

**DEPARTMENT OF POST HARVEST ENGINEERING & TECHNOLOGY
ALIGARH MUSLIM UNIVERSITY, ALIGARH**

Syllabus of Ph.D. Admission Test

**Section-A
Multiple Choice Questions**

Part I- Multiple Choice Questions on Research Methodology (40 Marks)

Writing Skills; Tenses, parts of speech, clauses, subject verb agreement, idioms and phrases, reading comprehension, synonyms-antonyms, hyponyms.

Mathematics and Statistics; Algebra, ordinary differential equations (ODE), numerical analysis, real and complex analysis, vector analysis, measure of central tendency, probability distribution function, deviation, standard deviation, and variance.

Research Formulation; Defining and formulating the research problem, Selecting the problem, Importance of Literature Review in defining a problem , Literature Review: Primary and secondary sources.

Part II- Multiple Choice Questions on Subject (10 Marks)

Food Engineering-I, Transport Processes, Refrigeration Engineering, Livestock and Aquaculture Food Products Processing, Food Engineering-II, Food Storage Engineering, Food Preservation Technology, Dairy Products Processing, Food Quality Standards and Regulations, Packaging and Handling of Foods, Fruit and Vegetable Processing, Technology of Bakery and Confectionery Foods, Industrial Fermentation, Process Instrumentation and Control.

**Section-B
Subjective Questions (30 Marks)**

Food Engineering-I: Dry and wet grinding, size reduction equipment, size measurement and analysis, standard sieves, Membrane separation processes, Fluidization Characteristics, liquid solid fluidization, minimum fluidization, voidage and minimum fluidization velocity, filtration and washing filter aids filter media, classification of filtration, Design of filtration equipment, Mixing and Agitation, Mixing phenomena, Flow pattern and impellers, vortex formation and prevention, Mixing equipment, Centrifugation, Material balance, Energy balance, kinetics of chemical reactions in foods.

Transport Processes: Transport phenomena, basic microscopic momentum transfer, laws of molecular transport, 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, Thermal energy and species transport equations, Steady, unsteady, unidimensional, multidimensional thermal energy processes, Molecular diffusion, Fick's law, diffusion in solids, liquids and gases, heat and mass transfer analogy.

Livestock and Aquaculture Food Products Processing: Status of meat industries, export oriented and integrated plants, municipal slaughter houses vs. modern slaughter house Meat composition, its nutritive aspect, meat production, animal and poultry slaughtering, post-mortem changes, physicochemical changes,

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post rigor condition of meat, PSE and DFD conditions of meat, whole sale cuts of carcass, Meat refrigeration, freezing, thawing and frozen storage, Cured meats-curing ingredients and their roles, methods of curing, Smoked meats composition of smoke, production of smoke, advantages of liquid smoke, Canned meat, Meat cooking- dry and moist cooking methods, its effect on quality, Sectioned and formed meat production method, tumbling and massaging Meat sausages-classification, ingredients and production technology of sausages, Meat Analysis and quality control, bacteriological tests, Rapid methods of analysis for fat, protein and moisture. Egg-composition, egg candling, storage and dehydration. Egg products processing, Fish preservation by icing, smoking, canning freezing, causes of fish spoilage. By products of meat, poultry and fish processing industry, Surimi production process, Types of fish, composition and nutritive value, factors affecting the quality of fish, Drying, Curing, salting, Smoking, Freezing and Canning of fishes, By-products of meat, fish, and poultry industry and their uses.

Refrigeration Engineering: 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- ideal heat pump and refrigerator, Reverse Carnot cycle for a gas and vapour as working substances, Properties of pure substances and their representation on various property diagrams-pv, Ts, ph, hs diagrams, Refrigerants-nomenclature and properties, Vapour-compression refrigeration cycle: definition of terms, simple and actual cycle with liquid refrigerant sub-cooling, vapour refrigerant superheating. Compound compression refrigeration system with inter-cooling, flash gas removal. Multi-evaporator systems, Vapour absorption refrigeration system: aqua ammonia system, Munters-Platen system, Gas cycle, refrigeration: Bell Coleman cycle, Steam-jet refrigeration, Psychrometrics: definition of terms, psychrometric chart, psychrometric processes, Cold preservation of foods: freezing techniques- air freezing, contact freezing, immersion freezing.

Food Quality standards and Regulations: Examination of canned food products, FAO/WHO Codex Alimentarius Commission standard of canned pine apple, particulars of specifications, essential composition, allowances and defects, standards and analysis of water, 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, Disc colorimeter, Lovibond Tintometer, Spectrophotometer), Primary and secondary texture characteristics-consistency (Bostwick and Adams consistometer), viscosity (Efflux tube viscometer, Brooke field viscometer), texture measurement, texture measuring instruments, texture profile analysis, 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 Engineering-II: Heat transfer- mode of heat transfer, Methods of heat generation and application to food, steady and unsteady heat transfer, thermal process calculation, Principle of Mass Transfer, Diffusion, Molecular diffusion in fluids, diffusivity of fluids, mass transfer co-efficient in laminar flow of effective diffusivity, Rheology of solid foods, Distillation – Vapour liquid equilibrium, relative volatility, flash & batch distillation, steam distillation, vacuum distillation, Distillation with reflux, McCabe Thiele Method of Calculation for number of theoretical Stages, total/minimum reflux ratio for McCabe-Thiele method,

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Extraction: Liquid-liquid extraction, liquid-liquid extraction equipment, Leaching: Introduction, leaching equipment, Principles of continuous-counter current leaching, Gas liquid extraction.

Food Storage Engineering: Storage losses in agricultural commodities, Grain Storage: levels of storage, physical properties of grain affecting storability, types of spoilage and factors of spoilage, Control of factors of grain spoilage: microorganisms, insects and pests, rodents and other vertebrates,

Rural storage structures for grains, Design considerations of bulk storage structures - grain pressure theories, air distribution systems and aeration fans, Design considerations of bag storage structures, Storage of perishables/ semi-perishables: factors of spoilage and their control, Advantages and limitations of refrigerated storage, Design aspects of cold storage-cooling load calculation and selection of components of refrigeration systems, Controlled atmosphere storage, biochemical aspect of CA storage, effects of concentrations of compositional gases on physico-chemical characteristics of Fruits and vegetables, Equipment for creating and maintaining controlled atmosphere.

Food Preservation Technology: Food preservation, Principles of heat preservation, high temperature preservation, evaluation of process time and time temperature combination. Nutritional losses due to thermal processing, Principles of evaporation, types of evaporators: single effect and multiple effect evaporator, batch type pan evaporator, rising film falling film evaporators, Low temperature preservation, difference among chilling, refrigeration and freezing, evaluation of freezing and thawing time, structural changes in foods during freezing and thawing, Methods of freezing. Intermediate moisture foods, Theory of microwave heating, Penetration depth of microwave, dielectric properties of food materials, working principle of magnetron. Principles of food irradiation: energy of radiation, effect of radiation on micro-organisms. Biological methods of food preservation: food fermentation, Dehydration of foods: basic dehydration process, dehydration systems: Tray or cabinet dryers, tunnel dryers, pulp drying, fluidized bed drying, freeze drying, changes in food during drying.

Fruit and Vegetable Processing: Introduction: Status of production and processing of fruits and vegetables in India. Challenges before fruit and vegetable processing industry in India and government promotional policies. Postharvest losses in fruits and vegetables and their reasons, Chemical composition and nutritional values of fruits and vegetables. Postharvest physiology of fruits and vegetables: biochemistry of respiration, respiratory responses of climacteric and non climacteric fruits. Physiological developments during maturation: Chemical and nutritional changes. Physiological disorders: chilling injury, its mechanism and preventive measures, mineral deficiency related disorders and their preventions, Processing techniques - Thermal processing: canning and bottling, drying/dehydration, concentration/ evaporation. Freezing, methods and equipment, Fermented and unfermented fruit beverages, Quality evaluation of fruit and vegetable products, By - product utilization, economic considerations in fruit and vegetable processing.

Technology of Bakery and Confectionery Food: Status of bakery food in India. Technology of bread production. Different methods of bread manufacture, Quality control tests, gluten test, alcoholic acidity, dough raising capacity etc. Bread making, equipment and machine used in different unit operations, Cookies & biscuits manufacturing technology, biscuit shaping/ cutting machine, raw materials bulk and others, Role of baking ingredients, quality control of bread biscuits production. PFA rules for raw materials & products, use of preservatives and flour improvers, emulsifiers and stabilizers. Technology of cake production, methods of

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cake production, cake quality, cake faults. Different types of cake pastry formulation and production various type of pastry. Wafers, rusks and their production. Losses in baking, packaging of baked products, Bakery sanitation & hygiene. Sugar confectionary, various types of sugar used in confectionary, typical confectionary products like fondants, lozenges and drops, toffees, caramels and fudges, Jams, jellies and marmalades, Cocoa processing, cocoa powder and cocoa butter, Chocolate confectionary production technology.

Industrial Fermentation: Introduction and definition of fermentation and terms related to fermentation, nutritional value of fermented food, requirement's of fermentation, various substrate 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.

Process Instrumentation and Control: Introduction to instrumentation, Classification of instruments. Functional elements of instruments and their presentation. Static performance characteristics: accuracy, precision, sensitivity, etc. Types of errors in measurements and their sources. 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, Bode plot method for response of higher order instruments.

Transducers: analog transducers-electromechanical transducers, opto-electric transducers, digital transducers-encoder discs, frequency domain transducers. Signal conditioners: amplifiers, filters, integrating and differentiating elements, analog-to-digital converters. Indicating, recording & display elements: CRO, galvanometric recorders and displays, servo type potentiometric recorder, etc.

Measurement of food processing parameters: Temperature, pressure, flow, specific gravity, viscosity, liquid level, humidity, etc. Instruments for the measurement of calorific value, dust concentration and pollution of water/air.

Dairy Products Processing: The milk: definition by PFA, nutritional importance and status of milk production and processing. Milk constituents: their roles and nutritional significance. Properties of milk: chemical and physical. Microorganisms in milk and their roles. Quality testes of milk: platform tests (sensory test, COB test, sedimentation test), alcohol alizarin, resazurine, MBR test, acidity, protein, fat, etc. Handling of milk: milk cleaning, chilling and transportation.

Types of market milks: full cream, standardized milk, toned, double toned milks and their production methods. Processing of fluid milk: pasteurization, sterilization, separation and homogenization. Technology of milk products: cream, butter, cheese, khova, whey, yoghurt, ice-cream, condensed and dried milk.

Packaging of fluid milk and dairy products: glass bottles, flexible pouches, aseptic packaging system. Cleaning and sanitization of dairy plant equipments/machineries: types of dairy detergents, methods and procedure of cleaning, basic principle of CIP cleaning.

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