

FOOD TECHNOLOGY

SEMESTER I

Paper 1: Principles of Food Processing

Introduction: Definition and scope of Food Science and Technology, historical development of food processing and preservation, general principles of food preservation.

Preservation by heating: Principles of the method, Types of microorganisms, bacterial load, sterilization and commercial sterility, thermal resistance of the microorganisms and enzymes.

Canning and bottling: General aspects of canning and bottling, processing operations exhausting and sealing.

Retorting, ultra-high temperature processes, determination of thermal processing equipments, canning/ bottling of various food products.

Refrigeration and freezing preservation: Refrigeration and storage of fresh foods. Major requirements of a refrigeration plant, controlled atmospheric storage, refrigerated storage of various foods, freezing point of selected foods, influence of freezing and freezing rate of the quality of food products, methods of freezing, storage and thawing of frozen foods.

Drying and Dehydrations: Sun drying of various foods, water activity and its effects on the keeping quality, sorption isotherms and their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors effecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods; intermediate moisture foods.

Concentration and (Evaporation): Application in food industry, processes and equipment for manufacture of various concentrated food and their keeping quality, properties of liquid, single and multiple effect evaporation.

Radiations: Sources of radiations, effect of microorganisms and their different nutrients; Radiation units and doses for foods, dose requirements for radiation preservation of foods, safe limits, irradiation mechanism and survival curve, irradiation of packaging material. Microwave heating: Principles and application in food processing.

Chemical preservation: Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking.

Effect of various food processing operations on the nutrients if foods.

Paper 2: Food Chemistry

Energy metabolism: Basal metabolic requirements and activity. Recommended dietary allowances' Concept of a balanced diet, Menu planning.

Water: Properties, bonding and chemistry.

Carbohydrates: Classification, structure and properties of carbohydrates, role of carbohydrates in food industry. Sugar, starch, cellulose, glucans, hemicelluloses, gums, pectic substances, polysaccharides. Dietary requirements, Deficiency, Metabolic defects such as diabetes associated with carbohydrates.

Proteins: Classification, structure, properties, purification and denaturation of proteins. Protein interaction and degradation, protein-protein interaction, protein-lipid complexes and protein-carbohydrate complex.

Major protein systems and factors affecting them, the nature of interaction in proteins derived from milk, Egg protein, meat protein, fish muscle proteins, oil seed proteins and cereal proteins. Metabolic antagonist and allergens associated with food proteins, concept of protein quality, dietary requirements, deficiency symptoms

Lipids: Classification and physio-chemical properties of lipids. Refining of crude oils, hydrogenation and winterization, Vegetable and animal fat, margarine, lard, butter. Frying and shortening. Flavor changes in fats and oil. Lipid oxidation, factors affecting lipid oxidation, auto-oxidation, biological significance of auto-oxidation of lipids. Dietary requirements, effects of excess and deficiency: obesity, cardiovascular diseases.

Enzymes: Nature, classification and properties of food enzyme, enzyme activity in different food systems. Commercial availability. Food enzyme technology, Immobilization of enzymes, removal of toxins through enzymes, flavor production by enzymes.

Vitamins: Role of vitamins in food industry, effect of various processing treatments and fortification of foods, sources, effects of deficiency

Minerals _Role of minerals in food industry, effects of various processing treatments . effects of excess , if any , and deficiency

Biological changes in foods

Plant pigments and their roles in food industry, bitter substance and tannins.

Browning reaction in foods ; enzymic and non enzymic browning in foods of vegetable and animal origin during storage and processing of foods.

Paper 3: Instrumentation and Analytical Techniques

Preparation of chemical solutions: concept of molar, molal and normal solutions pH and buffers importance and measurement of pH

Chromatographic techniques; General principles .partition and adsorption chromatography, paper, thin layer, gas liquid, ion exchange and affinity chromatography, gel filtration, introduction to high pressure liquid chromatography

Electrophoretic Techniques: _General principles. Paper and gel electrophoresis, polyacrylamide gel electrophoresis

Spectroscopy: Beers and lamberts law, extinction coefficient, general principles of colorimeters and spectrophotometers, atomic spectroscopy, emission spectroscopy IR spectroscopy

Fluorimetry: spectrophluorimeters, Flame photometry and atomic adsorption spectrophotometry

Use of radioisotopes.

Microbiological assays: microscopy

Paper 4: Research Methodology, Statistics and Computer Applications (Revised)

Section:A

Scientific Approach to Research ;_Meaning, significance, types of research studies.

Research process: Formulating the problem, objectives, hypothesis, Experimental design, sample design, collecting data, analysis of data, interpretation, preparation of report.

Sampling design: Census vs sample survey, steps types

Scaling technique: Continuum, Reliability, Validity, scale construction techniques

Experimental designs: Randomized block design

Processing of data: Development of code book

Section B

Measurements: nature of measurements, types of measurement scale, Frequency distribution, graphical presentation of data.

Measures of central tendency: Computation of mean median and mode, their uses

Measures of variability: computation of mean deviation, Quartile deviation and standard deviation, their uses.

Correlation: Regression, Meaning, spearman and pearson's techniques of correlation, linear regression.

Chi-square;

Test of significance of difference between means; t-test

Analysis of Variance (ANOVA): one way and two ways

Applications to food quality assessment:

Section C

Computer Application: Use of computer for preparing and presenting documents spreadsheets appropriate statistical and other relevant packages, Internet

Computer application in food technology, response surface methodology

Practical Sem 1

1. Preparation of standard solutions for chemical analysis i.e HCl H₂SO₄ KMNO₄, Sodium thiosulphate and iodine.
2. Determination of pH and acidity of foods
3. Determination of proximate composition of foods
 - a) Moisture
 - b) Protein
 - c) Fat
 - d) Total ash
 - e) Crude fibre
 - f) Carbohydrate
 - g) Caloric Value
4. Determination of minerals and food products
 - a) Calcium by titration
 - b) Phosphorous by spectrophotometer
 - c) Iron by spectrophotometer
5. Estimation of reducing, non reducing total sugars in cereals and fruits & vegetable products.
6. Determination of starch content in food products
7. Estimation of fats & oils
 - a) Free fatty acids
 - b) Peroxide value
 - c) Saponification value
 - d) RM Number
 - e) TBA test
 - f) Iodine value
 - g) Fat Adulteration test
8. Determination of NaCl content in food products
9. Determination of trypsin inhibitors
10. Qualitative analysis of compounds by chromatography techniques
 - a) Thin layer chromatography
 - b) Paper Chromatography: Descending, Ascending and Circular Paper chromatography
 - c) By using High Performance Liquid Chromatography
11. Use of electrophoresis in the determination of proteins.
12. Determination of Rheological properties by using texture analyzer.
13. Use of word processing software for creating reports.
14. Problem solving using spreadsheet
15. Statistical analysis.

SEMESTER II

Paper 1: Post Harvest Technology of Horticultural Crops:

Fruits and vegetables as living products: chemical composition: pre and post harvest changes, maturity standards for storage, desirable characteristics of fruits and vegetables of processing

Post harvest handling of fresh fruits and vegetables: Role of plants growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, conditions for transportation and storage, disease and injuries during marketing.

Storage of fresh fruits and vegetables, Containers: Tin, glass and other packaging materials used in fruits and vegetables preventions. Canning and botting; quality of raw materials, preparation of materials, preparation of syrups and brines, canning and bottling, effect of canning and botting on nutritive value, spoilage of canned foods, detection and control.

Fruit and vegetable juices: Preparation of juice, syrups, squashes, cordials and nectars; concentrations and drying of juice, packaging and storage and concentrations and powders; fortified and soft drinks.

Preservation by freezing, general methods for freezing of fruits and vegetables; problem relating to storage of frozen products; standards for frozen food products.

Dehydration of fruits and vegetables: Methods; packaging, storage, quality control during and after dehydration.

Pickles and chutneys: Preparation of various types of pickles-theory and practice; preparation of sauces and chutneys; problems relating to the shelf life of pickles and chutneys; quality control.

Tomato products: preparation of various tomato products, food standards and quality control.

Pectin; Raw materials; processes and uses of pectin, products based on pectin manufacture and quality control

Food additives: Use in fruit and vegetable preservation

Vinegar: General methods of preparation, food standards and quality control; uses

Utilization of waste from fruit and vegetables processing plant

Paper 2: Food Microbiology

General characteristics of microorganisms: Classification and identification of yeast, molds and groups of bacteria important in food industry.

Source of contamination: Air, water, soil, sewage, post processing contamination.

Intrinsic and extrinsic factors influencing growth of microorganisms in foods.

Classification of foods and general principles involved in their preservation

Effects on microbes of: Low temperature preservation, lethal effects of chilling, freezing and thawing, high temperature preservation. Heat resistance of microorganism, heat

penetration and thermal processing. Pasteurization, sterilization, canning and dehydration, chemical preservation and its toxic effects; irradiations.

Food Fermentations: Bacterial, yeast and mold cultures, single and mixed cultures, propagation, maintenance and evaluation of cultures; factors affecting activity of cultures, bacteriophages, residual antibiotics and chemicals.

Microbiology of fermentation: Fermented milks. Cereal foods. Vinegar, oriental foods, alcoholic beverages. Therapeutic value of fermented foods.

Food spoilage: Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins.

Pathogens in foods: Microbial infections and intoxications. Growth and survival of pathogens in foods

Food borne diseases: Investigation and control

Paper 3: Packaging of food materials

Introduction of packaging: Functions (containment, protection, convenience, communication). Principles in development of protective packaging, terminology, operations.

Different forms of food packages: Primary packaging: Pouches, bags, sacks, wraps, shrinkage, cans, bottles, cartons, tubes, glass containers. Secondary Packaging-boxes (Solid and Fibre board), drums and barrels etc.

Materials used for packaging: Different types of paper, paperboard, plastics, cellulose films, metallised films, coextrusion, lamination, thermo formed semi rigid containers, tin plates, steel, aluminium containers, glass containers.

Process of Packaging: Material handling, filling, air removal, sealing, retorting. Modified atmosphere packaging, vacuum and gas packaging. Package sterilization techniques, cushioning, unitizing, palletizing, sacking and containerization.

Quality control: Evaluation of packaging materials, toxicity, corrosion prevention, shelf life testing, minimization of transport losses. Hazards in handling and storage and packaging and their minimization

Packaging laws and regulations: Standards of weights and measures act. Advancement in packaging technology: smart packaging, active packaging, antimicrobial packaging etc.

Paper 4: Principles of Food Engineering

Size reduction process: Principles, theories and laws, energy considerations, equipments.

Mixing and forming theory and applications, mixing indices, equipments for solid and liquid. Fluid flow, laminar, turbulent and transitional ranges, velocity distribution profiles, basic equations, thermal velocity calculations.

Pasteurization: Theory and application, pasteurization of packaged and unpacked foods. Pasteurization, calculations, equipments.

Thermal processing: Death kinetics, thermal death curve, decimal reduction time. Z-factor, heat penetration curve, process time calculations. Mathematical and graphical solutions.

Evaporation: heat and mass balance, steam economy, heat recovery, efficient, process calculations.

Food dehydration: constant and falling rate periods, drying rate calculations.

Chilling, refrigeration and freezing: theories, characteristics curve, cooling rate calculations.

Separation processes: Filtration and centrifugation, theories and mathematical descriptions, constant rate and constant pressure filtration, equipment.

Extrusion: Theory and applications, extrusion cookers and cold extrusion, single and twin screw extruders, design considerations.

Membrane Technology, Reverse osmosis and Ultrafiltration, Micro filtration.

Supercritical gas extraction

Advances in fortification: Synthetic nutrients. Techniques of food fortification. Stability of nutrients in relation to processing.

Encapsulations: design and structure of microcapsules, release rate and mechanism. Techniques of microencapsulation, advantage and application of encapsulation.

Non thermal processing: High pressure processing, Pulse electric processing, ohmic heating.

Practical Semester II

1. Determination of Microbial count: Total viable, Thermophilic, Proteolytic, Lipolytic and aerobic spores, Farmers, coliform counts, yeast and mould count.
2. Determination of activity of starter cultures used and dairy industry.
3. Dye Reduction Test.
4. Determination of thermal resistance of enzymes and microorganisms
5. Analysis of canned food products for chemical and microbiological spoilage
6. Tin coating Test:
 - a) Tin coating weight measurement(Clarks Test)
 - b) Determination of the continuity of tin coating
 - c) Sulphide stain test and corrosion resistance test.
7. Determination of ascorbic acid content in food products.
8. Determination of tannins content in food products.
9. Dehydration of fruits and vegetables.
10. Preparation of tomato products like ketchup, puree and past.
11. Preparation of jam, jelly,
12. Pectin determination in fruit and vegetable products.
13. Determination of chemical preservatives in fruits and vegetable products.
14. Preparation and analysis of fruit beverages i.e. Squash and cordial.
15. Use of flame photometry in the estimation of trace metals like sodium and potassium.

SEMESTER 3

Paper 1: Processing of cereals, pulses and oilseeds :

Wheat technology: composition of grain and environmental effects on its processing quality, enzymes of wheat and their role in the manufacture of wheat products; principles of wheat milling and its effects on composition of flour, byproducts, chemical improvers- bleaching and maturing agents, property of dough and its rheology, manufacture of wheat products bread, biscuits etc; formation of premixes for bakery products; pasta goods and processed cereal foods for infants.

Rice technology : composition, type of proteins, starch content, amylase and amylopectin fractions; presence and effect of lipases; distribution of vitamins; minerals and proteins in rice grains and its relation to milling; rice milling operations and its effect on nutritive value; cooking quality; byproducts of rice milling and their utilization; processed and prepared mixes based on rice.

Legumes: composition, anti-nutritional factors, processing methods, methods of cooking.

Corn technology: composition, processing of corn for manufacture of corn grits, meal and flour, manufacture of corn flakes, corn syrup, corn starch, corn steep liquor, corn oil and canned corn.

Sorghum: chemical composition, refining and nutritive value.

Oilseeds: composition and processing of oilseeds as protein concentrations, properties and uses of oilseeds meals, technology, vegetable protein isolates; barrier compounds in the utilization of oil seed proteins low cost protein foods from oilseeds.

Paper 2 : Processing of milk and milk products

Importance of milk industry in India: collection, chilling, transportation, cream separation, standardization, pasteurization, sterilization, homogenization, packaging, storage and distribution of fluid milk, ultrahigh temperature processed milk.

Preparation of various types of milks: toned, homogenized, fortified, reconstituted and flavoured milk.

Technology of fermented milk products: principles and practices of manufacture, packaging, storage and marketing of dahi, cultured butter milk, acidophilus milk etc.

Cheese: manufacture of hard, semi hard, soft and processed cheeses. Storage, grading and marketing of cheese. Cheese defects and their control.

Butter: manufacture, packaging, storage and marketing of butter; butter defects and their control, margarine.

Technology of frozen milk products: classification, manufacture, packaging, storage and marketing of ice cream, ices, sherbets etc. defects of frozen products and their control.

Technology of evaporated and dried milk: manufacture of evaporated milk and milk powders, packaging storage defects and their control.

Technology of dairy by products: utilization of skim milk, buttermilk and whey for the manufacture of casein, lactose etc.

Technology of indigenous milk products: principles and practices of manufacture, packaging, storage and marketing of ghee, khoa, chenna and milk based foods.

Sanitary aspects: of dairy plant building, equipment and their maintenance. Disposal of dairy plant waste.

Application of membrane technology in dairy industry.

Paper 3: Quality control food standards and food laws

Quality assurance: water standards and analysis physical, chemical and microbiological characteristics of water analyses.

Raw materials: quality parameters and evaluation procedures.

Finished product quality: appearance, color, texture, viscosity, consistency, flavor, defects, bacterial contamination and foreign matter.

Sensory evaluation: selection of panel of judges, sensory characteristics of foods, types of tests.

Food adulteration: definition, common adulterants in different foods, contamination and foreign matter.

Sensory evaluation: selection of panel of judges, sensory characteristics of foods, types of tests.

Food adulteration: definition, common adulterants in different foods, contamination, methods of detection.

Food standards and laws: international(ISO9001,Codex) and national food laws(FPO, MMPO, Meat product order, Agmark)

Food safety and quality management system: good manufacturing practices, good hygienic practices and HACCP principles for food safety system.

Prevention of food adulteration act: food additives: coloring matter, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides and pesticides. PFA specification for food products.

Biological waste treatment: fundamentals of biological waste treatments, discharge of industrial wastes in river and sea.

Paper 4: Entrepreneurship in food processing:

Plant design concepts: general design considerations, feasibility analyses, plant location and location theory models, economic plant size.

Product and process design: flowcharts and their designs, equipment selection, plant layout development and evaluation, planning and design of service facilities.

Human resource planning: planning and design of marketing system, workers safety and plant hygiene.

Requirements in respect of building and building materials:

Analyses of plant costs and profitability: network analyses of planning, scheduling and management activities.

Introduction to marketing and economics: demand, supply, sample survey techniques, marketing information, consumer trends, consumer behaviour.

Introduction to operation research: definition, applications, inventory control, linear programming, queuing theory.

Entrepreneurship in food processing.

Practicals: Sem III

1. Physiochemical and rheological examination of wheat and its products test weight, kernel hardness, gluten content, milling tests.

2. Evaluation of rice amylase and amylopectin determination, gelatinization temperature, water absorption tests.

3. Experimental parboiling and assessment of degree of polishing.

4. Experimental baking of selected cereals products bread, biscuits.

5. Preparation of protein concentration and isolates and their evaluation for protein content and solubility.

6. Determination of yeast activity used in fermented cereal products.

7. Quality test for wheat flour used in the baked products:

A) Maltose Number

B) Water Absorption

C) Sedimentation value

D) Alcohol Acidity

8. Texture profile analysis of baked cereals food products by texture analyzer

9. Plate form test for raw milk.

10. Determination of fat content in milk powders and icecream products.

11. Determination of milk adulterants: Starch, Urea, Formaldehyde and sugar.

12. Operation, cleaning and sterilization of dairy plant machinery involved in fluid milk processing.

13. Preparation of toned, homogenized, fortified, reconstituted and flavored milk.

14. Manufacture of fermented milk.

15. To study the kinetics of enzymes and manufacture of cheeses.

16. Manufacture of butter.

17. Manufacture of ice-cream, ices, sherbets.

18. Manufacture of casein, ghee, khoa, chhena.

19. Sensory analysis of food products:

a) Paired comparison test.

b) Duo-trio test

c) Hedonic test

d) Triangle test

e) Ranking test

f) Single sample test

g) Composite scoring test

Analysis of water used in food industries: Alkalinity, Acidity, Hardness, PH , TPC and Coliform count.

SEMESTER- 4

PAPER-1 Industrial Food Fermentation

Characteristics, Nutritional requirement and maintenance of microorganism used for fermentation. Basic needs of a fermentation process: Sterilization, inoculum development, aeration, agitation, temperature P^H control and airtight operation. Conventional fermented foods, production of baker's yeast. Alcoholic beverages: Beer, Wine and distilled beverages. Microbial production of organic acids (acetic, citric, propionic etc.) amino acids (L-lysine, L-glutamic acid etc.) vitamins (Riboflavin, cyanocobalamin etc.) and Enzymes (lipase, protease, amylase etc.). Solid state and submerged fermentation process. Single cell protein and hydrocarbon fermentation.

PAPER-2 Technology of Meat , Fish and Poultry Products

Anet- mortem examination of meat animals, scientific slaughtering, post mortem changes. Tenderization and curing of Meat, beef mutton, pork, sausages and other meat products. Catch, handling and transportation of fish, spoilage , processing and preservation of fish, shell fish and other sea products. Poultry processing and canning of poultry products. Physical, chemical nutritional and functional characteristics of egg. Quality deterioration, preservation, and processing of egg. Manufacturing of egg white, egg yolk and whole egg solid/powder.

PAPER- 3 Food Plant Safety and Waste Management

Industrial hygiene and safety aspects related to toxicity, noise, pressure, temperature, vibration , radiation etc. Safety elements: site of layout, process stages. Risk analysis and assessment. Prevention of losses, pressure relief, provision for fire fighting release of hazardous material from tanks and pipes. Relief system: Types and Location. Disaster planning and management: regulation, legislation and government role related to safety of food plant. Characterization and utilization of by products from food processing industries. Effluent Characterization. Concepts of primary treatment of food industry effluent: Screening sedimentation flotation, temperature and P^H . Biological oxidation: Activated sludge process, trickling filter, Rotating biological contractor, lagoons, oxidation ditches. Anaerobic digestion and composting. Advance waste water treatment system: use of membrane, ion exchange, electro dialysis, magnetic separation. Handling and disposal of sludge.

PAPER- 4 Practicals & Summer Training

IIPR
Dairy
Industry Training
Project Dissertation.