneurial skills.
• To develop skills needed in the milling of pulses and in the processing and milling of maize which will promote gainful employment.
• To learn about 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.

Unit I

**PADDY PROCESSING:** Composition of paddy and Quality characteristics. Curing of Paddy – Parboiling Processes. Physico-chemical changes during parboiling – Cold Water soaking and Hot water soaking processes, Methods of grain drying- LSU Dryer, By Products of Paddy Processing - Paddy husk and its uses as husk ash, activated carbon, furfural and other by products. Production of Flattened and Puffed Rice from Paddy.

Unit II


Unit III


Unit IV

**MILLING AND PROCESSING OF MAIZE:** Dry milling of maize, Storage and drying, Pre-cleaning, cleaning equipment, degermination and dehusking, Roller milling, Sifting, Purifying, Aspiration, Pneumatics in a maize mill. Products of milling - Flour, Semolina, Brewers’ grits etc and their applications. Wet milling of Maize and corn: Modern methods of processing, Cleaning, Steeping, Degermination, Bran and Fibre separation, Gluten and Starch Separation. Equipment needed for Degermination, Debraning and starch separation. 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

Text Books

Reference Books

12FP209 HEAT AND MASS TRANSFER

Credits: 4:0:0

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 Outcome:
• The students will be able to apply their knowledge on thermal fluid sciences in processing of food.

Unit I

Unit II

Unit III
Unit IV

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-equirmolar diffusion-diffusion of water vapour through air-mass transfer coefficient – convective mass transfer

Text Book
Reference Books

12FP210 FOOD BIOCHEMISTRY AND NUTRITION

Credits: 3:0:0

Course Objectives:
- To understand about Biochemical cycles
- To impart basic knowledge about Biosynthesis of macromolecules
- To understand about Nutrition, its importance and anti-nutritional factors
- To know about specialized nutrition

Course Outcome:
- To get exposure about Nutrition and its importance, nutritive values of different food sources.

Unit I

UNIT II

Unit III

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, and phytates.

Unit V

Text Books

Reference books

12FP211 FLUID MECHANICS AND HEAT TRANSFER LAB

Credits: 0:0:2

List of Experiments
1. Determination of pipe friction and pressure drop under sudden contraction and expansion during fluid flow
2. Determination of Equivalent Length of pipe fittings during fluid flow
3. Determination of Pressure drop in Helical coil
4. Determination of Pressure drop in annular pipes
5. Calibration of Venturi meter & Rotameter
6. Calibration of Orifice meter
7. Pressure drop across Packed-bed columns
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
13. Determination of particle size distribution using a gyratory sieve shaker
12FP212 FOOD BIOCHEMISTRY LAB

Credits: 0:0:2

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

12FP213 ENZYMEOLOGY LAB

Credits: 0:0:2

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

12FP214 FOOD REFRIGERATION AND COLD STORAGE CONSTRUCTION

Credits: 3:0:0

Course Objective:
• To enable the students to understand the various concepts behind refrigeration and storage construction.

Course Outcome:
• The students will be able to apply their knowledge on cold storage of perishable products.
Unit I

Unit II

Unit III
FREEZING OF FOODS: Freezing equipment, Freezing rates, growth rate of ice crystals, crystal size and its effect of texture and quality of foods, Freezer types, Blast freezers, Contact Plate Freezers, conveyorized quick freezers, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables.

Unit IV
CHILLING OF FOODS: Chilling equipment for liquid foods. Secondary refrigerants and direct expansion techniques in chilling, Chilled foods transport and display cabinets - Basics of Chilled foods microbiology, Packaging of Chilled foods - Hygienic design considerations for chillers and chilled Storages. Cool storages and their applications. Evaporative cooling and its applications

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 ,At Grocery stores and display cases, Home refrigerators - Cooling chain summary - Storage and packaging

Text Book

Reference Books

12FP215 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.

Course Outcome:
- To understand the relationship between physical and functional properties of raw, semi-finished and processed food to obtain products with desired shelf life and quality

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

Unit II

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

Unit IV

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
Reference Books

12FP216 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING - I

Credits: 4:0:0

Course Objective:
- To understand the engineering principles involved in the processing of food products.

Course Outcomes:
- To understand the operation of equipment
- To develop new food process equipment and modification of existing equipments.

Unit I
MIXING: Definitions and principles – Unit systems SI units – Basic equations standards.

Unit II

Unit III

Unit IV
sedimentation in cyclones. Centrifugal separations – rate of separation – centrifuge equipment.

Unit V

Text Books

Reference Book

12FP217 PLANTATION PRODUCTS AND SPICES TECHNOLOGY

Credits: 3:0:0

Course Objectives:
- To understand about Coffee and its processing techniques, instant coffee, and quality grading
- To learn the Different types of tea and its manufacturing techniques, instant tea, quality parameters of tea
- To learn Cocoa and its processing, chocolate manufacturing technology
- To know the processing and chemistry of major and minor spices

Course Outcome:
- The students will be able to understand the processing steps involved for different plantation products and spices.

Unit I

Unit II

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

Unit V

Text Book

Reference Books

12FP218 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 (ice creams, fermented milk products)

Course Outcomes:
- The students will get exposure about milk and its processing methods.
- Gain knowledge of the various milk processing equipments.
- Gain knowledge on the production of various milk products.

Unit I
DAIRY CHEMISTRY AND MICROBIOLOGY: Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests, Quality and Quantity tests at reception, Cell count and other tests, Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases – Dietary recommendations – Applications of enzymes in dairy industry

Unit II
DAIRY PROCESSING EQUIPMENTS: Milk processing terminology, Processing flow sheet, milk processing equipments and their selection, Pasteurisers – HTST, LTLT, UHT

Unit III

Unit IV
MANUFACTURE OF ICE CREAM AND OTHER DAIRY PRODUCTS: Manufacture of Ice cream, calculation of ice cream mixes – Chemistry and technology –Microbiology of ice cream - Quality aspects - Quality aspects Extraction of casein from milk, properties, composition and industrial uses, Production of lactose and whey. Equipments for manufacture of ice cream, butter and ghee. Storage Units

Unit V
FERMENTED DAIRY PRODUCTS: Fermented products – Yoghurt, Curd, acidophilus milk etc.- Concept of Probiotics and prebiotic foods, Energy use in Dairy plant, sources of energy, cost of energy, Control of energy losses and Energy conservation.

Text Book

Reference Books

12FP219 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING AND GRAIN PROCESSING LAB

Credits: 0:0:2

List of Experiments
1. Experiment on Cross flow drier
2. Experiment on Plate type pasteurizer
3. Experiment on Size reduction mill
4. Experiment on Screen analysis
5. Experiment on Centrifuge
6. Experiment on Mixer
7. Experiment on Fluid bed drier
8. Experiment on LSU drier
9. Experiment on Cleaner cum grader
10. Experiment on Rubber Roll Sheller
11. Experiment on Rice polishers
12. Experiment on Destoner
13. Experiment on Parboiling
12FP220 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
13. Preparation of angel cake
14. Preparation of pound cake
15. Preparation of sponge cake
16. Preparation of rusks

12FP221 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.
8. Measurement of angle of repose
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.

12FP222 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING – II
Credits: 4:0:0

Course Objective:

• To understand the various unit operations involved in food industry.

Course Outcome:
To understand and improve the engineering operations that are critical to the food processing operations and industrial growth.

Unit I

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

Unit IV

Unit V

Text Books

Reference Book

12FP223 FOOD SAFETY REGULATIONS

Credits: 3:0:0

Course Objectives:
To enable the student to understand

- Importance of Food Safety
- Regulating authorities for food safety world over

**Course Outcome**

- On completion of the subject, the students will gain knowledge on regulations followed in various food industries.

**UNIT 1**

**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**


**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**

12FP224 PROCESS EQUIPMENT DESIGN

Credits: 4:0:0

Course Objective:
- To enable the student to design and develop equipments used in Food Processing operations.

Course Outcome:
- To gain technical know-how about the material requirements and design of various equipments needed in Food industries.

Unit I
MATERIALS: Metals and non metals, design of pressure vessels – cylindrical shell – internal and external pressure -under continued loadings. Numerical problem and design of pressure vessel.

Unit II
STORAGE VESSELS: Design of storage vessels – Rectangular Tank without stiffeners – with stiffeners – shell design – Numerical problem and design.

Unit III

Unit IV


Unit V
DRYERS: Types - General considerations – Design of Tray dryer , Rotary Dryer - Material Balance , Thermal energy Requirments , electrical energy Requirements, Performance Indices

Text Books
12FP225 PROCESS ECONOMICS AND PLANT LAYOUT DESIGN

Credits: 3:0:0

Course Objective:
- To enable the students understand the various concepts of economics, process development, design consideration and cost estimation in food industry.

Course Outcome:
- The students will be able to apply their knowledge to design projects for setting up a Food Processing Industry.

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 spreadsheet 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.

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. 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

Unit IV
PLANT OVERHEADS: Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc

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

Text Book

Reference Books

12FP226 FOOD ADDITIVES

Credits: 3:0:0

Course Objectives:
- To understand the importance of food additives in improving the overall quality of processed food
- To gain knowledge on their safety

Course Outcome:
- The students would be able to design newer products, with better quality using additives which are economical and safe

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
Reference Book

12FP227 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.

12FP228 ANALYSIS OF FOOD PRODUCTS OF PLANT ORIGIN (FRUITS AND VEGETABLES) LAB

Credits: 0:0:2

List of Experiments
1. Analysis of reducing sugars in jam
2. Analysis of total sugars in jam
3. Determination of pectin content of jam
4. Determination of acidity in fruit juices
5. Determination of total fruit solids in sauces
6. Determination of salt content in pickles
7. Determination of calcium content of jaggery
8. Estimation of lycopene in sauces
9. Estimation of carotenoids in mango juices
10. Estimation of anthocyanins
11. Estimation of ascorbic acid in fruit beverage
12. Estimation of polyphenol in a plant product

12FP229 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:
Students would be able to
- Appreciate the importance of fats and oils and their manufacture
- Develop technology for manufacture of designer fats
- Develop newer methods of analysis of oils and fats

Unit I

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

Unit IV

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

Reference book

12FP230 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 Outcome:
- The student will be able to understand about how to process meat, poultry and fish, preparation of different types of products from meat, poultry and fish

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 – Defleathering, 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, Product export and its sustenance, 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, in pack freezing, relative merits and demerits, Canning operations, Salting and drying of fish, pickling and preparation of fish protein concentrate, fish oil and other by products.

Text Book

Reference Books

12FP231 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 know the food additives and microbes associated with food
- To learn about the food borne diseases , food poisoning and food preservation principle

Course Outcome:
- To gain knowledge and develop skills on various principles associated with food processing.

Unit I

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; fermented foods and food chemicals, single cell protein.-examples and their applications

Unit IV
FOOD BORNE DISEASES: Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; 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

Reference Books

12FP232 BIOCHEMICAL ENGINEERING

Credits: 3:0:0

Course Objective:
- To enable the student to understand the basic biological concepts in food engineering

Course Outcome:
- To adopt processing methods of biological materials and processing using biological agents.

Unit I
Unit II

Unit II

Unit IV

Unit V

**Text Book**

**Reference Book**

**12FP233 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 Outcome:**
- To gain knowledge on the ingredients, process and machinery involved in bakery and confectionery technology.

**Unit I**
**BAKERY EQUIPMENTS AND TESTING OF FLOUR FOR BAKERY GOODS:** Laboratory testing of Wheat grain Quality, Moisture tests, Grain hardness testing. Testing, Visco graph, Amylograph, Ferinograph. Dough mixers, Dividers, rounders, Proofing, moulding, Ovens, Slicers, Packaging materials and equipment, Sanitation and safety.
Unit II


Unit III

SUGAR PRODUCTION PROCESS DETAILS: 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

TECHNOLOGY OF BEVERAGES MANUFACTURE (ALCOHOLIC AND NON ALCOHOLIC): Manufacture of beer, wine and champagne - Quality characteristics, Manufacture of distilled beverages including whisky, brandy, rum and gin – Quality aspects Manufacture of carbonated beverages – quality aspects – Manufacture of sugar-free, sugarless, carbonated beverages.

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


Reference Books


12FP234 FOOD PACKAGING TECHNOLOGY

Credits: 3:0:0

Course Objective:

- To enable the students to understand about packaging and packaging materials, interaction of food items with packaging materials
Course Outcome:
- The students will get exposure about how to package the food items using different techniques, how to use cans and films for packaging and its properties, how food items are interacting with packaging materials.

Unit I

Unit II

Unit III

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

Text Book

Reference Books
12FP235 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.

Course Outcome:
- To gain knowledge on the various aspects of storage of grains and storage structures.

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
GRAIN DRYING: Moisture content, equilibrium moisture content; free and bound water, rate of drying, constant and falling rate of drying rate; factors affecting rate of drying process, types of dryers used for drying of grains.

Unit III
GRAIN STORAGE: Principles, moisture movement during bulk storage of grains, pressure distribution in storage bins, methods of aeration, various theories, Physical, chemical, microbiological and sensory changes occurring during storage, Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations.

Unit IV
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 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

12FP236 EMERGING TECHNOLOGIES IN FOOD PROCESS ENGINEERING
Course Objectives:
To enable the student to understand:
- Emerging / alternative technologies applied to food processing
- Relative advantages / disadvantages over existing technologies
- Economics and commercialization of newer technologies
- Strategies for applying the same to a wide range of food

Course Outcomes:
- The student understands different Emerging technology in Food Processing.
- To apply the knowledge in real time Food Processing Innovations

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

Unit II

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

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)

Text Book

Reference Books
12FP237 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:
- To understand the importance of Functional food for preventive therapy
- To develop methods for extraction and identification of nutraceutically significant molecules.

Unit I
NUTRACEUTICALS: HISTORICAL, TECHNOLOGICAL ASPECTS AND CLASSIFICATIONS:

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 - ω – 3 fish oils and their role in Glycemic control- ω – 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.

References:
Unit IV
LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS:

Unit V

Text Book

12FP238 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 Outcome:
- The students will be able to apply their knowledge on drying technology in various food industries.

Unit I

Unit II

Unit III
SPRAY DRYING OF FOODS: Principles of Spray Drying Processes – Atomization - Drop Size and Size Distribution Wheel Atomizers - Pressure Nozzles - Pneumatic Nozzles - Chamber Design - Chamber Shape - Air-Droplet Contact Systems - Powder and Air
UNIT IV

Unit V

Text Books

Reference Books

12FP239 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 Soanpapdi
11. Preparation of Mysorepak
12. Preparation of Gummies
13. Preparation of aerated confectionery

12FP240 ANALYSIS OF FOOD PRODUCTS OF ANIMAL AND PLANTATION PRODUCTS ORIGIN LAB
Credits: 0:0:2

List of Experiments
1. Estimation of fat in milk by Gerber’s method
2. Estimation of curcumin in turmeric
3. Estimation of cholesterol in egg.
4. Estimation of salt in dried fish
5. Estimation of iodine value of butter
6. Determination of moisture content of spices
7. Determination of total volatile oil by Clavenger apparatus
8. Determination of Scoville’s index of capsaicin
9. Analysis of total extractives and ash content of tea
10. Determination of tannins in tea.
11. Determination of cocoa butter content of chocolates
12. Determination of caffeine content of coffee
13. Analysis of Food Samples by HPLC, GC.

12FP241 FOOD ADDITIVES LAB

Credits: 0:0:2

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 Carotenoid
8. Estimation of Chlorophyll
9. Estimation of Anthocyanin
10. Estimation of Iron
11. Estimation of Copper
12. Determination of Saccharin
13. Estimation of Salt in Iodised salt

12FP242 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:
- Students to acquire knowledge on the basics of food processing
- Students will have a know-how on the various processing technologies involving fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products
• Students to acquire basic knowledge on microbiology of food products
• Students will have an overview of 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

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

Text Books

12FP243 TECHNOLOGY OF PACKAGING

Credits: 3:0:0
Course Objectives:
- To provide knowledge on packaging and packaging materials.
- To understand the working various packaging methods.
- To enable the students to understand the interaction of food items with packaging materials.

Course Outcome:
- The students will get exposure about packaging, packaging materials and packaging methods.

Unit I

Unit II

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, 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 - Filling and Sealing of pouches, pouch from fill seal machines.

Unit V
INTERACTION OF FOOD MATERIAL WITH PACKAGING MATERIAL: Active packaging, moisture control, CO₂ and Oxygen scavenging, Modified atmosphere packaging – principles, applications. Permeability of gases in packs. Speciality packages. Tests on packaging materials, Mechanical strength (Tension, notch and tearing strengths), Gas and water vapour transmission rates.

Text Book

Reference Books

12FP301 ADVANCES IN FOOD MICROBIOLOGY

Credits: 4:0:0

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

Unit I

Unit II
MICROBIOLOGY OF PRESERVATION: General concepts about molds, bacteria and yeasts. Effect of high temperature on microbes – TDT, D value, Z value, 12D concept, calculation of process time. Effect of low temperature, radiation, drying on microbes.

Unit III
FOOD FERMENTATION: Manufacture, spoilage and defects of Bread, malt beverages, wines, vinegar, fermented vegetables, fermented dairy products, oriental fermented foods.

Unit IV
FOODS AND ENZYMES FROM MICROORGANISMS: General principles of culture maintenance and preparation for food fermentation – Single cell protein – Fats from microbes – production of amino acids - production of other substances added to food - production of enzymes.

Unit V
MICROBIOLOGY IN FOOD SANITATION: Bacteriology of water supplies - Sewage and waste treatment and disposal – Microbiology of the food product - Good Manufacturing Practices (GMP) – Hazard Analysis and Critical Control Points (HACCP).

Text Book
Reference Book

12FP302 SEPARATION PROCESSES IN FOOD ENGINEERING

Credits: 4:0:0

Course Objective:
- To enable the students understand the concepts of separation of solids and liquids in food engineering application.

Course Outcome:
- On completion of the subject, the students will be able to apply their knowledge on filtration technique, design of centrifuge, RO system in the food industries.

Unit I
BASIC PRINCIPLES OF FLUID FLOW: Pressure head in fluids-devices to measure pressures- U tube manometer- Pitot tube, types of flow-laminar-turbulent, simple mass balance and continuity equation, pressure drop due to friction, drag coefficient, flow in packed beds.

Unit II
MECHANICAL SEPARATIONS: Mechanical separation-screeners - sedimentation, gravity sedimentation, Sedimentation of solid particles in gas media, stokes law. Filtration, constant volume filtration, Constant pressure filtration, Industrial applications and equipments for Filtration and Sedimentation.

Unit III
SEPARATION BY CENTRIFUGATION: Centrifugal separation-Sedimentation, filtration centrifuges, Basic equations. Different types of centrifuges – Basket, Tubular Bowl, Decanting, Disk bowl, Desludging (Self Cleaning) Bowl Centrifuges, Nozzle centrifuges. Importance of balancing of rotating masses, feed and discharge arrangement in each case. Specific characteristics - advantages and applications.

Unit IV
FILTRATION BY MEMBRANE SYSTEMS: Definitions; Reverse Osmosis (RO), Nano filtration (NF), Diafiltration, Ultra filtration (UF) and Micro filtration (MF), Molecular weight cut off in each case. Membranes and their characteristics, Cross flow filtration; Configuration of membranes, membrane materials, Pumps and other membrane equipment. Applications in food industry, relative advantages and limitations.

Unit V
ABSORPTION 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 Applications of diffusion and migration in food packaging

Text Books

Reference Books

12FP303 TECHNOLOGY OF FOOD FLAVOURANTS & COLOURANTS

Credits: 4:0:0

Course Objectives:
To enable the student to understand
- Basics of foods flavors and colours
- Chemistry & technology of natural flavours, pigments

Course Outcomes:
On completion of the course the student would be able
- To develop methods for stabilization of natural colorants
- To develop aroma chemicals
- To develop techniques for analysis of colorants and aroma chemicals

Unit I

Unit II
TECHNOLOGY OF NATURAL FLAVOURS: Classification – Alliaceous flavours – Bittering agents, Coffee and Cocoa, Fruit flavours.Evolution of flavours during processing – enzymatic development, effect of roasting, cooking frying on flavour developments- Essential oils and oleoresins –Extraction – Super critical fluid extraction - Continuous and semi-continuous methods- Effect of types of solvents used. Liquid and dry flavour production - Staling of flavours. Microbial and cell suspensions in the synthesis of flavours
Unit III
CHLOROPHYLL & CAROTENOIDS: Chlorophyll and chlorophyll derivatives, Haems and bilins, Carotenoids, annatto, saffron, turmeric- Stability to pH, temperature and other processing conditions - Technology for the production of dried colourants - Caramel colour. Microbial and cell suspensions in the synthesis of colours.

Unit IV
ANTHOCYANINS & FLAVANOIDs: Anthocyanins and betalains, Less common colourants – Acylated β-ring substituted anthocyanins, Monascus, cochineal and related pigments, Stability to pH, temperature and other processing conditions. Technology for the production of dried colourants.

Unit V
ANALYSIS OF FLAVOURS AND COLOURS: Total component analysis – Basics and methods – Recent developments. Head space analysis – static and dynamic methods – basic principles – method and developments - Solid phase micro extraction of aroma components - E nose technology. Tristimulus colorimetry – Basics and application to foods

Text Books

Reference Books

12FP304 ADVANCES IN FOOD ENGINEERING

Credits: 4:0:0

Course Objectives:
To enable the students to study & understand the
- Heat preservation methods.
- Aseptic Packaging of processed foods

Course Outcomes:
- The knowledge on Food Engineering will help to conserve and minimize the losses of food produced.
- The primary goal on food security can be achieved.

Unit I
PRESERVATION ASPECTS: Heat preservation of foods - thermo bacteriology, process calculation and selection – low temperature preservation - microbiological aspects, cooling
Unit II
MINIMAL PROCESSING: Minimal Processing of Foods with thermal methods and non thermal methods- safety criteria in minimally processed foods- Minimal processing in practice- fruits & vegetables-seafood- effect on enzymatic and texture property- quality changes- packaging and storage conditions- Future developments

Unit III
OSMOTIC, HEAT PUMP & FREEZE DRYING: Application of light pulses in sterilization of foods and packaging materials- Foam mat drying - osmotic dehydration –heat pump drying - freeze drying - recent advances in freeze drying

Unit IV
SPRAY DRYING: Recent developments on design and practice of spray drying - drying behavior of droplets – flash evaporation - extraction and distillation process – energy calculation process – energy requirements in different methods of dehydration - super critical fluid extraction

Unit V
ASEPTIC PACKAGING & EXTRUSION: Advances in aseptic processing and packaging - processes, design of process, decontamination of packaging - extrusion cooking - recent developments, methods, equipment, and design criteria of extruders.

Text Books

Reference Books

12FP305 FOOD MICROBIOLOGY LAB

Credits: 0:0:2

List of Experiments
1. Experiment on Microscopy
2. Experiment on sterilization and disinfection
3. Experiment on isolation of microorganisms by pure culture technique
4. Experiment on monochrome staining & gram staining
5. Experiment on negative staining & spore staining
6. Experiment on Hanging drop technique
7. Experiment on isolation of MO from spoiled food
8. Experiment on isolation of MO from air
9. Experiment on water quality analysis
10. Experiment on Lactophenol cotton blue staining
11. Experiment on methylene blue reduction test, phosphate test for milk samples
12. Experiment on biochemical test (TSI, catalase, oxidase, hydrogen peroxide)
13. Experiment on production of wine
14. Experiment on production on enzyme amylase
15. Experiment on phenol coefficient test.

12FP306 FOOD ENGINEERING LAB

Credits: 0:0:2

List of Experiments
1. Experiment on Vacuum shelf drier.
2. Experiment on plate pasteurizer.
3. Experiment on tubular pasteurizer.
4. Experiment on vibro fluidizer.
5. Experiment on Fluidized bed drier.
6. Experiment on Spray drier.
7. Experiment on Freeze drier.
8. Experiment on canning of vegetables.
9. Experiment on canning of fruits.
10. Experiment on twin screw extruder.
11. Experiment on Sigma mixer.
12. Experiment on retort pouch sterilizing unit.
13. Experiment on bottling of fruit juices.
14. Experiment on bottling of vegetable products.
15. Experiment on vacuum packaging

12FP307 KINETICS OF FOOD SYSTEMS

Credits: 3:1:0

Course Objectives:
- To enable students understand the physical chemistry and kinetics of food systems
- To make the students understand the interaction of food constituents in maintaining the texture and structure of a food

Course Outcomes:
Students would be able
- To develop new products which are nutritional and cost effective
- To predict their behavior during storage
- To develop cheaper sources of raw materials for a product

Unit I
GLASS TRANSITIONS IN FOODS: Basics of theory of glass transitions – crystalline and amorphous polymers, - difference, Glass transition temperature, crystallite melting point,
Crystal melting point – Key elements of the food polymer science approach – Fringed micelle structural model – the dynamics map – Effect of molecular weight on Tg – Plasticizer – water as a plasticizer - Crystallisation – gelation mechanism – Polymer crystallization kinetics theory - Importance in food systems

Unit II

Unit III

Unit IV
STRUCTURES & PROPERTIES OF FOOD EMULSIONS: General aspects of emulsions – Types of food emulsions – Oil in water, water in oil, water in oil in water- Measurement of particle size and size distributions in emulsions - Factors affecting stability of emulsions – Structures of adsorbed layers on the surfaces of emulsion droplets - Importance of interfacial layer – Protein stabilized emulsions and foams

Unit V
KINETICS OF NON-ENZYMATIC BROWNING: Introduction – Mechanism of Maillard Reaction – Factors influencing Maillard reaction – Type of amino acid, pH, type of sugar, solvent state, sugar – amine ratio, temperature, Fluorescence (pH and Temperature interactions) – Kinetics of Maillard browning

Text Books

Reference Books

12FP308 MASS TRANSFER PROCESSES IN FOOD ENGINEERING

Credits: 4:0:0
Course Objective:
- To enable the student to understand the importance of mass transfer processes in Food Engineering applications.

Course Outcome:
- On completion of the syllabus, the students will be able to apply their knowledge on distillation, evaporation, separation and super critical fluid extraction processes in various food industries.

Unit I
BASIC PRINCIPLES OF SEPARATION PROCESSES: Basic principles of food processing SI system of basics units, Conservation of mass and materials balances, energy and heat units, conservation of energy and heat balances Units and dimensions of engineering parameters, dimensionless ratios, and calculations involving various physical parameters.

Unit II
VAPOR LIQUID SEPARATION PROCESSES: Vapor- liquid equilibrium relations, single stage equilibrium contact for vapor liquid system, relative volatility of vapor liquid system Distillation - Steam distillation, applications and equipment, Mass transfer phenomenon applied to food systems.

Unit III
EVAPORATION: Needs, basic principles, Single and multiple effect evaporation, Heat economy, Vapour recompression, Thermo and mechanical systems, boiling point elevation, Falling film, climbing film tubular evaporators, plate evaporators, thin film and scraped surface evaporators.

Unit IV
GAS LIQUID SEPARATION PROCESSES: Concentrations, Gas-liquid equilibria, Solid liquid equilibria, Equilibrium concentration relationships, operating conditions; Basics of Solid-liquid extraction processes, liquid-liquid extraction, with food application examples.

Unit V
EXTRACTION AND LEACHING: Mechanical extraction – Expellers, screw press, filter press. Liquid-liquid extraction, liquid-solid extraction, phase diagram determination of extraction steps by McCabe-Thiele method. Super critical Fluid extraction - Super critical Fluid State, Properties of Super critical CO2, Density, Viscosity, Volatility etc. Supercritical Phase Equilibria, Solubility, SCFE systems and components, Applications; extraction of Fatty acids, oleoresins and essential oils; Relative advantages, limitations and economics.

Text Books

Reference Books
Credits: 4:0:0

Course Objectives:
To enable the student to understand
• High Intensity Pulse Techniques, Light Pulses,
• Food irradiation, high pressure processing and biocatalysts

Course Outcome:
• 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.

Unit I
HURDLE TECHNOLOGY: Hurdle technology - principles and applications - hurdle effect in fermented food, shelf stable products, and intermediate moisture foods- total quality of foods - optimal range of hurdles and potential safety - application of hurdle technology – fruit preservation, dairy products and meat

Unit II
LIGHT PULSE TECHNIQUE: High-intensity pulse technique- Processing systems- design of static chambers- continuous chambers- other chamber designs- generation of different voltage waveforms- oscillation magnetic fields for food processing- generation of magnetic fields - mechanisms of inactivation of microorganisms in food preservation.

Unit III

Unit IV
FOOD IRRADIATION & HIGH PRESSURE PROCESSING: Food irradiation - advantages and applications, microwave processing - interaction with food materials, material properties, effect of microorganisms, microwave equipment – high pressure processing – Principles - equipment, processing and effect on microorganisms.

Unit V
BIOCATALYSTS: Biocatalysts- Sources-Types- Processes in Food Industry- Enzymatic Synthesis of Food Additives – Biocatalysis using enzymes-flavours & fragrance – Biosensors types- application of biosensors to food industry requirements- Development of Biosensors

Text Books

Reference Book

12FP310 FOOD PACKAGING AND STORAGE ENGINEERING

Credits: 4:0:0

Course Objectives:
To enable the students to understand
• Different packaging techniques
• Different Storage techniques

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 will help to understand the designing of various storage structures and theories related to it.

Unit I

Unit II

Unit III

Unit IV

Unit V

Text Books

Reference Books

12FP311 FOOD ANALYSIS LAB

Credits: 0:0:2

List of Experiments
1. Analysis of Jam – Moisture and Total sugars.
2. Analysis of milk – Determination of fat content by Gerber’s method
3. Analysis of Coffee – Estimation of total extractives
5. Analysis of tea – Total extractives in tea
6. Analysis of tea – Tannin content of tea
8. Kinetics of bi-phasic (solid-liquid) extraction of natural colours
9. Kinetics of degradation of colours
10. Column chromatographic separation of colours
11. Kinetics of Maillard browning
12. Sensory analysis
13. Estimation of iron content
14. Estimation of copper

12FP312 TRANSPORT PROCESSES IN FOOD ENGINEERING LAB

Credits: 0:0:2

List of Experiments
1. Drying studies using through flow dryer – drying rate and drying curve.
2. Determination of overall heat-transfer co-efficient of a tubular pasteurizer.
3. Determination of crushing efficiency of sugar cane crusher.
4. Performance evaluation of an extruder.
5. Calibration of rota meter.
6. Determination of heat transfer through composite walls.
7. Determination of pressure losses in pipes due to sudden enlargement and contraction..
8. Calibration of venturi meter and orifice meter.
10. Determination of overall heat transfer coefficient in shell and tube heat exchanger.
11. Determination of aerodynamic properties using fluidised bed column.
12. Determination of mixing index of a mixer – sigma, ribbon, planetary mixers.
13. Determination of mass transfer coefficient using Fick’s law.
15. Determination of mass transfer rate in leaching / extraction

12FP313 FOOD ENZYMEOLOGY LAB

Credits: 0:0:2

List of Experiments
1. Estimation of reducing sugars by dinitrosalicylic acid method.
2. Estimation of proteins by the hartree-lowry method.
3. Amylases - optimisation of ph & temperature.
5. Time study / enzyme kinetics of amylases.
6. Optimisation of ph and temperature of protease.
8. Time study / enzyme kinetics of protease.
11. Techniques of enzyme immobilization.
13. Qualitative tests for presence of enzymes – catalase, peroxidase and urease.
15. Test for phosphatase activity in milk

12FP314 FOOD PRODUCT TECHNOLOGY AND PACKAGING LAB

Credits: 0:0:2

List of Experiments
2. Preparation of traditional aerated confectionery.
3. Preparation of traditional products from legumes.
5. Determination of water vapour transmission rate of the given packaging material – polythene.
7. Determination of migration characteristics of packaging materials using different simulants -alcohol as a stimulant.
8. Determination of continuity of tin coating in cans by thiocyanate test for porosity.
10. Determination of grease resistance of papers used in food industry – butter paper & toffee wraps.
11. Determination of half value (hvp) of products stored in ldpe (low densitypolyethylene) films by direct weighing method & break down method.
12. Estimation of half value (hvp) of products stored in hdpe (high density polyethylene) films by direct weighing method & break down method.

12FP315 FOOD SAFETY REGULATIONS AND CONTROL

Credit: 4:0:0

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

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.

Unit I

STRUCTURE, ORGANIZATION AND PRACTICAL OPERATION OF INTERNATIONAL INTERGOVERNMENTAL FOOD REGULATION BODIES:


Unit II

REGULATING AUTHORITY OF FOOD SAFETY IN INDIA AND ITS ROLE:


Unit III

FOOD LABELING – REGULATIONS:


Unit IV
GENERAL ASPECTS OF 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

Text Books

Reference Book
1. Rajesh Mehta and J. George - Food Safety Regulation Concerns and Trade- The Developing Country Perspective. Published by Macmillan India Ltd., New Delhi. 2005

12FP316 INSTRUMENTAL TECHNIQUES OF FOOD ANALYSIS

Credit: 4:0:0

Course Objectives:
- To enable the students to understand the basics of various techniques available for the analysis of a food commodity.
- To make the students appreciate the instruments for analysis and their advancements till date.

Course Outcomes:
Students will be able to
- Apply the instrumental techniques learnt towards the analysis of food materials and
- Develop / improve methods of analysis with improved sensitivity and reproducibility

Unit I
BASIC CONCEPTS IN CHROMATOGRAPHY: Chromatogram, distribution coefficient, retention volume, capacity factor, Gaussian profile, theoretical plates, selectivity, resolution, kinetic processes – Physical forces and interactions – Ionic interactions, van der Waals forces, hydrogen bonding, charge transfer – Modes of separation – Adsorption, Partition, Ion exchange, size-exclusion
High performance liquid chromatography: Basic principles – Mobile phase – Instrumentation – Injector, Column, Pump, detector, Types of detector – advantages of HPLC over other techniques – Applications of HPLC to food analysis

Unit II
GAS CHROMATOGRAPHY AND FTIR SPECTROSCOPY: Principles – Definitions, terms relating to Retention of analytes, column efficiency, sample component separation - Theory of Gas chromatography – Instrumentation – Carrier gas source, inlet system, columns, types of detectors – FID, TCD, ECD, MSD – application of GC to food analysis

FTIR Spectroscopy: Principles of Infrared spectroscopy – Instrumentation - Data handling Techniques, Spectral rationing, co-adding, Baseline correction, peak measurements, measurement of overlapping bands, smoothing and interpolation, spectral subtraction – quantitative analysis- Sampling methods , transmission cells, attenuated total reflectance – Applications in foods

Unit III

ATOMIC ABSORPTION SPECTROSCOPY: Introduction to AAS – Components of an AA spectrometer – Overview, Light sources, Nebuliser / Atomiser assemblies, Nebulisers, flames, optics, detectors, support gases, AAS measurements- approaches to improving the S/N ratio – Interferences – Chemical, Physical, Ionisation, Background and spectral – Calibration techniques – External standards and Standard additions – Minimising uncertainties – Atomisation techniques

Atomic emission spectrometry (AES): ICP – Mass spectrometry - Atomic Fluorescence Spectrometry (AFS) : Trace metal determinations in Biological samples

Unit IV

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY: Electromagnetic spectrum – The NMR Phenomenon – Types of information provided by NMR spectra – Instrumental and Experimental Considerations – Solid state NMR – application of NMR to Food analysis

Unit V

MASS SPECTROMETRY: Process – Ionization techniques – Instrumentation – Linked scanning techniques – application of MS in Food Science – application of GC/MS, LC/MS / FAB/MS / MS/MS and linked scan techniques

Capillary electrophoresis: Instrumentation and components – Modes of CE – Capillary zone electrophoresis, Micellar electrokinetic chromatography (MECK), Capillary gel electrophoresis (CGE), Capillary isoelectric focusing (CIEF), Capillary Isotachophoresis (CITP) – Applications of CE in analysis of food substances

Text book

Reference Books

12FP317 ENGINEERING PROPERTIES OF FOOD MATERIALS

Credit: 4:0:0

Course Objectives:
• To enable students to understand the different engineering properties of food materials.
• To make the students to acquire knowledge of engineering properties in the designing of food processing systems.

Course Outcome:
• The course will help to understand the relationship between Engineering and Functional properties of raw, semi finished and processed food to obtain products with desired shelf life and quality.

Unit I

Unit II

Unit III

Unit IV

Unit V
Text Books

Reference Books

12FP318 FRUIT AND VEGETABLE PROCESS ENGINEERING

Credit: 4:0:0

Course Objectives:
To enable the student to know about
• Post harvest technology of fruits and vegetables.
• Processing & preservation techniques of fruits and vegetables

Course Outcomes:
• To identify suitable equipments for fruit and vegetable processing
• To apply the knowledge of processing methods of fruits and vegetables in food industries.

Unit I
CONCEPTS OF FRUIT AND VEGETABLE PROCESSING: Importance of post harvest technology of fruits and vegetables -post harvest handling and physiology of fruits and vegetables -Fruit ripening – changes during ripening-recommended ripening conditions for fruits – sources of ethylene for ripening – ethylene reactions with O2 and CO2-Spoilage of fruits and vegetables and their processed produc ts -Deteriorative factors and their control – enzymatic changes, chemical changes, physical, changes and biological changes

Unit II
PRESERVATION TECHNIQUES: Biochemistry of fruits-implication on processing-Principles and methods of preservation of fruits and vegetables-Pre-treatments- blanching – methods-Commercial canning of fruits and vegetables-Minimal processing of fruits and vegetables-merits and demerits-Hurdle technology – applications Thermal and non-thermal preservation of fruits and vegetables - Quick freezing preservation of fruits and vegetables – principle – advantages

Unit III

Unit IV

Unit V

Text Books

Reference Books

12FP319 FOOD BIOCHEMISTRY AND NUTRITION

Credit: 4:0:0

Course Objectives:
- To enable students understand the basics of food biochemistry and nutrition.
- To make the students appreciate the importance of nutrition and enable them to develop new products of high nutritive value

Course Outcome:
- Students will be able to apply their knowledge in Food Biochemistry and nutrition in designing new range of products with improved nutritional characteristics (Nutraceuticals, probiotics etc.)

Unit I
CARBOHYDRATE METABOLISM: Electron transport chain - glycolysis, TCA cycle, gluconeogenesis, Pentose phosphate shunt, Embden Meyerhof Pathway (EMP), urea cycle, interconnection of pathways, Metabolic regulation, Bioenergetics: Respiratory chain ATP cycle, energy rich compounds

Unit II
AMINOACID AND LIPID METABOLISM: Biosyntheses 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.

Unit III

Unit IV
INBORN ERRORS OF CARBOHYDRATE, PROTEIN AND FAT METABOLISM: 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, phytoallexins, phytates

Unit V

Text Books

Reference Books

12FP320 ADVANCES IN FOOD AND WATER MICROBIOLOGY

Credit: 4:0:0
Course Objectives:
- To enable students to understand the basics of microbiology and its importance in food and water.
- To study their impact on health and diseases transmitted.
- To recycle waste and appreciate the importance of anaerobic digestion in relation to energy.

Course Outcomes:
Students demonstrate their ability to
- Identify and solve problems related to Food and Water Microbiology and
- Develop ways for ensuring a microbially safe product in Food Industries.

Unit I
**FOOD AND MICROORGANISMS:** General concepts about bacteria, molds and yeasts - Factors affecting the growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure – combined effects of factors affecting growth.

Unit II
**MICROBIOLOGY OF WATER:** Soft and hard water – its implications in Food processing industry - Definition of potable water, contaminated water and polluted water – Diseases transmitted through water – cholera, typhoid, dysentery (Amoebic / Bacillary) – coliforms and its importance – MPN count of coliforms – Permissible limits in drinking water – Advantages and disadvantages of chlorination of water.

Unit III
**FOOD SPOILAGE AND DEFECTS:** Classification- Food infections – bacterial and other types; Food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for food spoilage – spoilage of canned foods

Unit IV
**FOODS AND ENZYMES FROM MICROORGANISMS:** General principles of culture maintenance and preparation for food fermentation – single cell protein – fats from microbes – production of amino acids – production of other substances added to food – production of enzymes.

Unit V
**MICROBIOLOGY IN FOOD SANITATION:** Bacteriology of water supplies – sewage and waste treatment and disposal – Anaerobic digestion pathways in relation to biogas output – Good Manufacturing Practices (GMP) – Hazard Analysis and Critical Control Points (HACCP).

Text Books

Reference Book
12FP321 NUTRACEUTICALS AND FUNCTIONAL FOODS

Credit: 4:0:0

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 student will be able to develop strategies for isolation and purification of nutraceutically important components.
• Design processes for large scale production of nutraceuticals.
• Develop important analytical techniques for identification of same.

Unit I
NUTRACEUTICALS: HISTORICAL, TELEOLOGICAL ASPECTS AND CLASSIFICATION:
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
FLAVONOIDS AND CAROTENOIDS AS ANTIOXIDANTS:
General background on phytochemicals as antioxidants - Flavonoids and Lipoprotein oxidation - Evidence for specific Antioxidant mechanisms of Flavonoids – Anticancer and Cholesterol-lowering effect of citrus 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 - ω – 3 fish oils and their role in Glycemic control- ω – 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:
Unit V

Text Book

12FP322 RESEARCH METHODOLOGY FOR FOOD ENGINEERS

Credits: 4:0:0

Course Objective:
• To impart the knowledge about the method by which the research has to be carried out.

Course Outcomes:
The students will be able to
• Choose the ideal experimental design based in the given problem
• Apply statistical methods for effectively conducting the experiments
• Prepare research reports in conformance with standards

Unit I

Unit II
DATA COLLECTION, SAMPLING DESIGN AND LITERATURE REVIEW: Sources of Data: Primary Data - Secondary Data – Collection of Data through Questionnaire and Schedules - Difference between Questionnaires and Schedules; Sampling Design: Steps in Sample Design – Procedure – Characteristics – Types of Sample Design; Difference between Survey and Experiment; Proceedings for reviewing the Literature: Search for existing Literature – Review the Literature selected – Develop a Theoretical Framework – Develop a Conceptual Framework.

Unit III
Correlation and Regression Analysis – Analysis of Variance, Completely Randomized Design, Randomized Block Design, Latin Square Design. ANOVA – One way and two way.

Unit IV

Unit V

Text Books

Reference Books

12FP323 GREEN CHEMISTRY AND TECHNOLOGY

Credits: 4:0:0

Course Objectives:
To enable the students understand
- the basics of Green chemistry
- the importance of eco-friendly methods of manufacture of various products

Course Outcomes:
On completion of the course, the students will be able to
- choose an eco-friendly and cost-effective method of manufacture of products
- Improve existing methods for improved efficiency and economics
- Develop novel methods for improved efficiency and economics

Unit I
Uneconomic reaction - Reduction of energy requirement – Some energy efficiency improvements and Alternate energy sources - Chemistry of Atmosphere – Chemistry of oceans

Unit II
**SUSTAINABILITY AND LCA:** Concept of Sustainability – Green Chemistry and Sustainability parameters – LCA methodology – Methodological Framework – Applications of LCA – Product Oriented LCA – Process Oriented LCA

Unit III

Unit IV
**BIOCATALYSIS AND GREEN CATALYSTS FOR INDUSTRY:** Chemical production by Biocatalysts – Bulk chemicals, Pharmaceuticals, Flavour and Fragrance Compounds, Carbohydrates and Polymers - Green Biocatalytic processes – Biocatalysis in Supercritical Carbon dioxide, Biocatalysis in Waste treatment and Biodesulfarisation - Supported Reagents – Envirocats – Advantages – Activation – General methods for using Envirocats - Commercial Applications of Envirocats – Benzoylations, Olefin Alkylation, Sulfonilation, Esterificatins and Aerobic oxidation

Unit V
**PROCESS INTENSIFICATION FOR GREEN CHEMISTRY AND EXTRACTION OF NATURAL PRODUCTS WITH SUPERHEATED WATER:** Relevance to Green Chemistry – Spinning Disc reactor – Microreactors – Intensified Cross-Corrugated Multifunctional Membranes - Properties of Superheated water – Extraction of materials other than natural products – Chromatography with Superheated Water – Extraction of Rosemary – Extraction of other plant materials

**Text Book**

**12FP324 ADVANCES IN FOOD PACKAGING TECHNOLOGY**

**Credits 4:0:0**

**Course Objectives:**
To enable the student to know about
- Novel food packaging technology
- Active and Intelligent food packaging for preservation of food materials.

**Course Outcomes:**
- To identify suitable techniques for Novel food packaging.
• To apply the knowledge of Active and Intelligent Packaging in Food packaging industries.

Unit I
ACTIVE AND INTELLIGENT PACKAGING: Role of packaging in the food chain - Active packaging techniques - Intelligent packaging techniques - Current use of Novel packaging techniques – Current research - The legislative context – Consumers and Novel packaging – sources of future information and advice - Materials used in active and intelligent packaging - oxygen scavenging technology- Selecting the right type of oxygen scavenger - Ethylene scavenging technology – Carbon-di-oxide and scavengers- Future trends.

Unit II
ANTIMICROBIAL FOOD PACKAGING AND FLAVOUR - PACKAGING INTERACTIONS: Antimicrobial agents - Constructing an antimicrobial packaging system-factors affecting the effectiveness of antimicrobial packaging – Non-migratory bioactive polymers in food packaging – advantages, limitations and applications - Accelerated shelf life testing – Interaction of Food and packaging contents – Factors affecting product / package interactions with examples

Unit III

Unit IV
NOVEL MAP APPLICATIONS FOR FRESH PREPARED PRODUCTS: Novel MAP gases- testing novel MAP applications- applying high oxygen – Carbon dioxide as an antimicrobial gas – Microbial safety of MAP – Effect of MAP on the nutrition quality of respiring and non respiring food product – Vitamin-C, Carotenoids, Phenolic compounds and glucosinolates- Colour changes and stability in fruit and vegetables - Colour measurement-processes of colour change- colour stability and MAP - Combined low oxygen high carbon dioxide and other gases- MAP performance.

Unit V

Text Books
Reference Book
LIST OF SUBJECTS

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12FP325 BIOCATALYSIS

Credits: 4:0:0

Objective:
- To enable the students understand the nature of various enzymes and methods of production, purification and formulation
- To make the students understand the kinetics of enzyme inhibition and modes of operation of enzyme reactors
- To make the students understand the application of enzymes in synthesis of novel compounds

Outcome:
Students would be able
- To isolate new enzymes which are cost effective
- To predict their nature and accordingly modify the system for optimum activity
- To design various types of reactions using enzymes that are eco-friendly

Unit I
Introduction: The discovery of enzymes- catalysis and bio- catalysis - enzymes as catalysts, structure- functionality relationships- Classification of enzymes - commercial importance of enzymes in biosynthesis- the concept and determination of enzyme activity- enzyme production- enzyme sources- enzyme synthesis- enzyme recovery- enzyme purification- enzyme formulation

Unit II
Enzyme Kinetics: Kinetics of enzymatic reactions- enzyme immobilization- methods of immobilization- evaluation of immobilization- partition effects- diffusional restriction- external and internal restriction- combined effects of external and internal restriction- environmental variables in enzyme kinetics

Unit III
Enzyme Reactors And Non-Enzymatic Biological Catalysis: Types of reactors- modes of operation- design fundamentals- design of enzyme reactors under ideal conditions, batch reactor, continuous stirred tank reactor- continuous packed bed reactor under plug flow regime- non enzymatic biological catalysis- catalytic RNA- synthetic enzyme models. Isomerases- cofactor – independent racemases and epimerases – allylic isomerases
Unit IV

Proteases And Lipases: Proteases- chemical synthesis of peptides- proteases as catalysts for peptide synthesis- enzymatic synthesis of peptides- process considerations for synthesis of peptides- sources and production of lipases - structure and functionality of lipases- improvement of lipases by medium and biocatalyst engg- application of lipases

Unit V

Oxidoreductases And Aldolases: Oxidoreductase as powerful biocatalysts for green chemistry- mild and selective oxidations catalyzed by oxidases- redox biotransformation catalysed by dehydrogenases- immobilization and stabilization of dehydrogenases- reactor engineering- use of aldolases for asymmetric synthesis- definition and classifications- preparation of aldolase biocatalysts- applications

Text Book:

Reference Book:
Objective:
- To enable students understand the importance of nanotechnology in food applications
- To make the students understand the role of nanotechnology in food ingredients, additives, supplements and food packaging
- To enable the student understand the structures of naturally occurring food nano substances and ethical issues of nanotechnology in food

Outcome:
- Students will attain knowledge about the designing of food nano substances, food nano packaging materials, nano-sized food ingredients and additives
- Students would be able to develop nanosensors for testing the quality of the foods

Unit I
Basics of Nanotechnology and Nanostructures in Food: Background-Evolution of new technologies in the food sector-Public perception of nanotechnology food products-Properties of nanomaterials-Nanomaterials for food applications-Nano-sized food ingredients and additives in relation to digestion of food-Natural nanostructures in food-Naturally occurring food nano substances and nanostructure-Designing food nanostructures-The status of natural nanostructures in food

Unit II

Unit III
Nanotechnology in Food Packaging: Introduction-Reasons to package food products-Physical properties of packaging materials-Antimicrobial functionality-Visual indicators-Improvement of mechanical properties through nanocomposites-Improvement of the barrier properties, nanocomposites, nano-structured coatings-Improvement of the performance of bio-based polymers-Surface biocides-Active packaging materials-Intelligent packaging concepts-Potential migration of nano-particles from food contact materials

Unit IV
Nanotechnology and Food Allergy, Nano-Ethics: Introduction-Molecules in foods involved in triggering allergies-Plant food allergens-Animal food allergens-Food structure processing and food allergy-Impact of nanoscale structures on allergic potential of foods-Nano-ethics-Historical background-Identifying and avoiding unethical nanotechnological products-Ensuring ethical nanotechnological research, innovation and production-Nano-ethics as the question of the good nanotechnological society
Unit V

Food Functionality and The Physics of Bionanotechnology: Risk Governance: Introduction-
Physics and structures in food bionanotechnology-Fibrillar structures-Plate-like structures-
Spherically symmetric structures-Biocontinuous structures in protein-polysaccharide systems-
Gastronomy and nanodomain: Molecular gastronomy-Guiding principles for risk governance-
Nanofoods knowns and unknowns-New for old-A nanovision for the future food

Text Book:
1. Qasim Chaudhry, Lawrence Castle and Richard Watkins, “Nanotechnologies in Food”

Reference Book
1. Lynn J. Frewer, Willem, Norde, Arnout Fischer, and Frans Kampers, “Nanotechnology in
Agri-Food Sector” Published by Wiley-VCH Verlag GmbH & co. KGaA Harchstr.
12FP327 ADVANCES IN DRYING TECHNOLOGY

Credits: 4:0:0

Objective:
- To enable the students understand the concepts of different drying models
- To make the students understand the processing parameters and drying rates of product
- To enable the students to design and develop various dryers used in food processing operations

Outcome:
- The knowledge on drying technology will help to conserve and minimize the losses of food produced
- Student would be able to predict the drying curves for a product
- Students would be able to design eco-friendly dryers with cost effective

Unit-I

Unit-II
Basic Process Calculations And Simulations In Drying: Basic classes of models and generic dryer types-General rules for a dryer model formulation-Mass and energy balances-Constitutive equations-Auxiliary relationships-Property databases-General remarks on solving models-Basic models of dryers in steady state-Distributed parameter models for the solid-Models for batch dryers-Models for semi-continuous dryers-Shortcut methods for dryer calculation-Software tools for dryer calculations

Unit-III

Unit IV
Industrial Dryers: Fluidized bed dryer, parameters of fluidized bed dryer, types of fluidized bed dryer, Spray drying systems - principle, atomized chamber design, new development in spray drying, -Freeze drying process-Microwave freeze drying-Freeze drying plant equipment-Industrial freeze dryer- Microwave and dielectric heating-equipment and industrial application for microwave and dielectric heating and drying- Spouted bed drying - experimental device and
procedure spouted bed drying-drying results- basic operation and application of flash dryer-design of flash dryer- basic principle on infrared drying-industrial infrared drying application.

**Unit V**


**Text Book:**

**Reference Book:**
13FP301 FOOD PLANT LAYOUT AND DESIGN

Credits: 3:0:0

Objective:
To enable the student to understand:
- The importance of Food plant layout and design.
- The various factors involved in the site selection and design of food plant layout.
- The concept of preparing cost estimate and economics.
- The importance HACCP and food safety laws governing food industries.
- The environmental pollution control in food industries.

Outcome:
On completion of the course, the student will gain knowledge and exposed to
- Design and setting up of new food processing plant as Entrepreneur and/or consultant.
- Prepare cost estimate and economic analysis of food industry.
- Implement the food safety standards in food industries.
- Help to minimize the food industry losses and maximize the processed food production

Unit I
SITE SELECTION: Site selection - Factors - Case Study: Site Selection - Product Capacity and quality – Storage of Raw materials and Product - Waste Disposal, Utilities – Requirements for water, electricity, labor, transportation facilities, refrigeration, boiler- laboratory - Plans for Future Expansion- Hours of Operation- Completion Date- Safety

Unit II

Unit III
CLEANING AND SANITATION: Goals of cleaning and sanitizing – Types of soil – Cleaning criteria and measurement – The cleaning process – Environmental aspects – Cleaning Kinetics – Hygienic design – Cleanability test methods – Water treatment

Unit IV

Unit V
ECONOMICS: Cost of Producing a Product- Capital - Elementary Profitability Measures- Time Value of Money- Compound Interest- Net Present Value- Rate of Return- Comparison of Net

**Text Books:**


**Reference books:**

13FP302 FOOD ENGINEERING LAB

Credits : 0:0:2

Objective:

To enable the students to have the practical experience on
- Various Unit Operations
- Use of Instrumentation In Food Analysis
- Engineering Property measurements
- Efficiency of Food Processing Machineries

Outcome:

- The student can use this understanding /knowledge for the design, development, operation and maintenance of food processing machines thereby increasing the processing production rates.
- The mechanization will reduce the labour requirement, time and cost of production

The faculty conducting the Laboratory will prepare a list of experiments [10/5 for 2/1 credit] and get the approval of HoD and notify it at the beginning of each semester.