Indian Institute of Food Processing technology, Thanjavur
Post Graduate Entrance Examination- 2020
Ph.D. (Food Technology) in Food Process Engineering syllabus

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 variouscharts 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 convention 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/chainConveyors 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. Retails 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 flavorsin 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-**t**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 vaccupets; 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.