

FT-8101 ENGINEERING PROPERTIES OF BIOMATERIALS AND APPLICATIONS

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Credits:4

Unit – I

Introduction: Biomaterials and their properties in relation to processing, their role in the development of new products and processes

(04 Hrs)

Physico-Chemical Characteristics: Physico-chemical characteristics: shape, sphericity, size, volume, density, porosity, surface area, coefficients of friction, and angle of repose and influence of constituents on processing and design of equipments

(08 Hrs)

Unit – II

Mechanical & Rheological Properties: Flow behaviour of granular and powdered food materials, textural profile analysis of food products

(06 Hrs)

Aero and hydrodynamic characteristics: Concepts and application of drag coefficients, terminal velocity in agricultural products processing and handling

(06 Hrs)

Unit – III

Thermal, Electrical and Optical Properties: Specific heat, thermal conductivity, thermal diffusivity, electrical resistance and conductance, dielectric constant, reflectivity, transmittivity and absorptivity of incident rays.

(12 Hrs)

Unit – IV

Applications: Application of engineering properties in process development as well as design and operation of equipment and structures associated with handling, processing and storage of raw as well as processed food products

(12 Hrs)

Recommended Books

Title	Author	Publisher
Engineering Properties of Foods	M.A. Rao & S.S. H. Rizvi	
Micro-structural principles of food processing and Engineering	J. M. Aguilera & D. W. Stanley	
Physical properties of plant and animal materials	N. N. Mohsenin	

FT-8102 FOOD RHEOLOGY AND MICROSTRUCTURE

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Credits:4

Unit – I

Examining Food Microstructures: History of Food Microstructure Studies, Light Microscopy, Transmission Electron Microscopy, Scanning Electron Microscopy, Other Instrumentation and Techniques (04 Hrs)

Fundamentals of Structuring: Polymer, Colloid, and Materials Science; Food Polymers, Polymer Solutions, Phase Transitions, Colloids and Surface Chemistry, Mechanical and Rheological Properties, Rheology of Foods, Mechanical Properties of Food Solids, Food Structure in the Mouth and Beyond (08 Hrs)

Unit – II

Image Analysis: Image Acquisition, Image Processing, Measurement Analysis (03 Hrs)

Food Structuring: Traditional Food Structuring and Texture Improvement, Approaches to Food Structuring, Extrusion and Spinning, Structuring Fat Products, Structure and Stability, Gels, Gelation Mechanisms, Mixed Gels, The Microstructure of Gels, Structure-Property Relations in Gels (10 Hrs)

Unit – III

Microstructural Components and Food Assemblies: Water and Ice, Proteins, Lipids, Carbohydrates, Cells and Cell Membranes, Structural Aspects of Animal Tissue, Structural Aspects of Plant Tissue (06 Hrs)

Food Microstructure and Quality: Measurement of Texture, Structural Aspects of Food Texture, Quality and Structure (06 Hrs)

Unit – IV

Microstructure and Mass Transfer: Solid-Liquid Extraction: Fundamental Aspects of Extraction, The Extraction process, Extraction of Food Materials, Modifying Microstructure, Modeling the Extraction Process (06 Hrs)

Simultaneous Heat and Mass Transfer: Dehydration: Basic Concepts, The Drying Process, Osmotic Dehydration, Influence of Drying on Structural Properties, Frying of Foods (02 Hrs)

The Micro-structural Approach: Structure-Property Relationships, The Micro-structural Approach (03 Hrs)

Recommended Books:

Title	Author
<u>Microstructural Principles of Food Processing Engineering</u>	José Miguel Aguilera
<u>Food Texture</u>	Moskowitz
<u>Principles of Food Processing</u>	Richard W. Hartel
<u>Phase Transitions in Foods</u>	Yrjö H. Roos
<u>New Frontiers in Food Microstructure</u>	Donald B. Bechtel
<u>Mass transfer</u>	Thomas Kilgore Sherwood
<u>Image Analysis for the Biological Sciences</u>	C. A. Glasbey
<u>An Introduction to Rheology</u>	H.A. Barnes
<u>Fat Crystal Networks</u>	Alejandro G. Marangoni
<u>Multidimensional Microscopy</u>	Philip C. Cheng
<u>Food Emulsions</u>	Stig Friberg
<u>Dehydration of Foods</u>	Gustavo V. Barbosa-Cánovas
<u>Food Processing (Industry at Work)</u>	Melvin Berger
<u>Polymer Gels</u>	D. DeRossi
<u>Thermal Processing of Packaged Foods</u>	S.D. Holdsworth
<u>Chemical Engineering for the Food Industry</u>	D. Leo Pyle

FT-8103 ADVANCES IN FOOD PROCESS TECHNOLOGY

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Credits:4

Unit – I

Modeling of Microbial Food Spoilages: Microbial growth dynamics models, partial differentiation equation models, application of models in thermal preservation, Concept, mechanism of microbial destructions, equipments etc.

(06 Hrs)

Membrane Technology: Introduction to pressure activated membrane processes, performance of RO/UF and NF and industrial application.

(06 Hrs)

Unit – II

Supercritical Fluid Extraction: Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application.

(06 Hrs)

Use of Microwave Energy in Foods: Theory of microwave heating, dielectric properties of food materials, working principle of magnetron, microwave blanching, sterilization and finish drying.

(06 Hrs)

Unit – III

Hurdle Technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

(04 Hrs)

High Pressure Processing of Foods: Concept of high pressure processing, quality changes, effects of pressure on microorganisms and its application in food processing.

(04 Hrs)

Unit – IV

Ultrasonic in Food Processing: Properties and generation of ultrasonic, ultrasonic imaging, application of ultrasonics as an analytical tool and processing techniques

(04 Hrs)

Newer Techniques in Food Processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, micronization in food processing and preservation

(08 Hrs)

Nanotechnology: Principles, mechanism and applications in foods

(04 Hrs)

Recommended Books:

Title

New Methods of Food Preservation
(Non Thermal Processing of Foods)

Introduction to Food Engineering
Food processing technology

Author

G. W. Gould

R. P. Singh
Fellows, P. J.

FT-8104 NOVEL TECHNIQUES IN FOOD PACKAGING

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Credits:4

Unit – I

Active and intelligent packaging: Active Packaging Techniques and intelligent Packaging Techniques, current use of novel Packaging Techniques, consumers and novel Packaging
(04 Hrs)

Oxygen, ethylene and other scavengers: Oxygen scavenging technology, selecting right types of oxygen scavenger, ethylene scavenging technology, carbon dioxide and other scavengers
(04 Hrs)

Antimicrobial food packaging: Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging
(04 Hrs)

Unit – II

Non-migratory bioactive polymers (NMBP) in food packaging: Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications
(04 Hrs)

Time Temperature indicators (TTIs): Defining and classifying TTIs, Requirements for TTIs, development of TTIs, Maximizing the effectiveness of TTIs, Using TTIs to monitor shelf life during distribution
(08 Hrs)

The use of freshness indicator in packaging: Compounds indicating the quality of packaged food products, freshness indicators, pathogen indicators, other methods for spoilage detection
(04 Hrs)

Unit – III

Packaging-flavour interaction: Factors affecting flavour absorption, role of food matrix, role of differing packaging materials, flavour modification and sensory quality
(02 Hrs)

Moisture regulation: Silica gel, clay, molecular sieve, humectants, salts, irreversible adsorption
(02 Hrs)

Developments in modified atmosphere packaging (MAP): Novel MAP gas, testing novel MAP applications, applying high oxygen MAP
(03 Hrs)

Recycling packaging materials: Recyclability of packaging plastics, improving the recyclability of plastics packaging, testing safety and quality of recycled materials, using recycled plastics in packaging
(03 Hrs)

Unit – IV

Green plastics for food packaging: Problems of plastic packaging wastes, range of biopolymers, developing novel biodegradable materials
(02 Hrs)

Integrating Intelligent packaging, storage and distribution: Supply chain for perishable foods, role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and TTIs
(04 Hrs)

Testing consumer responses to new packaging concepts: New packaging techniques and the consumers, methods for testing consumer responses, consumer attitudes towards active and intelligent packaging
(03 Hrs)

Safety and legislative aspects of packaging: Regulatory considerations, plastic, metal, paper and glass packaging
(03 Hrs)

Recommended Books:

Title

Novel Food Packaging Techniques
Food Packaging
Handbook of Package Engineering
A Handbook of Food Packaging

Author

Ahvenainen
Robertson
Hanlon, Kelsey & Forcinio
Paine and Paine

FT-8105 FOOD QUALITY AND PLANT MANAGEMENT

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Credits:4

Unit – I

Food laws, regulation, standards and specifications: Agmark- 1937, FPO 1955, PFA – 1954, BIS –1952, consumer protection act –1986, Vanaspati control order –1978, export quality control and inspection act- 1963, food safety and standards act - 2006, ISO–9000 series: 9001, 9002, 9000 (2000)

(08 Hrs)

Unit – II

Quality Control, Production planning and Network analysis: Introduction, Evaluation of food quality; Statistical approaches in quality control and quality assurance; objectives of production planning and concept of total quality control (TQM). Requirement of good manufacturing process (GMP), good hygienic process (GHP), use of hazard analysis critical control Point (HACCP) and its implication in food industries, Procedure of production control, Project planning network / PERT and CPM network.

(16 Hrs)

Unit – III

Analytical Techniques in Foods: Application and operating parameters of Spectrophotometry, AAS, GC, HPLC.

(08 Hrs)

Industrial Legislation, Disputes and trade Unions: Industrial legislation and laws, acts and disputes. Industrial disputes act –1947, WTO, GATT, CAC, Patent Laws and IPR

(06 Hrs)

Unit – IV

Industrial Organization structure: Types of organization structure, Principles of development of organization structure, forms of business organization, Division of industries, industrial sectors (private and public), Problems associated to public sector industries, social obligations of industries towards society

(10 Hrs)

Recommended Books:

Title	Author	Publisher
Quality control in food industry (Vol. I and II)	Kramer and Twigg	
Hand book of analysis Fruits and Vegetables Pdts.	Ranganna	Tata Mc Graw Hill, New Delhi
Modern method of analysis	Stewart and Whittaker	
Sensory quality control	M.A. Amerian	
Food analysis theory and practices	Pomeranz and Meloan	CBS, New Delhi
Food analysis and quality control	M.Jacob	CBS, New Delhi
Sensory analysis of food	J.R. Piggot	
Food analysis Principle and technique	Dieter W. Geuwedit and Whitaker	

FT-8201 FOOD PROCESS EQUIPMENT DESIGN

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Credits:5

Unit – I

Machine Design: Introduction to equipment or machine design, Basic requirements for machine elements and machines, classification of engineering materials, selection of materials for engineering purposes, mechanical properties of metals, Manufacturing considerations in machine design; introduction to load, stress, strain, Young Modulus of Elasticity or Stress modulus or Modulus of rigidity, Stress strain diagram, Factor of safety, Theories of failure under static load, Corrosion mechanism and its control. (12 Hrs)

CAD/CAM: Concepts and applications in design

(03 Hrs)

Unit – II

Riveted Joints: Introduction Riveted points, kinds of riveted joints, failures of riveted joints, strength of riveted joint, Riveted value, efficiency of riveted joint, assumption for design of riveted joint, Design of riveted joint, Numerical problems. (08 Hrs)

Welded Joints: Introduction to welding, advantages of welded joints over riveted joints, disadvantages of welding joints, classification of welding processes, types of welded joints, strength of welded joints, numerical problems (06 Hrs)

Shafts, Keys & Coupling: Different types of shafts, failures in shafts, design of strength shafts and axels, Types of keys, strength of keys, types of shafts coupling & their designs

(04 Hrs)

Unit – III

Pressure Vessels: Basic data for design of pressure vessels, classification of pressure vessels, stresses in thin cylindrical cshell, circumferential (hoop) stresses and longitudinal stresses, design of thick pressure vessels by Lame's equation, Vlavarino equation, Birine's equation and Barlow's equation, Design of cylinder heads and cover plates, optimum proportions of a vessel, determination of optimum vessel size, Purging of vessels, Stresses induced in vellels; Reinforcement of cylinder for high pressure vessels (12 Hrs)

Storage Tanks: Loss mechanism in storage tanks, optimum proportions of a storage tank, spherical storage tanks, design of rectangular storage tanks, different types of roofs of tanks, nozzles and mountings in storage tanks, estimation of nozzle diameter for drain and vent in a storage tank

(06 Hrs)

Unit – IV

Heat Exchangers: Concept of overall heat transfer coefficient, LMTD, efficiency of parallel and counter current flow heat exchanger, design of double pipe heat exchanger, design of hair pin heat exchanger, multitude finned inner tubes, design of shell and tube heat exchanger (07 Hrs)

Design of Pipes: Different types of pipes, fabrication method of different types of pipes, testing of piping material, colour codes, different types of piping pints, different types of flow regulators

(03 Hrs)

Recommended Books:

Title

Process equipment design
Fundamentals of food process Engg.
Food Engg. Operations
Food Process Engg.
Fundamentals of Engg. Heat and Mass Transfer
Equipments for bakers

Author

M. V. Joshi
R.T. Toledo
Brennan, J.G. and J.R. Cowell
Heldman, D.R. and R.P.Singh
R.C. Sachdeva
S. A. Matz

FT-8202 TECHNOLOGY OF FROZEN FOODS

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Credits:3

Unit – I

Fundamentals of Freezing: Glass transitions in frozen foods and biomaterials, Microbiology of frozen foods, Thermophysical properties of frozen foods, Freezing loads and Freezing time calculation, Innovations in freezing process

(08 Hrs)

Unit – II

Facilities for the Cold Chain: Freezing methods and equipment, Cold store design and maintenance, Transportation of frozen foods, Retail display equipment and management, Household refrigerators and freezers, Monitoring and control of the cold chain.

(06 Hrs)

Unit – III

Quality and Safety of Frozen Foods: Quality and safety of frozen meat and meat product, Quality and safety of frozen poultry and poultry products, Safety and quality of frozen fish, Shellfish, and related products, Quality and safety of frozen vegetables, Quality and safety of frozen fruits, Quality and safety of frozen dairy products, Quality and safety of frozen ready meads, Quality and safety of frozen bakery products, Quality and safety of frozen eggs and egg products

(10 Hrs)

Unit – IV

Monitoring and Measuring Techniques for Quality and Safety: Chemical Measurements, Sensory analysis of frozen foods, Foodborne illnesses and detection of pathogenic microorganisms, Shelf-life prediction of frozen foods.

(04 Hrs)

Packaging of Frozen Foods: Introduction to frozen food packaging, Plastic packaging of frozen foods, Paper and card packaging of frozen foods, Packaging of frozen foods with other materials, Packaging machinery

(08 Hrs)

Recommended Books:

Title	Author	
Quality in Frozen Foods	Marilyn C. Erickson, Yen-Con Hung	
Handbook of Frozen Foods	<u>Isabel Guerrero Legaretta</u>	
Managing Frozen Foods	Kennedy Chris J	CBS, New Delhi

FT-8203 COMPUTER SIMULATION AND MODELING IN FOOD PROCESSING

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Credits:5

Unit – I

Modelling and Simulation: Fundamentals of modeling and simulation; Definition of basic terms like system, entity attribute, activity, state of system, system environment; categories of system, stochastic activities; Different steps for modulation and simulation, Types of models; Advantages of modulation and simulation, disadvantages of modulation; Monte Carlo Method or random simulation, Application areas of simulation

(12 Hrs)

Unit – II

Computer programmes, flow charts and algorithm of some numerical methods: Numerical methods for solving of transcendental model equations; Iterative convergence method, derivation and algorithm of bisectional method or intermediate value theorem; False position or Regula Falsi method; Newton Raphson method, Convergence of Newton Raphson method, Generalized Newton's method for multiple roots, Secant Method, Convergence of secant method; Iterative or method of successive approximation; Introduction to numerical integration, trapezoidal rule, Simpson's 1/3 rd rule, Truncation error in Trapezoidal rule, Simpson's 1/3 rd rule. Solution of Ordinary Differential Equation Model: Picard Method, Taylor's Series method, Euler's method, Modified Euler's method, First order, third and fourth order, Runge Kutta method. Solution of partial differential equations models: Differential Laplace, Poisson, parabolic and hyperbolic equation, Finite difference method, graphical method, Bender - Schmidt method

(20 Hrs)

Unit – III

Optimization: Introduction, optimization theory, optimization methods, Graphical and numerical methods of optimization, Unconstrained optimization, Constrained optimization, Programming optimization, experimental optimization, Response surface methodology (RSM)

(12 Hrs)

Unit – IV

Modelling and simulation of some food engineering operations: Thermal processing, convection dehydration, osmotic dehydration, spray drying, Freeze Drying, Freezing process; deep fat frying; extrusion process; filtration processes; membrane separation process; distillation and Extraction processes

(16 Hrs)

Recommended Books:

Title

Computerized Control Systems in the Food Industry
Response surface methodology
Computer aided techniques in Food Technology
Response surfaces design and analysis
Design of Experiments

Author

Gauri S. Mittal
R. H. Myers
Israel Saguy
A. I. Khuri & J. A. Cornell
Montgomery

FT-8204 FLAVOUR TECHNOLOGY

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Credits:3

Unit – I

Introduction: Fundamentals of flavour, Classification of food flavor, flavour profile, factors affecting flavours, bioflavour and reconstituted flavour, flavor release from foods, interaction of flavor compounds with foods

(06 Hrs)

Flavour Extraction: Methods of flavour extraction, isolation, separation and equipment

(03 Hrs)

Unit – II

Flavor Precursors: Flavor Compounds from Carbohydrates and Proteins, Lipid oxidation

(03 Hrs)

Flavour intensifiers: Flavour intensifiers and their effects, Chemistry and technology of various flavour intensifiers

(03 Hrs)

Flavour Biogenesis: Fruit aroma, vegetable aroma, Methyl ketones, diacetyl, acetaldehyde, lactones, terpenes, esters, pyrazines, vanilla flavour, enzyme and fermentation flavors

(05 Hrs)

Unit – III

Process Flavors: Effect of processing on flavor compounds, Non enzymatic browning, heat reaction flavors

(05 Hrs)

Food Flavours: Flavour constituents: Onion, garlic, cheese, milk, meat, wine, coffee, tea, chocolate, citrus flavour

(04 Hrs)

Unit – IV

Flavour encapsulation and stabilization: Principles and techniques of flavour encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavour and their applications in food industry, Packaging and flavor compounds interaction, Effect of storage, processing, transportation and environmental conditions on flavour components / constituents

(07 Hrs)

Recommended Books:

Title	Author
Source Book of Flavors	Reineccius, G.
Flavour chemistry and technology	Heath, H. B.
Understanding Natural Flavors.	Piggott, J. R., Paterson, A.
Food Flavor:	Morton, I. D., Macleod A. J.
Recent advances in flavour researches	Yamanishi, T.
Bioprocess Production of Flavor, Fragrance, and Color Ingredients	Gabelman, A.
Food Flavorings.	Ashurst P. R.

FT-8205 NUTRACEUTICALS AND FUNCTIONAL FOODS

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Credits:4

Unit – I

Defining nutraceuticals and functional foods, Nature, type and scope of nutraceutical and functional foods

(04 Hrs)

Nutraceutical and functional food applications and their health benefits, Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions

(06 Hrs)

Unit – II

Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc

(04 Hrs)

Antioxidants and other phytochemicals, (isoflavones, lycopenes), their role as nutraceuticals and functional foods, Dietary fibers and complex carbohydrates as functional food ingredients

(06 Hrs)

Protein as a functional food ingredient, Probiotic foods and their functional role, Herbs as functional, health promoting activity of common herbs

(04 Hrs)

Unit – III

Cereal products as functional foods – oats, wheat bran, rice bran etc.

(04 Hrs)

Functional vegetables products, oil seeds and sea foods

(04 Hrs)

Coffee, tea and other beverages as functional foods/drinks and their protective effects

(04 Hrs)

Unit – IV

Effects of processing, storage and interactions of various environmental factors on the potentials of such foods

(06 Hrs)

Marketing and regulatory issues for functional foods and nutraceuticals

(03 Hrs)

Recent development and advances in the areas of nutraceutical and functional foods

(03 Hrs)

Recommended Books:

Title	Author
Functional Foods	R. Chadwick,S. Henson,B. Moseley,G.
Methods of Analysis for Functional Foods and Nutraceuticals	W. Jeffrey Hurst
Handbook of Functional Dairy Products	
Functional Foods	Mazza
Handbook of Nutraceuticals and Functional Foods	Robert E.C. Wildman

FT-9101A

ADVANCES IN DAIRY ENGINEERING & TECH.

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Credits:4

Unit – I

Introduction: Physico-thermal properties of milk and milk products and its application in processing and equipment design

(04 Hrs)

Homogenization of milk: Principle of homogenization, single and double stage homogenizers, care and maintenance of homogenizers, design principles of homogenizers, application of homogenization in dairy industry

(06 Hrs)

Unit – II

Tanks, Pumps, Stirrer mixtures: Designs and equipment of tank, types of tanks, pumps in dairy industry, Agitation and mixing, construction of agitators, patterns of flow & power consumption

(04 Hrs)

Thermal processing of milk: Pasteurization of milk; batch, flash and continuous pasteurizer, HTST pasteurizer and design principle and thermal death kinetics, care and maintenance, UHT processing of milk, quality changes during processing of milk

(08 Hrs)

Unit – III

Concentration of milk: Evaporator, types of evaporator, machineries, heat and mass balance in single and multiple effect evaporator, performance characteristics of evaporators and their selection criteria, steam economy

(10 Hrs)

Unit – IV

Spray and drum drying: Theory of drying, estimation of drying rates and drying time, drying equipments, particle size calculation, design of spray and drum dryer

(08 Hrs)

Dairy products: Frozen dairy products, Cheese, Casein and its derivatives, Lactose their composition, standards, manufacturing, process control and quality control parameters

(08 Hrs)

Recommended Books:

Title

Dairy products

Milk and Milk Products

Ice Cream

Dairy Engineering

Author

Lampart, Lincoln M.

Eckles, Comb and Macy

Arbuckle

John T Bowen

Unit – I

Meat Industry: Meat and meat products in India-an Industrial profile, Meat production and trade practices, Prospects and problems in production of fresh meat in India, Research and Development activities on meat, fish and poultry products (06 Hrs)

Gross and microstructure of muscle, Mechanism of muscle contraction and relaxation: Organization of skeletal muscle from gross structure to molecular level, Muscle Communication (sarcolemma, sarcoplasmic reticulum, Innervation), Muscle metabolism, Different types of connective tissues and their relevance to properties of meat, Myofibrillar proteins and their major functions, Nervous tissue, nerves and the nature of stimuli, membrane potential in nerve and muscle, Events that occur during relaxation and contraction

(10 Hrs)

Unit – II

Cattle and beef, sheep and mutton, pig and pork and their fabrication: Breeds, Pre slaughter care, ante and post mortem, slaughter, handling of offal (edible and inedible).Cuts of beef, pork and mutton (10 Hrs)

Meat inspection and grading: Application and Enforcement of inspection laws, elements of inspection (sanitation, antemortem inspection, postmortem inspection, condemnation, product inspection, laboratory inspection, labeling). Identification of inspected products, product inspection, types of grades, factors used to establish quality grades, conformation, fleshing and finish

(06 Hrs)

Unit – III

Properties of fresh meat: Perception of tenderness, Factors effecting tenderness, connective tissue, collagen, sarcomere contractile state, Myofibrillar tenderness, marbling, Methods to improve tenderness (Electrical stimulation, aging, Meat color, Pigments associated with color, Chemical state of pigments, methods to improve meat color. Water holding capacity (Net charge effect and stearic effect) (05 Hrs)

Poultry meat: Kind of poultry, processing of poultry. Special poultry products, Breaded poultry, Smoked turkey, Packaged pre cooked chicken, Freeze dried poultry meat

(04 Hrs)

Unit – IV

Meat analogues and restructured meat products: Textured plant proteins, processes for preparation of meat analogues and restructured meat products (03 Hrs)

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

(04 Hrs)

Recommended Books:

Title	Author
Meat poultry and Sea Food Technology	Henricksons
Fish Technology	R.J. Robert
Poultry product Technology	G.J. Mountney
Meat Processing	Joseph Kerry, John Kerry and David Ledwood
Meat Hand Book	Albert Levie
Poultry Processing	G.H.Weiss:
Processing of Aquatic Food Products	F.W. Wheaton and T. B. Lawson
Poultry meat processing and quality	G Mead

FT-9101C BIOTECHNOLOGICAL TOOLS IN FOOD ANALYSIS

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Credits:4

Unit – I

Introduction: Concept of Biotechnology, history, old vs new Biotechnology, Different food borne pathogens

(04 Hrs)

Genetic Engineering: Concept, different vector systems used in gene cloning, gene cloning procedures: isolation of DNA fragment, joining to vector, expression & selector of recombinant with suitable example, DNA fingerprinting, Method of DNA fingerprinting, Identification techniques, Practical applications

(12 Hrs)

Unit – II

Polymerase Chain Reaction: Introduction and principle, process of PCR, Development of a PCR assay, PCR optimization, Practical modifications to the PCR technique, Advantages and disadvantages, Applications, Application of PCR in the detection of different pathogen species, MPCR analysis

(10 Hrs)

Unit – III

ELISA: Concept of Antigen & Antibody, ELISA, Types of ELISA, Methods, ELISA kits, Applications in food and agriculture

(06 Hrs)

Immunoassay kits: Types of Immunoassays, Principle of detection of kits, Monoclonal Antibodies-antigen, antibody, Nomenclature, Production of monoclonal antibodies-in vitro and in -vivo, merits and demerits, application in food industries

(08 Hrs)

Unit – IV

Biosensor: Types of biosensor- Calorimetric, Potentiometric, Amperometric, Optical, Piezo-electric, Immunosensors, Principle of detection, Application, Biosensors in food analysis

(08 Hrs)

FT-9101D EXPERIMENTAL DESIGN AND STATISTICS

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Credits:4

Unit – I

Introduction: Basic statistical concepts, concepts Strategy of experiments, basic principles, guidelines for designing experiments and importance of designed experiments in food research

(05 Hrs)

Multiple Regression and correlation: Multivariate relationships, multiple linear regression, multiple and partial correlation, significance of testing in multiple correlation, variable selection in multiple regression

(06 Hrs)

Unit – II

Design of experiments: Full factorial design, 2K design, completely randomized design, randomized block design, central composite design, central composite rotatable design, factorial design, Box Behenken design, applications of various designs in food processing research, limitations of individual design

(07 Hrs)

Unit – III

Data analysis and modeling: Multiple regression analysis, canonical analysis, ridge analysis, variable selection, mathematical modeling, interpretation of model parameters and selection criteria of best models

(06 Hrs)

Unit – IV

Multivariate analysis: Concept of cluster analysis, factor analysis, principal component analysis

(06 Hrs)

Recommended Books:

Title	Author
Statistical Methods	W. G. Cochran
Response surface methodology	R. H. Myers
Computer aided techniques in Food Technology	Israel Saguy
Response surfaces design and analysis	A. I. Khuri & J. A. Cornell

FT-9102A ADVANCES IN FRUITS & VEGETABLE TECH.

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Credits:4

Unit – I

Introduction: Importance of fruits and vegetable processing, impact on Indian economy, processing concept

(04 Hrs)

Processing characteristics: Advances in fruits and vegetable selection, grading, sorting, blanching and other pre processing steps in automation of processing line, kinetics of quality changes: physical, chemical, sensory and nutritional changes during processing

(08 Hrs)

Unit – II

Thermal processing: Influence of elevated temperature on microbial population, product quality, process time calculation, blanching techniques and purpose of blanching, determination of blanching processes, concept of commercial sterilization, heating and cooling of food in container, influence of commercial sterilization on product quality

(10 Hrs)

Aseptic processing: Concept of aseptic processing and packaging, quality assurance, machineries and their maintenance, package characteristics

(06 Hrs)

Unit – III

Drying and Dehydration: Concept of drying and drying curves, state of water in fruits and vegetables, drying effect on product quality and nutritive value, Advances in drying of fruits and vegetables

(08 Hrs)

Unit – IV

Minimally processed fruits and vegetables: Concept of hurdle technology, thermal heating approach to minimal processing, high frequency heating, microwave heating and ohmic heating

(12 Hrs)

Recommended Books

Title

Commercial Fruit Processing

Commercial Fruits and Vegetable Products

Thermobacterology in Food Process

Handbook of Fruit science and Technology: Production, Composition, storage and processing

Freezing Effects on Food Quality

Handbook of Food Analysis

Postharvest Physiology of Vegetables

Author

Woodruf and Luh

W.V. Cruess

Stumbo C.R.

D.K. salunkhe and S.S. Kadam

Lester E. Jeremiah

Leo M.L. Nollet

J. Weichmann

FT-9102B ADVANCES IN CEREAL AND PULSES TECH.

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Credits:4

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

(08 Hrs)

Rice Milling: Paddy dehusking processes: rice mill flow chart, Engelberg huller mills, modern rice mills. Components of modern rice mill, pre cleaners, shellers, under runner shellers and centrifugal shellers, paddy separators – Satake and Schule designs, Polishers-cone polishers and other types, bran and brokens separators, Rice mill yields and loss due to brokens at different stages of milling, Rice mill machinery handling. Methods of rice bran oil extraction

(08 Hrs)

Unit - II

Milling of Pulses: Major Pulses grown in the country and their application, Status of Pulse milling industry in India, need for modernization, Traditional milling process, merits and demerits, Drying of legumes, Sun drying, Traditional Processing steps – 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, merits and demerits, Dehusking in Pulse Pearler, Water conditioning, splitting of pulses in Pulse splitter, process flow chart, Merits and demerits, Mini dal mill, working principle, advantages and disadvantages, Grinding of split pulses, pulse flour products, their applications, equipment used

(10 Hrs)

Unit - III

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

(06 Hrs)

Wet milling of Maize and corn: Modern methods of processing, Cleaning, Steeping, Degermination, Bran and Fibre separation, Gluten and Starch Separation, extraction process; Equipment needed for Degermination, Debranning 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.

(08 Hrs)

Unit - IV

Storage and Handling: Bag Storage, Bag Storage structure design, Parameters of good storage structure, Cover Plinth Storage Structures, CAP storage (Ceiling and Plinth Storage), Plans for Bag storage, lay outs, Dunnage, Materials for Dunnage, Pallets, Protection against Rodents, Fungi, Pests and Mites, Fumigation Processes for bag storage piles, Bulk Storage in silos and large Bins; Problems of Silo storage, Construction of Silos, Physical load and mechanical strength of Silos, concrete and Metal 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

(08 Hrs)

Recommended Books:

Title

Post Harvest Technology of Cereals, Pulses and Oilseeds
The Chemistry and Technology of Cereals as Food and Feed
Technology of Cereals

Maize-Recent Progress in Chemistry and Technology
Pulses – Chemistry, Technology and Nutrition
Modern Cereal Science and Technology
Storage of Cereal Grains and their Products
Hand Book Of Cereal Science and Technology

Author

Chakraverty, A
Samuel Matz
N. L. Kent and A. D. Evans
George E Inglett
Ruth H. Matthews
Y. Pomeranz
Cryde M. Christensen
Karel Kulp and Joseph P Pante

FT-9102C BIOPROCESS ENGINEERING

L T P
3 1 0

Credits:4

Unit – I

Introduction: Interaction of chemical engineering, biochemistry and microbiology, Chemical Reaction kinetics, kinetics of batch and continuous cultures, process variables, biocatalyst and enzyme kinetics

(08 Hrs)

Unit – II

Sterilization and Sanitation: Thermal death kinetics, sterilization of equipment and media, yield and product recovery; plant and environmental sanitation

(06 Hrs)

Product recovery operations: Handling of materials in microbial systems, filtration, centrifugation, sedimentation, chromatography, membrane separation (UF and NF) and electrophoresis, separation and disintegration of cells for product recovery operations

(08 Hrs)

Unit – III

Fermentor and bioreactors: Transport phenomenon in microbial systems, types of reactor, working principles, aeration and agitation, design and analysis of biological fermentor and bioreactors; advances in continuous fermentation

(10 Hrs)

Bioprocess instrumentation: Offline analytical methods, physical, chemical and biosensors, online sensors

(06 Hrs)

Unit – IV

Modeling, simulation and scale-up: Bioprocess modeling and simulation and its application in industrial fermentation, scale-up of fermentation processes

(10 Hrs)

Recommended Books:

Title

Biochemical Engg.
Biochemical Engg. Fundamentals
Advances in biochemical Engg.
Principles of Fermentation Tech

Author

Aiba and Humphrey
Bailey and Ollis
Schimid
Stanbury

FT-9102D ADVANCED FOOD PROCESS ENGG

L T P
3 1 0

Credits:4

Unit – I

Fluid Foods: Material and energy balance, Flow of fluids foods. Hygienic design concepts, sanitary pipe fittings, pumps and fans, bulk milk coolers, milk collecting and chilling centers, milk tanks, stirrers and mixers, milk reception equipment, pasteurizers, sterilizers and treatment by irradiations, CIP system, corrosion process and their controls

(08 Hrs)

Unit – II

Separators: Centrifugation, separation, cyclone separators, homogenizers, ultra-filtration, reverse osmosis and electrodialysis, Equipment for cheese, ice cream, butter manufacture, and other special milk products

(06 Hrs)

Unit – III

Thermal Processing: Thermal processing, sterilization classification U.H.T. systems and recent advances, factors affecting spoilage of different types of food products and design of thermal processes. Survival curves, thermal death curves, analysis of thermal resistance data, process time evaluation, Design of batch and continuous sterilization cycles in vat, inter-relationship between batch and continuous reactors, design calculations

(10 Hrs)

Unit – IV

Refrigeration: Refrigeration cycles, performance of refrigeration compressors, refrigeration system balance and multiple evaporation systems. Flash cooling, design of condensers, evaporators, cooling towers, thermo-electric cooling, cryogenics, different refrigeration systems for ultra low refrigeration

Thermodynamics of Food Freezing: Properties of frozen foods, freezing point depression, Ice crystal formation, Enthalpy change during freezing, experimental related numerical problems, Predicting rates of product freezing and design of food freezing equipment

Energy Management: Energy audit and management strategies in food process industries

(16 Hrs)

Reference Books:

Title	Author
Fundamentals of Engineering Heat and mass transfer	R.C. Sachdeva
Fundamentals of Food Process Engineering	R.T. Toledo
Food Engineering Operations	Brennan, J.G. and J.R. Cowell
Food Process Engineering	Heldman, D.R. and R.P.Singh
Elements of Food Engg	Harper J.C.
Fundamentals of Food Process Engg	Charm S.E.
Thermobacteriology in Food Process	Stumbo C.R.