

ADMISSIONS 2022–23

FULL TIME DEGREE PROGRAMMES

NIFTEM-T Entrance-Examination Syllabus

M.Tech. (Food Technology) in Food Process Engineering

- | | |
|--|---|
| Unit 1: Heat and Mass Transfer | Unit 6: Food Packaging Technology |
| Unit 2: Engineering Properties | Unit 7: Material Handling and Storage |
| Unit 3: Post Harvest Unit Operations | Unit 8: Plant layout, Design, Instrumentation and process control |
| Unit 4: Process Technology and Machinery | Unit 9: Processing of Meat, Fish and Poultry Products |
| Unit 5: Dairy Engineering and Technology | Unit 10: Food chemistry, microbiology and Quality Standards |

M.Tech. (Food Technology) in Food Process Technology

- | | |
|--|---|
| Unit 1: Introductory to Food Science and Technology | Unit 6: Food Quality Management |
| Unit 2: Fruits and Vegetable Processing | Unit 7: Food Packaging and labeling |
| Unit 3: Processing of food grains, spices and plantation crops | Unit 8: Food Product Development and Health Foods |
| Unit 4: Dairy Science and Technology | Unit 9: Food Chemistry |
| Unit 5: Technology of Meat, Fish and Poultry Products: | Unit 10: Food Microbiology |

M.Tech. (Food Technology) in Food Safety and Quality Assurance

- | | |
|--|--|
| Unit 1: Principles of Food Safety | Unit 6: Food Science and Technology |
| Unit 2: Food Chemistry | Unit 7: Preservation of fruits and vegetables |
| Unit 3: Analytical Techniques for Food Quality | Unit 8: Processing of food grains, spices and plantation crops |
| Unit 4: Food Microbiology | Unit 9: Technology of Dairy/Meat / Fish / Poultry Products |
| Unit 5: Food Laws and Regulations | Unit 10: Food Packaging and labeling |

Ph.D. (Food Technology) in Food Process Engineering

- | | |
|--|--|
| Unit 1: Heat and Mass Transfer | Unit 6: Food Packaging Technology |
| Unit 2: Engineering Properties | Unit 7: Material Handling and Storage |
| Unit 3: Post Harvest Unit Operations | Unit 8: Plant layout, Design, Instrumentation and process control |
| Unit 4: Process Technology and Machinery | Unit 9: Processing of Meat, Fish and Poultry Products: |
| Unit 5: Dairy Engineering and Technology | Unit 10: Food chemistry, microbiology and Quality Standards |
| | Unit 11: Operational research/modelling/research methodology/
intellectual property and its management/concepts in
laboratory techniques/research ethics |

Ph.D. (Food Technology) in Food Process Technology

- | | |
|--|--|
| Unit 1: Food Chemistry and Nutrition | Unit 6: Food Packaging |
| Unit 2: Food Product Development and Quality Evaluation | Unit 7: Food Biotechnology |
| Unit 3: Fruits and Vegetable Processing | Unit 8: Food Microbiology |
| Unit 4: Processing of Milk, Meat, Poultry and
Marine Products | Unit 9: Emerging Trends in Food Process Technology |
| Unit 5: Functional Foods and Nutraceuticals | Unit 10: Statistical methods for food science & technology |

Syllabus for

M.Tech. (Food Technology) in Food Process Engineering

Unit 1: Heat and Mass Transfer

Basic laws of thermodynamics, thermodynamic properties and processes, energy equations, heat, work, heat engine, heat pump, refrigeration and steam tables. Introduction to heat and mass transfer and their analogous behavior, steady and unsteady state heat/mass transfer, analytical and numerical solution of unsteady state heat/mass transfer, use of various charts in solving problems. Convective heat transfer in food processing systems involving laminar and turbulent flow- heat transfer in boiling liquids - regimes of boiling, heat transfer between fluids and solid foods, natural & forced convection, boundary layer diffusion equations and convection regimes. Design of heat exchanger, radiation heat transfer, black bodies, grey bodies, combined radiation and convection heat transfer - radiation surface coefficient, applications in food processing. EMC, sorption and desorption isotherms, water activity and psychrometry. Modes of heat transfer, heat exchanger. Mass transfer and mass- heat- momentum transfer analogies. Fluid statics, fluid dynamics, continuity equation and Bernoulli's theorem. Dimensional analysis – applications in food processing.

Unit 2: Engineering Properties

Importance of engineering properties of biological materials; physical characteristics viz. shape, size, volume, density, porosity, surface areas, Frictional characteristics viz., rolling resistance, angle of repose. Properties of bulk particulate solids viz. specific surface area, mean diameter, flow rate. Aerodynamics characteristics viz. drag coefficient and terminal velocity. Thermal properties viz. specific heat, thermal conductivity, thermal diffusivity. Dielectric properties viz. dielectric and microwave radiation, dielectric constant and energy absorption. Optical properties; transmittance and reflectance. Rheological properties and stress-strain-time relationship, rheological models, visco-elasticity.

Unit 3: Post Harvest Unit Operations

Technology & equipment for grading, cleaning, washing, sorting, shelling, cyclone separation, centrifugal separation, dehusking, decortication, milling, polishing, pearling, drying, heating, cooling, freezing, pasteurization and sterilization of foods, size reduction, cryogenic grinding, granulation, crystallization, membrane separation processes; Evaporation, Distillation, Mixing, coagulation, mechanical separation processes, viz. sedimentation, clarification, filtration, pressing, expelling, leaching, extraction, extrusion.

Unit 4: Process Technology and Machinery

Pre-milling, conditioning, process technology and machinery for cereals, pulses, oil seeds, fruits, vegetables, spices, condiments, plantation crops, meat, fish and poultry products. Emerging techniques- Thermal and non-thermal processing, hybrid drying technologies, nondestructive quality evaluation, high pressure processing, ohmic heating, ultraviolet light, pulsed electric field, pulsed light field, ozone processing, RF treatment, plasma techniques, nano techniques in food processing, ultrasound treatment, encapsulation of food ingredients and Hurdle technology. Agricultural by-products/residue utilization and Waste disposal of food processing plants.

Unit 5: Dairy Engineering and Technology

Physical and chemical properties of milk – Chilling, pasteurization, sterilization, homogenization, cream separation – theory & machineries - Butter and cheese processing - Ice cream and milk powder production - membrane separation of milk – ultra filtration - reverse osmosis—membrane material and structures – packaging and filling of milk and milk products – production and Processing of Special Milks, condensed and evaporated milk, Fat Rich Dairy products and indigenous milk products, Fermented Milk Products and Milk by-products.

Unit 6: Food Packaging Technology

Packaging terminologies. Functions of food packaging. Packaging requirements for different environments. Basis for selection of packaging material. Metal and Glass – Manufacturing, properties and its applications. Paper

and polymers films as food packaging material-types, properties, manufacturing and its applications. Filling systems. Labels and bar coding - printing on packaging materials. Aseptic packaging, vacuum packaging, MAP, CAP, biodegradable packaging materials. Nano composite as packaging materials. Testing of packaging materials and instruments.

Unit 7: Material Handling and Storage

Bulk conveying equipment, viz. belt conveyors, screw/auger conveyors, bucket elevators, drag/chain Conveyors and Pneumatic conveyors. Estimation of energy requirement and capacity, Operation and maintenance of conveying equipment. Food grain storage practices and structures – Traditional, improved and modern. Controlled and modified atmospheric storage. Cold storage design & operations and cooling load calculations.

Unit 8: Plant layout, Design, Instrumentation and process control

Computer aided design and analysis of machines and machine components. Materials, manufacturing processes, design of elements and selection of standard parts viz. pulley, chains, sprockets, bearings, belts, fasteners, hydraulic components, pipes, hoses. Plant design concepts and general design considerations, plant location, product and process design, process flow charts, equipment selection, plant layout. Design and selection of machinery for handling utilities like water, steam, fuel etc. and disposal of effluents and residues. Static and dynamic characteristics of instruments, Transducers elements, intermediate elements, indicating and recording elements. Measurement of motion, force, torque, power, temperature, humidity, pressure and flow. Physical and chemical sensors, biosensor.

Unit 9: Processing of Meat, Fish and Poultry Products

Chemistry, Nutritional value and microscopic structure of meat tissue. Ante mortem inspection, principle and methods of slaughtering of various animals and poultry birds, Post mortem examination and Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Meat tenderization, meat preservation like curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Value addition and byproducts utilizations. factors influencing keeping quality of meat. Processing and preservation of fish and its products. On board handling and transportation of fish. Preservation canning, smoking and freezing of fresh and sea water fish and its products. Utilization of by-products from fish processing industries. Structure and composition of egg, factors affecting egg quality. Quality measurement of egg. Preservation methods of shell eggs and egg products freezing- pasteurization- desugarisation. Technology of egg products viz. egg powder, albumen and flakes.

Unit 10: Food chemistry, microbiology and Quality Standards

Importance of microorganisms in food – primary sources of microorganisms in food – intrinsic and extrinsic parameters of food affecting microbial growth - Microbial spoilage of foods - Assessing microbial load in foods – microscopic, cultural, physical, chemical - Fermented and microbial foods - Food borne diseases and safety. Thermal death time and process time calculations. Classification, structure and functional properties of Carbohydrates, Proteins and lipids. water soluble and fat soluble vitamins, role of minerals in nutrition. Proximate analysis of food constituents. Chemical and biochemical changes during processing and storage of foods. Classification and applications of enzymes, food additives, pigments and flavors in food processing. Principle and methods for subjective and objective quality evaluation of foods. Measurement techniques and instruments for food quality determination, destructive and non-destructive quality evaluation. International, National Food laws and standards –FSSAI, PFA, FPO, BIS, AGMARK, APEDA, FDA, ISO, GRAS, EU, CAC, TQM, GMP, GAP, HACCP. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Syllabus for

M.Tech. (Food Technology) in Food Process Technology

Unit 1: Introductory to Food Science and Technology

Basics of food science and technology. Methods of food preservation such as heat processing, pasteurization, canning, dehydration, freezing, freeze drying, fermentation, microwave, irradiation and chemical additives. Refrigerated, modified and controlled atmospheric storage. Aseptic preservation, hurdle technology. Use of non-thermal technologies - microfiltration, bacteriofugation, high voltage electric fields, pulse electric fields, high pressure processing, irradiation, thermosonication, alternate-thermal technologies - ohmic heating, dielectric heating, microwave, RF, infrared biological technologies - antimicrobial enzymes and bacteriocins in food processing. Intermediate moisture food products, low acid foods, high acid foods and shelf stable foods. Unit operations of food processing viz. grading, cleaning, washing, sorting, size reduction, cryogenic grinding, crystallization, membrane separation processes; Evaporation, Distillation, Mixing, coagulation, mechanical separation processes, filtration, pressing, expelling, leaching, extraction, extrusion.

Unit 2: Fruits and Vegetable Processing

harvest handling. Primary, secondary, value addition and storage of fruits and vegetables. Extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, chips, pickles- equipments used. Minimally processing of fruit and vegetables. Dehydrated fruits and vegetables. Technology of Preservation by sugar, salt, chemical. Fermented foods and beverages from fruit and vegetables. Aerated drinks, frozen fruits and vegetables, IQF products. By-products utilization of fruits and vegetable processing industry.

Unit 3: Processing of food grains, spices and plantation crops

Structure, composition, milling and processing of different food grains like wheat, rice, maize, oat, pulses, millets and oil seeds. Anti-nutritional factors in food grains and oilseeds. Milling of food grains. Primary and secondary processing. Value added food grain products like breads, biscuits, cakes, doughnuts, buns, pasta goods, extruded, Instant ready mixtures, puffed foods, confectionary products, breakfast cereals, snack foods, malted food products, legume based food products. Milling and parboiling of rice. By-products of rice milling and their utilization. Oil seed processing: expelling, solvent extraction, refining and hydrogenation. Spices and plantation crops processing - Post harvest processing of major and minor spices, tea, coffee, cocoa, coconut, cashew and oil palm. Extraction of essential oils & oleoresins and encapsulation technologies.

Unit 4: Dairy Science and Technology

Milk composition, Physical and chemical properties of milk. Milk reception. Dairy plant operations viz. receiving, cooling separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. Toned, double toned, standardised, UHT, fortified, reconstituted and flavoured milks. Technology of fermented milks. Milk products processing viz. cream, butter, ghee, cheese, condensed milk, evaporated milk, whole and skimmed milk powder, ice cream, khoa, channa, paneer and similar products. Judging and grading of milk products. Dairy plant sanitation and waste disposal, CIP.

Unit 5: Technology of Meat, Fish and Poultry Products:

Chemistry, Nutritional value and microscopic structure of meat tissue. Ante mortem inspection, principle and methods of slaughtering of various animals and poultry birds, Post mortem examination and Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Meat tenderization, meat preservation like curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Value addition and byproducts utilizations. Factors influencing keeping quality of meat. Processing and preservation of fish and its products. On board handling and transportation of fish. Preservation canning, smoking and freezing of fresh and sea water fish and its products. Utilization of by-products from fish processing industries. Structure and composition of egg, factors affecting egg quality. Quality measurement of egg. Preservation methods of shell eggs and egg products freezing- pasteurization- desugaring. Technology of egg products viz. egg powder, albumen and flakes.

Unit 6: Food Quality Management

Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, safety, recall and liability. Food adulterations & detection techniques.

Measurement techniques and instruments for food quality determination. National Food laws and standards - PFA, FPO, BIS, APEDA. International standards and organizations – FDA, ISO, GRAS, EU, CAC, TQM, GMP, GAP, HACCP. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Unit 7: Food Packaging and labeling

Packaging terminologies. Functions of food packaging. Packaging requirements for different environments. Basis for selection of packaging material. Packaging materials viz. properties and testing procedures, packaging technologies for perishables and highly perishables fresh and processed foods. Packaging technologies for. Shelf life studies. Recent trends in packaging, aseptic, active packaging, smart packaging, intelligent packaging, modified atmosphere, vacuum and gas packaging. Labelling requirements.

Unit 8: Food Product Development and Health Foods

Socio-cultural, psychological and economical consideration for food appearance, domestic and export marketing. Consumer trends and their impact on new product development. Product development viz. to conceive ideas, evaluation of ideas, developing ideas into products, test marketing and commercialization. Role of food in human nutrition. Nutritional disorders, natural contaminants and health hazards associated with foods. Diet therapy, probiotic and prebiotic foods. Therapeutic, organic foods, designer foods, nutrigenomics, nutraceutical and functional foods.

Unit 9: Food Chemistry

Carbohydrates: structure and functional properties of mono-, oligo-, & poly-saccharides including starch, cellulose, pectic substances and dietary fibre, gelatinization and retrogradation of starch. Proteins: classification and structure of proteins in food, Lipids: classification and structure of lipids, rancidity, polymerization and polymorphism. Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. Food flavours: terpenes, esters, aldehydes, ketones and quinines. Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic and non-enzymatic browning. Nutrition: balanced diet, essential amino acids and essential fatty acids, protein efficiency ratio, water soluble and fat soluble vitamins, role of minerals in nutrition, co-factors, anti-nutrients, nutraceuticals, Chemical and biochemical changes during processing and storage.

Unit 10: Food Microbiology

Characteristics of microorganisms: morphology of bacteria, yeast, mold and actinomycetes, spores and vegetative cells, gram-staining. Microbial growth: growth and death kinetics, serial dilution technique. Food spoilage: spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products. Toxins from microbes - aflatoxins: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera. Fermented foods and beverages: curd, yoghurt, cheese, pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages and sausage. Thermal death time and process time calculations.

Syllabus for

M.Tech. (Food Technology) in Food Safety and Quality Assurance

Unit I: Principles of Food Safety

Food Sanitation and safety: Factors contributing to physical, chemical and biological contamination in food chain, prevention and control of food borne hazards, definition and regulation of food sanitation, sources of contamination, personal hygiene-food handlers, cleaning compounds, sanitation methods, waste disposal strategy (solid and liquid waste) and pest control. Food adulteration: common adulterants, simple tests for detection of adulteration. Food additives- classification, functional role and safety issues.

Unit II: Food Chemistry

Carbohydrates: structure and functional properties of mono-, oligo-, & poly-saccharides including starch, cellulose, pectic substances and dietary fibre, gelatinization and retrogradation of starch. Proteins: classification and structure of proteins in food, Lipids: classification and structure of lipids, rancidity, polymerization and polymorphism. Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. Food flavours: terpenes, esters, aldehydes, ketones and quinines. Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic and non-enzymatic browning. Nutrition: balanced diet, essential amino acids and essential fatty acids, protein efficiency ratio, water soluble and fat soluble vitamins, role of minerals in nutrition, co-factors, anti-nutrients, nutraceuticals, Chemical and biochemical changes during processing and storage

Unit III: Analytical Techniques for Food Quality

Analytical method used for quality determination: chemical and physical, microbiological, biochemical and sensory analysis. Analytical methods of determination of basic food components: protein, saccharides, lipids, vitamins, water, minerals and trace elements, sensory active compounds, anti-nutritive and natural toxic compounds, food additives and food contaminants. Basic principles of chromatography. Paper Chromatography. Spectrophotometric techniques: Spectrophotometry introduction and principles.

Unit IV: Food Microbiology

Characteristics of microorganisms: morphology of bacteria, yeast and mold, spores and vegetative cells, Gram-staining. Microbial growth: growth and death kinetics, serial dilution technique. Food spoilage: spoilage microorganisms in different food products including fruit & vegetable, milk, fish, meat, egg, cereals and their products. Toxins from microbes - mycotoxins: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera. Fermented foods and beverages: curd, yoghurt, cheese, pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages and sausage. Thermal death time and process time calculations.

Unit V: Food Laws and Regulations

Food Safety Systems: Quality systems standards including ISO; Auditing; Good Manufacturing Practice and HACCP. Food Laws & Implementing Agencies-National: FSSAI. International Scenario in Food Regulation USDA, EFSA, UK, Canada, A & NZ, Japan, Malaysia, Singapore; Consumer Movements; Intellectual Property Rights and Trade Marks: Protection of investment and efforts in research and development by patenting; Criteria of patentability; National and international patent; Terms of patents; Copyright. International Agencies in Food Regulation: Food Codex Alimentarius: Various aspects and relation with domestic laws; FAO, WHO, WTO.

Unit VI: Food Science and Technology

Basics of food science and technology. Methods of food preservation such as heat processing, pasteurization, canning, dehydration, freezing, freeze drying, fermentation, microwave, irradiation and chemical additives. Refrigerated, modified and controlled atmospheric storage. Aseptic preservation, hurdle technology. non-thermal technologies, alternate-thermal technologies. Intermediate moisture food products, low acid foods, high acid foods and shelf stable foods. Socio-cultural, psychological and economical consideration for food appearance, domestic and export marketing. Consumer trends and their impact on new product development. Product development viz. to conceive ideas, evaluation of ideas, developing ideas into products, test marketing and commercialization. Role of food in human nutrition. Nutritional disorders, natural contaminants and health hazards associated with foods. Diet therapy, probiotic and prebiotic foods Therapeutic, organic foods, designer foods, nutrigenomics, nutraceutical and functional foods.

Unit VII: Preservation of fruits and vegetables

Post-harvest handling. Primary, secondary, value addition and storage of fruits and vegetables. storage under ambient conditions, low temperature storage, evaporative cooling – cold storage of horticultural commodities – estimation of cooling load - controlled atmosphere storage – concept and methods –modified atmosphere packaging – gas composition, quality of storage – waxing of fruits – types of wax, equipment and advantages. Extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, chips, pickles - equipments used. Minimally processing of fruit and vegetables. Dehydrated fruits and vegetables. Technology of Preservation by sugar, salt, chemical. Fermented foods and beverages from fruit and vegetables. Aerated drinks, frozen fruits and vegetables, IQF products. By-products utilization of fruits and vegetable processing industry.

Unit VIII: Processing of food grains, spices and plantation crops

Structure, composition, milling and processing of different food grains like wheat, rice, maize, oat, pulses, millets and oil seeds. Anti-nutritional factors in food grains and oilseeds. Milling of food grains. Primary and secondary processing. Value added food grain products like breads, biscuits, cakes, doughnuts, buns, pasta goods, extruded, Instant ready mixtures, puffed foods, confectionary products, breakfast cereals, snack foods, malted food products, legume based food products. Milling and parboiling of rice. Products and by-products of rice milling and their utilization. Oil seed processing: expelling, solvent extraction, refining and hydrogenation. Spices and plantation crops processing - Post harvest processing of major and minor spices, tea, coffee, cocoa, coconut, cashew and oil palm. Extraction of essential oils & oleoresins and encapsulation technologies. Unit operations of food processing viz. grading, cleaning, washing, sorting, size reduction, cryogenic grinding, crystallization, membrane separation processes; Evaporation, Distillation, Mixing, coagulation, mechanical separation processes, filtration, pressing, expelling, leaching, extraction, extrusion.

Unit IX: Technology of Dairy/Meat / Fish / Poultry Products

Milk composition, Physical and chemical properties of milk. Toned, double toned, standardized, UHT, fortified, reconstituted and flavored milks. Technology of fermented milks. Milk products processing viz. cream, butter, ghee, cheese, condensed milk, evaporated milk, whole and skimmed milk powder, ice cream, khoa, channa, paneer and similar products. Judging and grading of milk products.

Chemistry, Nutritional value and microscopic structure of meat tissue. Ante mortem inspection, principle and methods of slaughtering of various animals and poultry birds, Post mortem examination and Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Meat tenderization, meat preservation like curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Processing and preservation of fish and its products. Structure and composition of egg, factors affecting egg quality. Quality measurement of egg. Preservation methods of shell eggs and egg products freezing- pasteurization- desugarisation. Technology of egg products viz. egg powder, albumen and flakes.

Unit X: Food Packaging and labeling

Packaging terminologies. Functions of food packaging. Packaging requirements for different environments. Basis for selection of packaging material. Packaging materials viz. properties and testing procedures, packaging technologies for perishables and highly perishables' fresh and processed foods Packaging technologies for. Shelf life studies. Recent trends in packaging, aseptic, active packaging, smart packaging, intelligent packaging, modified atmosphere, vacuum and gas packaging. Food labelling requirements.

Syllabus for

Ph.D. (Food Technology) in Food Process Engineering

Unit 1: Heat and Mass Transfer

Basic laws of thermodynamics, thermodynamic properties and processes, energy equations, heat, work, heat engine, heat pump, refrigeration and steam tables. Introduction to heat and mass transfer and their analogous behavior, steady and unsteady state heat/mass transfer, analytical and numerical solution of unsteady state heat/mass transfer, use of various charts in solving problems. Convective heat transfer in food processing systems involving laminar and turbulent flow- heat transfer in boiling liquids - regimes of boiling, heat transfer between fluids and solid foods, natural & forced convection, boundary layer diffusion equations and convection regimes. Design of heat exchanger, radiation heat transfer, black bodies, grey bodies, combined radiation and convection heat transfer - radiation surface coefficient, applications in food processing. EMC, sorption and desorption isotherms, water activity and psychrometry. Modes of heat transfer, heat exchanger. Mass transfer and mass- heat-momentum transfer analogies. Fluid statics, fluid dynamics, continuity equation and Bernoulli's theorem. Dimensional analysis – applications in food processing.

Unit 2: Engineering Properties

Importance of engineering properties of biological materials; physical characteristics viz. shape, size, volume, density, porosity, surface areas, Frictional characteristics viz., rolling resistance, angle of repose. Properties of bulk particulate solids viz. specific surface area, mean diameter, flow rate. Aerodynamics characteristics viz. drag coefficient and terminal velocity. Thermal properties viz. specific heat, thermal conductivity, thermal diffusivity. Dielectric properties viz. dielectric and microwave radiation, dielectric constant and energy absorption. Optical properties; transmittance and reflectance. Rheological properties and stress-strain-time relationship, rheological models, visco-elasticity.

Unit 3: Post Harvest Unit Operations

Technology & equipment for grading, cleaning, washing, sorting, shelling, cyclone separation, centrifugal separation, dehulling, decortication, milling, polishing, pearling, drying, heating, cooling, freezing, pasteurization and sterilization of foods, size reduction, cryogenic grinding, granulation, crystallization, membrane separation processes; Evaporation, Distillation, Mixing, coagulation, mechanical separation processes, viz. sedimentation, clarification, filtration, pressing, expelling, leaching, extraction, extrusion.

Unit 4: Process Technology and Machinery

Pre-milling, conditioning, process technology and machinery for cereals, pulses, oil seeds, fruits, vegetables, spices, condiments, plantation crops, meat, fish and poultry products. Emerging techniques- Thermal and non-thermal processing, hybrid drying technologies, nondestructive quality evaluation, high pressure processing, ohmic heating, ultraviolet light, pulsed electric field, pulsed light field, ozone processing, RF treatment, plasma techniques, nano techniques in food processing, ultrasound treatment, encapsulation of food ingredients and Hurdle technology. Agricultural by-products/residue utilization and Waste disposal of food processing plants.

Unit 5: Dairy Engineering and Technology

Physical and chemical properties of milk – Chilling, pasteurization, sterilization, homogenization, cream separation – theory & machineries - Butter and cheese processing - Ice cream and milk powder production - membrane separation of milk – ultra filtration - reverse osmosis—membrane material and structures – packaging and filling of milk and milk products – production and Processing of Special Milks, condensed and evaporated milk, Fat Rich Dairy products and indigenous milk products, Fermented Milk Products and Milk by-products.

Unit 6: Food Packaging Technology

Packaging terminologies. Functions of food packaging. Packaging requirements for different environments. Basis for selection of packaging material. Metal and Glass – Manufacturing, properties and its applications. Paper and polymers films as food packaging material-types, properties, manufacturing and its applications. Filling systems. Labels and bar coding - printing on packaging materials. Aseptic packaging, vacuum packaging, MAP, CAP, biodegradable packaging materials. Nano composite as packaging materials. Testing of packaging materials and instruments.

Unit 7: Material Handling and Storage

Bulk conveying equipment, viz. belt conveyors, screw/auger conveyors, bucket elevators, drag/chain Conveyors and Pneumatic conveyors. Estimation of energy requirement and capacity, Operation and maintenance of

conveying equipment. Food grain storage practices and structures – Traditional, improved and modern. Controlled and modified atmospheric storage. Cold storage design & operations and cooling load calculations.

Unit 8: Plant layout, Design, Instrumentation and process control

Computer aided design and analysis of machines and machine components. Materials, manufacturing processes, design of elements and selection of standard parts viz. pulley, chains, sprockets, bearings, belts, fasteners, hydraulic components, pipes, hoses. Plant design concepts and general design considerations, plant location, product and process design, process flow charts, equipment selection, plant layout. Design and selection of machinery for handling utilities like water, steam, fuel etc. and disposal of effluents and residues. Static and dynamic characteristics of instruments, Transducers elements, intermediate elements, indicating and recording elements. Measurement of motion, force, torque, power, temperature, humidity, pressure and flow. Physical and chemical sensors, biosensor.

Unit 9: Processing of Meat, Fish and Poultry Products:

Chemistry, Nutritional value and microscopic structure of meat tissue. Ante mortem inspection, principle and methods of slaughtering of various animals and poultry birds, Post mortem examination and Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Meat tenderization, meat preservation like curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Value addition and byproducts utilizations. Factors influencing keeping quality of meat. Processing and preservation of fish and its products. On board handling and transportation of fish. Preservation canning, smoking and freezing of fresh and sea water fish and its products. Utilization of by-products from fish processing industries. Structure and composition of egg, factors affecting egg quality. Quality measurement of egg. Preservation methods of shell eggs and egg products freezing- pasteurization- desugarisation. Technology of egg products viz. egg powder, albumen and flakes.

Unit 10: Food chemistry, microbiology and Quality Standards

Importance of microorganisms in food – primary sources of microorganisms in food – intrinsic and extrinsic parameters of food affecting microbial growth - Microbial spoilage of foods - Assessing microbial load in foods – microscopic, cultural, physical, chemical - Fermented and microbial foods - Food borne diseases and safety. Thermal death time and process time calculations. Classification, structure and functional properties of Carbohydrates, Proteins and lipids. Water soluble and fat soluble vitamins, role of minerals in nutrition. Proximate analysis of food constituents. Chemical and biochemical changes during processing and storage of foods. Classification and applications of enzymes, food additives, pigments and flavors in food processing. Principle and methods for subjective and objective quality evaluation of foods. Measurement techniques and instruments for food quality determination, destructive and non-destructive quality evaluation. International, National Food laws and standards – FSSAI, PFA, FPO, BIS, AGMARK, APEDA, FDA, ISO, GRAS, EU, CAC, TQM, GMP, GAP, HACCP. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Unit 11: Operational research/modelling/research methodology/ intellectual property and its management/concepts in laboratory techniques/research ethics

Optimization – Optimizing Single Variable Functions; Multi Variable Functions. Types of hypothesis. Testing of hypothesis. Research Design. Types of data, concepts of population, sample and sampling techniques. Basic probability theory and theory of distribution. Analysis of data: graphical and diagrammatic presentation, measures of central tendencies- mean, median, mode. Measures of dispersion-range, mean deviation and standard deviation, simple linear correlation and regression, tests of significance-test and chi square test. Methods of data collection: Schedules and questionnaire, survey, interview, case study, home visits, and scaling methods. Reliability and validity of measuring tools. Access to sequence database on the internet. Research methodology: Meaning, objectives and types of research, significance of research. Definition and identification of a research problem, justification, theory and hypothesis. Research design: Features of a good design, concepts of variables, experimental and control groups. Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers 'rights and biodiversity protection. Concepts in Laboratory techniques: Safety measures while in Lab; Handling of chemical substances; use of burettes, pipettes, measuring cylinders, flasks, separator funnel, condensers, micropipettes and vacuumpets; washing, drying and sterilization of glassware; Drying of solvents/ chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Media preparation; use and handling of different processing and testing equipment. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

Syllabus for

Ph.D. (Food Technology) in Food Process Technology

Unit 1: Food Chemistry and Nutrition

Water relationships in foods: water activity and its relevance to deteriorative processes in foods (chemical, enzymic, physical and microbial changes). Interactions among food components and their effect on sensory, nutritional and processing quality. Therapeutic, Parenteral and Geriatric nutrition and relevant food formulations. Amino acids classification, physical properties, chemical reactions, synthesis of amino acids in food fortification. Fatty acids nomenclature and classification, physical properties and chemical reactions. Biosynthesis of unsaturated fatty acids.

Unit 2: Food Product Development and Quality Evaluation

New Food Product Development (NPD) process and activities, Stage-Gate model NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe development; Food needs and consumer preference - Market survey and its importance. Process design, equipment needed; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; Quality, safety and regulatory aspects - Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination;

Unit 3: Fruits and Vegetable Processing

Physiology of development, ripening and senescence of fruits and vegetables, Harvesting and harvesting indices of fruits and vegetables, postharvest changes of fruits and vegetables, precooling and primary processing of fruits and vegetables. Minimal processing techniques. Enzymatic effects on flavor and texture of fresh-cut fruits and vegetables, preservative treatments for fresh-cut fruits and vegetables. Edible coatings, gas permeation properties of edible coatings, wettability and coating effectiveness. Utilization of by-products from fruits and vegetables processing industries. Valorisation of fruits and vegetable industries waste for developing active biomolecules.

Unit 4: Processing of Milk, Meat, Poultry and Marine Products

Present status of value added products from milk - method of manufacture – indigenous milk products - Whey powder, protein concentrate and isolate; Hygiene in milk product manufacture, assessment of hygiene requirements, CIP, HACCP outline, Testing of Milk and Milk Products, Treatment of Dairy Wastes. Current trends and prospects of meat industry - Abattoir Layout, designing - equipment, operation and maintenance of slaughter houses and processing plants - hygiene and sanitary conditions in meat processing plant-pre slaughter judging, inspection, grading of animals. Utilization of byproducts and wastes from meat. Advances in poultry dressing, meat yield, preservation, microbiology and quality control methods. standards and marketing of egg and egg products- preservation and maintenance of quality of eggs - spoilage of egg and its prevention packaging of egg and egg products. preservation of postharvest fish freshness; transportation in refrigerated vehicles; deodorization of transport systems; grading and preservation of shell fish; pickling and preparation of fish protein concentrate, fish oil and other by products.

Unit 5: Functional Foods and Nutraceuticals

Properties and functions of various nutraceuticals – functional food ingredients – protein, complex carbohydrate like dietary fibre as functional food ingredient – probiotic, prebiotic and symbiotic and their functional role. Concept of free radicals and antioxidants; antioxidants role as nutraceuticals and functional foods. ultra violet spectroscopy; infrared absorption spectroscopy; near-infrared absorption spectroscopy; mass spectroscopy; nuclear magnetic resonance spectroscopy; CHN analysis; x-ray crystallography Anti-nutritional factors present in foods - types of inhibitors present in various foods and their inactivation.

Unit 6: Food Packaging

Active and intelligent packaging - Oxygen, ethylene and other scavengers - Constructing an antimicrobial packaging system, Factors affecting the effectiveness of antimicrobial packaging - Non-migratory bioactive polymers (NMBP) in food packaging - Time- temperature indicators (TTIs) - Packaging-flavour interactions, Factors affecting flavour absorption, role of the food matrix, role of differing packaging materials - Novel MAP gases, Testing novel MAP applications - biodegradable packaging materials, emerging trends in packaging, food marketing and role of packaging.

Unit 7: Food Biotechnology

Chemical nature of the genetic material, properties, structure and functions of the genetic material - Plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; - Design of PCR primers, RT-PCR, qRT-PCR - Immobilization of enzymes; types of immobilized cell systems, large scale cell immobilization, uses and applications in industries - Testing for GMOs, current guidelines for production, release and movement of GMOs, labeling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004.

Unit 8: Food Microbiology

Foods as ecological niches, Relevant microbial groups, Microbes found in raw materials and foods that are detrimental to quality, Factors that influence the development of microbes in food, newer and rapid methods for qualitative and quantitative assay demonstrating the presence and characterization of microbes, Stress, damage, adaptation, reparation, death. Microbial growth in food: intrinsic, extrinsic and implicit factors, Microbial interactions, Inorganic, organic and antibiotic additives. Effects of enzymes and other proteins, Combination systems, Adaptation phenomena and stress phenomena, Effect of injury on growth or survival, Commercial available databases. Microbial behaviour against the newer methods of food processing, Adoption and resistance development, Microbes as test organisms, as sensors and as tools for future applications in energy production and food and non food industrial products. Modern methods of cell culture: synchronous and co- cell culture, continuous cell culture in liquid and solid media, Cell immobilization and applications, Pre and probiotics cultures.

Unit 9: Emerging Trends in Food Process Technology

Novel Thermal Techniques, dielectric heating Microwave processing - RF- heating, equipment, processing and effect on microorganisms, IR heating, Electrical resistance heating of food - heat generation - ohmic heater, heating models - principles and application - influence on microorganisms and food ingredients - Ultra filtration, Reverse Osmosis, Evaporation, Freeze concentration, drying techniques Hybrid drying, Spray Freeze drying, electro spray drying, Heat pump drying, Refractance window drying, Impingement drying - Freezing time estimation - High pressure processing of food - Ultrasound application- mechanism of inactivation of microorganisms and enzymes - Oscillating Magnetic Fields - Ozone for inactivation - Factors affecting efficacy of ozone Processing- Cold plasma concepts - microbial inactivation-quality of products-safety. UV light and pulsed light preservation - microbial inactivation mechanism. Pulsed Electric Field - Principles of operation - Equipment - processing - control parameters - Irradiation technologies - general mode of action - Equipment and operational parameters - ionizing radiation- dosimetry - lethal effects on microorganisms.

Unit 10: Statistical methods for food science & technology

Descriptive statistics, Mean, variance, probability, conditional probability, Probability distribution. Density functions, Mean variance. Data and its nature; data representation; diagrams and graphs using MS Excel, Measures of Central tendency; Dispersion, Skewness and Kurtosis; Binomial and Normal Distributions. Confidence Interval of mean; Test of significance; Non-parametric tests; Simple, Partial and Multiple correlations. Estimation, confidence intervals hypothesis testing, Basic principles of Experimental Designs; Analysis of Variance; Elements of Quality Control.