**Syllabus for Ph.D. Entrance Test (Food Technology) -2025**

**UNIT I - FOOD MICROBIOLOGY**

**Scope of food microbiology**. **Microbial growth pattern**– Growth curve of microbial cultures, its application to food preservation. Factors affecting microbial growth- pH, moisture content, Eh, nutrient content, antimicrobial constituents, biological structures, extrinsic factors. Control of microbial growth in foods–High temperature, freezing, refrigeration, chemical preservatives, irradiation.

**Types of microorganism associated with food** –Mold, bacteria and yeast-general characteristics, morphological features, reproduction, physiological requirements, common molds associated with foods. Viruses- Structure and replication with particular reference to food born viruses. Biochemical changes caused by micro-organisms–Degradation of carbohydrates, fermentation, degradation of lipids, degradation of proteins and amino acids, putrefaction.

**Microbial contamination and spoilage of foods**–Vegetables, cereals, pulses, oilseeds, milk and meat during handling, processing and storage. Spoilage of processed foods-Canned products, causes of spoilage, appearance of spoiled cans, types of spoilage of canned foods by yeast, moulds and bacteria. **Food borne disease** – Staphylococcal gastroenteritis, Botulism, Listeriosis, Salmonellasis, Shigillosis. Toxicants of microbial origins –Aflatoxins, ochratoxins, patulin, botulim, enterotoxins. Detection of food borne pathogens - Physical, chemical and immunological methods of detecting microbes in foods with special reference to Staphyllococcus, Clostridium, Lysteria, Yersenia, Salmonella, Escherichia, Vibrio. **Biosensors**. **Techniques of inoculation**

**UNIT II - FOOD BIOCHEMISTRY**

**Water in foods**–Water activity and shelf life of foods, moisture sorption isotherms, hysteresis. Water solute interactions- Free water, bound water, interaction of water with ionic and non-ionic groups. **Carbohydrates**– Classification, Structure and properties. Chemical reactions in foods, starch gelatinization and retro-gradation, modified starches, alginate, pectin, carageenan. Non- enzymatic browning. Factors affecting the rate of non-enzymatic browning. **Lipids** - Classification, Structure and use of lipids in food, saturated and unsaturated foods, hydrogenation of fats. Physical and chemical properties of lipids–Lipid oxidation, rancidity, factors affecting rate of oxidization, methods to measure lipid oxidization, control of rancidity. Effect of processing on functional properties and nutritive value–Thermal decomposition, chemistry of frying.

**Protein and amino acids** - Physical and chemical properties, protein structure, forces governing stability of proteins, denaturating agents, Functional properties of proteins – Protein hydration, solubility, emulsifying properties, foaming properties. Modification of proteins –Alkylation, acylation, phosphorylation, esterification, enzymatic modification. Effect of processing on protein quality. **Enzymes in foods** –Papain, lipoxygenase, PPO, use of pectnaise, cellulase and amylase in food industry.

**Pigments in foods** –Heme compounds, chlorophyll, alteration of chlorophyll, preservation of chlorophyll during processing, carotenoids and their properties, anthocyanins, their properties and stability, betalains and their properties, use of pigments and biocolours. **Food flavours** –Taste modalities, sweet, sour, bitter and salty, astringency, pungency, flavours from lactic acid –ethanol fermentation. **Browning reactions –Enzymatic and non-enzymatic**, factors affecting their rate. **Food contaminants** - Additives and toxicants.

**UNIT III - PRINCIPLES OF FOOD PROCESSING**

**Status of Indian food industry**. Principles of Food Processing**. Thermal Processing** –Canning, Sterilization, Pasteurization, Extrusion. **Dehydration**–Water activity, types of dryers, effect of dehydration on food quality. Freeze drying. Intermediate moisture foods. **Fermentation**–Types, nutritional importance of fermented foods. **Preservation by chemicals** –Benzoate, sorbate, propionate, sulphur dioxide, anti-oxidants, Hurdle Technology **Irradiation**–Mechanism, dosimetery, equipment, effect of irradiation on micro-organisms, and on food. Safety and wholesomeness of irradiated foods. Aseptic processing–Equipment, characteristics, HTST and UHT processing,

**Membrane processing**–Advantages, types of membranes, equipments, applications and effect on foods. **Minimally processed foods**–Preservation and packaging of minimally processed foods. **Microwave processin**g–Electromagnetic spectrum, difference between microwave and infrared energy, dielectric constant, relaxation time, equipment and applications. **Refrigeration and frozen storage**- Components of refrigerator, freezing curves, equipment, freezing and chilling injuries. **Controlled atmospheric storag**e –Principle, design considerations, effects of CA storage on food quality. Modified atmospheric storage - Gas storage, hypobaric storage.

**UNIT IV – CEREALS, PULSES AND OILSEEDS**

**Cereals** - General introduction to cereals, new varieties, production trends of wheat, rice, barely, oats, corn, sorghum, pearl millet and minor millets in India. Structure and nutrients distribution in cereals. **Wheat**–Structure, types and composition of wheat grain, molecular basis of wheat grain hardness and softness. Milling of wheat–Quality of flour and flour treatment. Vital wheat gluten. Carbohydrates and Lipids in bread making. Enzymes of wheat and their technological significance. **Dough chemistry and rheology**. Technology of bread, biscuits, cakes, durum wheat and pasta products.

**Rice**- Grain structure, chemical composition, milling. By products of rice milling and their utilization. Parboiling of rice, effect of aging on rice quality, rice products, enrichment with vitamin and minerals, byproduct utilization. **Barley** -Chemical constituents, processing, pearling and malting of barley. **Corn** - wet and dry milling, corn flakes. Preparation of extruded products. **Millets**- Types, classification and processing technology

**Oilseeds** -Types of oil seeds and their chemical composition, oil extraction–Mechanical and solvent extraction. Refining of crude oils–Degumming, bleaching and deodorization. Processing of oil seeds for protein concentrates and isolates. Margarine manufacturing processing and its uses. Pulses- Structure and composition of pulses, their importance in Indian diet. Dhal milling and processing of pulses. Fermented and traditional products.

**UNIT V – FRUIT AND VEGETABLE TECHNOLOGY**

**Fruits and vegetables - classification and composition**. Fruit maturing and ripening indices. Principles and methods of fruit and vegetable preservation. Quality factors of fruits and vegetables for processing. **Principles of storage of fruits and vegetables.** Types of storage: natural, ventilated, low temperature storage, CA and MA storages.

**Preservation of fruits and vegetables**, by heat, chemicals, sugar, salt, fermentation, drying etc. Canning of fruits and vegetables, tin cans, glass containers, seaming technology. Aseptic canning technology. **Fruit & vegetables juices** - Preparation and preservation of juices, syrup, cordials, nectars, juice concentrate. Pectin and related compounds, jams, jellies, marmalades, preserves, candies. Theory of gel formation. Pickles and vinegar production, tomato products. Minimially Processed Fruits and Vegetables

**Drying and dehydration** of fruits and vegetables, problems related to storage of dehydrated products. Freezing and freeze-drying of food and frozen products. Post-harvest Physiology of Fruits and vegetables

**UNIT VI- ANIMAL PRODUCTS TECHNOLOGY**

 **Dairy industry in India** and its scope. Sources and composition of milk, nutritive value. Factors affecting composition of milk. Storage, transportation and distribution of milk. Processing of market milk- standardization, toning of milk, homogenization. Pasteurization and sterilization. **Milk products** - Processing of cream, butter oil, cheese spread, condensed milk, evaporated milk, whole and skimmed milk. **Production of Ice creams.** Quality control in Ice cream manufacturing. Production of fermented milk products. Instantization of milk and milk products. Judging and grading of milk and its products. In plant cleaning system. Quality standards of milk and milk products. Packaging of dairy products. By product utilization of dairy Industry. CIP, Technology of traditional dairy products.

**Meat industry-** Scope of meat industry in India with special reference to J&K. Sources of meat, composition and nutritive value of meat. Microscopic structure of meat. Factors affecting meat production and quality. **Slaughtering of animals and poultry**. Inspection and grading of meat. Factors affecting post mortem changes. Properties and shelf life of meat. Meat quality evaluation. Mechanical deboning. Meat tenderization and aging, pickling and smoking of meat.

 Meat plant sanitation and safety. By product utilization. Recent trends in meat processing. Traditional meat products of J&K. **Eggs** - Structure, composition, nutritive value and functional properties. Preservation of eggs by different methods. Factor affecting egg quality and measures of egg quality. **Fish** -Types, composition, structure. Post mortem changes in fish. Handling of fresh water fish. Canning, smoking, freezing and dehydration of fish. Radiation processing of fish. Fish sausage, fish oil and fish meal production.

**UNIT VII**- **FOOD PACKAGING**

**Introduction to packaging.** Packaging operation, package functions and design. Principles in the development of protective packaging.Deteriorative changes in foodstuffs and packaging methods for prevention.Shelf life of packaged food stuffs, method to extend shelf life. Migration of contaminants. **Food containers**–Rigid containers, Corrosion of containers (Tin plate).Can Fabrication.Flexible packaging materials and their properties–Bags, pouches, wrappers, cartons and othertraditional package.Shrink packaging, retortable pouches.Wooden boxes, crates, plywood and wire bound boxes. **Corrugated and fiber board boxes**.Textile and paper sacks.Factors affecting package stability.Special problems in packaging of food stuff.Consideration in packaging performance–WVTR, GTR, bursting strength, tensile strength, droptest, puncture test.

**Packaging equipments**–Can former; form, fill and seal machine; bags, shrink packing unit; tetra pack units. **Packaging standards** and regulations, labeling, regulations and functions of labelling. Flexible and laminated pouches, aluminum as packaging material. Biodegradable, edible and active packaging. Intelligent packaging. Nanosensors. Preservative packaging for fresh meats, poultry. Packaging requirements of fruits / vegetables, meat, milk, fruit juices and pulps, spices.

**UNIT VIII– FOOD ENGINEERING**

Unit and dimensions in food engineering. **Material balance** –Basic principles, total mass balance, component mass balance, numerical problems based on dilution, concentration and dehydration. **Fluid flow** - Fluid statics, fluid dynamics, fluid flow applications. **Heat transfer** - Modes of heat transfer, conduction, convection and radiation, blanching, pasteurization, distillation. **Energy balance** - Introduction to laws of thermodynamics, specific heat of solids and liquids, properties of saturated and superheated steam, steam tables, heat balance, numerical problems based on heat balanced.

**Heat exchanger**–scraped surface, double pipe, shell and tube and plate heat exchangers. Thermal process calculations- D Value, Z value, F value calculation of process time for canned foods. **Evaporation**–Single effect evaporators, multiple effect evaporators, steam economy, essence recovery during evaporation. **Dehydration** –Psychrometry, ERH, EMC. **Mechanical handling**- Conveying and elevation.

**Size reduction** – Elastic stress limit, yield point, Kicks law, Rittengers law, Bonds law. Equipment for fibrous foods – slicing, dicing, flaking, shredding, pulping and chopping. Equipment of dry foods –ball mills, disc mills, hammer mills, roller mills. Size reduction of liquid foods – homogenization. **Mixing** –Theory of solids mixing, theory of liquids mixing, equipment for low, medium and high viscosity foods. Mixtures for dry and fortified foods

**UNIT IX**- **FOOD ANALYSIS AND QUALITY ASSURANCE**

**Food sampling**- various methods of sampling, preservation of sample, Factors affecting sampling size. analysis of results. **Flame photometry –** Principle, instrumentation and applications. **Absorption spectroscopy -** Principle, instrumentation and applications. ICP. **X-ray analysis of Foods**-Properties, production & detection, x- ray tubes, detectors, x- rayfluorescence, sources, application in food industry. **Electrophoresis**–Applications, principles of separation of neutral molecules, separation of optical isomers and buffers. **Mass spectroscopy**–Components, Low voltage Mass Spectrometry, Quantitative analysis.

**Chromatography-**Different types (HPLC, GLC) their principles and applications. **Rheology measurement** - Farinograph, Amylograph, Viscosity measurement, Texture analysis. **Differential Scanning Calorimetry-** Principles, Instrumentation and applications. Scanning Electron Microscopy - Principles, Instrumentation and applications

**Methods of quality assessment**–Subjective & objective methods. Statistical quality control–X & R charts, steps for developing control charts. Properties of foods–Color, gloss, flavour, consistency, viscosity, texture & their relationship with quality. **Quality evaluation of foods**-Fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products. Establishment of food testing laboratory-Infrastructure requirement, design and accreditation considerations. National & International Food laws - FSSA 2006 Codex Alimentarius Commission, IPR and patents. GMP, HACCP. **Sensory evaluation** - Definition, objectives. Panel screening - Selection methods, interaction and threshold. Methods of sensory evaluation

**UNIT X**- **NEUTRACEUTICAL AND TOXICOLOGY**

**Neutraceutical** – Sources, Definition and Classification, Mechanism of action. Neutraceutical factors in specific foods. **Dietary fibre** -Types, Effects of fibre deficient diets, physical and physiological properties, hypocholesterolemic, hypolilpidemic and hypoglycemic effects, its role in prevention of CHD, **Probiotics and prebiotics** –common probiotic products, yoghurt, kefir and ice-cream. Health benefits of probiotics. Shikimic & Malvonic acid pathway, ROS, Oxidative stress

**Omega 3 fatty acids**- introduction, nomenclature. Biological and functional effects. Omega 3 fatty acids and insulin resistance. **Olive oil** – Composition and its health benefits. Phytochemicals and Antioxidants –Introduction, therapeutic properties of some common plants. Flavonoids, Carotenoids, capsaicinoids as disease prevention agents.

**Toxicology** – Basic concepts, dose effect and response, dose response relationship, statistical concept of toxicity, toxicity testing. Toxicological testing methods, manifestation of organ toxicity. Carcinogenesis, mutagenesis and teratogenesis. Measurement of toxicity and toxicants. Xenobiotics - absorption, translocation and excretion of xenobiotics. Biotransformation of bio xenobiotics. Naturally occurring toxins in foods –occurrence and denaturation.

**Food additives and their toxics effect** (Artificial sweeteners, dyes, preservatives, synthetic flavours). Toxins produced during processing. Poisonous forms of foods –mushrooms and sea foods. Heavy metals, radio nucleotides and industrial containments. Food packaging containments.