Ph.D. Programme
College of Agriculture
Agri. Meteorology Syllabus

Unit-I: Solar radiation and laws of radiation; greenhouse effect, albedo, and heat balance of the earth and atmosphere; variation of pressure and temperature with height, potential temperature, pressure gradient, cyclonic and anticyclonic motions; geostropic and gradient winds; equations of motion; general circulation, turbulence, vorticity and atmospheric waves. Effect of earth's rotation on zonal distribution of radiation, rainfall, temperature, and wind; the trade winds, equatorial trough and its movement; the SE Asia monsoon, El Nino, La Nina and ENSO.

Unit-II: Meaning and scope of agricultural meteorology; components of agricultural meteorology; role and responsibilities of agricultural meteorologists. Importance of meteorological parameters in agriculture; weather forecasts for agriculture at short, medium and long range levels; agromet advisories, preparation, dissemination and economic impact analysis; introduction to GIS, GPS and remote sensing; Concept, definition, types of drought and their causes; prediction of drought; crop water stress index and crop stress detection; air pollution and its influence on vegetation. Concepts of mechanistic and deterministic models; weather data and phenology-based approaches to crop modeling; validation and testing of models. Climatic change, greenhouse effect, CO_2 increase, global warming and their impact on agriculture; climate classification, agro-climatic zones and agro-ecological regions of India and Haryana.

Unit-III: Properties of atmosphere near the earth's surface; exchange of mass, momentum and energy between surface and overlaying atmosphere. Molecular and eddy transport of heat, water vapour and momentum, frictional effects, eddy diffusion, mixing length; temperature instability; microclimate near the bare ground, soil moisture and temperature variation with depth; Richardson number, Reynold's analogy. Micrometeorology of plant canopies; distribution of temperature, humidity, vapour pressure, wind and carbon dioxide; modification of microclimate due to cultural practices, intercropping; radiation distribution and utilization by plant communities, leaf temperature and its biological effects; concepts of evapotranspiration and its estimation approaches.

Unit-IV: Fundamentals of measurement techniques; exposure and operation of meteorological instruments/ equipments in Agromet Observatory; theory and working principles of radiation and temperature instruments, precipitation, dew and wind instruments. Working principles of evapotranspiration and photosynthesis instruments, soil thermometers, soil heat flux plates and instruments for measuring soil moisture. Automatic weather station – data logger and sensors, nano-sensors for measurement of weather variables; computation and interpretation of data.

Agribusiness

UNIT1: Management functions- planning, organizing, staffing, motivating and leading, controlling; Managerial skills; levels of management; Decision making; Management by objectives; Nature, scope and significance of organizational behavior; leadership styles, group dynamics, motivation, organizational culture or climate, conflict management, organizational change; Human resource planning, Job analysis, recruitment and selection, Human resource Training and Development, Performance Appraisal, Compensation management, Worker's Participation in Management; Meaning, types, and process of research; Research methodology in management- exploratory, descriptive, experimental, diagnostic; Problem formulation, formulation of hypotheses, scales of measurement, sources of data, instruments of data collection; Sampling - Probability and non-probability sampling techniques.

UNIT 2: Role of agriculture in Indian economy; Definition, nature, scope, prospects and types of Agribusiness; Unique features of agri-products; Buffer stock; procurement and working of Public Distribution System; Working and Functioning of organizations such as Food Corporation of India, Cotton Corporation of India, NAFED & Warehousing Corporations; Delivery system and channels in marketing of Seeds, Fertilizers, Agricultural Machinery, Pesticides; Meaning, types and determinants of demand, demand function, demand elasticity, production function, least-cost input combination and returns to scale, cost concepts, cost-output relationship, pricing and output under different market structure; The national income; economic growth, phases of business cycles; Farm management problems and decisions; Farm management Principles; Farm planning and budgeting, Risk and uncertainty in farming.

UNIT 3: Need, scope and functions of financial management; importance of agricultural finance, classification of credit, estimation of credit requirement, 3Rs of credit, balance sheet, income statement, cash flow statement for an agribusiness unit; Financial and operating leverage; factors affecting capital structure, features of an optimal capital structure; concept and components of working capital, need for working capital in agribusiness; functioning of cooperative credit institutions, commercial banks, regional rural banks & NABARD; Ecology of cooperative administration, cooperative sector and economic development; nature, functions and purpose of cooperatives; role of leadership in cooperative management; The state and cooperative movement, effects of cooperative law in management, long range planning for cooperative expansion, policy making; credit cooperatives, cooperative marketing, dairy cooperative.

UNIT 4: Agricultural market structure – meaning, components and dynamics of market structure; Formulation of marketing strategy; Agribusiness marketing environment; Design of marketing mix; Market segmentation and targeting; Determinants of consumer's behaviour, Stages and estimation of demand of new product; Product life cycle: Grading and standardization; Storage and warehousing, and transportation management for agricultural products; Marketing agencies/intermediaries, distribution channels involved in agribusiness; Nature and characteristics of rural markets, potential of rural markets in India, rural communication and distribution, Marketing of consumer durable and non-durable goods and services in the rural markets, innovation in rural marketing; WTO and its implications for agriculture sector; TRIPS, TRIMS quotas, anti dumping duties, quantitative and qualitative restrictions, tariff and non-tariff measures, trade liberalization, subsidies, green and red boxes, Importance of foreign trade.

Agricultural Economics

Unit-I

Basic concepts in micro and macro economics, theory of consumer behaviour-cardinal and ordinal utility approach, Income and substitution effects, Indifference curve , Consumer surplus, Derivation and elasticity of demand and supply., producers' surplus. Market equilibrium, behavior of firms in competitive markets, different market structures, theory of factor markets, general equilibrium theory, market failure and externalities, welfare economics, pareto optimality, social welfare criteria and functions. Nature and scope of macro economics, Keynesian concepts, national income concepts and its measurement, classical and modern theory of employment, effective demand. Consumption function, concept of multiplier and accelerator, rate of interest - Classical, Neo-classical and Keynesian version, classical and Keynesian theory of unemployment, quantity, theory of money, Inflation: nature, types, effects and control, IS & LM framework, general equilibrium of product and money markets, monetary and fiscal policy, business/trade cycles and economic growth models.

Unit-II

Nature, scope, significance of production economics and farm management, principles of farm management, farm resources and farm planning, farm inventory and budgeting, basic concepts in production economics, production functions-types and specifications, theory of product choice; selection of optimal product combination, types of costs and cost functions, returns to scale, profit maximization and cost minimization, economies and diseconomies of scale, types of farming and farming systems, appraisal of farm business income and efficiency measures, technical, allocative and economic efficiencies, risk and uncertainty, diversification and crop insurance. Basic concepts in agricultural finance, 3R's and 7P's of credit, institutional and non-institutional sources of credit, tools of financial management,project, project cycle, planning and appraisal of agricultural project

Unit-III

Concepts in agricultural marketing, marketing problems, functions, intermediaries and marketable & marketed surplus estimation, efficiency, marketing costs and margins, market integration different approaches for marketing- functional, institutional, commodity, behavioural system and legal economic approach. Cooperative marketing and regulated markets, marketing regulation, acts of different states, benefits of regulation, suggestions for improvements in regulated markets, state trading, warehousing and other government, ICT in marketing of agricultural commodities, market information service, sources of global information-market research-special problems in international market research. Spatial and temporal price relationship- price forecasting, price policy and economic development. Fundamental vs. applied research, concept of researchable problem, research prioritization, hypothesis-types, objectives and testing, review of literature. Theory and design of sampling, methods of sampling. Project proposals, research design and techniques. Collection and sources of data-questionnaire and interview schedule.

Unit-IV

Basic concepts in econometrics, two variable regression, its assumptions, approaches to estimation -OLS, BLUE, MLE and their properties, multiple regression estimation and interpretation. Assumptions, identification, consequences and remedies for multi-collinearity, heteroscedasticity and autocorrelation, data problems and remedial approaches, model specification. Use of dummy variables-limited dependent variables – specification, estimation and interpretation. Simultaneous equation models. Basic concepts in Linear Programming, uses of LP in different fields, formulation of LP problems, graphic solution, Primal and dual in L.P. Concept of simplex method, solving profit maximization and cost minimization problems. Extensions of LP models: Variable resource and price programming, recursive programming, dynamic programming. Concepts of game theory.

AGRONOMY

Unit-I: Crop growth analysis in relation to environment; geo-ecological zones of India. Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit. Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield. Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress. Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

Unit-II: Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions. Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients. Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management. Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions. Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermin compost and residue wastes in crops.

Unit-III: Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices. Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides. Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation. Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and

perennial weed control. Integrated weed management; cost: benefit analysis of weed management.

Unit-IV: Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states. Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; microirrigation system; fertigation; management of water in controlled environments and polyhouses. Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency. Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

ENTOMOLOGY

UNIT-I Principles, utility and relevance of insect morphology, insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications. Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano, photo and chemo-receptors).

Structure, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive and endocrine system. Physiology of integument, moulting; growth, metamorphosis and diapause.

UNIT-II Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda – Classes – Ellipura, Diplura and Insecta- Orders contained. Distinguishing characters, general biology, habits and habitats of Insect orders and economically as well as agriculturally important families contained in them.

UNIT-III History, Definition and basic Concepts of insect ecology. Abundance and diversity of insects, estimates and causal factors. Basic principles of abiotic and biotic factors and their generalised action on insects. Population growth, Concepts of Carrying capacity, Environmental Resistance, Life Tables and their application to insect biology. Survivorship curves, Population dynamics- Environmental factors, dispersal and migration, Diapause (Quiescence) - aestivation, hibernation. Food chain and ecological succession. Inter and intra specific interactions, preypredator interactions. Functional and numerical response. Pest management as applied ecology. History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; augmentation and conservation. Role of EPN, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects. Mass production of quality biocontrol agents- Successful biological control projects. Importation of natural enemies, biotechnology in biological control. History, definition, Concept, philosophy, ecological principles, economic threshold concept, and economic consideration in IPM. Tools of pest management

and their integration- legislative, cultural, biological, chemical, physical and mechanical methods; pest survey and surveillance, forecasting, pest and pesticide risk analysis; cost-benefit ratios. Host Plant Resistance to insects, screening techniques, breeding methods including transgenics and importance of plant resistance in IPM. Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect, mite and non-insect pests of cereals, millets, pulses, tobacco, fibre crops, forages, sugarcane, oilseeds, fruit crops, vegetable crops, plantation crop, spices and condiments, ornamental, medicinal and aromatic plants, pests in polyhouses/protected cultivation and their management.

UNIT-IV Insecticide Toxicology – Definition, Principle Scope & History of Chemical Control. Pesticide Industry in India. Classification of insecticides based on mode of entry, mode of action and chemical nature. Structure and mode of action of all important group/classes of insecticides, Evaluation of insecticide toxicity and joint action of insecticides. Insecticide metabolism, pest resistance to insecticides; mechanisms, types of resistance and management. Insecticide residues, their significance and environmental implications. Insecticide Act.

Extension Education

UNIT-I: Extension Education – Meaning, objectives, concepts, principles and philosophy. Pioneering Extension efforts and their implications in Indian Agricultural Extension; Analysis of Extension systems of ICAR and SAU; State Departments Extension system and NGOs; Poverty Alleviation Programmes – SGSY, SGRY, PMGSY, DPAP, DDP, CAPART; Employment Generation Programmes – NREGP, Women Development Programmes – ICDS, MSY, RMK, Problems in Rural Development. Current Approaches in Extension: Decentralised Decision Making, Bottom up Planning, Farming System Approach, Farming Situation Based Extension, Market – Led – Extension, Farm Field School, ATIC, Kisan Call Centres, NAIP etc.

UNIT-II: Communication process; Methods and Forms of communication; Key communicators; Media in communication – Role of mass media in dissemination of farm technology. Modern communication media – Electronic video, Tele Text, Tele conference, Computer Assisted Instruction, Computer technology and its implications. Agril. Journalism and its role in rural development, Basics of writing – News stories, feature articles, magazine articles, farm bulletins and folders. Techniques of collection of materials for news stories and feature articles; photo journalism, communicating with pictures, Radio and TV Journalism, Techniques of writing scripts for Radio and TV. Community Radio, Web, Tele, and Video conferencing. ICTs- Concept, definition, tools and application in extension education. Reorganizing the extension efforts using ICTs, advantages, limitations and opportunities. ICTs projects. Different approaches (models) of ICTs. ICT use in field of extension- Expert systems on selected crops and enterprises; Self learning CDs, agricultural web sites and portals. Computer Aided Extension. Knowledge management, Information kiosks, Multimedia. Online, Offline Extension. Tools- Mobile technologies, e-learning concepts. Extension approaches-pre-requisites, information and science needs of farming community. Emerging issues in ICT.

UNIT-III: Diffusion – concept and meaning, elements; traditions of research on diffusion; the generation of innovations; innovation-development process; converting research into practice. The adoption process. Adopter categories; Perceived

attributes of Innovation and their rate of adoption, factors influencing rate of adoption. Diffusion effect and concept of over adoption, opinion leadership measurement and characteristics of opinion leaders, monomorphic and polymorphic opinion leadership, multi-step flow of innovation; concepts of homophily and heterophily and their influence on flow of innovations; The innovation-decision process.

UNIT-IV: Research and Behavioural sciences research. Review of literature – need, search procedure, sources of literature, planning the review work. Research problem - selection, formulation and principles, factors and criteria in selection, statement and development of the research problem. Objectives – meaning, types and criteria for judging the objectives. Concept and Construct – Meaning, role of concepts in research and conceptual frame work development in research. Variable and Definition – Meaning, types and their role in research and characteristics of workable definitions, Hypothesis; Measurement – meaning, importance, use of appropriate statistics at different levels, criteria for judging the measuring instrument in research. Validity and Reliability – meaning and methods of their testing. Sampling – universe, Sample and Sampling. Research Designs – meaning, purpose and criteria, types, advantages and limitations. Experimental design – advantages and limitations. Data Collection devices – interview, enquiry forms and schedules, questionnaires. Meaning, advantages and limitations in Check lists and Rating scales' use. Observation – meaning, types, advantages and limitations. Case studies and Social survey; Data processing; Report writing and References in reporting.

FLORICULTURE & LANDSCAPE ARCHITECTURE

UNIT-I: Scope of flowers in global trade, Significance in the domestic market/export, Varietal wealth and diversity, cultivation practices of rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation, dahlia, gerbera, gladioli, orchids, anthurium, aster, heliconia, liliums, nerium flower crops and petunia, hibiscus, bougainvillea, flowering annuals (zinnia, cosmos, dianthus, snap dragon, pansy), propagation, nursery management, transplanting techniques, soil and climate requirements, field preparation, systems of planting, water and nutrient management, weed management, rationing, training and pruning, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM. Flower forcing and year round flowering, production for special occasions through physiological interventions, chemical regulation. Patents and Plant Variety Protection in India. Introduction, selection, domestication, polyploid and mutation breeding for varietal development, Role of heterosis, Production of hybrids, Male sterility, incompatibility problems, seed production of flower crops.

UNIT-II: Landscape designs, Styles of garden, types of gardens: English, Mughal, Japanese, Persian, Spanish, Italian, Buddha garden. Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks. Garden plant components, arboretum, shrubbery, fernery, arches and pergolas, edges and hedges, climbers and creepers, cacti and succulents, herbs, annuals, flower borders and beds, ground covers,

carpet beds, bamboo groves. Lawns: Establishment and maintenance, special types of gardens, vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, colour wheels, temple garden, sacred groves. Bio-aesthetic planning,eco-tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, waterscaping, and xeriscaping.

UNIT-III: Prospects of protected floriculture in India; Types of protected structures – Greenhouses, polyhouses, shade houses, rain shelters etc., Suitable flower crops for protected cultivation.Environment control – management and manipulation of temperature, light, humidity, air and CO2; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation. Containers and substrates, soil decontamination, layout of drip and fertigation system, water and nutrient management, weed management, physiological disorders, IPM and IDM. Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.Harvest indices, harvesting techniques, post-harvest handling techniques, Precooling, sorting, grading, packing, storage, quality standards.

UNIT-IV: Prospects of value addition, National and global scenario, production and exports. Types of value added products, value addition in cut & loose flowers: garlands, veni, floats, floral decorations, flower arrangement, styles, Ikebana, morebana, free style, bouquets, button-holes, flower baskets, corsages, floral wreaths, garlands, etc.; Techniques in dry flower making – Drying, bleaching, dyeing, embedding, pressing; Designing and arrangement – dry flower baskets, bouquets, pot-pourri, wall hangings, button holes, greeting cards, wreaths; Concrete and essential oils; Selection of species and varieties (including non-conventional species), extraction methods, Types of pigments, carotenoids, anthocyanin, chlorophyll, betalains; Significance of natural pigments, Extraction methods; Applications

DEPARTMENT OF FORESTRY

UNIT I: Forest ecosystem concept, stand dynamics-forest succession, competition and tolerance, classification of world's forest vegetation. Productivity and vegetation forms of India, forest composition and structure. Ecophysiology of tree growth, effect of radiation & water relationship, mineral nutrients and temperature. Natural regeneration of species and types including unevenaged silviculture. Intermediate treatments. Agroforestry objectives, importance, potential and impediments in implementation. Overview of global agro-forestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, shelter-belts and windbreaks, energy plantations and homestead gardens. Production potential of different silvi-pasture system. Diagnosis and Design – Trends in Agroforestry systems research and development.

UNIT II: Measurement of tree parameters. Estimation of volume, growth and yield of individual tree and forest stands,. Preparation of volume & its application, yield and stand tables. Forest inventory, Sampling methods adopted in forestry, Use of GPS in forest inventory. Measurement stand density. Simulation techniques. Growth and yield prediction models – their preparation and applications. Principles of forest management; scope and object of forest management, ecosystem management,

development of forest management in India. Site quality evaluation and importance. Stand density, classical approaches to yield regulation in forest management, salient features and strategies. Forest valuation and appraisal in regulated forests.

UNIT III: Chemistry in relation to forest products. Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Cell wall constituents. Chemistry of cellulose, starch, hemicelluloses and lignin. Extraneous components of wood – water and organic solvent soluble. Chemical composition of oleoresin from major pine species. Structural difference among different gums (arabic, ghatti, tragacanth). Important diseases and insect pests of nurseries, farm forestry, plantations, avenue trees and their management. Insect pests and mycoflora of seeds of forest trees and their management. Role of mycorrhiza in tree health. Biological control of insect pests and diseases of forest trees.

UNIT IV: Global warming and forests. Green House Effect and its consequences. Ozone depletion. Conservations laws and acts. Forest genetics resources of India: timber and non timber species. Documentation and evaluation of forest genetic resources (FGR), *in situ* and *ex situ* conservation of gene resources. Biological diversity and its significance to sustainable use. Handling and storage of FGR. Intellectual property rights. Quarantine laws and FGR exchange. General concept of forest tree breeding, tree improvement and forest genetics. Variation in trees importance and its causes. Natural variation as a basis for tree improvement. Geographic variations – Ecotypes, clines, races and land races. Seed, seed formation, dispersal, storage, stratification and seed dormancy. Selective breeding methods- mass, family, within family, family plus within family. Plus tree selection for wood quality, disease resistance and agroforestry objectives. Selection strategies and choice of breeding methods and progress in selective breeding in forest trees. Indirect selection for biotic and abiotic stresses. Progeny and clone testing. Seed orchards – type, functions and importance. Estimating genetic parameters and genetic gain. Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis.

FRUIT SCIENCE

UNIT-I: Biodiversity and conservation of tropical, subtropical and temperate fruit crops; issues and goals, centers of origin of cultivated fruits; primary and secondary centers of genetic diversity. Present status of gene centers; exploration and collection of germplasm; conservation of genetic resources – *in situ* and *ex situ.* introduction of germplasm, plant quarantine. Intellectual property rights.

Origin and taxonomical status, blossom biology, breeding objectives, biotechnological interventions, achievements in tropical, subtropical and temperate fruit crops

UNIT-II: Fruit growth and development, parameters, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units, thermoperiodism. Assimilate partitioning, and influence of water, mineral nutrition, and biosynthesis of plant growth harmones, physiology of dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development. manipulation of

growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

UNIT-III Commercial varieties of regional, national and international importance of tropical, subtropical and temperate fruit crops, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators, abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, 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 IV: Maturity indices, physiology and biochemistry of fruit ripening, ethylene evolution, factors leading to post-harvest loss, treatments, chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage-ventilated, refrigerated, MAS, CA storage, physical injuries and disorders. Packing methods, principles and methods of preservation, food processing, dried and dehydrated products, nutritionally, packaging technology, processing waste management, food safety standards.

GENETICS AND PLANT BREEDING

UNIT-I:

Mendel's laws; Chromosomal theory of inheritance; Multiple alleles; Gene interactions; Sex determination, differentiation and sex-linkage; Sex-influenced and sex limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes; Extra chromosomal inheritance; Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Tetrad analysis; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis; Genetic fine structure analysis; Allelic complementation, Split genes; Transposable genetic elements; Overlapping genes, Pseudogenes, Oncogenes; Gene families and clusters. Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, Molecular chaperones and gene expression; Gene regulation in eukaryotes; RNA editing; PCR based cloning, positional cloning; Anti-sense RNA and ribozymes; Micro- RNAs (miRNAs). Genomics and proteomics; Functional and pharmacogenomics; Metagenomics; Gene silencing; Genetics of mitochondria and chloroplasts. Hardy-Weinberg equilibrium; Concepts of Eugenics, Epigenetics; Genetic disorders and Behavioural genetics;

UNIT-II:

Genetic basis of breeding self- and cross – pollinated. Breeding methods in self and cross pollinated crops, hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds. Breeding methods in asexually/clonally propagated crops, Self-incompatibility and male sterility in crop plants; ideotype

breeding; Special breeding techniques, Breeding for abiotic and biotic stresses., maintenance breeding, PPV&FRA.

UNIT-III:

Multiple factor hypothesis, Nature of gene action - additive, dominance, epistatic and linkage effects. Principles of Analysis of Variance (ANOVA) - Expected Variance Components, Random and fixed models, MANOVA, Biplot Analysis, Comparison of Means and variances for significance Designs for plant breeding experiments – principles and applications – Genetic diversity analysis – metroglyph, cluster and D2 analyses, phenotypic and genotypic correlations, Path analysis and Parent - progeny regression analysis - Discriminant function and principal component analyses - selection indices - selection of parents, Simultaneous selection models- Concepts of selection – heritability and genetic advance. Generation mean analysis, mating designs- Diallel, Partial Diallel, Line x tester analysis, NCDs and TTC., Models for GxE analysis and stability parameters - AMMI analysis

UNIT-IV:

Biotechnology and its relevance in agriculture, callus, suspension cultures, cloning, Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation. Genotyping; sequencing techniques; Biochemical and Molecular markers: morphological, biochemical and DNA-based markers mapping populations. Molecular mapping and tagging of gene. Statistical tools in marker analysis, Robotics, Gene pyramiding. MAS & molecular breeding, Genomics and genoinformatics for crop improvement, Integrating functional genomics, Recombinant DNA technology, transgenes, method of gene transformations, selectable markers and clean transformation techniques, Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial release, molecular farming. GMO; International regulations, Biosafety issues of GMOs, Regulatory procedures in major countries including India, ethical, legal and social issues; IPR, Bioinformatics & Bioinformatics tools. Nanotechnology and its applications in crop improvement programmes.

Nematology
Unit:I

History of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry. Broad classification, nematode biology, physiology and ecology.Types of parasitism; nature of damage and general symptomatology; interaction of plant parasitic nematodes with other organisms. Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes. Microscopy and use other laboratory equipments. Survey and surveillance methods; collection of soil and plant samples; techniques for extraction of nematodes from soil and plant material; estimation of population densities.Techniques involved in killing, fixing, clearing and mounting nematodes; measurements, .*In vitro* and *in vivo* culturing nematodes..Staining nematodes in plant tissues. Application of molecular techniques in Nematology.

UNIT:II

Introduction and general organization of nematode body.Morphology and anatomy of nematode cuticle, hypodermis, musculature and pseudocoelom. Details and variation of digestive system, reproductive system, excretory-secretory systems, nervous system and associated sense organs. Principles of nematode systematics. Placement of nematodes in Animal Kingdom and comparison with related organisms.Classification of Phylum Nematoda- Orders of Class Adenophorea and Secernentea; Diagnosis of Order Tylenchida- Suborder Tylenchina, Hoplolaimina and Criconematina; Infraorders Tylenchata and Anguinata- their families and genera. Diagnosis of genera and families of Suborders Hoplolaimina and Criconematina. Orders Aphelenchida, Dorylaimida, Triplonchida, Rhabditida with emphasis on economically important taxa.

Unit: III

Diagnosis of causal organism, distribution, host range, biology and life cycle, nature of damage, symptoms, interaction with other organisms, and management of nematode diseases in different cereal crops (wheat,rice maize sorghum), pulses, Sugarcane, Fibre, fodder and oilseed crops, vegetable crops. Nematode problems of protected cultivation. Nematodes of minor importance, fruit crops, mushroom, plantation, medicinal and aromatic crops. Red ring disease of coconut and pine wilt disease of forest crops.

UNIT:IV

Concepts, history, principles and practices of nematode management; integrated nematode management. of nematode management; crop loss estimation, cost-benefit ratios and pest risk analysis. Chemical methods- nematicides, their types, classification, mode of action, applicators and application methods, antidotes, and economizing nematicidal use. Cultural practices, physical and mechanical methods of nematode control. Biological methods- concepts and terminology, use of predators and parasites as biological control agents, their mass multiplication and field use; phytotherapeutic methods – use of antagonistic plants and antinemic plant products. Genetic methods- plant resistance; legal methods- quarantine regulations; integrated nematode management- concepts and applications.

PLANT PATHOLOGY

UNIT-I Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors, altered plant metabolism as affected by plant pathogens. Genetics of resistance; ‘R’ genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. Disease management strategies. Methods to prove Koch’s postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of haemocytometer, stage and ocular micrometer, centrifuge, pH meter, camera lucida. Microscopic techniques and staining methods, phase contrast system,

chromatography,use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

UNIT-II Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology. Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi. The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens Types and importance, fungal genetics and variability in fungi. Crop diseases of cereals, pulses, oilseeds, vegetables, fruits, plantation and fibre crops caused by fungal pathogens.

UNIT-III History of plant viruses, composition and structure of viruses. Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship. Virus nomenclature and classification, genome organization, replication and movement of viruses. Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics. Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-microscope and ultramicrotome. Origin and evolution, mechanism of resistance, genetic engineering, ecology, and management of plant viruses. Crop diseases of cereals, pulses, oilseeds, vegetables, fruits, plantation and fibre crops caused by viruses and viroids.

UNIT-IV History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya, importance of phytopathogenic bacteria. Evolution, classification and nomenclature of phytopathogenic procarya and important diseases caused by them. Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya. General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios. Procaryotic inhibitors and their mode of action against phytopathogenic bacteria. Survival and dissemination of phytopathogenic bacteria. Crop diseases of cereals, pulses, oilseeds, vegetables, fruits, plantation and fibre crops caused by bacterial, phytoplasma and other fastidious procaryotes.

Seed Science & Technology

UNIT-I: Floral types, structure and biology in relation to pollination mechanisms; sporogenesis: microsporogenesis and megasporogenesis; gametogenesis, effect of environmental factors on floral biology. Fertilization –embryo sac structure, process, barriers to fertilization, male sterility and self incompatibility system in hybrid seed production. Embryogenesis-development of typical monocot and dicot embryos; endosperm development, endosperm and cotyledons; external and internal features of monocot and dicot seed; seed coat structure. Apomixis–identification, classification, significance and its utilization indifferent crops for hybrid seed production; Polyembryony-types and significance; synthetic seeds.

UNIT-II: Factors responsible for deterioration; seed production in self and cross pollinated crops, Principles of hybrid seed production, isolation distance, synchronization of flowering, roguing etc, role of pollinators and their management. Seed multiplication ratios, seed replacement rate, demand and supply; suitable areas of seed production and storage, agronomy of seed production–agro climatic requirements and their influence on quality seed production; generation system of seed multiplication; maintenance of Nucleus seed, production of Breeder, Foundation and Certified seed–criteria involved; life span of a variety; Methods of development of hybrids and CHA in hybrid seed production; one, two and three line system; maintenance of parental lines of hybrids; planning and management of hybrid seed production technology of major field crops and vegetables. Seed quality control system and organization, seed village concept; Seed production agencies, seed industry.

UNIT-III: Historical development of Seed Industry in India; Seed Act (1966), Seed Rules (1968), Seed (Control) Order 1983; Plants, Fruits and Seeds Order (1989); National Seed Development Policy (1988) and EXIM Policy; New Seed Bill-2004 etc. Seed Certification-history, concept and objectives of seed certification; phases of seed certification; Indian Minimum Seed Certification Standards (IMSCS), Field inspection, grow-out tests; OECD seed certification schemes, Introduction to WTO and IPRs; PPV & FR Act, 2001, UPOV and its role, Principles and importance of seed processing, preparation of seeds before processing, machines used to prepare seed for processing (Delinters, extractors, debearder, sacrifier etc.) Operation maintenance of different seed processing machinery such as air screen cleaner, indented cylinder, disc separator, gravity separator, seed treating and treaters. Seed drying-principles and methods, E.M.C. Theory of drying, types of storage structures, methods of maintaining safe seed moisture, thumb rule and its relevance, seed storage structures. Seed packaging, principles, practices, materials, weighing and bagging machines

UNIT-V: Seed quality: concept, components and their role in seed quality control; Seed Sampling: types of samples; sampling devices; procedure of seed sampling; sampling intensity; physical purity analysis; components of purity analysis, Seed moisture content: importance of moisture content; principles and methods of moisture estimation, Germination; requirements for germination, procedure for test; seedling evaluation; dormancy, importance, causal mechanisms, types and methods for breaking dormancy. Different viability and Vigour tests; quick viability test (TZ-test) Genetic purity testing: objective and criteria for genetic purity testing; types of tests; principles and procedures of chemical, biochemical and molecular tests. Seed health Testing: field and seed standards; designated diseases, objectionable weeds-significance of seed borne diseases and detection methods for seed borne fungi, Testing of GM seeds and trait purity.

Department of Soil science

Unit I

Scope of soil physics and its relation with other branches of soil science, Soil compaction and soil strength, swelling and shrinkage-basic concepts. Characterization and management soil structure; soil aggregation, aggregate stability; Soil tilth, pudding its effect on soil physical properties. Soil water retention,

soil water constants, soil water potential and measurement of soil-moisture potential. Water flow in saturated and unsaturated soils, Poiseuille's and Darcy's law; hydraulic conductivity. Hydrologic cycle, field water balance; soil-plant atmosphere continuum. Composition of soil air, aeration requirement for plant growth and its management. Thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth.

Unit-II

Soil fertility and soil productivity, essential plant nutrients- functions and deficiency symptoms. Nitrogen, Phosphorus - sources, their forms immobilization and mineralization, nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen and phosphorus under lowland and upland conditions. Potassium- forms, equilibrium in soils and its agricultural significance. Calcium, magnesium and sulphur- their source, forms, fertilizers and their behavior in soils. Micronutrients- critical limits and factors affecting their availability, correction of deficiencies in plant. Quality- intensity relationships; soil test crop response correlations. Soil fertility evaluation methods and soil quality in relation to sustainable agriculture.

Unit III

Chemical composition of the earth's crust and soils. Inorganic and organic colloids, diffuse double layer theories of soil colloids, Zeta potential, stability, coagulation/flocculation of soil colloids; electrometric properties of soil colloids, soil organic matter and its fractionation. Cations exchange- theories, donnan-membrane equilibrium concept, clay- membrane electrodes and ionic activity measurement, thermodynamics, Ion exchange phenomena and its practical implications in plant nutrition. Chemistry of acid and salt- affected soils and electrochemistry of submerged soils.

Unit IV

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism. Chemical composition of clay minerals, Factors of soil formation, soil forming processes, soil profile and weathering sequences of minerals with special reference to Indian soils. Soil classification systems- historical developments and modern systems of soil classification. Soil survey, its types and techniques, Soil series and procedure for establishing soil series. Soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps. Landform- soil relationship; major soil groups of India. Land capability and land irritability classification; land evaluation and land use type- concept and application; approaches.

VEGETABLE SCIENCE

UNIT-1

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of potato, Cole crops: cabbage, cauliflower, knoll kohl, sprouting broccoli, brussels sprout, Root crops: carrot, radish,

turnip, and beetroot, Bulb crops: onion and garlic, peas and broad bean, green leafy cool season vegetables.

UNIT-2

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of tomato, eggplant, hot and sweet peppers, okra, beans, cowpea and cluster bean, Cucurbitaceous crops, tapioca and sweet potato, green leafy warm season vegetables.

UNIT-3

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, breeding methods (introduction, selection, hybridization, mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act. of Potato , tomato, eggplant, hot pepper, sweet pepper and okra, peas and beans, amaranth, chenopods and lettuce, gourds, melons, pumpkins and squashes, cabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca.

UNIT-4

Definition of growth and development Cellular structures and their functions;, growth analysis and its importance in vegetable production. Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cyktokinins and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production. Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance. Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening. Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.

College of Agril. Engg. & Technology

Farm Machinery and Power Engineering

Unit I

Status of farm mechanization. Principles, procedures, fundamentals and economic considerations for design and development of farm power and machinery systems. Design considerations, procedure and their applications in agricultural tractors & typical machines. Analytical design considerations of linkages/ components in farm machinery and its

application. Design of selected farm equipments: – tillage, seeding, planting, intercultural, plant protection, harvesting and threshing. Design of rotary, vibrating and oscillating machines. Design and selection of matching power unit. Safety devices for tractors & farm implements.

Unit II

Soil dynamics in tillage and traction: Dynamic properties of soil and their measurement, stress-strain relationships, theory of soil failure. Mechanics of tillage tools and geometry of soil tool system, design parameters and performance of tillage tools. Traction devices, tyres-types, function & size, their selection; mechanics of traction devices. Deflection between traction devices and soil, slippage and sinkage of wheels, evaluation and prediction of traction performance, design of traction and transport devices. Soil compaction by agricultural vehicles and machines.

Unit III

Testing and evaluation of tractors and farm equipment: Types of tests; test procedure, national and international codes. Test equipment; usage and limitations. Power losses in dynamometers and hydraulic test equipment. Prototype feasibility testing and field evaluation. Laboratory and field testing of selected farm equipment. Non-destructive testing techniques. Tractor performance testing, evaluation and interpretation of results. Technical specifications of tractors available in India, modern trends in tractor design and development, Parameters affecting design of tractor engine and their selection. Design of fuel efficient engine components and tractor systems like transmission, steering, front suspension, hydraulic system & hitching, chassis, driver's seat, work-place area and controls. Tyre selection Mechanics of tractor. Computer aided design and its application in agricultural tractors. System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection. Maintenance and scheduling of operations.

Unit IV

Principles of soil working tools: shares, discs, shovels, sweeps and blades, rotatillers and puddlers. Metering of seeds and granular fertilizers with various mechanism, effect of various parameters on distribution of seed and fertilizer in seed cum fertilizer drills and planters, flow of seeds and fertilizers through tubes and boots. Theory of atomization, specific energy for atomization, electrostatic spraying and dusting, spray distribution patterns. Theory of mechanical separation of grains from earheads/pods. Parameters affecting performance of threshers, theory of root crop harvesters, power requirement of various components of field machines. Vibration motion and its terminology; principal modes of vibration; vibration of lumped parameters systems and continuous systems. Lagrange equation.

Processing & Food Engineering

Unit I

Introduction to heat and mass transfer and their analogous behavior, steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations. Fluid flow and continuity equation, Phase equilibria, Mass transfer application in food processing. Convective heat transfer in food processing heat transfer between fluids and solid foods, Lumped heat analysis, Dimensionless numbers, mixing of fluids, Thermodynamic properties and process, Heat pump, refrigeration and heat engines.

Unit II

Engineering properties of biological materials (i.e. physical, electrical, thermal, optical etc.); physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Non-Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behavior. Application of Engineering properties in design and operations of agricultural

equipment and structures, Basic instrumentation, Sensory evaluation of food.

Unit III

Psychrometry and environment control, drying and dehydration, dryers, seed drying and processing, Sorption and desorption isotherm, water activity, EMC, Thermal processing operations; Basic concepts related to thermal processing, Evaporation, blanching, pasteurization, distillation, Refrigeration principles and Food freezing. Mechanical separation techniques, size separation equipments; Filtration, sieving, centrifugation, Material handling equipment, conveyors and elevators; Size reduction processes; Production, processing and utilization of cereal, pulses and oilseeds.

Unit IV

Storage of grains, biochemical changes during storage, storage factors affecting losses, storage requirements. Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, different fumigants used for pest control, Storage structure design theory, Structural requirements in grain storage, method of stacking. Packaging of processed products. Microwave, irradiation, ohmic heating, Pulse electric field preservation, High pressure processing techniques, Extrusion cooking, Advanced in food process engineering.

Soil and Water Engineering

Unit I

Hydrologic process and systems; Hydrologic problems of small watershed; Hydrologic characteristics of watershed. Measurement and analysis of hydrologic parameters, rainfall-runoff models, stream flow measurement and analysis of data. Hydrograph analysis; Unit hydrograph theory; Synthetic and dimension less hydrograph, convolution of unit hydrograph. Flood routing (reservoir and channel routing). Open channel and their properties, energy and momentum, critical flow computation and application.

Unit II

Irrigation principles: efficiency, soil plant water relationships, Irrigation scheduling methods, Surface irrigation, hydraulics of water advance and recession. Design of Border, furrow and check basin irrigation; Sub Irrigation methods and concepts. Design criteria of sprinkler and micro irrigation systems, hydraulics of sprinkler and micro irrigation systems. Fertigation aspects. Underground water conveyance system; Basic hydraulic design of centrifugal pump, water hammer problem in centrifugal pump. Performance characteristics of pumps. Non-conventional energy sources for pumping, wind mills, micro turbines, solar pumps, hydraulic ram- their selection and design criteria.

Unit III

Differential equations of saturated flow, initial and boundary conditions. Dupuit and Boussinesq approximations and linearization techniques. Analysis of seepage from canals and ditches. Unsaturated flow theory, Infiltration and capillary rise flux dynamics. Hydrodynamic dispersion in soil-aquifer system. Properties affecting groundwater storage and movement, groundwater balance, Well hydraulics, steady and unsteady state flow in confined, unconfined and semi-confined aquifers, steady flow in sloping aquifers, partial penetrating wells. Analysis of multi-aquifers. Flow analysis in interfering wells. Pumping tests and determination of aquifer parameters. Techniques for groundwater recharge. Theories and applications of surface and sub-surface drainage, steady state, unsteady state drainage equations for layered and non-layered soils, horizontal sub-surface drainage. Principle and applications of steady sate and unsteady state equations (falling and fluctuating water table conditions). Salt balance, leaching requirement and management practices under drained conditions; Design of different components of sub-surface drainage systems, theories of vertical drainage and multiple well point system. Disposal of drainage effluents.

Unit IV

Probability and continuous frequency distribution; Fitting empirical distributions. Layout and planning of soil and water conservation measures; Design principles of soil and water conservation structures including contour bunds and terraces; Gully control measures. Hydraulic jump and energy dissipaters for soil conservation structures; Hydrologic, hydraulic and structural design of drop structures. Sediment deposition process. Estimation of sediment load, earthen dams, seepage through dams and stability analysis. Rainwater harvesting, Flood control and stream bank protection measures.

College of Basic Sciences & Humanities

Biochemistry

Unit-I: Biochemistry in agriculture; pH, acid, base and buffers; covalent and non-covalent forces; physical techniques for determination of structure of biopolymers. Carbohydrates, lipids, proteins, nucleic acids; biomembranes; thermodynamics; vitamins and hormones; cell, organelles, methods of studying metabolism, compartmentation of metabolic pathways. Catabolic and anabolic pathways of carbohydrates, lipids, amino acids, nucleic acids, their regulation and metabolic disorders. Bioenergetics; signal transduction; metabolic engineering.

Unit-II: Enzyme history; classification, compartmentalization, cofactors, ribozymes, isozymes, abzymes. multienzyme complexes; specificity; active site mapping; mechanisms of catalysis; purification. kinetics; inhibition and activation; allosteric enzymes and their kinetics; regulation; enzyme applications; immobilization, biosensors. History of molecular biology; nucleic acids as genetic material, DNA, RNA. Genome organization; replication, restriction enzymes; site directed mutagenesis; molecular mechanism of mutation; DNA repair mechanisms. transcription, RNA editing and processing; genetic code, translation and post-translational modifications; regulation of gene expression. DNA modifying enzymes, vectors; recombinant DNA technology; nucleic acid hybridization; gene libraries; PCR; DNA sequencing; applications of gene cloning; genetic engineering, transgenics; genomics, transcriptomics and proteomics.

Unit-III: Absorption maxima; estimation of carbohydrates, amino acids, proteins and nucleic acids. chromatography; electrophoresis. Centrifugation: Cell fractionation; radioisotopes. Pigments, photosynthesis: C_2, C_3, C_4, CAM pathways; Sucrose-starch interconversion; biosynthesis of structural carbohydrates, storage proteins and lipids; nitrogen fixation and nitrate assimilation; sulphate reduction and incorporation of sulphur in to amino acids, secondary metabolites. seed germination and development; fruit ripening; phytohormones.

Unit-IV: Digestion, absorption of food; detoxification; respiration; animal hormones; hormone receptors; immunoglobulins; monoclonal antibodies; formation of antibody; antibody diversity; complement systems, major histocompatibility complexes; cell mediated immune response; mechanisms of immunity. Nutrition; balanced diet; biochemical composition; energy and food value of food grains, fruits and vegetables; nutritional characteristics of carbohydrates, proteins, fats and their interactions. Biochemical, nutritional aspects of vitamins, minerals, nutraceuticals, antinutritional factors; post harvest storage, food spoilage, lipase, lipoxygenase, oxidative rancidity and antioxidants. food additives; food flavours and aroma; nutritional quality of plant, dairy, poultry and marine products.

Chemistry

Unit-I: The concepts of free energy, entropy,enthalpy and laws of thermodynamics, partial molar properties; thermodynamics of ideal and real gases and gas mixtures.

Thermodynamics of ideal and non-ideal binary solutions; activity coefficients of electrolytes. Phase equilibrium, Gibbs and Helmeholtz energy;Free energy change electrochemistry; conductance and its application, transport nulse Galvanic Cell, EMF and free energy. Concentration of cells with and without transport oxidation reduction potential activities; determined of activity co-efficient solutions of ideal and non-ideal solutions, methods of expressing concentration of solution, colligative properties, Roult's Law, relative lowering of vapour pressure elevation of boiling point and depression of freezing point.Theories of reaction rates, collisions theory, transition state theory, theory of unimolecular reactions-Lindemann`s mechanism; rate constants of fast reactions - relaxations, stop-flow and flash photolysis techniques. Polymerisation, explosion, ionic reactions. Complex reactions-electron transfer reactions, consecutive, opposing reactions; kinetics of catalytic reactions, acid base catalysis, effect of pH and salt effects. Freundlich`s adsorption isotherm, Langmuirs adsorption isotherm and its limitations.B.E.T adsorption isotherm; chemi sorption, kinetics of surface reaction and their mechanism.

Unit-II: Review of the atomic structure-wave mechanical approach, wave functions for hydrogen atom, radial distribution curves for s, p, d and f orbitals, angular wave functions for s, p, d and f orbitals-their significance and use.Application of VB, MO and VSEPR theories in explaining the structure of simple molecules. Rules for fundamental vibrations. Hybridization: Electron deficient compound acid and bases- review of arthenius and BranspedThonjes Lewis concept.The theories of bonding in coordination compunds -valence bond theory, electroneutrality principle and back-bonding, crystal field theory and its application for understanding magnetic and spectral properties of metal complexes, structural effects of crystal field splitting (ionic radii, Jahn-Teller effect). Thermodynamical effects of crystal field splitting (hydration, ligation and lattice energies). Limitations of crystal field theory; adjusted crystal field theory (ligand field theory); appplictionof molecular orbital theory of square planar, tetrahedral and octahedral complexes; stability of complexes-methods of determination. Factors influencing stability; substitution reactions in octahedral complexes and associated stereochemical changes, redox reactions in coordination compounds and their mechanism.Transition metal complexes of pi acceptor ligands.Periodictable: main group elements (s&p blocks).

Unit-III: Stereochemistry and conformation analysis-conformation and configuration, geometrical and optical isomers, methods of resolution, asymmetric synthesis.Aromaticy; steric effects; Reactive intermediates, carbocations, carbanions, free radicals, carbenes, arynes, nitrenes. Organic reaction mechanism: substitution (Sn^1& Sn^2), addition, elimination and rearrangement reactions. Name reactions: MannichReaction, wagner-Meerwein rearrangement pinacol-pinacolone re-arrangement, PrinsReaction, OppenaurOxidation, Bayer-Villger Oxidation, Sand Meyer Reaction, Bechmann rearrangement Wolf-Kishner Reduction, main feature of photochemistry and peri-cyclic reaction, electroreaction, cycloaddition reaction, synthesis and reactivity of Furan, Thiophene, Pyrrole, Pyridine. Structures and chemistry of terpenes-geraneol, citralamyrins, terpeneol, pinene, camphor, squalene and abietic acid; isoprene rule; biogenesis of mono, di-and tri terpenoids. Synthesis and chemistry of ß-carotene, steroidscholesterolergosterol, sex hormones, progesterone, testosterone, cortisone; plant hormones: auxin B and A, kinetin, abscisic acid, gibberllins. Alkaloid- general structural determination, atropine, quinine, reserpine, morphine, nicotine, epherdrine, cocaine. Acetogenins-anthocyanins,flavones, flavonols, isoflavones, quinones.Coumarins, flavonoids; porphyrins, haemin, chlorophyll; structures of starch and cellulose.

Unit-IV- Basic principles and application of chromatography; column, paper, thin layer and ion exchangechromatography; gas liquid chromatography (GLC), highperformance Chromatography (HPLC), structure- elucidation of organic compounds with the help of UV-Vis, FTIR, ^{1}HNMR, mass spectroscopy:Gc-MS and LC-MS techniques and their applications; qualitative and quantitative analysis of elements of organic compounds.

FOOD SCIENCE & TECHNOLOGY

Unit-I

Principles of food processing and preservation; Processing and preservation by heat, low temperature, drying, concentration and non-thermal methods; Enzymes and microorganisms in processing. Food allergens, toxins and anti-nutritional factors. Carbohydrates, proteins, lipids and water: classification, physical, chemical and functional properties; Properties of minerals, vitamins, pigments, flavor components. Food additives: types and functions, permissible limits and safety aspects; Food groups and their composition. Essential nutrients- sources, functions, deficiency diseases, requirements and RDA.

Microbiology and spoilage of various food and food products; Physical and chemical methods to control microorganisms; Food poisoning and food borne infections; Prebiotic and probiotic; Fermented foods & beverages. Food engineering processes: size reduction, mixing and homogenization. Principles of thermodynamics, heat and mass transfer & kinetics of reactions. Thermal, chilling and freezing properties of foods; Heat exchanger & process heat transfer. Packaging : Principle, functions & problems, types, design, equipments; materials- their properties, evaluation & performance. Packaging of perishable and processed foods.

Unit-II

Structure, composition, quality parameters, processing, and storage quality of cereals, pulses ,oilseeds, fruits and vegetables. Grain milling technology– parameters, methods, treatments & pre-treatments, machinery, products and by-products; Ready-to-cook, Ready-to-eat, instantized products, extrusion cooking, protein concentrates and isolates. Bakery and confectionary- manufacturing technology, raw materials & quality parameters; Maturity indices, harvesting, handling, physiological, biochemical changes, post harvest management, post harvest disorders, and losses of fruits and vegetables; Processing of pulp, juices, puree, concentrates, IQF, frozen F&V. Technology for processed products like pickles, chutneys, sauces, candies, bars, toffees, jam, jellies, fruit powder, IMF, fruit beverages etc. Beverages processing technology: tea, coffee, cocoa, water, alcoholic and non-alcoholic. Spices & condiments processing.

Unit-III

Market milk- composition, quality evaluation and testing. Procurement, transportation and processing of market milk. Cleaning and sanitization of dairy equipments,, methods of manufacture, evaluation of quality, composition, standards and defects of cream, butter, condensed & evaporated milk; dried milk, skim & whole milk powder, ice cream, softy, and cheese. Method of manufacture of Indigenous milk products. Meat, marine, egg & poultry: composition, grading, processing, preservation, packaging transportation & storage of products & by-products; post-mortem muscle biochemistry. Modern abattoirs, ante-mortem handling. Stunning methods, slaughtering and dressing, offal handling and inspection.

Unit-IV

Quality: concept, attributes, measurement and evaluation. Sampling techniques; Water activity & Color measurement. Principles & methods in food analysis using Spectroscopic techniques, fluorescence, IR, NMR, atomic absorption and emission photometry, polarimetry, refractometry, nephalometry, Chromatographic separation, gas analysis, radio-tracers, rheology and texture analysis. Various methods for detection of microorganisms in foods. Indicator organisms

Sensory evaluation: parameters, techniques, methods and applications. Biosensors & non-destructive methods in quality evaluation of foods. Quality management systems; Indian & International quality systems and standards like FSSAI, Codex, ISO and Global food safety initiative; export import policy; Quality assurance: TQM, GMP/GHP, GLP, GAP, sanitary and hygienic practices, HACCP etc.; Food adulteration and food safety, IPR and Patent.

Molecular Biology & Biotechnology

Unit I

General structure and constituents of plant and animal cells; Cell wall and cell membrane: their structure and composition; Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus and Vacuoles etc.; Cell division and regulation of cell cycle; Membrane transport: Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

Unit II

History, scope and importance of biotechnology and molecular biology; nucleic acids as genetic material; chemistry, structure and properties of DNA and RNA; Genome organization in prokaryotes and eukaryotes; repetitive and non repetitive DNA: satellite DNA; DNA replication: DNA polymerases, topoisomerases, DNA ligase; DNA repair mechanisms; molecular mechanism of mutation; site directed mutagenesis; reverse transcriptase; Ribosome: structure and function, organization of ribosomal proteins and RNA genes; transcription; RNA editing; RNA processing etc; genetic code; aminoacyl tRNA synthases and translation; inhibitors of replication, transcription and translation; post translational modifications; regulation of gene expression in prokaryotes and eukaryotes. Genomics: Whole genome analysis and comparative genomics; classical ways of genome analysis; large fragment genomic libraries; Applications of genomics in agriculture, human health and industry.

Unit III

Recombinant DNA technology: nucleases, restriction enzymes and other DNA modifying enzymes; vectors; techniques of recombinant DNA technology and gene cloning; Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting; gene libraries; PCR: principles, variations and applications of PCR; gene cloning by PCR and recombinant DNA technology; gene isolation; DNA sequencing and its automation. Molecular markers: RFLP, RAPD, SSR, AFLP, SNP etc.; linkage mapping; genetic, cytogenetic and physical maps; association mapping; allele mining; marker assisted selection; gene introgression and pyramiding; use of markers in plant breeding. Application of plant biotechnology in agriculture; Public

perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights.

Unit IV

History of plant cell and tissue culture; Culture media: composition of different constituents including growth regulators, gelling substances, sugar, major and micro salts; medium preparation and its sterilization; Various types of culture: callus, suspension, nurse, root, meristem, ovary etc.; *In vitro* differentiation: organogenesis and somatic embryogenesis; Haploid production; Somaclonal variation; Somatic cell hybridization; germplasm conservation; Synthetic seeds; Production of secondary metabolites; Transgenic plants: Methods of plant transformation, Vectors , examples of useful gene transferred, genetic and molecular analyses of transgenics, problems in gene transfer, status of transgenic research, Public perception and bioethical issues involved in the production of transgenics.

Animal cell and tissue culture: techniques and their applications. Importance of biochemistry in plant sciences, Enzymes properties, Photosynthesis; respiration, molecular organization of immunoglobulins, industrially important microorganisms, fermentation systems, Bioreactor, Downstream processing Mendelian principles of inheritance; central tendency and dispersion, Correlation and Regression

AGRICULTURAL MICROBIOLOGY

Unit 1: General Microbiology

Scope of microbiology. Controversy over spontaneous generation. History related to microbial world. Isolation and preservation of different types of microorganisms. Methods of sterilization. Microscopy: Optical, phase contrast, fluorescent, dark field and electron. Techniques used in identification and classification of bacteria. Prokaryotic cell organisation, Archaebacteria and eukaryotic cell organisation. Important characteristics of different groups of prokaryotes – photosynthetic bacteria, blue green algae, chemoautotrophic bacteria, spore forming bacteria, mycoplasma, viruses, bacteriophages and actinomycetes. Heterotrophic bacteria, nitrobacteria, nitrogen-fixing bacteria and cyanobacteria, lactic acid bacteria, halophiles, thermophiles acidophiles and methanogens. Structure and classification of viruses, Growth of viruses, Lytic and lysogenic cycles, Plant viruses, Viroids.

Unit 2: Microbial Ecology and Physiology

Principles of microbial ecology, Microbiology of ecosystems - soil, rhizosphere, phyllosphere, water - fresh and marine, and air. Microbial interactions - symbiosis, synergism, commenalism, parasitism, amensalism, antagonism and predation, adoption of micro-organisms to various ecosystems. Microbial growth curve. Mathematical expression of growth -continuous and batch cultures. Diauxic and synchronous growth. Sporulation in Bacteria. Microbial nutrition. Bacterial metabolism - aerobic and anaerobic respiration, electron transport chain, microbial photosynthesis, oxidative and substrate level photo-phosphorylation. Biosynthesis of cell wall. Mechanism of action of common antibiotics on microbes.

Unit 3: Soil Microbiology

Major groups of soil microorganisms. Root exudates and rhizosphere effects. Plant growth promoting rhizobacteria and their mode of action. Manipulation of rhizosphere

microflora in plant productivity. Microbial biomass. Nitrogen cycle: ammonification, nitrification and denitrification. Biological nitrogen fixation–symbiotic and asymbiotic. Biochemistry and genetics of nitrogen fixation. Microbial transformations of phosphorus, sulphur and other micro nutrients. Role of bio-fertilizers in agriculture and forestry. Pollution of soil, water and air. Bioremediation of soil and other environments, Formation and composition of soil organic matter: fulvic acid and humic acid. Management of solid and liquid organic wastes, composting, biogas, Sewage and industrial effluent treatment and their safe disposal.

Unit 4: Microbial Biotechnology

Types of fermentation. Fermenter designs and types. Control of fermentation process - batch, feed batch and continuous. Downstream processing in fermentation industry. Industrial production of metabolites - organic acids, alcohols, antibiotics. Production of single cell proteins and probiotics, hormones, biofertilizers, biopesticides. Microbiology of various raw and processed foods. Like milk, meat, fish, egg, fruits, vegetables, juices, flour, canned foods etc. Fermented food – vinegar, wine, saucrkraut, pickles, cheese and yoghurt. Food borne illness andFood preservation, contamination and spoilage, food-borne illness and intoxication.

PLANT PHYSIOLOGY

Unit 1: Metabolic Processes and Growth Regulation

Cell organelles and their physiological functions water relations, water potential of plant cells. Mechanism of wateruptake by roots transport in roots, movement of water in plants, water loss from plants, Evapo-transpiration. Stomata, structure function - Mechanism of stomatal movement, antitranspirants. Photosynthesis and bioproductivity. Photochemical process-Chloroplast, its structure, CAM plantsand their significance. Rubisco structure andregulations, Photorespiration and its significance, CO_2fixation as a diffusive process,effect of environmental factors on photosynthetic rates. Translocations of photosynthates and its importance insink growth. Mitochondrial respiration, growth and maintenance respiration, cyanide resistantrespiration and its significance. Nitrogen metabolism. Lipid metabolismstorage,protective and structural lipids. Secondary metabolites and their significance in plant defencemechanism. Mineral Nutrion: Dual mechanism and other concepts of ion uptake. Loading and unloading Rhizosphere and root biology, root growth, influence of micro-organism in nutrient acquisition, release and uptake by plant roots. Concept of nutrient use efficiency, Heavy metal toxicity and concept of phytoremediation. Interaction of phytohormones and nutrients.

Unit 2: Abiotic Stress Responses in Plants

Abiotic stresses affecting plant productivity. interactions between biotic and abiotic stresses. Drought characteristic features, waterpotential in the soil-plant-air continuum.Transpiration and it’s regulation – stomatal functions/VPD. Physiological process affected by drought.Drought resistance mechanisms: Characteristics of resurrection plants. Osmotic adjustmentOsmo-protectants, stress proteins. Water use efficiency as a drought resistance trait. Molecularresponses to water deficit stress perception, expression of regulatory and function genes andsignificance of gene products. Stress and hormones- asnegative signal. Oxidative stress: High temperature stress: tolerance mechanisms- chilling stress; effects on physiological processes. Salinity: species variation in salt tolerance. Salinity effects at cellular

andwhole plant level, tolerance mechanisms. Breeding for salt resistance. Role of phytochelatins. The greenhouse gases and global warning, global carbon deposits. Effect of elevated gases on plant growth and development and air pollution.

Unit 3: Plant Growth Regulators and Plant Development

Plant growth regulators, Brassinosteriods, triacontanol,phenols polyamines, jasmonates, Classification, site of synthesis,biosynthetic pathways and metabolism and influence on plant growth and development by hormones. Hormone receptorsand signal transduction. Hormonal regulation of gene expressions at variousdevelopmental stages . Herbicides, classification and their mode of action. Role of crop physiology in agriculture, crop growth and productivity, crop growth models describingsyield (Duncan/Passioura), phenology-crop productivity, growth factors related to biomass. Net assimilation rate. Biomass and yield relations. Structure of seeds. Seed development patterns. Chemical composition of seeds. Physiological processes. Seed respiration, Mobilization of stored resource in seeds. Harmonal regulation of seed germination. Seed desiccation damage, role of LEA proteins. Seed viability. Seed dormancy and priming.

Unit 4: Physiology of Flowering and Post Harvest Physiology

Flowering phenomenon, juvenility- transition to flowering, Control of flowering – photoperiodism, thermoperiodism, vernalization, photomorphogenesis, photoreceptors, phytochrome, cryptochrome, physiology of flowering,. Flowering response-to environmental features (light, temperature, stress) etc. Physiological processes mediating fertilization (pollen-stigma interactions), seed and fruit development, seed and fruit abortion and means to overcome it. Physiological basis of cytoplasmic male sterility and fertility restoration. Gene expression in flowering.Physiological and biochemical changesduring fruit ripening and storage. Senescence and post harvest life of cut flowers. Physical,physiological and chemical control of post - harvest deterioration of fruits, vegetables and cut flowersand its significance during storage and transport. Molecular approach in regulation of fruit ripening.

SOCIOLOGY

Unit - I

Historical background of emergence of sociology and sociological perspective, Emile Durkheim: division of labour in society, theory of suicide. Max Weber : contribution to sociological thoughts, Karl Marx: dialectical materialism, class conflict, alienation and political power. G.H. Mead: symbolic interactionism. Structural–functionalism and post-structuralism: SF Nodel, T Parsons, RK Merton, C Levis Strauss. Conflict theory: Karl Marx, R. Dahrendorf, L.A. Coser, Critical theory of neo-Marxism and Recent trends in sociological theory.

Unit - II

Research Methodology: Nature, scope and types of Social Research; Problem of objectivity, Ethics in Social Research. Quantitative methods and survey research: Assumptions of quantification and measurement, survey techniques, research design, sampling design, hypothesis, reliability and validity. Qualitative research techniques: Techniques and methods of qualitative research, participant observation/ethnography, interview guide, case study method, content analysis, oral and life history. Data collection: Types and sources of data, Techniques of data

collection – observation, schedule, questionnaire, interview, caste-study and mixed method. Statistics in social research: Measures of central tendency dispersion, chi-square, reliability & validity.

Unit - III

Rural society in India: characteristics of peasant and agrarian society, agrarian movement and globalization. Planned change for rural society, Panchayati Raj, community development programmes and rural development strategies. Social Institutions, Problems of rural society, Rural poverty, emigration, landless labour. Indian society: Unity in diversity, varnashrama system, Caste-features, functions and changing aspects. Rural, urban and tribal society in India. Underprivileged sections in India : Women, scheduled castes, scheduled tribes, other backward groups and role of social legislation.

Unit - IV

Rural sociology, Social stratification, Social groups, Leadership, Social structure, Social organization, Social control, Social change, Sanskritization, westernization, modernization and socialization. Decision making, Demography, water sanitation, pollution energy, housing and urban development, environment, technology and society. Nationalism, Religion, Social psychology: personality, group dynamics, motivation and emotion. Culture, Impact of agricultural technology on rural life, Law and polity.

STATISTICS

Unit I

Introduction to statistics, meaning, importance and limitations of statistics, collection of data, primary and secondary data, tabulation and presentation of data through diagrams and graphs, measures of central tendency and dispersion and their properties, moments, skewness and kurtosis. Sample space and events, classical, empirical and axiomatic definitions of probability, Laws of probability, Conditional probability and Bayes' theorem, Independence of events, Random variable, Mathematical expectation and its properties, Moments, Moments generating, function, Characteristic function and probability generating functions along with their applications; Standard probability distributions and their properties, Chebyshev, Cauchy – Schwarz, Jenson, Holders and Minkowski's inequalities. Different modes of convergence and their interrelations. Weak and Strong laws of large numbers, Central limit theorem and its various forms. Correlation, rank correlation, interaclass correlation, partial and multiple correlations, simple and multiple regression and curve fitting by the method of least squares.

Unit II

Statistic, estimate and estimator, properties of a good estimator unbaisedness, consistency, sufficiency and efficiency, Neyman-Fisher factorization theorem, distributions admitting sufficient statistics, uniformly minimum variance unbiased estimator, Cramer-Rao inequality, Rao-Blackwell theorem, completeness of a statistic, Lehman Scheffe theorem, Methods of estimation- method of moments, method of maximum likelihood and the properties of the estimators obtained by these methods.

Hypotheses-Null and alternative, simple and composite, type-I and type-II errors, critical region, level of significance, size and power function of the test, unbiased test, most powerful and uniformly most powerful test, Neyman-Pearson lemma and Likelihood Ratio test, tests based on t, F , Chi-square statistic, large sample tests, interval estimation and best confidence intervals. Sequential analysis, Wald's SPRT and its properties, OC and ASN functions. Nonparametric tests, advantages and disadvantages of non-parametric tests, sign test, Wilcoxon signed ranked test, run test for randomness, median test, Mann–Whitney test, Kolmogorov-Smirnov test.

Unit III

Population and sample, sampling unit and sampling frame, sampling Vs complete enumeration, random and purposive sampling, simple random sampling with and without replacement, stratified random sampling proportional and optimum allocations, systematic, cluster and two stage sampling, estimation of population mean and total using above methods and their comparisons, Ratio and regression methods of estimation, probability proportional to size sampling with and without replacement, cumulative total method and Lahiri`s method.

Analysis of variance, one way and two way classifications, Orthogonality, contrasts, mutually orthogonal contrasts, design of experiments- basic principles of design of experiments, uniformity trials, CRD, RBD, LSD, split plot design and BIBD, construction of BIB and PBIB designs, Lattice designs, alpha designs, cyclic designs, augmented designs, general analysis of block designs. 2^n and 3^n -factorial experiments with and without confounding, missing plot technique.

Unit IV

Analysis of segregation, Detection and estimation of linkage, Random mating and Hardy- Weinberg's Law, Forces affecting gene frequency, Fisher's Fundamental theorem of Natural selection, Disequilibrium due to linkage for two pair of genes and for sex linked genes, Polygenic system for quantitative characters, Genetic variance and its partitioning, Inbreeding, Heritability, Repeatability, Regular systems of inbreeding, Effects of inbreeding, Path Analysis, Genetic Correlation, Heterosis, Selection for improvement, Simultaneous selection for several characters, General and specific combining abilities.

Multivariate Normal distribution, its properties and characteristic function, estimation of its mean vector and dispersion matrix, Wishart distribution and its properties, Hotelling T^2 statistic, its distribution and applications, Mahalanobis D^2 statistic and its relationship with Hotelling T^2 statistic, principal component analysis, factor analysis, canonical correlation, canonical variates and discriminant analysis.

Zoology

Unit.-I. Systematics:

Details of the functional and evolutionary modification in various systems of invertebrates and vertebrates, fundamental concepts and patterns in systematics, animal diversity, classification, identification and nomenclatureof invertebrate and vertebrate. Principles and methods of nomenclature; keys, their kinds and uses

Unit.-II. Ecology and Wild Life Conservation:

Environmental biology; community; ecosystems, their types, properties and characteristics. Population, its characteristics, population interactions. Community

structure and metabolism, biogeochemical and nutrient cycles, ecological succession, limiting factors, environmental pollution
Wild life; concepts and principles of wild life management, conservation and control, legislation, wildlife parks and sanctuaries, Distribution, ecology and adaptations in animals

Unit.-III. Animal Physiology & Behaviour:
Physiology of nutrition, thermoregulation, cellular immunity. Neural, humoral and pharmacological regulation of cardio-vascular activities. Neural integration, interneural communication; importance of specialized nervecells. Physiology of endocrine glands, hormonal receptors; physiology of reproduction and hormonal control of reproductive behaviour Origin and evolution of behaviour, instinct and learning; modes of communication, significance of biorhythms
Unit.-IV.Developmental Biology: Introduction to microtomic and ultramicrotomic techniques along with the details of development biology

College of Home Science

Foods and Nutrition

Unit I Familiarization to terms and calculations used in preparation of various standard solutions. Sample and sampling techniques. Principles, techniques and applications of colorimetry, spectrophotometer and atomic absorption spectrophotometer, fluorimetry, flame photometry and electrophoresis. Principles, techniques and application of chromatography (paper chromatography, TLC, GLC, HPLC). Introduction to animal assay.

Unit II Assessment of the nutritional status at individual, household and institutional level: direct and indirect methods. Ecological, socio-cultural, economic and demographic correlations of malnutrition; prevalence, etiology, biochemical and metabolic changes in vitamin A deficiency, PEM, iron deficiency anemia, IDD. Major nutritional problems of the state, nation and world. Nutrition intervention- definition, importance, methods of nutrition intervention and their impact evaluation. National nutritional programmes and policies; nutritional surveillance.

Unit III Adulthood: nutritional requirements & intake as affected by sex, occupation, income. Pregnancy: physiological changes in pregnancy, weight gain during pregnancy, food and nutrient requirements, storage of nutrients during pregnancy and impact of good nutrition on the outcome of pregnancy, complications of pregnancy and their nutritional management. Lactation: physiology of lactation, impact of nutrition on efficiency of milk production, food and nutrient requirements during lactation. Infancy: role of nutrition on physical and mental development, rate of growth - weight as an indicator, assessment of growth, nutrient requirement during infancy, feeding of infants – value of breast feeding, breast milk composition, breast feeding Vs artificial feeding, types of milk and their use in infant feeding, methods of formula preparation, weaning and supplementary foods, weaning practices in the community, special nutritional concern in infant feeding, feeding the premature and low birth weight infants. Nutritional disorders and common ailments in infancy, feeding the sick child, immunization schedule and growth charts. Preschool age: growth and development – physical and mental, prevalence of malnutrition in preschool years and food habits, nutritional requirements during

preschool year and supplementary foods. School age: growth and development, nutritional requirements of school age children, specific problems in feeding school children. Adolescence: physical and physiological changes, nutritional requirements of adolescents, food preferences and nutritional problems. Elderly: physical and physiological changes, nutritional requirement, problems of old age, nutrients influencing aging process.

Unit IV Role of dietician in a health care team in hospital and community. Newer concepts in dietary management of various nutritional disorders and disease conditions: fevers, infections. Dietary management during burns, allergy, gastrointestinal disorders and liver diseases. Dietary management of cardiovascular diseases, renal disorders and obesity. Dietary management of diabetes, cancer and HIV. Nutrition in critical care.

Family Resource Management

Unit – I APPROACHES TO RESOURCE MANAGEMENT

Systems approach to Family Resource Management, Concepts: values, origin & development, classification, characteristics, hierarchy, value clusters, value conflicts and changing values; goals; classification, chain of goals, setting of goals, changing goals, goal priorities and crisis; standards: origin, characteristics, resource: nature, types, measurement, changing resource availability and needs, guidelines for use of resource, resource allocation and utilization interrelationship among concepts. Decision making process. Application of management process to time, money and energy for work simplification. Management process; planning, types and dimensions, planning in a systems perspective, factors affecting planning; implementation, controlling, checking the progress, evaluation; evaluation of resources, use and feedback. Motivation; importance, approaches, elements of sound motivation; Leadership: importance, theories, styles. Stress: nature, types, its management, decision making process, types and styles, decision linkages, decision conflicts and coping strategies, communication: communication process, types, components, functions and barriers.

Unit – II FUNDAMENTALS OF ERGONOMICS

Significance and scope of ergonomics – man, machine and environment system interactions –Anthropometry: principles, measurements; Application of Anthropometry in ergonomics and design –Human body in relation to ergonomic study. Body composition, body size. Fundamentals of work physiology; muscular efforts, energy consumption, physical fitness: measurement using different techniques. Physical work capacity and factors affecting energy requirements and costs for various activities; fatigue. Physiological indices of work, work-rest cycle. Fundamentals of work physiology; muscular efforts, energy consumption, physical fitness, Bio-mechanical parameters; Work postures, Postural variations, musculoskeletal discomfort and their measurement, OWAS technique, environmental parameters: temperature, humidity, light, sound; Evaluation and effect on worker and work performance Ergonomic investigations: Techniques and problems – Ergonomic requirements for people with special needs.

Unit – III ADVANCED INTERIOR SPACE MANAGEMENT

Effect of interior design and decoration on family well being with particular reference to special needs - Functional and aesthetic considerations in use of elements and principles of design. Advances in design process of residential and commercial interiors. Trends in decoration treatments for interiors and interior backgrounds from past to resent in furniture, furnishings, accessories, lighting, fittings and fixtures, wall & floor

surface materials, finishes. Changing trends in thermal, acoustics and safety mechanisms.

Unit – IV ADVANCED HOUSING

Historical perspective of the architectural features of buildings –Structural features of residential buildings in different geo-climatic conditions -Social-cultural and economic issues in housing. Housing stock quality, demand and supply in urban and rural areas of India -Role of Government and non-government organizations in providing and regulating housing needs. Vastushastra-Ancient Science of house design - Emerging techniques in the house construction, Low -cost building materials and fabrication techniques, Eco and Ergo friendly house design, house wiring, sanitary fittings, acoustics, rain water harvesting structures for houses. Estimation of cost and housing finance, recent developments in building Bye Laws - Housing research-Landscape planning.

Extension Education and Communication Management

UNIT-I: Extension efforts in India after independence: Community Development Programme; Panchayati Raj Institutions; T & V system; Special programmes for poor, women and children: IRDP, SGSY, NLM, TRYSEM, DWCRA, ICDS, MNREGA, Beti Bachao Beti Padhao etc. Extension approaches and organisations: ATMA, DRDA, Central Social Welfare Board, State Social Welfare Board, NABARD; Extension system of ICAR, SAUs and state departments; Problems and issues of extension management in India; Critical appraisal of management of various extension organizations; Role of NGO/voluntary organisations in rural development; Five Year Plans in India; Comparative extension system of selected developed and developing countries: USA, UK, Israel, China, Pakistan, Japan and Brazil; Gender perspectives in development of women

UNIT-II: Training: Concept and importance in Human Resource Development (HRD) and rural development; Types and models of training; Participatory training methods; Lecturette, interactive demonstration, brain storming, case studies, syndicate method, simulation exercises, role play etc. UNIT; Designing, management and delivery of training programme; Monitoring, evaluation and impact assessment; extension programme planning : objectives, principles and process; Techniques of participatory planning: RRA, PRA, PLA and their application in extension; Project management techniques: PERT, CPM, SWOT analysis; Concept and formation of women SHGs.

UNIT-III: Communication: concept, meaning, importance, models, theories and types; Communication approaches: individual, group and mass; Communication fidelity, credibility, empathy, feedback and factors affecting communication process; Barriers in communication; Communication skills: reading ,writing, public speaking etc; Concept and element of diffusion; Concept and stages of Innovation: decision process, attributes and consequences of Innovations; Adopter categories and innovativeness; Development communication; Recent advances in communication: internet, e-mail, fax, mobile, interactive video, teleconferencing, computer and computer networking, AGRINET and e-Governance; Process of print and elctronic media production: newspaper, magazine and other extension publications (leaflets, brochures, newsletters, bulletins, booklets, posters, radio, TV; Multimedia: concept and evolution; Fundamentals of making a multi media programme: text, graphics and audio

UNIT IV : Social research: meaning and importance; Types of research; Qualities of researcher; Steps of research: selection and delineating of research problem, statement of general and specific objective, formulation of hypothesis; Variable and their types; Planning research design, selection and development of data collection tools, collection of data, analysis and interpretation of data, drawing conclusion, writing abstract and research report; Review of literature: importance, sources of literature, organizing review, collection and presentation; Sampling: meaning and importance, sampling techniques, determine size of sample; Research Design: historical, experimental, ex-post-facto, survey, case study, field studies; Techniques of data collection: observation, interview, questionnaire, projective technique, content analysis and sociometry; Scale and tests; Validity and reliability.

HUMAN DEVELOPMENT AND FAMILY STUDIES

Unit -I Theories of Human Development: psychoanalytic theory of Sigmund Freud, psycho-social theory of Erikson, stimulus response theories, Piaget's theory of cognitive development, moral development theory of Kohlberg and Piaget, Bronfrenbrenner's ecological systems theory, attachment theory of Bowlby and Ainsworth. Chomsky's language development theory, socio-cultural theory by Vygotsky.

Unit -II Life Span Development: physical and motor, perceptual, cognition and metacognition and language development, emotional maturity, stability and catharsis, vulnerability and resilience, culture and its impact on development, influence of cultural factors. Integrated view of development from a life span perspective; recent research trends in human development issues.

Unit - III History and development of early childhood education; contribution of educationists – MK Gandhi, RN Tagore, Zakir Hussain, Sri Aurobindo, Krishnamurthi, Tarabai Modak, Jawaharlal Nehru, Kothari Commission, Yashpal committee report. Contributions of Martin Luther, John Ames Comenius, Johan Pestalozzi, Friedrich Froebel, John Dewey, Robert Owen, Maria Montessori, Jean Piaget, B.S. Bloom, J.Mc V Hunt.: National policies on early childhood programs; concept of school readiness

Unit - IV Assessment – definition, function, concept of measurement, techniques and their relative efficacy in measuring different aspect of human development, methods and techniques of assessment in human development: anthropometry, sociometry, psychometry, psychological tests, projective techniques, individual and group tests, , trends and challenges in assessment of human behaviour; ethical issues in the assessment of human development, scientific methods and their criteria - reliability, validity control and item analysis, development of test /scale and standardization procedure, types of scales nominal, ordinal, interval and ratio scale.

TEXTILE AND APPAREL DESIGNING

Unit-I

Chemistry of polymers- polymerisation, types, degree and characteristics; structure of textile fibres- general, molecular bonding, length, orientation, and requirements of fibre forming substances; structure and property relations of the fibres - repeating units, bonds, reactive groups and physical properties; commercial processes of fibres; study of new fibres-bio-component and biconstituent fibres; blending – principles, technology and types; importance of textile testing, standardization and quality control, functions of BIS and other standards; Sampling techniques; moisture relations in textiles; standard conditions of testing; fibre testing - length, linear density, maturity; yarn testing – yarn number, single and lea strength, twist, crimp and evenness; fabric testing –weight, thickness, strength – breaking, tear and bursting ; abrasion resistance – flat, flex; pilling; crease recovery; stiffness; drapability; air permeability; thermal properties; flammability and assessment of other safety aspects in textiles; water permeability – repellency, wicking and dimensional stability; comfort and fabric handle measurement.

Unit-II

Advanced techniques of pattern making and draping - incorporating style lines and fullness; principles of contouring, surplice/off shoulder and halter designs; built-in necklines, cowls and collars; skirts, advanced sleeve variations, exaggerated armholes, pockets, bias cut dresses; jackets, types of pants; pattern adoption to knits.

Unit-III

Textile auxiliaries, selection, classification and use in important processing operations in which auxiliaries are used; chemistry and synthesis of surface active agents- essential requirements of a
surfactant, classification, anionic surfactants, cationic agents, non-ionic surfactants,
biodegradability of surfactants; finishing agents, stiffening agents, cross linking agents, optical brightening agents, softeners, water repellents, flame retarding agents, antistatic agents, soil release agents, antipilling agents, mothproof and mildew proof agents; methods of evaluation of textile auxiliaries; eco-friendly auxiliaries.

Unit-IV

Ideal workstation for CAD- Selection of suitable hardware and software; role of computers in textile and apparel designing production; types of images and characteristics; saving of images; colour ways in computers, creation of new designs for textile surface - planning for various weave designs – stripes, checks etc; leading to application and change of fabric texture, print and colour; creation of designs in apparel; texture variation by using effects like embossing, blooming, transparency and translucent look on a garment; use of 3 D softwares for customisation of created designs as per end uses; fashion trends in accessories: introduction, designing and product developments of trims, foot wears, hand bags, buttons, buckles, belts, hats, scarf, jewelry, neck ties

Syllabus for Ph.D. Entrance in Physics

Section 1: Mathematical Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Fourier series, Fourier and Laplace transforms. elements of complex analysis: Cauchy Riemann conditions, Cauchy's theorems, singularities, residue theorem and applications.

Section 2: Classical Mechanics

Newton's laws. Dynamical systems, Central force motions. Kepler's problem. Two body Collisions - scattering in laboratory and Centre of mass frames. Motion of rigid body. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Special theory of relativity, Lorentz transformations, relativistic kinematics and mass–energy equivalence.

Section 3: Electromagnetic Theory

Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space.

Section 4: Quantum Mechanics

Postulates of quantum mechanics; uncertainty principle; Schrodinger equation; one-, two- and three-dimensional potential problems; particle in a box, transmission through one dimensional potential barriers, harmonic oscillator, linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent and dependent perturbation theory; elementary scattering theory.

Section 5: Thermodynamics and Statistical Physics

Laws of thermodynamics and their consequences. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.

Section 6: Solid State Physics

Bravais lattices. Reciprocal lattice. Bonding of solids. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall effect. Electron motion

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in a periodic potential, band theory of solids: metals, insulators and semiconductors. elements of superconductivity: Type-I and Type II superconductors, Meissner effect, London equation. Nano-structured materials and their properties.

Section 7: Electronics

Multivibrators. Semiconductor devices: diodes, Bipolar Junction Transistors, Field Effect Transistors; operational amplifiers: negative feedback circuits, active filters and oscillators; regulated power supplies; basic digital logic circuits, sequential circuits, flip-flops, counters, registers, A/D and D/A conversion. Microprocessor, Opto-electronic Devices.

Section 8: Nuclear and Particle Physics

Deutron Problem. Nuclear radii and charge distributions, nuclear binding energy, Nuclear models, liquid drop model: semi-empirical mass formula, Fermi gas model of nucleus, nuclear shell model; nuclear force and two nucleon problem; alpha decay, beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance.

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CCS Haryana Agricultural University Hisar
BOTANY SYLLABUS
Ph. D. Entrance

UNIT I: DIVERSITY OF CRYPTOGAMS

General introduction, brief history and classification, reproduction, life cycle pattern of algae and fungi. Bryophyta: General characters, Classification, life cycle pattern and economic importance, Pteridophyta: General characters, Classification, reproduction and life cycle.

UNIT II: DIVERSITY OF PHANEROGAMS

Gymnosperms: General characters, classification, reproduction and life cycle, Angiosperms: General characters, taxonomic ranks, types of classification (artificial, natural and phylogenetic) salient features of Bentham & Hooker's system of classification with merits and demerits, binomial nomenclature. Codes of nomenclature, ICBN and its preamble and major rules.

UNIT III: CELL BIOLOGY AND GENETICS

Cell, cell organelles, structure and their functions, Cell division- Process and significance of Mitosis and Meiosis, Cell cycle. Mendelian Genetics: Laws of inheritance, Monohybrid cross, Dihybrid cross, Back cross and Test cross, Gene interaction and epistasis, Sex linked inheritance, Chromosomal Aberrations

UNIT IV: MORPHOLOGY AND MORPHOGENESIS OF ANGIOSPERMS

Angiospermic flower and its different parts, their phylogeny. Principles of Taxonomy– Taxonomic structure, hierarchy, concept of species and development. Systematic position of some selected families on the basis of phylogeny and their economic importance.

UNIT V: HISTOLOGY AND ANATOMY

Meristem, Simple Tissues, Complex Tissues, Secretary Tissues, Root, stem and leaf anatomy of dicotyledons and monocotyledons, Secondary and Anomalous secondary growth in dicot and monocot root and stem

UNIT VI: PLANT EMBRYOLOGY

History of plant embryology, development and structure of microsporangium, development and structure of male gametophyte, pollen physiology. Development and structure of ovule/megasporangium, development and structure of female gametophytes. Pollination, fertilization, self-incompatibility, development of endosperm, embryo and seed. Polyembryony and apomixis, parthenocarpy and parthenogenesis. In vitro culture of embryo, embryo rescue after wide hybridization and its application, anther and pollen, somatic hybridization, endosperm culture and production of triploids.

UNIT VII: ECOLOGY

Ecology – Definition and Scope, Structure of ecosystem (Abiotic and Biotic), Types of ecosystem, Ecological pyramids and energy flow, Food chain and Food web, Morphological and anatomical adaptations of plants to water stress conditions-Hydrophytes, Xerophytes and ,

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halophytes, Pollution: Causes and effects of water, soil and air pollution and their control measures.

UNIT VIII: ECONOMIC BOTANY

Botanical name, family, method of cultivation and economic importance of Cereals, Pulses, Fiber yielding plants, Oil yielding plants, Timber yielding plants and Medicinal plants (Aloe, Ocimum, Adathoda, Withania). Sources of forest products and cultivation- tannins and dyes, gums and resins, rubber and latex and paper pulp. Study of important fumigatories, masticatories and beverages such as tobacco, nut, tea, coffee and cocoa. Brief account of non-traditional economic plants- jojoba and guayale. Utilization of byproducts of crops– cotton stalks, paddy husks and coconut fibers.

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Ph.D. (Mathematics) Entrance Examination Syllabus

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.
Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis: Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations: Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics: Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies. Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

19/7/19

SYLLABUS FOR ENVIRONMENTAL SCIENCES

INTRODUTION TO ENVIRONMENTAL SCIENCES

Definitions and concepts in environmental sciences; ecology, ecosystem and environments; components of environments and their interactions; Structure and functions of ecosystems; biotic and abiotic interactions; energy flow and nutrient cycling in different ecosystems-trophic levels, food chains, Productivity models; Ecosystems and biogeographic regions; Natural resources of India: land, soil, water and forest and their conservation, Effects of deforestation on soil erosion; Biodiversity- Levels and Scales of Biodiversity- genetic, Species and Ecosystem Diversity; Origin of Life, Organic Evolution; Genesis of Biodiversity; Biodiversity changes in space and time; Speciation and Isolation Mechanism; Global Climate Change and Loss of Biodiversity; Bio-productivity and Sustainability; Biodiversity and Life Security – Food Health, Environmental and Job Security. In-situ and Ex-situ conservation of biological diversity.

MICROBES AND ENVIRONMENT

Introduction and scope of environment microbiology; Microbial diversity of soil, air and water, Microbial interactions; Microbes in normal and extreme environments & their classification; Factors governing microbial life in extreme environment; Microbial technology in pollution abatement and its bioremediation; Waste management by biogas technology and composting, Sewage treatment; Concept of BOD, COD, DO, CO_2 and C^{l2} in water; Biofuels; Recovery of metals and petroleum; Soil biota, Soil microbial ecology, types of organisms in different soils; Soil microbial biomass; Microbial interactions: unculturable soil biota; Biofertilizers, soil enzyme activities and importance; Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; Biochemical composition and biodegradation of soil organic matter and crop residues; Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures; Biotic factors in soil development.

SOIL, WATER AND AIR POLLUTION

Soil, water and air Pollution problems associated agriculture; Nature and sources of pollutants-agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc; Air, water and soil pollutants-their CPC standards and effects on plants, animals and human beings; Sewage and industrial effluents- effects on soil properties/health/plant growth and human beings; Pesticides and their classifications, behaviour in soil and effects on soil microorganism; Toxic elements- their sources, behaviour in soil and effects on nutrients availability and on plant health and due to leaching of nutrients and pesticides from soil, emission of greenhouse gases- carbon dioxide, methane and nitroxide. Remediation/amelioration of contaminated soil, water and air. Factors affecting plant response to air pollution; Acid rain, physiological and biochemical effects of SO_2, HF, PAN and O_3 on vegetation, toxicity symptoms on vegetation.

ENVIRONMENTAL CHEMISTRY

Toxic chemicals in Environment; Pesticides: Persistent organic pollutants, Mode of action, Carbamates, Organophophates, Pyrethroids, Mode of Entry; Metabolic pathways of some insecticides (DDT, Parathion); Brief account of herbicides; Green Chemistry: Principle and concepts of green chemistry; Water Chemistry: Water quality parameters and standards, Dissolution reactions, Complexation reaction, Effect of parameters on water quality (Temperature, Salinity, pH, Turbidity, DO, Nutrients, Faecal coliforms); Chemistry of house products: Chemistry of cleaning, Surfactants, Chelating agents, Soaps and detergents; Polymer and Plastics (Chemical structure and types).

ENVIRONMENTAL POLICY, LAW AND INTERNATIONAL CONVENTIONS

Environmental and Development Policies: Land and agricultural policies; Land use policy, Policy on resettlement and rehabilitation, Forest Policies in India; National Forest Policy 1952 and 1988, National Environment Policy 2006, Policy on abetment of pollution, National Water Policy; Convention on International Trade in Endangered, Convention on wetlands, Control of trans-boundary movement of hazardous wastes and their disposal, The Montreal Protocol, Convention on Biological Diversity 1992 (CBD), Cartagena Protocol on bio-safety 2000(CPB), United Nation Framework, Convention of Climate Change.

DEPARTMENT OF BUSINESS MANAGEMENT

SYLLABUS – Ph.D. Entrance Examination **Subject: Management**

Unit – I: General Management

Management – Concept, Process, Theories and Approaches, Management Roles and Skills, Functions – Planning, Organizing, Staffing, Coordinating and Controlling, Communication – Types, Process and Barriers, Entrepreneurship Development.
Managerial Economics – Concept & Importance, Demand& Cost analysis, Elasticity Forecasting, Market Structures – Market Classification.
Organisational Behaviour, Individual Behaviour – Personality, Perception, Values, Attitude, Learning, Group Behaviour – Team Building, Leadership, Group Dynamics, Organizational Culture & Climate, Organization Development, Organisational Change.
Strategic Management- SWOT Analysis, Corporate Strategy, Business Portfolio Analysis - BCG Matrix, CSR
Research Methodology- Data Collection & Questionnaire Design, Sampling – Concept, Process and Techniques, Types of scales, Hypothesis Testing
Operations Management – Role and Scope, Facility Location and Layout – Site Selection and Analysis, Layout – Design and Process, Total Quality Management – KAIZEN, Benchmarking, Six Sigma; ISO 9000 Series Standards.

Unit – II: HRM

Human Resource Management – Concept, Perspectives, Influences and Recent Trends, Human Resource Planning, Recruitment and Selection, Induction, Training and Development, Job Analysis, Job Evaluation, Motivation and theories, Compensation Managementand Performance Appraisal, Talent Management & Skill Development, Employee Engagement & Work Life Balance, Industrial Relations: Disputes & Grievance Management, Labour Welfare and Social Security, Trade Union & Collective Bargaining.

Unit– III: Finance and Accounting

Accounting Principles and Standards, Preparation of Financial Statements, Financial Statement Analysis – Ratio Analysis, Funds Flow and Cash Flow Analysis, Marginal Costing, Cost Volume Profit Analysis, Standard Costing & Variance Analysis, Financial Management, Concept & Functions, Capital Structure – Theories, Cost of Capital, Sources and Finance, Budgeting and Budgetary Control, Types and Process, Zero base Budgeting.
Time Preference for Money, Valuation of Bonds and Shares, Risk and Returns; Capital Budgeting – Nature of Investment, Evaluation, Dividend – Theories and Determination, Mergers and Acquisition, Portfolio Management – CAPM, Working Capital Management – Determinants, Cash, Inventory, Receivables and Payables Management. Financial Institutions, Commercial Banks, Cooperative Banks, Micro Finance.

Unit –IV: Marketing Management

Marketing – Concept, Orientation, Trends and Tasks, Customer Value and Satisfaction, Market Segmentation, Positioning and Targeting, Product and Pricing Decision – Product Mix, Product Life Cycle, New Product development, Pricing – Types and Strategies, Distribution and promotion decision – Marketing channels, IMC, Advertising and Sales promotion
Consumer and Industrial Buying Behaviour, Branding decisions, Managing Sales Force, Personal Selling, Service, Customer Relationship Marketing, Retail Management, Emerging Trends in Marketing – Concept of e-Marketing, Direct Marketing, Digital Marketing and Green Marketing, International Marketing – Entry Mode Decisions.

Syllabus for Ph.D Entrance Examination

Ph.D Aquaculture

Unit: Sustainable Aquaculture

Present scenario and problems: Trends in global and Indian aquaculture; different farming systems; intensive systems and constraints - environmental degradation and disease outbreaks. Sustainability and development: Systems approach and its application in aquaculture with special reference to resource-poor systems; Role of aquatic resources in food and nutrition; Environmental issues: Exotic species introduction; escapement; contamination of indigenous gene pool; salinization of soil and water; environmental impact; over exploitation of wild stocks; mangrove deforestation. Strategies for sustainability: Sustainability concept; food security; biosecurity; organic farming; integrated farming; responsible aquaculture; rotational aquaculture; bioremediation; role of biotechnology, traceability. Sustainable use of antibiotics. Economic viability, value addition.

Unit: Soil and Water Quality Management in Aquaculture

Soil and water interaction: Physical and chemical properties of soil and water, Productivity vs nutrient quality and quantity of soil and water; aquatic microorganisms and their role in carbon, nitrogen, phosphorus and sulphur cycles and impact on aquatic habitats and species. Soil and water quality monitoring: soil and water quality standards; soil and water quality monitoring and management. Fertilizers and manures: Different kinds of fertilizers and manures, fertilizer grade, source, rate and frequency of application, Biofertilizers, Use of treated sewage for pond fertilization, Utilization of bioactive compounds by microorganisms. Soil and water quality management: Cat clay/pyrite soil, seepage, water treatment, water filtration devices, aeration, chlorination, ozonization and UV radiation, Algal bloom control, eutrophication, Aquatic weed management, Waste water treatment practices, Role of microorganisms in fish production, fish health and fish safety

Unit: Nutrition and Feed Technology

Fish nutrition: Principles of fish nutrition and terminologies, nutritional requirements of cultivable finfish and shellfish: larvae, juveniles and adults. Nutritional biochemistry: Classification, nutrient quality and evaluation of proteins, lipids and carbohydrates.Role of nutrients: amino acids, fatty acids, proteins, lipids, carbohydrates, vitamins and minerals. Nutritional physiology: Digestion, accretions and nutrient flow, Factors affecting digestibility. microbial toxins, methods of elimination, nutrient deficiency and symptoms. Feed Resources: Nutritional value of feed ingredients and live feed, Contribution from natural food to nutrient requirements of fish.

Unit Aquatic Animal Health Management

Basics of fish and shellfish health management: Host-pathogen-environment relationship, Management of culture systems, Environmental stress. Defence system in fish and shellfish, Antibody and cell mediated immunity in fish and shellfish. Parasitic and mycotic diseases: General characteristics, Epizootiology, Diagnosis, Life cycle, Prevention and treatment. Infectious bacterial and viral diseases: General characteristics, Epizootiology, Diagnosis, Prevention and treatment. Non-infectious Diseases: Nutritional diseases, water, soil, environmental parameters and their effects on fish health. Disease in hatcheries and grow- out systems. Disease surveillance and reporting.

Disease control and management: Environment management, chemotherapeutic agents, host management, prophylaxis- vaccines, adjuvants, immunostimulants and probiotics.

Ph.D Fisheries Resources Management

Unit: Inland Fisheries Resources

Categorization of different freshwater fisheries resources: Ponds, lakes, bheels, tanks, estuaries, brackish water lagoons, wetlands, biosphere reserves and mangroves and derelict water bodies their problems and management aspects. Bheel fisheries resources of India: Open and closed bheels, productivity conditions, Capture scenario, prospects of culture based systems. Riverine fisheries resources: habitat modification and improvement (rehabilitation of channels and flood plains), protection and restoration of fish movements (different types of fish passes and enhancement of fish migration), management and repair of riverine vegetation, stock enhancement strategies like introduction of new species, pre- and post- stocking management, potential risk of stocking. Cold water fisheries of India: Present trends, problems due to habitat destruction, management aspects, prospects of sports fisheries in India. Reservoir Fisheries: Classification of reservoirs, present productivity levels, management practices. Estuarine fisheries: classification of estuaries- present productivity level- potential; Problem – management practices. Community participation in fishery resource management.

Unit: Marine Fisheries Resource Management

Major fishing nation of the world, major fishing regions, present trend of marine capture fisheries. Important finfish and shellfish resources in demersal and pelagic systems; conservation strategies. Principles of

management of fisheries resources objectives of management, issues and challenges of managing multi-gear fisheries. Sustainability: Principles, social economic ecological biological and legal issues Fisheries co-management. Fisheries and fishing methods in open waters: Inshore fisheries (up to 50 m depth), offshore fisheries (50-200 m depth) High sea fisheries (beyond 200m) up to outer limit of EEZ and in International waters. Conservation aspects: Biodiversity principles, categorization of species into endangered; Case studies of fisheries conflicts depending on problems in different states.

Unit: Marine Ecosystems, Biodiversity and Conservation

Biology of selected endangered species of sponges, corals, gastropods, bivalves, sea cucumbers, fishes, sea snakes, turtles, birds and marine mammals. IUCN criteria –- Red List, Wild life protection act, International treaties and conventions, Marine Protected Areas, Sanctuaries and Biosphere reserves. Establishment of National marine parks, *in situ* and *ex situ* conservation. Marine and Coastal Ecosystems – Overview; physico-chemical environment; ecological notions; plankton; benthos, mangroves; sea grasses and corals.

Unit: Tropical Fish Stock Assessment

Stock concept. Estimation of growth parameters and mortality rates. Virtual population methods. Gear selectivity. Sampling of commercial catches. Yield per recruit model. Surplus production model. Swept area method - Box model. Stock recruitment relationship – Stochastic model – estimation of technical reference point MSY and other yield base reference point.

Ph.D Aquatic Environment Management

Unit: Aquatic Environment and Biodiversity

Concepts in aquatic environment: Aquatic environment/ecosystem – components-structure and functions; Ecological concepts – succession, homeostasis, natality and mortality, r and k selection; Concepts of habitat and ecological niche; carrying capacity. Environmental concerns: Environmental concerns – population explosion, industrialization, urbanization, and natural calamities; Overexploitation of resources; Environmental stresses; Global Warming; Ozone Depletion. Biodiversity: Biodiversity – Definition and concept; Factors influencing aquatic biodiversity; Types of biodiversity - Species diversity in different ecosystems, Genetic Diversity, and Habitat Diversity; Biodiversity indices and their significance; Global diversity patterns and loss of biodiversity.

Unit: Chemical Interactions in The Aquatic Environment

Basic chemistry principles: Chemical reaction kinetics, chemical equilibria and redox chemistry, solubility concept, dissolution kinetics, processes controlling elemental cycling in the earth's crust, oceans and atmosphere.Soil properties: Soil structure and texture; Composition of oxide and silicate minerals in relation to surface chemical processes; Ion exchange - concept and source of cation exchange capacity (CEC), adsorption on to clay minerals of major cations, specific adsorption of major and minor nutrients, and heavy metal ions.Nutrient dynamics: Chemistry of soil-nutrient interactions and water permeability; Organic substances - biological processes in the degradation and conversion of organic matter; Humus and biogeochemical substances - structure, reactivity, solubility and mobility; Transport of nutrients, Soil-water interactions, Pollutant dynamics: Pollutant cycling, bio-accumulation, bio-availability, speciation and transport of contaminants (*e.g.*, pesticides and heavy metals).

Unit: Integrated Coastal Zone Management

Coastal resources: Coastal natural resources systems: flora and fauna, trophic relationship, nutrient production, cycle and transport; Mangrove ecosystem - species diversity and distribution of mangroves in India, Other inter-tidal system- Seagrass system, Coral reef system, Sandy beach system, Lagoon and estuary system. Developmental activities and biodiversity loss: Ecological issues, Non- sustainable development, Pollution, threats to biodiversity, habitat destruction, Depletion of fisheries resources, impacts of global environment changes, Multiple uses of the Coastal Zone, Urban settlement, Industrial development, waste disposal, Shore protection works, ports and marine transportation. Land transportation infrastructure, Coastal Zone Management: Integrated Coastal Zone Management (ICZM): its need and benefits, Management mechanisms- Pollution control, Protected areas (sanctuaries, marine parks and biosphere reserves), Protection from natural hazards; Socioeconomic impacts and its assessment, Disaster management for coastal environment.

Unit: Aquatic Pollution and Wastewater Management

Aquatic pollution and its management: Aquatic pollution – sources, types and their impacts; Pollution problems of groundwater resources –sources of contamination, management issues. Pollutants - Sewage, pesticides, oils, metals, radioactive wastes, biomedical wastes, etc. Dispersal of pollutants; Algal blooms and their management, Methods of pollution surveys. Waste disposal and water quality criteria used in different parts of world - national and international standards, Management strategies.

Wastewater management: classification and characteristics of sewage and industrial effluents; treatment methods for water and waste water; Principles of aeration, chlorination, ozonation and U.V. irradiation. solid waste management; removal of nitrogen and phosphorus from waste water; Role of aquatic macrophytes in treatment of wastewater.

Ph.D Fish Processing Technology

Unit: Technology of Fish Freezing and Frozen Storage

Freezing: Structure of water and ice, Influence of solutes on the structure of water and ice, phase equlibria and freezing curves of pure water and binary solutions, freezing curve for fish. Determination of freezing points from time- temperature plots, calculation of freezing time. Crystallization, homogeneous and heterogeneous nucleation, super cooling, crystal growth, eutectic point, location of ice crystals in tissue, physical changes during freezing. Technological aspects of freezing: Slow and rapid freezing, Methods of freezing, comparison of various freezing methods, product processing, packaging and different types of freezers. Theories of cryopreservation, glazing. Frozen storage: Physical and chemical changes. Chemical changes in lipids, proteins and nucleotides, freeze denaturation and theories on denaturation, changes in pH, bacterial changes, sensory changes, texture, taste, odour, effect of post-mortem condition on sensory qualities. temperature and duration of storage on quality and shelf life. Arrangements within a cold storage, handling and stacking systems. Filleting of fish, treatments, glazing, packaging and freezing. Different methods of Processing and thawing, Recent advances in fish thawing.

Unit: Thermal Processing Of Fishery Products

Principles of thermal processing. Mechanism of heat transfer: conduction, convection, radiation and dielectric and microwave heating, unsteady state of transfer, heat resistance of bacteria and spores, decimal reduction time, thermal death time, "Z" and "F" values, 12D concept, heat penetration, cold point, can size, shape, contents etc. on heat penetration, determination of process time. Heating equipment.Classification of foods: low acid, medium acid and acidic foods, absolute sterility, statistical sterility, commercial sterility, pasteurisation and sterilisation.Canning process, steps involved, process flow, additives, HTST processing and aseptic canning, principles and process details, canning machinery and equipment, canning process for fish/shellfish, value added and ready to use canned products. Spoilage of canned food, Combination and synergistic effects. Hurdle technology, effects of irradiation on protein, lipids, vitamins, bacteriological aspects, physical properties, shelf life and irradiated fish products.

Unit: Quality Assurances, Management and Certification

Quality management, total quality concept and application in fish trade. Quality assessment of fish and fishery products- physical, chemical, organoleptic and microbiological quality standards. Water quality and standards. Sensory evaluation of fish and fish products, basic aspects, different methods of evaluation, taste panel selection and constitution, statistical analysis.HACCP and Good manufacturing practices. National and International standards. Factory sanitation and hygiene: National and international requirements, SSOP, Sanitary and Phytosanitary measures.Food laws in India, integrated food law.

Unit: Applied Fish Biochemistry

Seafood proteins: Classification. Sarcoplasmic proteins, Myofibrillar proteins, Stroma proteins, Functional properties of seafood proteins: Solubility, emulsification, viscosity, water holding, stability, gelation, texture profile analysis. Changes in proteins during processing, Denaturation- At high and low temperatures and kinetics, dissociation / aggregation / coagulation, reversibility, significance to processing and quality. Hydrolysis and hydrolysates: Process and applications, proteinases. Post mortem biochemical changes, rigor mortis, K-value, TMAO and its decomposition products, demethylase. Macro and trace elements in fish and shellfish; Vitamins and Minerals of nutritional significance, toxic metals and their harmful effects and metallothionines. Flavour and pigments; amines, volatile fatty acids, carbonyls, sulphur containing compounds, carotenoids, isoprenoids in fish.Biogenic amines, Aflatoxins in cured fish.

Principles and methods involved in the separation and analysis of fish muscle constituents:

Ph.D Aquatic Animal Health

Unit: Viral and bacterial diseases of finfish and shellfish

Virology: General biology of viral infections, virus classification, virus replication. OIE Notifiable diseases. Aetiology, pathogenesis, epidemiology, treatment and control, immunology and molecular biology of viruses/viral diseases of finfishes with emphasis on the following: Epizootic haematopoietic Necrosis (EHN), Infectious Haematopoietic Necrosis (IHN), Oncorhynchus Masou Virus (OMV), Viral Encephalopathy and Retinopathy (VER), Spring Viraemia of Carp (SVC), Viral Haemorrhagic Septicaemia (VHS),Lymphocystis and Infectious Pancreatic Necrosis (IPN). Major viral pathogens of commercially important cultured crustaceans with special reference to shrimp and freshwater prawn: viral and bacterial; Biology, morphology, diagnostic methods, clinical signs and pathological changes associated with these pathogens; Viruses: WSSV, YHV, TSV, IHHNV, MBV, HPV, BP, BMN, LOVV, GAV, MrNV. Pathogenesis, virulence mechanisms, epidemiology, treatment and control measures of the bacterial diseases of finfish and shell fish with emphasis on Furunculosis, Haemorrhagic septicemia, Columnaris disease, Tail and fin rot, Bacterial gill disease, Vibriosis, Mycobacteriosis, Nocardiosis, Haemophilosis, Edwardsiellosis, enteric red mouth. Bacterial diseases of shellfish such as Vibriosis; Necrotizing hepatopancreatitis, rickettsial diseases, mycobacteriosis.

Unit: Parasitic Diseases of Finfish and Shellfish

Parasite taxonomy and morphology: Protozoan and metazoan parasites of fish and shellfish. Life cycle of fish and shellfish parasites. Parasite pathology, treatments and control of the disease caused by protozoan, Metazoan, Acanthocephalan, Crustacean, Shellfish parasites, Pathology, treatment and control of the disease caused by Microsporidians, Haplosporidians, Ciliates and Cephaline gregarines.

Unit: Health Management in Aquaculture

Review of various diseases of finfish and shellfish significant to aquaculture; diagnostic procedures and their application in aquaculture. Disease monitoring, surveillance, epidemiology, quarantine, certification and import risk analysis. Prophylaxis, hygiene and therapy of fish and shellfish diseases. Commonly used drugs/chemicals in aquaculture, drug delivery. Vaccines and vaccination, probiotics and bioremedial measures; immunostimulants and their role. Application of health management protocols and biosecurity principles in aquaculture. Longterm strategy in health management; Advances in disease control and management; Principles of SPF/SPR.

Unit: Systemic Fish Pathology

Introduction: Anatomy and physiology of teleost Integumentary, musculoskeletal, respiratory, circulatory, reticuloendothelial, renal, excretory and digestive systems. Pathophysiology: Stress and general adaptation syndrome, inflammatory response, necrosis and types, stages. Integumentary system: Cuticular, epidermal dermal and hypodermal changes, hyperplasia and ulceration. Respiratory system: Lamellar oedema, lamellar hyperplasia and lamellar fusion. Blood vascular system: Pathology of heart, vessels, blood composition, cellular components of blood and haemopoietic tissue. Digestive system: Digestive tract and its pathology; hepatic necrosis, lipid infiltration, hepatic granuloma, cirrhosis, pancreatic atrophy, neoplasia; epithelial sloughing of intestine. Excretory system: Kidney and its pathology, renal tubules and collecting ducts. Nervous system: Pathology of brain, spinal cord, peripheral nerves, meninges, sense organs. Musculoskeletal and Endocrine system: Pathological changes in red and white muscle bone and cartilages. Endocrine systems and pathology.

Systemic pathology in shrimp: Integument, respiratory, digestive and nervous system and its pathology.