

SYLLABUS FOR RESEARCH ENTRANCE TEST (RET-2014)

Ph. D. in Agriculture and Environmental Sciences

Unit-1: Crop production techniques for cereals, millets, legumes, oilseeds, fiber crops; Commercial varieties of fruits and vegetables - regional, national and international importance, physiological disorders- causes and remedies; Quality improvement by management practices-maturity indices, harvesting, grading, packing, storage and ripening techniques; Industrial and export potential; Agri. Export Zones (AEZ) and industrial supports.

Unit-2: Vitamins- biochemical functions and deficiency diseases; Fats and lipids-types of fatty acids and their significance in health; Biochemical composition and food value of various food grains (including cereals, pulses, oil seeds), fruits and vegetables; Antioxidants; Nutraceuticals; Food toxins and anti-metabolites; food additives; storage proteins.

Unit-3: Importance and scope of post harvest management of fruits and vegetables; Maturity indices and standards for different fruits and vegetables; methods of maturity determinations; physiology and biochemistry of maturity and ripening, enzymatic and textural changes, ethylene evolution and ethylene management, respiration, transpiration, regulation methods; Harvesting tools, harvesting practices for specific market requirements; post-harvest physiological and biochemical changes, disorders-chilling injury in fruits and vegetables, influence of pre-harvest practices and other factors affecting post harvest losses, packaging house operations, commodity pre-treatments- chemicals, wax coating, pre-packaging and irradiation; packaging of vegetables, post harvest, diseases and prevention from infestation, principles of transport; Methods and practices of storage- ventilated, refrigerated, MA, CA storage, hypobaric storage, pre-cooling and cold storage, zero energy cool chamber; storage disorders. Physical, physiological and chemical control of post - harvest deterioration of fruits, vegetables and its significance during storage and transport, Molecular approach in regulation of fruit ripening, Transgenic technology for improvement of shelf-life. post harvest technology of food grains (cereals, millets, legumes, oilseeds, fiber crops)

Unit-4: Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems and environment; Energy exchange and productivity-food chains and food webs-ecological pyramids, nutrient cycles and recycle pathways; Composition of air; Air pollution: sources, Effects of air pollutants on crops, vegetation, animals and human health; mitigation measures for combating air pollution; Global warming and greenhouse effect, sources and sinks of green house gases, major GHGs, analytical techniques of monitoring greenhouse gases in atmosphere; Stratospheric ozone layer depletion-effect of UV radiation on plants and human health; Soil and water pollution: sources and types of soil and water pollutants; Effects of pollutants on soil health and productivity; Point and non-point sources of water pollution, major types of water pollutants, their impacts on environment and agro-ecosystems; Resource, product recovery, recycling and value addition to wastes.

Unit-5: Isolation and purification of nucleic acids; Nucleic acids hybridization: Southern, northern and western blotting hybridization; Molecular biology of various stresses, viz. abiotic stresses like drought, salt, heavy metals and temperature; and biotic stresses like bacterial, fungal and viral diseases; Signal transduction and its molecular basis, molecular mechanism of plant hormone action mitochondrial control of fertility, structure, organization and regulation of nuclear gene concerning storage proteins and starch synthesis; Basic techniques in cell culture and somatic cell genetics, Regulation of cell cycle and cell division, Clonal propagation, Concept of cellular totipotency, anther culture, somaclonal and gametoclonal variations.

Ph. D. in Basic and Applied Sciences

Unit- 1

Macromolecules structure & Chemical properties of: Carbohydrates- Monosaccharide, Oligosaccharides, Polysaccharides. Lipids-Saturated fatty acids. Unsaturated fatty acids, Composition of fat, Phospholipids, Sphingolipid, Chemical deterioration of lipids, Amino acids, Peptide, Proteins-Primary, Secondary, Tertiary & Quaternary structure, Chemical modification of proteins.

Unit- 2

Definition scope and general principles of food toxicology, Manifestation of toxic effects, Safe food, Safety and Quality of food, Contaminant and adulterants in Food, Classification of contaminants: Physical, Chemical and Biological, Source of various contaminants, Food Safety issues from food processing and food packaging, Food additives: preservatives, antioxidants, artificial sweeteners, colouring agents, flavouring agents and flavour enhancers: Toxic effects and regulations. Dose response, LC₅₀, LD₅₀, ADI, TDO, MRL values.

Unit- 3

Micro-organisms in natural food products and their control. Microbial contamination in different categories of food products: vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Newer and rapid methods for qualitative and quantitative assay demonstrating the presence and characterization of microbes.

Unit- 4

Use of analytical techniques for food analysis: Chromatography, Spectroscopy, Polarimetry, thermal methods, Rheology of food products, Moisture analysis.

Unit- 5

Status of food industry in India. Sources of food and their classification- plant foods, animal foods, sea foods. Mechanism and Techniques: Types of preservatives, Advantages of preservation, mechanism of food preservations. Techniques of food preservations- thermal/heat processing(microwave, dielectric), chilling, freezing, chemical, fermentation, irradiation.

Unit- 6

Fermentation technology, Fermented food products. Application of genetic engineering to food production, Basics principles, methods and Application of Recombinant DNA technology to foods. GM foods, Cell Culture for foods, Basics in Food Bioinformatics.

Ph. D. in Food Business Management and Entrepreneurship

Unit 1: Production and Operation Management

Production and operations function and its relations to other management functions of an organization. Work System Design: Process planning, Method Study, Facilities layout, Line Balancing, Work Measurement, Work sampling and its applications. Work Flow Systems: Pull and push system, MRP, MRP-II, JIT, Cellular and FMS. Automated production lines. Manufacturing planning and control: Aggregate production planning, Master Production Scheduling, Shop Scheduling and Shop Floor Control. DRP and Demand Management. Materials Flow Control: Raw Material and WIP inventory control, JIT purchasing, Lead time control. Quality Assurance and Control: Statistical process control, Process capability improvement, Sampling inspection, Total Quality control, Quality Circle, Kaizen and other small group activities.

Unit 2: Innovation Management and New Product Development

Introduction to new product development, Proposal presentation for the new product/services, market feedback through survey and primary information collection and interpretation. Role of design, Customer and user needs assessment, Innovation and managing innovation, procedure for new product development, market research- photo type development – market testing – feedback- commercial production- feedback- improvement. Concept Development: context and planning, frameworks for understanding customer needs, Concept generation, Translating the voice of the customer, Concept Selection, Concept testing overview.

Unit 3: Food Economics

Introduction to economics, evolution of economic theory, micro and macro economic, equilibrium, utility analysis: law of diminishing marginal utility and law of equi marginal utility and their practical applications in food industry. Demand analysis: concept, law of demand, elasticity of demand, demand forecasting, Supply analysis; concept, law of supply, elasticity of supply. Applications in food industry, Production analysis: production function, laws of production, economics and diseconomies of scale. Cost and revenue curves and their relationships. Market structure: Price determination under different forms of market structures.

Unit 4: International Business in Food Sector

Concept of IB : Nature & importance of International Business, Modes of International Business. Cultural, Economic, Legal & Political environment faced by International Business. Globalization: features forces and effects; International Trade and FDI; Government Influence on trade, BOP, BOT, Exchange rate (in brief), Government and International Business: Rationale for interventions; Instruments of government interventions: tariff and non-tariff barriers, Trade Promotion Bodies and Councils: FIPB, ECGC, APEDA, International Trade and global institutions: WTO, UNCTAD, IMF, etc. Regional Trade Blocks (NAFTA, ASEAN, SAFTA, etc.). International trade practices in India: EXIM Policy, Foreign Trade Policy, Export import incentives.

Unit 5: Human Resources Management

Human Resources Management (HRM): Meaning and Scope, Difference between HRM and Personal Management, HRM functions and objectives, Role of HR managers. Strategic Human Resources Management: Nature of Strategies and Strategic Management, Strategic Management Process – Environmental Scanning, Strategy Formulation implementation and evaluation. Human Resources planning: Definition, purposes, processes and limiting factors; Human Resources Information system (HRIS): HR accounting and audit, Job Analysis – Job Description, Job Specification. Recruitment policy, recruitment procedures, recruitment methods and evaluation. Selection methods, the offer of employment, and evaluation of process. Training and Development: Purpose, Methods and issues of training and management development programmes, Evaluation of training Performance Appraisal:

Definition, Purpose of appraisal, Procedures and Techniques including 360 degree Performance Appraisal, Job Evaluation. Compensation Administration: Nature and Objectives of compensation, components of pay structures in India.

Unit 6: Principles of Management

Introduction to management and organizational environment- Management: Concept, process, principles and functions, levels of management, managerial roles, skills and competencies, Social Responsibilities and managerial ethics, Evolution of management thoughts: - Scientific Management, general administrative management, behavioural management theory- Maslow Needs Hierarchy, Theory X, Y, and Z toward understanding organizational behaviour, System Approach, Contingency theory, New thinking on management. Planning: concept, process, types and models, objectives and goals, hierarchy of objectives, MBO. Organizing- Defining organization structure-Organization charts Basics Departmentation formats Changing shapes of organizations Span of Control, Centralization and decentralization, Authority and Responsibility, Decision making: concept, process, types and challenges for decision. Individual and group decision making Motivation concepts and theory, Controlling-Control: process, tools for controlling.

Unit 7: Project Planning and Management

An Overview and Key Concepts of Project Management, Project planning & Project Feasibility Studies. DPR preparation for the project. Structures & techniques adopted by Project Management Institute (PMI). Human Aspects in Project Management, Project Scheduling with PERT/CPM, contingencies arrangement or plan 'B' preparation. Time-Cost-Trade-Off and Crashing of Projects.

Unit 8: Strategic Business Management

Understanding strategic and strategic management process, Levels of strategy, Basic model of strategic management, vision, mission, goal, objectives. Corporate mission and objectives: Concept of synergy and its importance in strategic management. Scanning the Environment: Environmental scanning and industry analysis, Internal Scanning SWOT analysis, Porter's model to determine industry attractiveness. Identifying Strategies. Alternatives, Growth strategies, mergers and Take-over, Joint ventures, Harvesting and retrenchment strategies. Peter Drucker's MBO, Minsberg and Micheal Porter. Selecting a Strategy: Evaluating strategic alternative-BCG Model, GE business planning grid, Royal Dutch/Shell's Directional Policy Matrix, Hofer's Product/Market Evaluation Portfolio Matrix. Strategy Selection Implementation: Strategy-structure fit, developing.

Ph. D. in Food Engineering

Unit 1: Engineering Properties and Quality of Biomaterials

Properties of food material (i.e. shape, size, volume, density, porosity, surface areas, friction, rolling resistance, angle of repose etc). Properties of bulk particulate solids (i.e. specific surface area, mean diameter, flow rate, Aerodynamics drag coefficient and terminal velocity, pressure drop through packed beds etc). Thermal properties (i.e. specific heat, thermal conductivity, thermal diffusivity. Dielectric properties viz. dielectric and microwave radiation, dielectric constant, energy absorption, heating etc). Optical properties and transmittance and reflectance. Rheological properties and stress-strain-time relationship.

Unit 2: Heat and Mass Transfer

Fluid transfer & continuity equation, Newtonian and non newtonian fluids, velocity, flow rate, pressure drop etc. Basic laws of thermodynamics, thermodynamic properties and processes, energy equations, heat, work, heat engine, heat pump, refrigeration and steam tables. EMC, sorption and desorption isotherms, water activity and psychrometry. Heat transfer and heat exchanger. Mass transfer and mass-heat-momentum transfer analogies.

Unit 3: Post Harvest Unit Operations

Unit operations i.e. cleaning, washing, grading, sorting, shelling, dehusking, decortication, milling, polishing, pearling, drying (evaporative, osmotic, air and freeze drying), pasteurization and sterilization of liquid foods, kinetics of microbial death, size reduction, cryogenic grinding, granulation, crystallization, filtration, membrane processing, microfiltration, ultra-filtration, nano-filtration, reverse osmosis, evaporation, distillation, mixing, clarification, coagulation, mechanical separation, sedimentation, pressing, expelling, leaching, extraction, palleting, extrusion, fermentation.

Unit 4: Material Handling, Packaging and Transport

Bulk conveying equipments viz. belt conveyors, screw/auger conveyors, bucket elevators and drag/chain conveyors. Estimation of energy requirement, damage to products during mechanical handling. Operation and maintenance of conveying equipments. Packaging material characteristics and selection. Packaging techniques and equipments for liquid, powder and granular materials, and horticultural produce. Recent trends in packaging: aseptic, Modified atmosphere packaging, controlled atmosphere packaging, Nano-composite packaging, Smart and active packaging, Edible films, Antioxidant and anti microbial packaging. Transportation of food by bullocks, trailers, trucks, rail wagons and containers. Refrigerated containers and trucks for perishable foods. Safety standards in handling, packaging and transport of agricultural produce.

Unit 5: Design of Processing Machinery

Design considerations of grain cleaners, graders, dryers, parboiling plants, size reduction machines, fermenters, centrifuges, cyclones, heat-exchanger, evaporators, filters, extrusion cookers etc and manufacturing processes.

Unit 6: Novel Food processing techniques

High pressure processing, Pulsed electric field, Pulsed UV light, Ultrasound, Ohmic heating, Irradiation.

Ph. D. in Food Science and Technology

Food Science: Carbohydrates, Proteins, Lipids, Pigments, Food flavours, Enzymatic and non-enzymatic browning; Nutrition: Balanced diet, Essential amino acids and fatty acids, PER, Water soluble and fat soluble vitamins, Role of minerals in nutrition, Antinutrients, Nutrition deficiency diseases, General Characteristics of microorganisms, Microbial growth in food: Intrinsic and extrinsic factors, Growth and death kinetics, serial dilution method for quantification; Microbial Food spoilage, Food borne illness Food Fermentation.

Food Products Technology: Processing principles: Canning, chilling, freezing, dehydration, control of water activity, CA and MA storage, fermentation, hurdle technology, addition of preservatives and food additives, Food packaging, cleaning in place and food laws.; Grain products processing: Milling of rice, wheat, and maize, parboiling of paddy, production of bread, biscuits, extruded products and breakfast cereals, Solvent extraction, refining and hydrogenation of oil; Fruits, vegetables and plantation products processing: Extraction, clarification concentration and packaging of fruit juice, Production of jam, jelly, marmalade, squash, candies, and pickles, pectin from fruit waste, tea, coffee, chocolate and essential oils from spices; Milk and milk products processing: Pasteurized and sterilized milk, cream, butter, ghee, ice-cream, cheese and milk powder; Animal products processing: Drying and canning of fish, post mortem changes, tenderization and freezing of meat, egg powder. Basic food engineering - Heat transfer: Heat transfer by conduction, convection, radiation, boiling and condensation, Unsteady state heat transfer in simple geometry, NTU- effectiveness relationship of co-current and counter current double pipe heat exchanger; Thermal operations: Energy requirement and rate of operations involved in process time evaluation in batch and continuous sterilization, evaporation of liquid foods, hot air drying of solids, spray and freeze-drying, freezing and crystallization; Mass transfer operations: Properties of air-water vapour mixture; Humidification and dehumidification operations.