

Department of Post Harvest Engineering and Technology
Faculty of Agricultural Sciences
Aligarh Muslim University, Aligarh

Syllabus for Ph. D. Admission Test 2022-23 onwards

SECTION-B

Engineering Properties of Food Materials:

Physical properties of grain, fruits and vegetables: size, volume, density, porosity, surface area and their methods of determinations; Rheological properties of food material: force, deformation, stress, strain, elastic, plastic behaviour, concept of Rheology, ASTM standard definitions of terms related to mechanical properties, rheological models, visco-elasticity, creep-stress relaxation, Newtonian and Non-Newtonian fluids, rheological properties of solid and liquid food; Thermal properties of food material: Specific heat, thermal conductivity, thermal diffusivity; Aerodynamic, Hydrodynamic and Frictional Properties of food material: Drag coefficient, terminal velocity, Relation between Drag coefficient and Reynolds number, Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, Contact stresses between bodies, Hertz problems, firmness and hardness.

Unit Operations in Food Process Engineering:

Basic of engineering mathematics; units and dimensions, mass and energy balance, Principle of size reduction, types of size reduction equipment's, energy laws in size reduction, screening of solids, size measurement and its analysis, standard sieves, membrane separation processes; Mixing: equipment's for solid, liquid mixing; energy requirements, mixing indices. Food freezing: Properties of frozen foods; freezing point depression, general introduction to enthalpy change during freezing, Plank's equation for predicting freezing time; food freezing equipment such as air blast freezers; plate freezers and immersion freezers. Evaporation: Thermodynamics of evaporation; boiling point elevation; heat transfer during evaporation; heat transfer coefficients, retention time, single and multiple effect evaporator, Food dehydration: Basic principles of dehydration, constant rate and falling rate periods of dehydration, equilibrium moisture content, fixed bed dehydration, drum dehydration, and fluidized bed drying, spray drying of liquid foods, different types of dryer and their specific applications in food processing sector.

Transport phenomena in food processing

Momentum, heat and mass transfer phenomena and their analogous behavior; steady and unsteady state heat conduction; analytical and numerical solution of unsteady state heat conduction equations; use of Gurnie-Lurie and Heisler Charts in solving heat conduction problems; Equation of continuity; equation of motion; velocity distribution in circular pipes and parallel plates; Generalized form of equations and simplifications, expansion and reduction of basic transport equations to specific transport problems. Convective heat transfer in food processing systems involving laminar and turbulent flow, Convective heat transfer flow over flat plate, flow over cylinder, flow over spheres, Radiation heat transfer and its governing laws, its applications in food processing. Molecular diffusion in gases, liquids and solids, molecular diffusion in biological solutions and suspensions molecular diffusion in solids, unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing.

Food Packaging

Introduction of Packaging, Importance, definition and functions of food packaging, Packaging materials, suitability and cost factor, Glass, Metal, Wooden boxes, Crates, Plywood, Fibre board boxes, Textiles and Paper sacks, Plastics in food packaging, . Environmental factors and food stability; permeability to gases and vapours, Packaging tests; tensile strength, compression, bursting, tear and impact test for packages, integrity testing of packages, cushioning effect on packaged foods, deterioration of packaged foods, shelf life calculation for packaged foods, water activity and sorption isotherms, water activity and food stability

Packaging systems; Modified Atmosphere and Controlled Atmosphere Packaging, Aseptic packaging including techniques, aseptic systems

Applied Instrumentation

Instruments and its classification, functional elements of instruments; Static performance characteristics: accuracy, precision, sensitivity, etc; Types of errors in measurements; estimation of uncertainties in measurement systems; Dynamic performance characteristic: Formulation of system equation; frequency response of first and second order instruments for harmonic and step inputs; Transducer: Transducer principles, types of transducers; Measurement of food processing parameters: Temperature measurement using Bi-metals, PTRs, Thermistors, Thermocouples, Electronic IC sensors and Pyrometers; Heat flux measurement; humidity measurement – Dry and Wet bulb; Pressure measurement: Manometers, Bourdon Tube, Diaphragm type transducer; Flow Measurement: Flow transducers; Positive displacement, venturimeter, Rotameter, Drag force, Ultrasonic, Electromagnetic, Hot wire anemometers; Liquid measurement: BOD and pH measurement; PCO₂ and grain quality measurement.

Low Temperature Preservation

Introduction to thermodynamics: types of thermodynamic systems, energy interactions. First law of thermodynamics for closed and open systems; Second law of thermodynamics: Kelvin-Planck and Clausius' statements, Carnot cycle; Carnot theorem; Reversed Carnot cycle; Properties of pure substances and their representation on various property diagrams- PV, Ts, ph, hs diagrams; Refrigerants - nomenclature and properties; Vapour-compression, refrigeration cycle, Gas cycle refrigeration, Bell Coleman cycle; Steam-jet, refrigeration; Psychrometric chart; Psychrometric processes; Cold preservation of foods: freezing techniques- air freezing; Contact freezing, Immersion freezing.

Mass Transfer Operations

Vapour-liquid separation processes: Vapour liquid equilibrium relations, relative volatility, flash & batch distillation, steam distillation, vacuum distillation, distillation with reflux single, stage and multistage equilibrium contact for vapour-liquid separation processes. Extraction: Liquid-liquid extraction, liquid-liquid extraction equipment, single and multistage extraction, Leaching: Introduction, leaching equipment, Principles of single and multistage continuous-counter current leaching. Stage and continuous gas-liquids separation processes: types of separation processes and methods, equilibrium relations between phases; single and multiple absorption in plate and packed towers. Principles of mass transfer, introduction to mass transfer and diffusion, molecular diffusion in fluids, molecular diffusion in biological solutions, molecular diffusion in solids, diffusivity of fluids, mass transfer co-efficient in laminar flow of effective diffusivity.

Food Quality and Safety Engineering

Proximate constituents and their evaluation/analysis; Estimation of moisture content, ash content, protein, fat and sugar content; Ultimate constituents; vitamins and pigments analysis; Examination of canned food products; Sensory evaluation- methods; Difference; Rating Sensitivity tests and interpretation of results; requirements for sensory evaluation e.g. laboratory set up, panel selection etc; Measurement of colour and consistency, (CIE system, working principles of Hunter colour difference meter, viscosity FPO regulations, FDA standards and procedure; Quality Control criteria for different foods; Microbiological examination of food products; Food adulteration and its detection; HACCP and ISO 9000-22000 in food industry. (FSSAI, PFA, BIS, AGMARK).

Food Chemistry and Microbiology

Classification and biological functions and nutritional importance of vitamins, minerals, carbohydrates, proteins, fats and oils; Structures of mono, di and polysaccharides, optical isomerism in sugars; role of storage and structural polysaccharides in nutrition; properties of polysaccharides and their hydrolysis; physical and chemical properties of fats, and oils; Vitamins and minerals, their sources and importance in human health; Enzymes classification, kinetics of enzyme catalyzed reaction; Factors affecting the enzyme catalyzed reaction rate; Michaelis Menton equation and its derivation; Enzyme inhibitors; Food pigments and food flavor; Microbiology: Cell theory, difference between prokaryotic and eukaryotic cells, Haeckel's Kingdom protista, Whittaker five kingdom classification; Germ theory and Koch's

postulates; Structures and types of microbial cells (bacteria, molds and yeasts); Microbial Growth: Culture maintenance and preservation; Contamination of foods; Microbial spoilage of dairy products, meat, fish, poultry and egg products, fruits and vegetable products, Cereal grains, bakery and confectionery products, fermented and canned foods; Microbiology of water; Food infection and food intoxication.

Fruits and Vegetable Process Engineering

Importance of post harvest technology of fruits and vegetables; Structure, cellular components; Composition and nutritive value of fruits and vegetables; fruit ripening, spoilage of fruits and vegetables; Physiological disorders and mineral deficiency related disorders and their preventions; Preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables; Cold storage of fruits and vegetables; Controlled atmosphere packaging of fruits and vegetables, gas composition, quality of storage. Dehydration of fruits and vegetables: osmotic dehydration, foam mat drying, Freeze drying; Sensory evaluation of fruit and vegetable products.

Industrial Fermentation

Introduction and definition of fermentation and terms related to fermentation; Nutritional value of fermented food; Requirements of fermentation; Various substrates used in fermentation; Different types of fermenters; Traditional fermented foods: Sauerkraut, oriental fermented foods like soy sauce, miso, tempeh, sofu etc; dairy fermented products, cultured milk, yoghurt, cheese production; Production technology of baker's yeast; Citric acid production, uses of citric acid in food and other industries; Antibiotics production and vinegar production; Alcoholic fermentation, Importance, sources, cultivation, purification, separation and isolation of microbial enzyme, conversion to storage form and immobilization of enzymes; industrial application of enzymes.