### SEMESTER – I

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OBJECTIVE
The course is targeted to develop the knowledge of students in Food Chemistry at advanced level. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

OUTCOME
On completion of the course the students are expected to
- Be able to understand the significant role of food biomolecules
- Grasp the functional role of food components and their interaction in food products in terms of color, flavor, texture and nutrient composition
- Understand the significance and role of microbe in fermentation, spoilage and food borne infectious diseases

UNIT I  WATER RELATIONS IN FOOD  5 +1
Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymatic, physical and microbial changes); Glass transitions and molecular mobility in foods, their relevance to quality and shelf life of food systems.

UNIT II  FOOD PROTEINS AND ENZYMES; STARCH, HYDROCOLLOIDS AND GUMS  12
Chemistry, structure and functions of amino acids and proteins (Review). Chemistry and structure of food proteins, enzymic reactions, kinetics, Maillard reactions, enzymic browning, Role of enzyme in food processing. Functional properties of proteins: modified proteins, application in product formulation. Starch, hydrocolloids and gums: occurrence, functions in food systems, properties, gelatinization, retrogradation and modified starches; Food carbohydrates: structural, analytical, physicochemical, nutritional and functional aspects of small molecular weight carbohydrates and polysaccharides of plant and microbial origin.

UNIT III  ANALYTICAL CHEMISTRY  12
Introduction to Chemical instrumentation; basic components of analytical instruments, optical detectors (photomultipliers, monochromators, etc.), electrical detectors (pH – electrodes, etc), miscellaneous detectors; Atomic and molecular emission, absorption and fluorescence spectroscopy, Basic principles of analytical instrumentation used in Food quality, Quality control of food and containers, migration of metals and compounds from container into food; Case studies.

UNIT IV  FOOD SPOILAGE AND FOOD FERMENTATION  12
History of microbiology of food; Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms (Review); Types of micro-organism normally associated with food-mold, yeast and bacteria; Micro-organism in natural food products and their control; Contaminants of food-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing; Biochemical changes caused by micro-organisms, deterioration of various types of food products.

MICROBIAL FOOD FERMENTATION
Microbes of importance in food fermentations: homo & hetero-fermentative bacteria, yeasts & fungi; lactic acid bacteria fermentation and starter cultures. Alcoholic fermentations—yeast fermentations, fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.
UNIT V  
FOOD PATHOGENS

Microbial growth in food: intrinsic, extrinsic and implicit factors (Review); Food poisoning and microbial toxins, Food borne intoxicants and mycotoxins; Microbial interactions; Use of antimicrobial chemicals - organic acids, sugars, sodium chloride, nitrates, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials – Their mode of action; Tolerance of microbes to chemical and physical methods in various foods; Effects on enzymes and other proteins; death kinetics of microbes; Combination systems. Adaptation phenomena and stress phenomena; Effect of injury on growth or survival; Microbial standards for different foods

REFERENCES

FD8102  
FOOD ADDITIVES

OBJECTIVE
To expose the students to the use of different chemical additives in foods during food processing and preservation

OUTCOME
- To understand the principles of chemical preservation of foods
- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

UNIT I  
INTRODUCTION
Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.

UNIT II  
ACIDITY REGULATORS AND PRESERVATIVES
Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations
UNIT III  EMULSIFIERS, STABILIZERS AND THICKENERS  9

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications.

Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

UNIT IV  ANTIOXIDANTS AND ANTI-CAKING AGENTS  9

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anticaking agents – definition, role in preventing spoilage, mode of action, permitted list of anticaking agents and food application.

UNIT V  COLOR AND ARTIFICIAL SWEETENERS  9

Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application.
Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.

REFERENCES


TOTAL : 45 PERIODS
UNIT II JOINTING

UNIT III PUMPS

UNIT IV BASIC PRINCIPLES OF THERMODYNAMICS
Laws of Thermodynamics – application – simple applied problems

UNIT V PRINCIPLE OF REFRIGERATION
Vapor compression and absorption systems – complete cycle – Definition of terms – Design of cold storage and air conditioning systems - types of loads in cold storage and their calculations, design of cold storage for food products, construction of cold storage, equipment selection, insulating materials, vapor barriers, care and maintenance of cold storage; concept of freezing – refrigeration requirements – Packing of frozen foods.

TOTAL : 60 PERIODS

REFERENCES

FD8111 CHEMICAL AND MICROBIAL ANALYSIS OF FOOD LAB

OBJECTIVE
To develop skills related to chemical and microbial analysis of food using various techniques

OUTCOME
The students will have the practical skills for: the sampling of foods and be able to apply physical, chemical and microbial techniques of analysis

EXPERIMENTS
1. Moisture estimation by Karl Fischer Titration
2. Soluble and insoluble Dietary Fibre
3. Determination of Fatty Acids in fats
4. Detection of allergens in Foods: soya, peanut
5. Estimation of Vitamin B by HPLC
6. Estimation of Fat soluble vitamins by HPLC
7. Determination of Antioxidant activity of foods
8. Detection of Salmonella by ELISA
9. Rapid methods for hygiene monitoring in equipments and plants
10. Membrane filtration in detection of pathogens, enrichment and detection

TOTAL : 90 PERIODS
OBJECTIVE
To expose the students in bioreactor and upstream processing, fermentation process and scale up, metabolic engineering and enzymes in food technology

OUTCOME
- To understand the concept of bioreactor configuration advanced fermentation processes and its control systems.
- To understand the modes of operation of a fermenter and its scale – up
- To acquire knowledge about case studies on microbial production of functional food ingredients and significance role of enzymes in food industry

UNIT I  BIOREACTOR AND UPSTREAM PROCESSING  12
Bioreactor Configuration, design and physic chemical variables to be monitored. Medium optimization : Design of experiments, Plackett Burman design, Response surface methodology – Principle, evaluation coefficients using statistical software, contour diagram and arriving at optimum numerically and graphically – Case studies in medium optimization. Sterilization concepts – Batch and continuous sterilization.

UNIT II  FERMENTATION PROCESS AND SCALEUP  12
Modes of fermentation process – batch, continuous, fed batch and cell recycle process. Aeration and agitation in fermentation process. Scaleup and scale down concepts. Validation concepts in Industries.

UNIT III  METABOLIC ENGINEERING  12
Introduction to metabolic engineering, flux balance analysis, Changing central metabolic pathways, Biosynthetic pathways to produce food ingredients – Case studies amino acids, carotenoids, plant products in microbes.

UNIT IV  ENZYMES IN FOOD TECHNOLOGY  12
Enzymes used in starch industries. Pectinases and its food applications. Enzymes in food processing industries. Enzymes in dairy industry. Lipooxygenases and food quality. Enzymatic synthesis of oligosaccharides.

UNIT V  CASE STUDIES ON PRODUCTION OF FOOD INGREDIENTS  12

TOTAL : 60 PERIODS

REFERENCES
OBJECTIVE
The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used. This course will enable students to appreciate the application of scientific principles in the packaging of foods.

OUTCOME
The students will gain knowledge on
- The different types of materials and media used for packaging foods.
- Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved in food safety, labeling of foods
- Methods of packaging, shelf life and food factors affecting packaging

UNIT I INTRODUCTION TO FOOD PACKAGING
An overview of packaging; Historical background of packaging; Packaging – Dimensions, Concepts, Functions, Definition, Significance, Classification; Hazards to the Packaging – Climatic Hazards, Mechanism of spoilage, Mechanical Hazards; Packaging Components – Unit/Retail Packaging, Intermediate/Secondary Packaging, Bulk/Transport Packaging; Traditional Packaging Materials; Importance of Packaging in Food Industry; Status of current packaging.

UNIT II PACKAGING MEDIA AND MATERIALS

UNIT III PACKAGING SYSTEMS AND METHODS
Vacuum packaging, Gas flush packaging, Tamper-evident packaging; Modified Atmosphere Packaging (MAP), Controlled Atmosphere Packaging (CAP) & Aseptic Packaging, Retort pouch technology, Bag-in-box; Microwave packaging; Active packaging; Bio-degradable packages, Edible packages; Use of smart packaging by the food industry; Use of sensor technology within the food packaging industry; Industrial packaging: unitizing – Shrink and Stretch Wrapping, palletizing, containerizing, stacking and materials handling; distribution systems for packaged foods including prevention of shock damage to articles during transportation; Rigid and semi-rigid containers; Thermoformed packages – skin packaging and Blister Packaging; Flexible containers; form-fill-seal systems; Shelf-Life Studies; Testing & evaluation of packaging materials & packages – retail packs, transport packages and ancillary packaging materials.

UNIT IV PACKAGING FRESH AND PROCESSED FOODS
Packaging requirements for different foods and processing methods- General classification and packaging types, varieties and trends; packaging of convenience foods; Packaging of Food products – Fresh Fruits and vegetables, Packaging of Fruit juices, Packaging of Jams and Jellies, Packaging of Pickles and Chutneys, Packaging of Fats and Edible oils, Packaging of Break-fast cereals, Packaging of Tea, Coffee & other Beverage products; Packaging of Soft Drinks; Packaging of Bakery products- Bread, Biscuits & Cakes; Packaging of Snack foods; Packaging of Ready-cook products; Packaging of Spices, Condiments, Oleoresins; Packaging of Meat and Poultry Products; Packaging of Fish and other Sea-foods; Packaging of Dairy Products; Packaging requirements for Thermal-processed, Dehydrated, Frozen, Irradiated and other specially processed foods.
UNIT V PACKAGING DESIGN & ENVIRONMENTAL ISSUES IN PACKAGING

Food marketing and role of packaging: Packaging aesthetic and graphic design; Coding and marking, including bar coding; RFID in packaging and Consumer attitudes to food packaging materials.

Packaging – Laws and regulations, safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials; Packaging material residues in food products; Environmental & Economic issues, recycling and waste disposal.

TOTAL: 45 PERIODS

REFERENCES
3. Mathlouthi, M. “Food Packaging and Preservation”, Aspen Publisher 1999

FD8203 FOOD PROCESS ENGINEERING

L T P C
3 1 0 4

OBJECTIVE
The course is aimed to introduce the students to the area of food processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects.

OUTCOME
On completion of the course the students are expected to
- Develop a clear understanding of the principles of different methods applied to the processing of foods
- Have a grasp of emerging processing technologies and hurdle concepts

UNIT I ASEPTIC PROCESSING

Food spoilage, advantages and disadvantages heat processing; heat resistance of microorganisms, concept of D, Z, Fo values and lethality in microbial inactivation, log reduction and Acceptable Quality levels; In Package and In flow thermal processing, heat penetration curves, cold point, calculation of processing time and temperature

Canning and Retort treatment of foods; Pasteurization, HTST and UHT treatment of milk, fruit juices and other liquid foods; construction and properties of packaging materials (flexible and rigid) of In Package and In flow thermal processing; aseptic technology.

Heat transfer equipment involved in “In Package and In flow thermal processing”- plate, spiral and shell and tube heat exchangers, aseptic processing and filling; Different products and processes using aseptic technology.

UNIT II DRYING AND ULTRAFILTRATION

Principles of drying, drying rate, factors affecting heat and mass transfer during drying; different drying methods including tray, drum, foam mat, spray, freeze and other newer drying methods; construction and design of drying equipment; application in food Industry Osmosis and reverse osmosis; Ultrafiltration and Reverse Osmosis and its application in food Industry including water treatment
UNIT III  RADIATION PROCESSING
Principles of radiation processing, applications like disinfestation, pasteurization and sterilization, extending shelf life of plant products, advantages and limitations; ionizing radiations, mechanisms of action, dosage for different applications in terms of products; equipment for generating ionizing radiation and exposure safety and Regulations governing irradiation of foods – India and abroad; product permitted to be irradiated and the levels; special labeling requirements of irradiated foods; Irradiation facilities in India

UNIT IV  EMERGING PROCESSING TECHNOLOGIES
High Pressure Processing – principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry, Pulsed electric field processing - principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry. Ohmic heating of foods - principles, mechanism of action, advantages and disadvantages over conventional processing; Equipment and applications in food industry, Infra – red heating – principles, mechanism of action food application

UNIT V  CONTROLLED/MODIFIED ATMOSPHERE STORAGE AND PACKAGING (CAS/MAP), ACTIVE PACKAGING
Principles of CAS and MAP, its advantages in preserving fresh fruits and vegetables and grains, Co2 tolerance, controlled storage rooms; respiration rate of fruits and vegetables role of barrier properties of packaging in MAP, designing of MAP for fruits and vegetables; application of MAP in extending the shelf life of processed foods Principles of active packaging; preservation role of active packaging and its application in foods

HURDLE TECHNOLOGY
Minimal processing of foods, principles of hurdle technology, advantages of hurdle technology, different types and classes of hurdles, homeostasis and application of hurdle technology in food preservation.

TOTAL : 60 PERIODS

REFERENCES

FD8211  ADVANCED BIOPROCESS LAB  L T P C
0 0 6 3

OBJECTIVE
To enable the students to understand the design, scale up and operation of equipment in handling of food based enzymes and cultivation of microbes relevant to food industry on industrial scale.

OUTCOME
The students will learn the following skills:
- To sterilize
- To operate the bioreactor
- To design experiments for evaluating the performance of the bioreactor
- To develop enzyme immobilized processes
EQUIPMENT NEEDED
Bioreactor
Centrifuge
Microfiltration unit
Homogenizer

EXPERIMENTS
1. Enzyme Kinetics and Evaluation of Coefficients by Computational Methods
2. Enzyme Immobilization – Cross Linking Method and Application
3. Enzyme Application – Use of Enzyme to Liquefy Starch and produce Glucose
   Scale down experiment to simulate large bioreactor condition and evaluate nutrient depletion quality.
5. Batch Cultivation – Evaluation of Yield Coefficients, Exhaust Gas Analysis, Carbon Distribution
6. Plackett Burman Design and Response Surface Methodology for getting an optimum condition

TOTAL : 90 PERIODS

REFERENCES

FD8311 ADVANCED FOOD ANALYSIS TECHNIQUES LAB

OBJECTIVE
To enable the students to understand the principles and methods of advanced techniques in the analysis of foods

OUTCOME
The students will learn the following skills:
- To apply different methods of extracting food components
- To use different types of spectrophotometers
- To use instruments that analyze the physical properties of foods

EXPERIMENTS
1. Determination of beta-carotene/lycopene in fruits using spectrophotometer
2. Estimation of nickel content in Hydrogenated vegetable oil by AAS.
3. Determination of added vitamin A in vanaspathy
4. Determination of sugars in soft drinks by HPLC.
5. Screening of corn/groundnuts for Aflatoxins by TLC method.
6. Determination of Refractive Index of oils
7. Detection of adulteration of honey using Polarimetry
8. Determination of antioxidant activity of foods by DPPH method
10. Texture Measurement of foods using Texture Analyser

TOTAL : 90 PERIODS

FD8312  FOOD PROCESSING AND QUALITY CONTROL LAB  L T P C  0 0 6 3

OBJECTIVE
To enable the students to understand the principles and methods of processing foods

OUTCOME
The students will learn the following skills
- To apply different methods of extracting food components to analyze the quality of foods
- To understand and use different techniques of food processing to preserve foods
- To use instruments that analyze the physical properties
1. Determination of absorbed oil content in fried foods.
2. Monitoring the primary and secondary oxidative rancidity in oils.
3. Determination of thermal load during retort processing of food products.
4. Determination of browning and colour measurement in foods.
5. Preparation of pickled vegetables, fruit jams, and bakery products; and their chemical analysis
6. Canning of vegetables & fruits - fruit juices, squashes, syrups and ready-to-serve beverages.
7. Drying of fruits and vegetables, quality control of processed products.
8. Spray drying of liquid foods
10. Shelf life calculation for moisture sensitive and oxygen sensitive foods.
12. Packaging of food products using retort pouch technology.

TOTAL : 90 PERIODS

FD8313  PROJECT WORK – PHASE I  L T P C  0 0 1 2 6

Students should identify one project that can be carried out in two phases either in-house or in industry or research institutes. When working outside, an internal guide from the department will monitor and review progress of work.
OBJECTIVE
The Course is aimed to explain the use of statistical methods which are mostly used in food and biotechnology and the corresponding basics in form of case studies. The focus should be on understanding how and when to use the appropriate statistical techniques. Emphasis has to be placed on prerequisites (statistical reasoning and planning of experiments) and the appropriate use of parametric statistical methods.

OUTCOME
On completion of the course the students are expected to gain knowledge on
- Analyzing and representing data
- Clear picture of sampling distribution
- Designing experiments
- Statistical quality control techniques pertain to Food Technology

UNIT I  PROBABILITY AND ITS DISTRIBUTIONS 6
Axioms of Probability-Addition and Multiplication theorems- Binomial, Poisson and Normal Distributions.

UNIT II  CURVE FITTING AND TIME SERIES 9
Curve fitting by method of Least Square - Regression analysis - Least Square Approximation - Fitting of non-linear curves; Correlation and Rank correlation coefficients; partial and multiple correlation and regression; Time Series-Moving Average method - Method of least squares - Measures of Seasonal variation.

UNIT III  SAMPLING DISTRIBUTIONS 9
Introduction to sampling techniques and their application to Food Technology- Fundamental concepts of acceptance sampling plans; single; double and sequential sampling plans; use of sampling inspection tables for selection of single and double sampling plans; introduction to sampling techniques and their application to consumer preference studies; acceptance sampling by attributes and variables. Tests based on Normal, students ‘t’ test , F and chi-square test- Goodness of fit Type I and Type II Error – Simple Problems.

UNIT IV  DESIGN OF EXPERIMENTS AND QUALITY CONTROL 12
Analysis of variance - One-way classification - Completely Randomized Design -Two way classification - Latin Square Design connected to Food Technology - limits missing plot technique - Factorial experiments; experimental designs in sensory evaluation.

UNIT V  QUALITY CONTROL PERTAINING TO FOOD TECHNOLOGY 9
Introduction to statistical quality control; control charts for variables and Process Control; histogram; mean and range charts; statistical basis - Process control, control charts of measurements and attributes, tolerance limits.

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
The course aims to develop the knowledge of students in the area of Cereal, pulse and oilseed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods.

OUTCOME
On completion of the course the students are expected to
- Be able to understand and identify the know-how technologies used for cereals, pulses, oilseeds
- Understand the application of scientific principles, processing and utilization of value added products
- Enable students to appreciate the application of scientific principles and technology in the processing of materials

UNIT I MAJOR CEREALS
15
Cereal Grains- new varieties, production trends of wheat, rice, barley, oat, corn, sorghum, pearl millet and minor millets in India; Structure and nutrient distribution in cereals, wheat types, Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapattis, malting and malt products; Rice- Milling, milling machine, effect of different factors on milling yield and rice quality, parboiling of rice, effect of aging of rice, rice products-enrichment with vitamin and minerals, byproduct utilization; Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Traditional and Fermented cereal products

UNIT II OTHER CEREALS
8
Corn- Wet and dry milling, Corn Products – Corn flakes, Corn starch, its derivatives syrup, germ oil, preparation of extruded products; canned corn products, puffed product, Barley-pearling and malting of barley. Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking.

UNIT III MILLETS
8
Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - Basic agricultural aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT IV PULSES AND LEGUMES
9
Basic agricultural aspects, structure, composition, storage, insect control, processing- Milling/splitting, dhal milling; processing of pulses- fermented and traditional products – puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT V OIL SEEDS
5
Oil seeds processing: Groundnut, mustard, soybean, sunflower, safflower, sesame and other oil bearing materials. Processing and utilization of soybean for value added products. Innovative products from oilseeds

TOTAL : 45 PERIODS
REFERENCES

FD8003 CHEMICAL ENGINEERING IN FOOD INDUSTRY L T P C
(For Science stream graduates) 3 0 0 3

OBJECTIVE
To understand the principles of process calculations and principles of fluid mechanics and its application

OUTCOME
- To perform calculations pertaining to processes and operations
- To apply fluid mechanics principles to applied problems

UNIT I MATERIAL AND ENERGY BALANCE

UNIT II FLUID MECHANICS

UNIT III HEAT TRANSFER

UNIT IV MASS TRANSFER

UNIT V MECHANICAL OPERATIONS

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
This course is aimed to develop the knowledge about pest infestation, risk associated and its prevention.

OUTCOME
- To get awareness about post harvest issues in stored grains and processed foods caused by pests.
- To improve the analyzing and problem-solving capabilities on risk assessments, prevention and control.

UNIT I  FOOD INFESTATION  9
Post harvest problems of infestation in stored food grains, spices and processed foods and food processing units; Economic losses and safety issues.

UNIT II  COMMON PESTS  9
Common pests involved in food storage and handling: pests and their habits: rodents, cockroaches, flies, ants, stored product insects – beetles, weevils, moths; birds and other vertebrates.

UNIT III  RISK FROM PESTS  9
Risk posed by pests to foods, food handlers and public; contamination, toxicology and microbiology, transmission of pathogens, food infection and food poisoning. Food hygiene: regulations, GHP and GMP relevant to pest control.

UNIT IV  PEST PREVENTION  9
Pest prevention- E-R-D Exclusion, restriction, destruction in food operations; building design and pest proofing, warehousing and storage areas, water and drains. Waste collection and disposal.

UNIT V  PEST CONTROL  9
Inspection and auditing, physical methods: use of monitoring traps/detectors – electric fly control units, pheromone traps; Chemical control methods – use of insecticides, pesticides and rodenticides, safety and environmental consideration of chemicals used for control, biopesticides; fumigation and disinfection; Pest awareness training and education. Integrated Pest Management in the food industry.

TOTAL : 45 PERIODS

REFERENCES
DAIRY PROCESSING

FD8005

OBJECTIVE
To provide in-depth knowledge in various unit operations and basic concepts in dairy processing

OUTCOME
To understand the principle and significance of
- Various Processing Methods (both thermal and emerging non-thermal) of market milk and milk product in dairy plant
- Dairy engineering inputs to dairy plant
- Dairy products analysis, Sanitation and Hygiene requirements

UNIT I INTRODUCTION TO MILK
Milk: Definition, composition, Physical and chemical properties; National and international standards; Present milk industry scenario and its future practices related to procurement and transportation

UNIT II MILK PROCESSING
Fundamentals of mechanical separation: Principle and application of centrifugal separation in Dairy industry (Cream Separator, Self-de-sludging, centrifuge, bactofuge, clarifier, tri-processor) their maintenance; Homogenizer: Classification and maintenance; UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, effect on milk quality; Methods of determining lethality of thermal processing; Non-thermal processing (working Principle, merits and demerits): Pulsed Electric field, Infra red, Ohmic heating, High hydrostatic pressure processing; Soy milk manufacturing and application of High Pressure Processing; Use of carbonation in extending the shelf life of dairy product; techno-economic considerations;

UNIT III UNIT OPERATIONS
Dehydration - Advances in drying of milk and milk products, freeze concentration, freeze dehydration: physicochemical changes during freeze drying and industrial developments; evaporation systems - evaporator; milk dryers; spray dryer and roller dryer; Water activity; energy of binding water, control of water activity of different milk products in relation to their chemical; microbiological and textural properties; Design of pressure vessel, storage tank, milk coolers, pasteurizing plants, flavor treating equipment.

UNIT IV SAFETY AND SANITATION
Current trends in cleaning and sanitization of dairy equipment: advanced CIP systems; pumps: classification, reciprocating, centrifugal pumps, pressure variation; Ultrasonic techniques in cleaning; bio-detergents, development of sanitizers- heat; chemical; radiation, mechanism of fouling and soil removal; Bio-films, assessing the effectiveness of cleaning and sanitization of dairy products; Application of HACCP system in dairy industry.

UNIT V DAIRY PRODUCTS PROCESSING AND ANALYSIS
Recent Developments in Yoghurt Manufacture, Modern Cheese processing: Hard and Soft Cheeses, Equipment for butter, ghee, ice-cream, cheese making and their maintenance; Developments in Cream Separation and Processing; Byproduct technology- Whey and Casein processing and utilization; Membrane processing: ultra filtration, nanofiltration and reverse osmosis, Effect of milk constituents on operation; Rapid, automated microbiological and analytical techniques in Dairy industry - Detecting pathogens, antibiotic and elementary xenobiotic residues in raw & processed dairy products; hurdle technology and its application in development of shelf-stable and intermediate-moisture foods.

TOTAL: 45 PERIODS
REFERENCES

FD8006  ECONOMICS AND TRADE IN FOOD  L T P C
3 0 0 3

OBJECTIVE
This course aims to emphasis the significant role of economics and trade in food sector

OUTCOME
- To understand the rudimentary concepts of Indian Economy under various sector and methods of measurement
- To update the economic reforms and Modern Technology
- To be aware of the importance of management in Quality domain

UNIT I  ECONOMICS FUNDAMENTALS
Nature of Indian Economy – Role of Agricultures Sector, Industrial Sector and Services Sector in the development of Indian Economy. National Income of India, Methods of its measurement – Growth of National Income, per capita income

UNIT II  INFRASTRUCTURE

UNIT III  ECONOMICS REFORMS

UNIT IV  IMPORTANCE OF MODERN TECHNOLOGY
Modern technology and its evaluation, Importance of Marketability and Feasibility, Definition of Trade and Business, Importance of Scale of Production, Capacity, Concept of productivity.

UNIT V  QUALITY MANAGEMENT
Total Quality Management, conventional methods, Agmark - certification of Food (Agro) Products Role and Function of Reserve Bank of India in Food Processing Sector, pricing policy fundamentals

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
To create awareness about environmental issues in food industry

OUTCOME
To acquire knowledge about Environmental pollutions, its measurements and management
To initiate projects on methods of utilizing wastes to make value added products
To understand and design Air duct and room air distribution for the basic control of Air Quality, Waste Water Treatment

UNIT I  ENVIRONMENT AND POLLUTION
Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control; Water pollution and its control; Xenobiotic compounds; Pesticides and pest management; processes; Solid wastes and management; Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; bioorganic pollution; microbial toxicants and pollutants, and their bio-degradation; biodegradation of plastics, biofouling and biofilms; bioremediation.

UNIT II  CONTROL OF AIR QUALITY
Air duct design and room air distribution; air conditioning systems; clean-room air conditioning; important pollutants of air; properties of particulate matter and air pollution control methods; air quality in the processing plants, legal requirements.

UNIT III  WASTE WATER TREATMENT
Waste water sources characteristics - standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; Physical unit operations in waste water treatment - screening; racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration, incineration; chemical unit operations in waste water treatment - reaction kinetics; chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption, disinfection; biological unit operations - aerobic and anaerobic

UNIT IV  STORAGE & DISPOSAL OF WASTE
Types of waste generated; Non-degradable & biodegradable wastes, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; Biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal; environmental laws; pests & their control.

UNIT V  UTILIZATION OF WASTE
Methods of utilizing wastes to make value added products- generation of biogas, extraction of specific components, use in animal feeds, zero emission plants; recovery & recycling of materials.

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
This course aims to explain the flavor, Spice and Plantation crops application in food industry

OUTCOME
- To understand the flavor profiling, analytical and processing techniques, quality aspects of flavor, spices and plantation products
- To acquire knowledge about stability studies on storage, processing, transportation

UNIT I FLAVOR – INTRODUCTION
Definition and Description of flavor, flavor profile. Measurement of flavor, particularly for wine, tea, coffee, spices and condiments. Natural and synthetic flavoring substances and their chemical characteristics. Flavor components/constituents of fruit and vegetables, coffee, tea and cocoa bean, spices and condiments

UNIT II FLAVOR PROCESSING AND STABILITY STUDIES
Effect of storage, cooking condition of various foods, processing, transportation and environmental condition on flavor components. Processing (industrial/commercial) technologies / methods of flavoring compounds of plant foods and their utilization and application
Recent developments in flavor research, processing and technology

UNIT III PLANTATION CROPS
Tea: Processing of tea, various types of tea, chemistry of constituents, fermentation, tea concentrates decaffeination process, Evaluation and grading of tea. Coffee: Processing of coffee, type of coffee, drying, fermentation, roasting and browning processes and their importance, chicory chemistry and technology. Analysis of tea and coffee, quality components - standards and specification of tea and coffee products. Processing and analysis of cocoa bean, beverages and study of factors that affect quality and uses for the consumers

UNIT IV SPICES- CLASSIFICATION, QUALITY AND FUNCTIONAL VALUE
Scope of spice processing in India, Types, spice qualities and specification, uses and physiological effects, components, antimicrobial and antioxidant properties, Medicinal value of condiments and spice products

UNIT V SPICE PROCESSING
Important spices added in food products, Processing and manufacturing of major Indian Spices: Pepper, cinnamon, cardamom, Nutmeg, saffron, turmeric and Ginger, minor spices- cloves, leafy spices, bay oregano, and seed spices. Spice processing machineries, packaging and handling of spices. Spice blends and extractives, essential and encapsulated oils, oleoresins – uses in processed foods

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
To provide knowledge in the various type of equipment used for unit operations in food processing

OUTCOME
To get through the principles, design and significance of
- Milling and extrusion equipments
- Downstream processing equipments
- Mixing, Blending and Filling Equipments
- Waste water treatment installations, Clean-in-Place (CIP) system

UNIT I MILLING AND EXTRUSION EQUIPMENTS
Milling equipments used for rice and wheat, pearling and flaking equipment; dhal mills; Extrusion processing: principles; different types and design of extruders

UNIT II WASHING, FILTRATION & CENTRIFUGATION EQUIPMENTS
Different Fruits and Vegetable washing systems; Conveyor belts - types, material of construction, product specific conveyors; Design of screw, bucket, belt, oscillating and vibratory conveyors; filtration of liquid foods (dairy, fruit & vegetables); centrifugation systems: Solid bowl and disc bowl centrifuges; cyclone separator and self cleaning centrifuge.

UNIT III MIXING, BLENDING & FILLING EQUIPMENTS
Agitation and mixing of liquid foods, powders and pastes; Mixers -ribbon blenders, augur, nauta, cone. Liquid and powder filling machines - like aseptic system, form and fill (volumetric and gravimetric), bottling machines.

UNIT IV HEAT PROCESSING & COOLING EQUIPMENTS
Autoclaves - types, operation; Different drying systems - Spray, Fluidized bed, tunnel; evaporators; pasteurizers, steamer, roaster ovens, kettles, baking & confectionery equipments Freezing equipments - Plate, Tunnel, blast, IQF, Liquid nitrogen, Heat exchangers - Tubular and Plate; Refrigerated transport and transportation in insulated containers.

UNIT V HYGIENIC DESIGN ASPECTS
Basic principles: as applied to various equipment- sanitary pipes and fittings, pumps, machines, tanks, stirrers and mixers, pasteurizers; evaporators; thermo-compressors and; dryers; sterilizers and treatment by irradiation; waste water treatment installations, Clean-in-Place (CIP) system; corrosion process and their control.

TOTAL : 45 PERIODS

REFERENCES
OBJECTIVE
To expose the students to the principles and different methods of food processing and preservation

OUTCOME
- To understand the principles of food processing and preservation.
- To understand the role of different methods of preservation on different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods
- To understand the materials and types of packaging for foods

UNIT I PRINCIPLES OF FRESH FOOD STORAGE
Nature of harvested crop, plant and animal; Product storage; Effect of cold storage and quality- storage of grains; Principles of refrigerated gas storage of food- Gas packed refrigerated foods; Sub atmospheric storage; gas atmospheric storage of foods.
Principles of food freezing: development of frozen food industry, the freezing point of foods, freezing of bakery products. Psychrometric chart, Freezing and cold storage. Freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT II PRINCIPLES OF CANNING AND DRYING
The art of appertizing; categories of foods for canning; spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food; improvement in canning technology. Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes; calculation of process time temperature-schedules.
Drying – A natural process: artificial drying, adiabatic driers, influence of drying on pigments and enzymes; Dehydration of fruits, vegetables, milk, animal products etc.
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures.
Newer methods of thermal processing- batch and continuous; application of infra-red microwaves; ohmic heating.

UNIT III PRINCIPLES OF FOOD CONCENTRATES
Control of water activity; preservation by concentration and dehydration; osmotic methods; High solid- high acid foods; Pectin and gel formation; Use of sugar and Invert sugar, jelly making, other food products,

UNIT IV NON-THERMAL METHODS
Chemical preservatives - Food additives, functional chemical additives applications. Chemical preservatives and antibiotics; Preservation by ionizing radiations- technology aspects of the radiations, pasteurization of foods; public health aspects, microbiology of irradiated foods; Ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT V FOOD PACKAGING
Packaging– Concepts, definition, Significance, classification; Packaging– Development, Retail/Unit ; Packaging of foods – fresh and processed; Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, vacuum packaging; MAP, costs of packaging and recycling of materials.

TOTAL : 45 PERIODS
**REFERENCES**


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**FD8011 FOOD PRODUCT DESIGN AND DEVELOPMENT**

**OBJECTIVE**
To study the steps and strategies related to Innovation in Food Products and New Food Product Development.

**OUTCOME**
- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development
- To enable the students to understand the process of development of food products
- To develop ideas for new food products which are nutritious, cost effective, functional and marketable

**UNIT I FOOD NEEDS & CONSUMER PREFERENCE**
Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept; advantages of processed foods in urbanised Modern Society; why people buy processed foods. Developing a Product to Meet the Requirements

**UNIT II DESIGNING NEW PRODUCTS**
New Food Product Development (NPD) process and activities, NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; recent developments in food ingredients/additives flavorings, colorings, emulsifiers, stabilizer and sweeteners; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients and novel processing technologies.

**UNIT III STANDARDIZATION & LARGE SCALE PRODUCTION**
Process design, equipment needed and Design; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

**UNIT IV QUALITY, SAFETY & REGULATORY ASPECTS**
Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.
UNIT V  ADVERTISEMENT, MARKETING & CASE STUDIES  
Product performance testing; market positioning, Marketing: developing test market strategies; various tools and methodologies to evaluate consumer attitudes, preferences and market acceptance factors; Case Studies of some successes and failures- Factors that influence NPD success, innovation case studies to highlight best practice in terms of the integration of technological and marketing approaches to NPD; food choice models and new product trends.

REFERENCES  
2. Fuller, G. W. “New Food Product Development: From Concept to Marketplace”, CRC, 2004  
5. Gupta, R. “Food Retailing: Emerging Trends”, ICFAI University Press, 2005  

FD8012  FOOD SUPPLY CHAIN MANAGEMENT  
L T P C  
3 0 0 3

OBJECTIVE  
To provide an introduction to the concepts and tools of supply chain management in the food and beverage industry

OUTCOME  
- To demonstrate an awareness of the role of supply chain management in competitive strategy in the food and drinks industry  
- To get a critical understanding of the buyer-supplier relationship debate  
- To be aware of the challenges involved in identifying, acquiring and managing the various resources required in food supply chains  
- To Develop a conceptual appreciation of the key supply chain management processes and their role in satisfying customer demands

UNIT I  INTRODUCTION  
Building blocks of Food Supply Chain Management, Significance in Nation’s Economy, International Food Supply Chains - Special emphasis to Indian Scenario and challenges thereof; Agricultural policy impacts, and problems in the modern food supply chain; Human Resource Development in Supply Chain, Understanding the changing customer needs: domestic and export.; Food Disaster and Hunger relief

UNIT II  MODULES  
Inbound and outbound logistics, Supply Chain as a source of competitive advantage, Buyer – Vendor co-ordination, Procurement, Vendor development and evaluation, reduced sourcing and supplier partnership – benefits, risks and critical success factors, The Logistics/SC product: Nature and classification of products, the product life cycle, product characteristics, weight – bulk ratio, substitutability, risk characteristics, product packaging, product pricing, geographic pricing methods, legal concerns; Coordination and management of transportation, Inter model transportation and third party transportation services; Facility location, Transportation infrastructure and management
UNIT III  ORDER PROCESSING 8
Multi-level supply control, Inventory control systems of stock replenishment, Cost elements, EOQ and derivative models; Order processing and information systems- Defining order processing, order status reporting- industrial order processing, retail order processing, customer order processing; web – based channel order planning.

UNIT IV  MODELS AND E-COMMERCE INPUTS 9
Porter’s industry analysis and value chain models; concept of total cost ownership; Use of stochastic models and combinatorial optimization in SC planning, layout, capacity planning, inventory optimization; Operation research models for operational and strategic issues in supply chain management, the Bullwhip effect and supply chain management game; Internet technologies and electronic commerce in SCM related to ERP, Q procurement, e-logistics, internet auctions

UNIT V  APPLICATION OF SUPPLY CHAIN MANAGEMENT IN MULTI-SECTOR 8
Specific supply chain practices (buy local vs. commodity supply chain)- Pre and Post Harvest Management of Fresh Produce; Food Manufacturing Restaurant and Hospitality Industry, Controlling Food Safety and Insuring Quality, Sustainable and Organic Food Supply Chains and Certification Programs. Benefits and risks associated with FDI in retail sector of India.

TOTAL : 45 PERIODS

REFERENCES

FD8013  FRUIT AND VEGETABLE TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVE
The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OUTCOME
On completion of the course the students are expected to
- Be able to understand and identify the specific processing technologies used for vegetables and fruits and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies, product specification and regulations.
- Grasp the changes in the composition of foods with respect to the type of processing technology used
UNIT I  
PRE-PROCESSING  
9
Fresh fruits and vegetables – Handling, grading, cleaning, pretreatments, transportation, pre cooling, chilling, modified atmosphere packaging, Controlled atmosphere storage, packaging, transportation, quality assurance.

UNIT II  FREEZING OF FRUITS AND VEGETABLES  
6
Different freezing methods and equipments, problems associated with specific fruits and vegetables.

UNIT III  DEHYDRATION OF FRUITS AND VEGETABLES  
9
Dehydration – different methods of drying including sun, tray, cabinet, drum, spray, vacuum, tunnel, spray, low temperature drying process, process calculations osmotic dehydration and other modern methods, choice of suitable methods, preserving the color, flavor and nutrient content of the products.

UNIT IV  CANNING, JUICES & CONCENTRATES  
9
Different unit operations involved in fruit and vegetable Pulp/ juice extraction, concentration, Bulk aseptic packaging of fruit and vegetable pulps, juices and concentrates; aseptic packaging of fruit drinks, juices and other products Bottling, canning - essential principles, different types of cans, unit operations in canning blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic; Vegetable Purees/pastes - processing of Tomato and tomato products.

UNIT V  FRUIT AND VEGETABLE PRODUCTS & STANDARDS  
9
Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres - specific processing, different packing including aseptic, Product specifications and standards; food regulations with respect to fruit and vegetable products.

TOTAL: 45 PERIODS

REFERENCES
1. Indira, G and Mohanram, M. “Fruits” NIN, 1996

FD8014  FUNCTIONAL FOODS AND INGREDIENTS  L T P C
(for Graduates with Food background)  9 0 0 3

OBJECTIVE
To impart the concept of nutraceuticals, functional ingredients and foods and their role in health and disease

OUTCOME
• To understand the different nutrient and non-nutrient functional ingredients and their sources
• To understand the role of phytochemicals and nutraceuticals in health and their therapeutic applications
UNIT I  NEED FOR FUNCTIONAL FOODS  6
Lifestyle changes & diet, lifestyle diseases like cardiovascular diseases, diabetes, cancer and effects of diet in their control

UNIT II  NUTRACEUTICALS & PHYTOCHEMICALS  15
Definition of Nutraceuticals and difference from nutrients. Traditional Health Sciences including Ayurveda, Unani, Chinese etc. Benefits of Nutraceuticals in controlling certain diseases; Natural Occurrence of certain phytochemicals and their usefulness in functional foods with following examples: Antioxidants and Flavonoids; Omega-3 Fatty Acids; Carotenoids; Dietary Fibre; Phytoestrogens; Glucosinolates; Organosulphur Compounds etc. their effectiveness in specific disease conditions; other functional ingredients in foods such as peptides, fatty acids, antimicrobial compounds; Clinical Studies including Structure-Activity relationship of active compound. Dosage for effective control of disease or health benefit with adequate safety; Studies with animals and humans; acute and chronic studies. Sea weeds as functional foods and as source of functional ingredients.

UNIT III  PRE- & PROBIOTICS  9
Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits. Examples of useful microbes and their benefits; Prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.

UNIT IV  PREPARATION OF PHYTOCHEMICALS FROM PLANT MATERIALS  6
Care in handling and storage of raw material with minimal damage to sensitive bioactive compounds; Extractive methods for maximum recovery and minimal destruction of active material; Stability studies.

UNIT V  DEVELOPMENT OF FUNCTIONAL FOODS  9
Developing Functional Foods; Use of bioactive compound in appropriate form with protective substances and activators; Effect of environmental conditions in food matrix on activity of bioactive compound; Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods; delivery of immunomodulators / vaccines in functional foods.

TOTAL : 45 PERIODS

REFERENCES

FD8015  MEAT, FISH AND POULTRY TECHNOLOGY  L T P C
3 0 0 3

OBJECTIVE
This course developed to denote the significance and necessity of organized animal product sector, controlled-advanced processing for efficient slaughtering of animals and poultry, value added egg and marine products.

OUTCOME
- Able to be aware of Feed, Breed Management on production and quality
- Get through Pre and Post slaughter handling techniques
- Capable of detailed understanding the detailed process flow of value added products from herbivores, poultry and marine species
UNIT I INTRODUCTION
Sources of meat and meat products in India, its importance in national economy; Effect of feed, breed and management on meat production and quality

UNIT II SLAUGHTERING OF ANIMALS AND POULTRY
Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant; Factors affecting post-mortem changes, properties and shelf-life of meat; Meat quality evaluation; Mechanical deboning, meat tenderization.

UNIT III MEAT PROCESSING
Structure and composition of meat, carcass chilling, ageing; storage of fresh meat-Modified atmosphere packaging, packaging of retail cuts; Processing and preservation-artificial tenderizing, chilling, freezing, curing, smoking, sausage manufacture, ready-to-eat meats and meat products; Aging, pickling and smoking of meat; Meat plant sanitation and safety, Byproduct utilization; Recent trends in meat processing; MMPO, MFPO, radiation processing; meat safety. Kosher and Halal certification, safety issues, regulation and quality assurance.

UNIT IV EGG AND EGG PRODUCTS
Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality; egg products- egg powder and frozen liquid eggs

UNIT V FISH AND MARINE PRODUCTS
Types of fish, composition, post harvest quality changes, post harvest losses, methods for assessing and preventing losses; structure, post-mortem changes in fish; handling of fresh water fish and marine fish; processing of fish, crab, prawns, seaweeds, canning, smoking, freezing and dehydration of fish; Fish sausage and home making;
Freezing techniques and irradiation process, value addition, preparation of fish products (fermented fish, fish products, fish soups, fish powder, prawn powder and cutlets), seaweed products like pickles, hydrocolloids and fish oil.

TOTAL : 45 PERIODS

REFERENCES
3. Kerry, J.P. “Improving the Sensory and Nutritional Quality of Fresh Meat”, CRC/Wood Head, 2009
4. Venugopal, V. “Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methods” (Food Science and Technology Vol. 13) , CRC press, 2006

FD8016 NEW PROCESS AND PRODUCTION SYSTEMS FOR FOOD L T P C
3 0 0 3

OBJECTIVE
This course is developed to explore the physico-chemical properties of functional food ingredients and optimization at molecular and macroscopic levels

OUTCOME
- Be Capable of characterizing molecules/groups of food compounds
- Greater Exposure with advanced techniques such as Super Critical fluid extraction, head space sampling, NMR, IR, Pulse Nuclear Magnetic Resonance spectroscopy
- Ability to get deep insight knowledge about the Bio-process technology for the production and improvement of functional food ingredients
UNIT I  INTRODUCTION  
Importance and need for processes to explore the physical-chemical properties of functional food ingredients and nutraceuticals and optimization of both the nutritional/physiological functionality of ingredients at the molecular, mesoscopic and macroscopic levels

UNIT II  EXTRACTION  
Different types of methods of extraction for molecules of interest and their optimization; Industrial processes for extraction of desirable and undesirable components from fresh and/or stored products by supercritical fluid (SCF)extraction and other techniques; application of ultrafiltration, reverse osmosis; nanofiltration and microfiltration in food industry.

UNIT III  FRACTIONATION  
Methods used for fractionation and characterization of molecules/groups of compounds such as polyphenols, phytaotes, saponins, phytoestrogens, fatty acids, volatile and aroma /flavour components - by head-space sampling, extraction, concentration, separation and identification techniques - chromatography with mass spectroscopic techniques, GC-MS, random MS and ESR, NMR, IR and Raman Spectroscopy; Pulse Nuclear Magnetic Resonance (PNMR) spectroscopy, X-ray crystallography and polarising light microscopy, scanning electron microscopy, spectro-polarimetry, circular dichroism and differential scanning calorimetry.

UNIT IV  SYNTHESIS OF INGREDIENTS  
Production of functional ingredients by microbes – oligosacharides, polysaccharides, biosweeteners, biopreservatives, flavour and colour components; Modification of phytoneutrients using enzymes or microbial fermentations to improve bioavailability, enhance water-solubility, slow-release applications, solubility in oil, and effecting hydroxylation/methylation patterns to modulate bioactivity.

UNIT V  BIOPROCESSING TECHNOLOGY FOR NUTRACEUTICALS  
Pasteurisation & Sterilization with high pressure – ultrahydrostatic pressure treatment, dense carbon-di-oxide treatment, encapsulation of nutraceuticals – materials, mechanical processes and chemical based processes, nanoencapsulation; packaging requirements and practices for functional foods; distillation and dehydration technologies to retain bioactive compounds.

TOTAL : 45 PERIODS

REFERENCES
FD8017  NUMERICAL METHODS  L T P C  3 0 0 3

OBJECTIVE
The course is aimed to impart basic knowledge about numerical solutions of partial differential equations.

OUTCOME
On completion of the course the students are expected to
- Have a basic understanding about interpolation and approximation
- Have learnt about various numerical solutions for ordinary and partial differential equations
- Have basic knowledge about perturbation theories

UNIT I  INTERPOLATION AND APPROXIMATION  9
Piecewise spline approximation, uniform approximation, rational approximation

UNIT II  NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATION  9
Euler Method, Improved Euler Method, Modified Euler method, Runge Kutta Method of Second and Fourth orders, Predictors – Corrector Methods of Miline and Adams – Bashforths

UNIT III  NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS  9
Second order equations, elliptic, parabolic, hyperbolic types using finite difference methods.

UNIT IV  FINITE ELEMENT METHODS  9
One dimensional stress deformation, global and local co-ordinates, one dimensional problems, interpolation functions, relations between global local coordinates, requirements for approximation functions, stress and strain relations, principle of minimum potential energy, potential energy approach for assembly, boundary conditions.

UNIT V  PERTURBATION METHOD  9
Perturbation theory, Regular and singular Perturbation Theory. Perturbation methods for linear Eigen Value problems, asymptotic matching

TOTAL : 45 PERIODS

REFERENCES

FD8018  QUALITY ASSURANCE AND SAFETY IN FOOD PROCESSING  L T P C  3 0 0 3

OBJECTIVE
To create awareness and understanding of quality control and assurance, risk assessments and GMPs, regulations in the food sector

OUTCOME
- To understand the process control, sampling methods, and quality control applied /used in food industry
- To appreciate the mandatory concept of HACCP and pre-requisite programmes
- To be aware of food safety management systems and updated Food regulations
UNIT I  QUALITY CONTROL AND ASSURANCE IN THE FOOD INDUSTRY  10
Defining quality, Objectives, importance and functions of quality control and quality assurance, quality cost; statistical quality control; material specifications, different types of defects, incoming and finished product inspection, acceptable quality levels, attributes and variables, role of distribution, acceptance by variable and attribute sampling, different sampling methods, process control and role of control charts; application examples in food industry.

UNIT II  ASSESSMENT OF FOOD SAFETY  9
Definition of food safety, importance of food safety; Causes of unsafe food; food hazards – biological, chemical and physical, allergens; sources and effects of food hazards; Risk assessment covering risk analysis, risk management and risk communication; GMO food and ingredient and its safety; concept of Acceptable Daily Intake of additives and its role in setting of standards.

UNIT III  GOOD MANUFACTURING PRACTICES (GMP) AND HACCP IN FOOD INDUSTRY  10
Food chain, Food safety hazards, probability of occurrence, severity of food safety hazard and its risk, different control measures against the food safety hazards; Objectives and role of GMP; essentials, implementation and maintenance of GMP in a food factory. CODEX guidelines, FSSA and ISO standards on GMP
Role of HACCP, seven principles of HACCP, categorization and monitoring of control measures, HACCP implementation and maintenance

UNIT IV  FOOD REGULATION  10
Need for food laws and regulations, consumer protection; Indian Food Laws governing food industry- Food Safety and Standards Act 2006 and Regulations made there under, structure and functions of Food Safety and Standard Authority of India, detailed understanding of Labeling and claim Regulations and regulations related to product standards, novel foods and novel ingredients and product approval.
Legal Metrology Act and Packaged commodity rules; mandatory BIS certification of food products, and Infant Milk Substitute Act
International standards and regulations – An overview of CODEX, EFSA, USFDA

UNIT V  FOOD SAFETY MANAGEMENT SYSTEMS  6
International organization of standardization (ISO), Food safety and quality management system, essentials of ISO 9001 and ISO 22000, accreditation and certification

REFERENCES
4. Mehta, R and George, J. “Food Safety Regulations Concerns and Trade” : The Developing Country Perspective”, Macmillan, 2005

TOTAL : 45 PERIODS
OBJECTIVE
The course aims to develop the skills and knowledge of sensory science and analysis.

OUTCOME
- To understand the sensory perceptions, anatomy of chemical senses
- To understand sensory profiling methods and concepts
- To be aware of advanced analytical techniques for the sensory profiling using instrumentation methods

UNIT I  SENSORY PERCEPTION  6
The perceptions of taste, smell and oral texture of foods; anatomy of the chemical senses-olfaction and taste; chemisthesis. Taste perception in food choice and control of eating.

UNIT II  SENSORY CHARACTERISTICS OF FOODS  9
Colour pigments in foods; artificial colours; colour perception. Classification of food flavours, Non-volatile and volatile flavour composition of foods; flavour perception. Rheology, classification of textural properties, structure and texture perception; Interactions between colour, flavour and texture.

UNIT III  SENSORY ANALYSIS OF FOODS  12
Basic requirements for sensory analysis- objectives, panel: size and screening, recruitment & training, testing environment & laboratory features, sensory threshold values: detection, difference, recognition & terminal thresholds analytical tests- discrimination tests- different types & descriptive tests- scaling procedures, flavour and texture profiling methods; simple and quantitative descriptive analysis. Measurement of off flavors and tastes; Data handling, analysis and presentation.

UNIT IV  CONSUMER TESTING  9
Consumer surveys and tests; acceptance & preference tests, hedonic scales, ratio scales, ranking & rating tests, central location tests.

UNIT V  SUBJECTIVE & OBJECTIVE METHODS OF EVALUATION  9
Instrumental methods of measuring sensory characteristics of foods- measurement of color, flavour and texture, electronic nose for aroma testing; relation between instrumental methods and sensory methods.

TOTAL: 45 PERIODS

REFERENCES
5. Otles, S. “Methods of Analysis of Food Components and Additives”, CRC/ Taylor & Francis, 2005