SYLLABUS FOR PHD ENTRANCE TEST
(FOOD TECHNOLOGY)

FOOD MICROBIOLOGY

Unit – I

- **History and scope of food microbiology**–Historical development in food preservation, food spoilage and food poisoning.
- **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.

Unit –II

- Types of microorganism associated with food –Mold-general characteristics, morphological features, reproduction, physiological requirements, common molds associated with foods.
- Bacteria–Morphological, physiological characteristics, important food spoilage and pathogenic bacteria, associated with foods.
- Yeast- General Characteristics, reproduction, cultural characteristics, physiological characteristics.
- 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.

Unit –III

- **Microbial contamination and spoilage of foods**–Vegetables, cereals, pulses, oilseeds, milk and meat during handling, processing and storage.
- **Microbiology of water and Atmosphere.**
- **Spoilage of processed foods** –Canned products, causes of spoilage, appearance of spoiled cans, types of spoilage of canned foods by yeast, moulds and bacteria.

Unit IV

- **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.*

FOOD BIOCHEMISTRY

Unit –I

- **Food chemistry** - Definition and importance. Approaches to the study of food chemistry, societal role of food chemists.
- **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 retrogradation, modified starches, alginate, pectin, carageenan. Non- enzymatic browning, Factors affecting the rate of non- enzymatic browning.

Unit –II

- **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.

Unit –III

- **Protein and amino acids** - Physical and chemical properties, protein structure, forces governing stability of proteins, denaturation.
- **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.
- **Loss of vitamins and minerals due to processing.**

Unit IV

- **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 effecting their rate.
- **Food contaminants** - Additives and toxicants.

PRINCIPLES OF FOOD PROCESSING

Unit –I

- **Food production**–Production of important food grains and pulses in India, consumption trend in India.
- **Status of Indian food industry**–Exports scenario of fruits, vegetables, spices, and their processed products.
- **Scope and importance of food processing**–Driving forces for food industry and constraints, challenges to food security, impact of WTO on food scenario, national and international perspective.
- **Approaches to combat world hunger.**

Unit–II

- **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**

Unit –III

- **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 processing–**Electro magnetic spectrum, difference between microwave and infrared energy, dielectric constant, relaxation time, equipment and applications.

Unit –IV

- **Refrigeration and frozen storage**- Components of refrigerator, freezing curves, equipment, freezing and chilling injuries.
- **Controlled atmospheric storage** –Principle, design considerations, effects of CA storage on food quality.
- **Modified atmospheric storage -** Gas storage, hypobaric storage.

PRINCIPLES OF FOOD ENGINEERING

Unit –I

- **Unit and dimensions** –Definition of dimension, unit, base unit, derived unit, precision, accuracy, systems of measurement, SI system, conversion of units, dimensional constant.
- **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 super heated 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.

Unit –II

- **Refrigeration–**Principle, refrigeration cycle, thermo dynamics of refrigeration system.
- **Food freezing**–Prediction of freezing time, chest freezers, blast freezers, belt freezers, fluidized bed freezers, immersion freezers.

- **Evaporation–**Single effect evaporators, multiple effect evaporators, steam economy, essence recovery during evaporation.
- Characteristics of building materials in relation to water and vapour.

Unit –III

- **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 foritilidae foods.

Unit –IV

- Food plant design - General consideration in designing the plant, plant location.
- Plant layout-types of layout considerations in efficient layout.
- Food plant hygiene –Cleaning, sterilizing, waste disposal methods.
- Engineering aspect of radiation processing.

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FOOD QUALITY ASSURANCE

Unit –I

- **Objectives, importance and functions of quality control.**
- **Methods of quality assessment**–Subjective & objective methods.
- **Sampling**–Types of samples, preparations & preservation of sample, sampling errors. Factors affecting sampling size.
- **Statistical quality control**–X & R charts, steps for developing control charts.

Unit –II

- **Properties of foods**–Colour , 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.

Unit - III

- **National & international Food laws**–AGMARK, PFA, FPO, Codex Alimentarius Commission, grades and standards. IPR and patents.

- **General hygiene and sanitation in food industry**–GMP, HACCP.
- **Food adulteration and food safety**–Physical, chemical & biological hazards in foods.

Unit IV

- **Sensory evaluation** - Definition, objectives.
- **Panel screening** - Selection methods, interaction and threshold.
- **Sensory evaluation methods / training**– Difference tests (Paired comparison, Duo Trio, Triangle), Rating (ranking, single sample, two sample, multiple sample, hedonic), sensitivity threshold test.
- **Instrumental analysis in quality control and food reheology**

FOOD PACKAGING

Unit –I

- 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.

Unit –II

- **Food containers**–Rigid containers, Corrosion of containers (Tin plate).
- **Can Fabrication.**
- **Flexible packaging materials and their properties**–Bags, pouches, wrappers, cartons and other traditional package.
- Shrink packaging, retortable pouches.
- Wooden boxes, crates, plywood and wire bound boxes.

Unit –III

- 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, drop test, puncture test.

Unit IV

- **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.
- Preservative packaging for fresh meats, poultry.
- Packaging requirements of fruits / vegetables, meat, milk, fruit juices and pulps, spices.

FOOD BIOTECHNOLOGY

Unit –I

- History and development of biotechnology.
- Scope and limitations of food biotechnology.
- Use of biotechnology in food industry, baking, fat and oil industry, fruit and vegetable industry, dairy industry.

Unit –II

- Application of genetics to food production. Basic concepts and methods of cloning, immobilization of microbial and cultured plant cells, Solid state and submerged fermentation, fermenter design.
- Principles of downstream processing- Bacterial starter culture, methods of inoculums and medium preparation, slurry processing and product isolation.

Unit –III

- **GM foods**– Safety aspects, consumer's attitudes marketing.
- Technological aspects of industrial production of enzymes (amylase, pectinase, proteases).
- Production of organic acids, amino acids, vitamins, antibiotics, baker'syeast,single cell proteins, enzymes.
- **Immobilized enzymes** –Methods of immobilization, effects of immobilization.

Unit –IV

- **Sprouts**–Bio-chemical changes during sprouting, nutritional significance.
- **Fermented foods**–Origin, scope and developmental, sauerkraut, yoghurt, cheese, miso, tempeh, idli, dosa, cider, fruit vinegar, vegetable pickle, traditional dairy products (kaladi).
- Regulatory and social aspects of biotechnology of foods.

ADVANCED TECHNIQUES OF FOOD ANALYSIS

Unit –I

- Role of analyst, various methods of sampling, analysis of results.

- **Refractometry**–Theory, instrumentation, specific & molar refraction, variables affecting refractive measurements, its applications, types of refractometers.
- **Principles and application of colorimetery**– Optical aspects (hue, value, chroma), tristimulus colour system, tintometers & hunter lab CDM.
- **Flame photometry**–Concept of ground state, excited state, ionization energy. resonance line, inferences , components of flame emission spectrophotometer.

Unit - II

- **Principles and application of atomic absorption spectroscopy**–Components of atomic absorption spectroscopy, ICP.
- **X-ray analysis of foods**–Properties, production & detection, x- ray tubes, detectors, x- ray fluorescence, 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.

Unit - III

- **Chromatography**–Different types (HPLC, Paper Chromatography, TLC, GLC) their principles and applications.
- **Rheology measurement**–Farinograph, Amylograph, Viscosity measurement, Texture analysis.

Unit IV

- Enzymatic methods, DSC, SEM.
- Rapid methods of microbial analysis, immunoassays.
- **Nuclear magnetic resonance (NMR)** –Principle, Components, Interpretation of NMR spectra, application of NMR.

CEREAL, LEGUME AND OIL SEED TECHNOLOGY

Unit –I

- 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.

Unit –II

- 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.
- Manufacturing techniques, uses and functionality of vital wheat gluten. Structure and functionality

of wheat proteins. 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.

Unit –III

- Rice- Grain structure, chemical composition, milling, milling machine.
- Effect of different factors on milling yield and rice quality. 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.
- Chemical constituents, processing, pearling and malting of barley.
- Corn - wet and dry milling, corn flakes.
- Preparation of extruded products.

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

FRUIT AND VEGETABLE TECHNOLOGY

Unit –I

- Fruit maturing and ripening indices.
- Principles and methods of fruit and vegetable preservation.
- Composition and related quality factors for processing.
- Principles of storage of fruits and vegetables.
- Types of storage: natural, ventilated, low temperature storage, CA and MA storages.

Unit –II

- 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.

Unit –III

- 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.

Unit –IV

- Drying and dehydration of fruits and vegetables, problems related to storage of dehydrated products.
- Freezing and freeze-drying of food and frozen products.
- Fruit products order (FPO) and quality control. .

STATISTICS AND COMPUTER APPLICATIONS

Unit –I

- **Collection of data:** Sources and methods.
- **Sampling:** Steps and techniques, size of sample, sampling and non- sampling errors**.**
- Processing operations, Presentation of data scaling techniques**.**
- Measures of central tendency: Mean, Median and Mode.

Unit –II

- **Measures of dispersion:** Quartile deviation, Mean Deviation, Standard deviation, Coefficient of variation.
- Correlation Analysis: Concept and significance, Karl parson's coefficient of correlation and concurrent deviations (Ungrouped data).
- Regression analysis: Lines of regression and Regression equations.

Unit –III

- **Testing of hypothesis:** Chi- square, t-test and F- test
- Analysis of variance: Concept and assumptions, Computation of one way analysis of variance.
- Experimental Design: RBD and LSD.

Unit IV

- **Introduction to Computer Softwares**: Operating systems: Types and differences, Application software.
- **Introduction to MS- excel**: Functions and formulae.
- **Software packages**: SPSS and Mini-tab.

NEUTRACEUTICALS AND FOOD TOXICOLOGY

Unit –I

- **Introduction** - Definition, Classification of neutraceutical factors.
- Food and non food sources.
- 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.

Unit –II

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

Unit –I11

- Basic concepts of toxicology- 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.
- 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 and their toxic effects.
- Toxins produced during processing.

Unit –IV

- Poisonous forms of foods –mushrooms and sea foods.
- Heavy metals, radio nucleotides and industrial containments.

- Food packaging containments.
- Residues in animal products.
- Residues in plant products.
- Anti obesity food supplements and toxic effects.

TECHNOLOGY OF MILK AND MILK PRODUCTS

Unit –I

- Diary industry in India and its scope.
- Sources and composition of milk, nutritive value.
- Factors affecting composition of milk.
- Processing of market milk- standardization, toning of milk, homogenization.

Unit –II

- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products - Processing of cream, butter oil, cheese spread, condensed milk, evaporated milk, whole and skimmed milk.

Unit –III

- Production of Ice creams.
- Quality control in Ice cream manufacturing.
- Production of fermented milk products.
- Instantization of milk and milk products.

Unit –IV

- 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.

TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS

Unit –I

- 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.

Unit –II

- 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.

Unit - III

- Meat plant sanitation and safety.
- By product utilization.
- Recent trends in meat processing.
- Traditional meat products of J&K.
- Structure, composition, nutritive value and functional properties of eggs.
- Preservation of eggs by different methods.
- Factor affecting egg quality and measures of egg quality.

Unit –IV

- Types of fish, composition, structure.
- Post mortem changes in fish.
- Handling of fresh water fish.
- Canning, smoking, freezing and dehydration of fish.
- Fish sausage.
- Radiation processing.
- MFPO.