

Syllabus for Entrance Test for Admission to M.Sc. (Agriculture)

Principles of Agronomy

Definition of agronomy, history, scope of the subject and its relation with other sciences, Tillage, classification of crops, seeds and sowing, intercultural operation, Planting geometry, harvesting, processing storage, concept of yield and yield components, harvest index, source sink relationship, crop growth rate, crop nutrition, manures and fertilizers - source, types and methods of application; green manuring crops, crop production in acidic soil, salt affected, flood affected, water logged & eroded areas, economic ecology.

Agricultural Meteorology

Agro-climatic zones of India and West Bengal. Different spheres in the earth, Agro-Meteorology- its definition and scope, Weather and climate, micro-climate, weather elements, Earths' atmosphere, Composition and structure, solar radiation, Nature, properties, depletion, solar constant and energy balance, Atmospheric, temperature, factors affecting, horizontal and vertical distribution, global warming- and its consequences in agriculture and other sector, Air Pressure variations; Wind: factors affecting, cyclones and anticyclones and general circulation, Atmospheric humidity, vapour pressure and saturation, Process of condensation, formation of dew, fog, mist, snow, rain and hail; Formation and classification of clouds, Introduction to monsoon, Basics of weather forecasting; Affects of weather elements on crops, animals and insect pest.

Livestock Production and Management

Place of livestock in the national economy, different livestock development programmes of Govt. of India. Important exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting fertility in livestock, reproductive behaviour like oestrus, parturition, farrowing etc. Milk secretion, milking of animals and factors affecting milk yield and composition. Selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing heifers and milch animals and other classes and types of animals, housing principles, space requirements for different species of livestock. Disease control measures, sanitation and care, breeding, feeding and production records. Breed characteristics of poultry, their methods of rearing, breeding, feeding and management, incubation, hatching and brooding, vaccination and prevention of diseases, preservation and marketing of eggs, its economics and keeping quality. Cost of production of milk, economical units of cattle, buffalo, sheep, goat and swine.

Introduction to Soil Science

Pedological and Edaphological concept, origin of the earth, Earth's crust, Rocks and minerals-classification and composition, weathering of Rocks & Minerals, Parent Material and its classification, soil formation-factors and processes; Soil physical properties-Soil texture-importance, textural classes, Soil Structure-classification, soil aggregation & its significance. Soil densities and porosity-bulk density and particle density of soils, void ratio, porosity-their significance, Soil colour-causes, importance and determination. Soil water-properties and behaviour of water, importance of soil water, ideas of soil water potentials,

soil moisture constants, soil water classification, available water, factor's affecting available water; Quality of irrigation water; Thermal properties of soils-soil temperature. Soil air-composition, gaseous exchange, influence on plant growth, soil temperature – source, thermal properties of soil, influence on plant growth.; Soil colloids, properties, nature, type and significance, layer silicate clays, their genesis and sources of charges. Absorption of ions. CEC, AEC, pH and buffering, buffering capacity of soil. Characteristic and reclamation of acid soil and salt affected soil, soil organic matter, composition and function, decomposability and humus formation, fractionation of soil organic matter.

Principles of Agricultural Economics

Economics: Meaning, Definition, Subject matter, Divisions of Economics, Importance of Economics; Agricultural Economics: Meaning, Definition; Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare. Wants: Meaning, Characteristics, Classifications of Wants, Importance. Theory of consumption: Total and Marginal Utility, Law of Diminishing Marginal utility, Meaning, Definition, Assumption, Limitations, Law of equimarginal utility, Indifference curve-concept. Consumer's surplus: Meaning, Definition, Importance. Demand: Meaning, Definition, Kinds of Demand, Demand schedule, Demand Curve, Law of Demand: Factors effecting, concepts of different elasticity of demand - Price, Income and Cross elasticity. Law of supply: Factors affecting, concepts of different elasticity of supply. Factors of production: Land, Labour, Capital and Organisation - concepts. Cost Concepts: Fixed and variable costs, Marginal cost. Market: Concepts, Classification of Market, Perfect and Imperfect. Welfare Economics: Meaning, Pareto's optimality. National Income: Concepts, Measurement. Public Finance: Meaning, Public expenditure and Public revenue - Meaning, their classification with examples. Inflation: Meaning, Definition, Kinds of inflation.

Crop Physiology

Introduction, Importance in Agriculture. Seed Physiology, Seed structures, Morphological, physiological and biochemical changes during seed development, Physiological maturity – Morphological and physiological changes associated with physiological maturity in crop, Harvestable maturity, Seed viability and vigour, Factors affecting seed viability and vigour. Methods of testing seed viability and vigour, Germination, Utilization of seed reserves during seed germination, Morphological, physiological and biochemical changes during seed germination, Factors affecting seed germination. Crop Water Relations, Physiological importance of water to plants, Water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water Use Efficiency, WUE in C₃, C₄ and CAM plants, Factors affecting WUE. Photosynthesis, Energy synthesis, Significance of C₃, C₄ and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting Photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops. Respiration and its significance, Importance of glycolysis, TCA cycle, Pentose phosphate pathway – Brief account of Growth respiration and maintenance respiration, Alternate respiration – Salt respiration – wound respiration – measurement of respiration. Nutriophysiology – Definition – Mengel's classification of plant nutrients – Physiology of nutrient uptake – Functions of plant nutrients – Deficiency and toxicity symptoms of plant nutrients – Foliar nutrition – Hydroponics. Introduction of Photoperiodism and Vernalisation in relation to crop productivity – Classification of plants – Commercial application of

photoperiodism – Photoperiodism Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Senescence and abscission – Definition – Classification – Theories of mechanism and control of senescence – Physiological and biochemical changes and their significance. Post Harvest Physiology – Seed dormancy – Definition – types of seed dormancy – Advantages and disadvantages of seed dormancy – Causes and remedial measures for breaking seed dormancy, Optimum conditions of seed storage – Factors influencing seed storage (ISTA standards). Fruit ripening – Metamorphic changes – Climateric and non-climateric fruits – Hormonal regulation of fruit ripening (with ethrel, CCC, Polaris, paclobuterozole).

Production Technology of Fruit Crops

Definition and importance of horticulture. Divisions of horticulture. Climatic zones of horticulture crops. Area and production of different fruit crops. Selection of site, fencing, and wind break, planting systems, high density planting, planning and establishment. Propagation methods and use of rootstocks. Methods of training and pruning. Use of growth regulators in fruit production. Package of practices for the cultivation of major fruits – mango, banana, citrus, guava, sapota, apple, litchi. Papaya, Minor fruits – pineapple, annonaceous fruits, pomegranate, ber, fig, phalsa, jack, pear, plum, peaches and cherry.

Crop Production Technology –I (Kharif-I)

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices (including weed- water- and nutrient- management) and yield of: **Fibre Crops**- Jute, Mesta, Sunhemp and Cotton; **Commercial Crops**: Sugarcane and Sugar beet and **Forage crops**: sorghum, maize, dinanath grass, napiergrass and paragrass.

Weed Management

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Plant Parasitic Nematodes and their Management

History of development of Phytonematology; Economic importance. General characteristics of Plant Parasitic Nematodes. Nematode- general morphology, biology, and classification upto family emphasising ones having economic important genera. Classification of nematodes by habitat. Association of Plant Parasitic nematodes with disease causing agents like fungi, virus and bacteria. Role of nematodes in plant disease complex; Important Plant Parasitic nematodes. Symptomatology. Integrated Management of nematode pests on crops.

Fundamentals of Statistics -I

Concept of Statistics; Frequency Distribution of Ungrouped and Grouped data; Measures of Central Tendency: AM, GM, HM, Median, Mode, Quartiles, Deciles, Percentiles; Measures of Dispersion: Range, Mean Deviation, Standard Deviation, Coefficient of Variation, Coefficient of Mean Deviation, Coefficient of Quartile Deviation; Moments, Skewness, Kurtosis.

Elementary Set Theory; Theory of Probability: Definitions (Classical, Empirical, Axiomatic) of Probability; Theorem on Total and Compound Probability (For two events only with proof), Pair-wise and Mutual Independence of Events; Random variable: Probability Mass Function and Probability Density Function; Mathematical Expectation and Variance; Theoretical Distributions: Binomial Distribution, Poisson Distribution and Normal Distribution ; Central Limit Theorem (Statement only).

Statistical Methods: Simple Correlation and Regression.

Elements of Computer Application

Definition and Characteristics of Computers. Organization of Computers. Computer Generations, Classifications of Computers, Data Representation in Computer, Logic Gates, Adder Circuit, Flip Flops, Binary Addition and Subtraction, Input / Output units, Computer Memory and Permanent Storage Devices. Types of Computer Softwares, Programming Languages, Flow Charts, BASIC and FORTRAN Programming, Introduction to Internet.

Principles of Genetics and Cytogenetics

Mendel's laws of inheritance and exceptions to the laws; Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits, Qualitative traits and differences between them; Multiple factor hypothesis; Cytoplasmic inheritance, it's characteristic features and difference between chromosomal and cytoplasmic inheritance; Mutation and it's characteristic features; Methods of inducing mutations and C / B technique. Gene expression and differential gene activation; Lac operon and Fine structure of Gene; Study of chromosome structure, morphology, number and types, Karyotype and Idiogram; Mitosis and meiosis, their significance and differences between them; DNA and it's structure, function, types, modes of replication and repair. RNA and its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Crossing over and factors affecting it; Mechanism of crossing over and Cytological proof of crossing over; Linkage, Types of linkage and estimation of linkage; Numerical chromosomal aberrations (Polyploidy) and evolution of different crop species like Cotton, Wheat, Tobacco, Triticale and Brassicas; Structural chromosomal aberrations.

Fundamentals of Rural Sociology and Educational Psychology

Sociology and Rural Sociology-Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension; Indian Rural Society-Important characteristics, Differences and Relationship between Rural and Urban societies; Social Groups – Meaning, Definition, Classification,

Factors considered in formation and organization of groups, Motivation in group formation and Role of Social groups in Agricultural Extension; Social Stratification – Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification – Characteristics and – Differences between Class & Caste System; Cultural concepts – Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension; Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension; Social Institutions – Meaning, Definition, Major institutions in Rural society, Functions and their Role in Agricultural Extension; Social Organizations – Meaning, Definition, Types of organizations and Role of Social organizations in Agricultural Extension; Social Control – Meaning, Definition, Need of social control and Means of Social control; Social change – Meaning, Definition, Nature of Social change, Dimensions of social change and factors of social change; Leadership – Meaning, Definition, Classification, Roles of a leader, Different methods of Selection of Professional and Lay leaders; Training of Leaders – Meaning, Definition, Methods of training, Advantages and Limitations in use of local leaders in Agricultural Extension; Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension; Intelligence – Meaning, Definition, Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension; Personality – Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension; Perception – Meaning, Definition, Stages, Principles and Importance of perception in Agricultural Extension; Instincts and Emotions – Meaning, Definition, Characteristics, Types and Role of Emotions in Agricultural Extension; Motivation – Meaning, Definition, Motivation cycle, Types, Classification of Motives, Techniques of motivation and Role of Motivation in Agricultural Extension; Teaching – Learning process – Meaning and Definition of Teaching, Learning, Learning experience and Learning situation, Elements of learning situation and its characteristics; Principles of learning and their implication for teaching.

Agricultural Microbiology

Definition, scope and applied areas of microbiology; **History and Development of Microbiology:** The discovery of microorganisms, Spontaneous generation conflict, Germ theory of diseases, Role of microbes in fermentation, Development of soil microbiology; **Position of microorganisms in the living World:** Protista, Prokaryotes and eukaryotes, Whittaker five kingdom classification ; **Microscopy and specimen preparation:** Bright field microscope, Simple and differential staining: smear preparation, fixation, mordant application etc.; **Prokaryotic cell structure and function:** Structure and function of capsule, flagella, cell wall, cytoplasmic membrane, mesosome, cytoplasm, ribosome, reserved food materials etc.; **Growth of microorganisms:** Definition of growth, Bacterial, yeast and fungal growth curve, Synchronous growth of bacteria, Measurement of bacterial growth, **Nutrition and Culture media:** Classification of microorganisms based on nutrition, function of nutrients, nutrients required for microorganisms, classification of culture media, classification of microorganisms based on temperature and oxygen requirement.; **Bacterial metabolism:** ATP generation (substrate level phosphorylation, oxidative phosphorylation and chemiosmosis), ATP generation by heterotrophic bacteria (respiration and fermentation) and autotrophic bacteria (chemoautotrophy and photoautotrophy); **Bacteriophages :** Properties and structure of bacterial viruses, Lytic and lysogenic cycles, viroids, prions.; **Soil Microbiology:** Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, biological nitrogen fixation. Microflora of rhizosphere and phyllosphere microflora, microbes in composting.; **Beneficial microorganisms in**

Agriculture: Biofertilizer (Bacterial, Cyanobacterial and fungal), microbial insecticides, microbial agents for control of plant diseases, Biodegradation, Biogas production, Biodegradable plastics, plant- microbe interactions.

Introduction to Plant Pathogens

Introduction to plant pathology; definitions and objectives of plant pathology; classification of plant diseases based on causative agent; History of plant pathology (Ancient India, Anton de Bary, Millardet, Robert Koch, Beijerinck, Leewenhoek, Smith, Butler); Terminologies (Parasite, Pathogen, Host, Resistance, Susceptibility, Virulence, Disease); **Mycology:** General characteristics of fungi, definition, brief historical background; Importance-beneficial roles and harmful roles; Types of vegetative structures; septa and its types; nutrition; modification of hypha; fungal tissue-like structures; Asexual reproduction-definition, methods; types of asexual fruit bodies; Sexual reproduction- definition, steps; terms related with sex organs, sex cells; methods of plasmogamy; types of sexual spores; homothallism and heterothallism; Classification of fungi; characters of each phylum, class (according to Alexopoulos, Mims and Blackwell, 1996); **Virology:** Definition, chemical composition, shape and size; Brief symptoms; brief transmission and control of plant viruses; **Bacteriology :** Definition; General characteristics of bacteria; shape and arrangement of bacterial cells; Structure of bacterial cell; Classification of prokaryotes; Reproduction in bacteria; Other microorganisms-Mycoplasma, Spiroplasma, Rickettsia;

Crop Production Technology –II (Rabi-I)

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices (including weed- water- and nutrient- management) and yield of: **Oilseed crops-** Groundnut, Soybean, Safflower and Niger; **Forage crops:** Berseem, Lucern and Oat; **Commercial crop:** tobacco.

Water Management of field crops: Principle and Practices

Irrigation: definition and objectives, water resources and irrigation development in India; Soil plant water relationships; Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, scheduling of irrigation; Methods of irrigation: surface, sprinkler and drip irrigation; Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane).

Principles of Plant Breeding

Floral biology, Emasculation and Pollination techniques in cereals, millets, pulses, oil seeds, fibers, plantation crops etc. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding – introduction and acclimatization. Selection, Mass selection Johansson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and

objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement.

Fundamentals of Entomology

Entomology as a science- Importance of Entomology in agriculture. History of Entomology in India. Position of insects in animal kingdom; Dominance of insects. ; General organization of insect body wall- its structure and function- cuticular appendages and processes. Body regions (morphological features)- insect head- mouth parts, compound eye, antenna. Thorax- legs, wings-structure and functional modifications. Abdomen- structure, abdominal appendages including external genitalia. Metamorphosis- post embryonic development; larvae, pupae types thereof.; Classification and nomenclature of insects- General characteristics of arthropods and Insecta. Classification of insects as per Imms' as revised by Richards and Davies. Salient taxonomic features of Orthoptera, Hemiptera, Thysanoptera, Coleoptera, Diptera, Hymenoptera, Lepidoptera, Isoptera and families thereof that is agriculturally important with example.; Structure and functions of digestive, respiratory, excretory, circulatory, nervous and reproductive systems in insects. Mode of Reproduction.

Agricultural Finance and Cooperation

Agricultural finance: nature and scope. Time value of money, Compounding and Discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's 5C's and 7 P's of credit, repayment plans. Insurance and Credit Guarantee Corporation of India. Assessment of crop losses, determination of compensation. Crop insurance, advantages and limitations in application, estimation of crop yields; History of financing agriculture in India. Commercial banks, nationalization of commercial banks. Lead bank scheme, regional rural banks, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank; Agricultural cooperation: philosophy and principles. History of Indian cooperative Movement, pre-independence and post independence periods, cooperation in different plan periods, cooperative credit structure: PACS, FSCS. Reorganisation of cooperative credit structure in Andhra Pradesh and single window system. Successful cooperative systems in Gujarat, Maharashtra. Punjab etc.

Biochemistry

Biochemistry – Introduction and importance; Biomolecules – Structure, properties & applications: Carbohydrates (occurrence, classification, structure, optical isomerism and optical activity, physical and chemical properties – reducing property, reactions with acids and alkalis, osazone formation), Amino acids, peptides and proteins (classification and structure, essential amino acids, properties of amino acids, colour reactions, amphoteric nature and isomerism, structure of proteins – primary, secondary, tertiary and quaternary; properties and reactions of proteins), Enzymes (classification and mechanism of action, factors affecting enzyme action, vitamins and minerals as co-factors and co-enzymes), Nucleotides and Nucleic acids (structure and functions), Lipids (classification, important fatty

acids and triglycerides, essential fatty acids, physical and chemical properties of oils, their rancidity, phospholipids, types and importance), Plant pigments – structure and function of chlorophyll and carotenoids, sterols, basic structure, role of brassinosterols in plants., Metabolism – glycolysis, citric acid cycle, oxidative phosphorylation, bioenergetics of glucose; fatty acid oxidation, bioenergetics of fatty acids and lipid biosynthesis; protein synthesis – replication, transcription and translation.

Principles of Plant Pathology and Plant Disease Management

Principles of plant pathology: Phenomenon of infection- pre-penetration; penetration; post-penetration; Survival and dispersal of plant pathogens; Pathogenesis - role of enzymes; toxins; growth regulators; polysaccharides; Defence mechanism in plant - pre and post infection, structural and biochemical; Disease epidemiology; forecasting; remote sensing.

General principles of plant diseases management – Importance, general Principles – Avoidance, exclusion, protection – Plant Quarantine and Inspection – Quarantine Rules and Regulations. Cultural methods – Rougeing, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage. Role and mechanisms of biological control and PGPR. Physical Methods – Heat and Chemical methods – Methods of application of fungicides. Host plant resistance – Application of biotechnology in plant disease management –Development of disease resistant transgenic plants through gene cloning. Integrated plant disease management (IDM) – Concept, advantages and importance.

Production Technology of Vegetables and Flowers

Importance of Olericulture, vegetable gardens, vegetable classification. Origin, area, production, varieties, package of practices for fruit vegetables –, tomato, brinjal, chillies, and okera; Cucurbitaceous vegetables – cucumber, ridge gourd, ash gourd, snake gourd, bottle gourd, bitter gourd and melons, Cole crops – cabbage, cauliflower and knol-khol. Bulb crops – onion and garlic. Beans and peas – French beans, cluster beans, dolichos beans, peas and cowpea. Tuber crops – potato, sweet potato, tapioca, colocasia, yams; Root crops – carrot, radish, turnip and beet root; Leafy vegetables – amaranthus, palak, gogu; Perennial vegetables – drumstick, coccinia and curry leaf. Importance of ornamental gardens. Planning of ornamental gardens. Types and styles of ornamental gardens. Use of trees, shrubs, climbers, palms, houseplants and seasonal flowers in the gardens. Package of practices for rose, jasmine, chrysanthemum, crossandra, marigold and tuberose.

Farm Power, Machinery and Renewable Energy

Farm power in India: sources, I.C engines, working principles, two stroke and four stroke engines, I.C. engine terminology, different systems of I.C. engine. Tractors, Types, Selection of tractor and cost of tractor power. Tillage implements: Primary and Secondary tillage implements, Implements for intercultural operations, seed drills, paddy transplanters, plant protection equipment and harvesting equipment;

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis

and gasification, Types of gasifiers, Producer gas and its utilization. Briquettes, Types of Briquetting machines, uses of Briquettes, Shredders. Solar energy, Solar air heaters, Solar space heating and cooling, Solar energy applications/Solar energy gadgets, Solar cookers, Solar water heating systems, solar grain dryers, Solar photo voltaic systems, solar lantern, Solar street lights, Solar pumping systems. Wind energy, Types of wind mills. Liquid Bio fuels, Bio diesel and Ethanol from agricultural produce, uses.

Fundamentals of Statistics –II

Sample Survey: Basic Concept and Preliminaries of Sampling Theory; Advantages of Sample Survey over Census Survey; Simple Random Sampling (SRS), SRSWR and SRSWOR; Estimators of Population Mean, Total and their Variances (formulae only) for SRS; Concepts of Sampling Errors and Non-sampling Errors.

Concepts of Statistical Hypotheses, Critical Region, Acceptance Region, Level of Significance; Type – I Error, Type – II Error, Power of a Test and Test of Significance; Application of τ , t , χ^2 and F Statistics.

Design of Experiment: Concept and Different Terms of Experimental Designs; Fundamental Principles, Uniformity Trial, Fertility Contour Map; Analysis of Variance: One Way and Two Way Classified Data (Equal Observation / Cell); Layout and Analysis of CRD, RBD and LSD.

Crop Production Technology-III (Kharif-II)

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices (including weed- water- and nutrient- management) and yield of kharif crops, **Cereals:** rice and maize,; **Coarse Cereals:** sorghum, pearl millet and minor millets; **Pulse crops** : pigeonpea, mungbean and urdbean; **Forage crops:** cowpea, cluster bean, rice bean; **Oilseed crop:** Sesame.

Dimensions of Agricultural Extension

Education- Meaning, Definition, Types-Formal, Informal and Non formal Education and their characteristics; Extension Education and Agricultural Extension- Meaning, Definition, Concept, Types, Function, Scope and importance, Objective, Principles, philosophy; Rural Development- Meaning, Definition, Concept, Objective, Importance and Problems in Rural Development; Development Programmes of Pre-independence era- Sriniketan attempt, Marthandam project, Gurgaon experiment, Gandhian constructive programme, Firka Development Programme, Etawah Pilot Project, Nilokheri project and Shortcomings of the early attempts; Community Development Programme (CDP)- Meaning, Definition, Concept, Philosophy, Principle, Objective, Organisation, Critical Analysis of CDP, Differences between Community Development and Extension Education, National Extension Service(NES); Panchayat Raj System- Meaning of Democratic Decentralisation, Local Self Government and Panchayat Raj, Three tier system of Panchayat Raj, Powers, Function and Organisational set up, Role of Panchayat in Agricultural Development; Agricultural Development Programmes – Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) High Yielding Varieties Programme (HYVP), Drought Prone Area Programme (DPAP) Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP), National Agricultural Innovation Project (NAIP); Social Justice and Poverty alleviation programmes – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanti Gram Swarajgar Yojana (SGSY), Chief Minister Employment Yojana (CMEY), National Rural Employment Guarantee Programme (NREGP); Women Development programmes – Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS) and Mahila Samridhi Yojana (MSY); Reorganized extension system (T&V System) – Salient features, Fort night Meetings, Monthly workshops, Linkages, Merits and Demerits, Emergence of Broad Based Extension (BBE)-KVK, ATIC etc..

Breeding of Field/Horticultural Crops

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Hardy-Weinberg Law; Study in respect of origin, distribution of species, wild relatives and forms, Cereals, (rice, wheat, maize); Pulses (redgram, greengram, blackgram); Oilseeds (Groundnut, sesame, mustard) etc. Fibers (Cotton, jute) etc. Vegetables (Tomato, bhindi, chilli, cucumbers); Flowers crops (Chrysanthemum, rose, gerbera & marigold); Fruit crops (aonla, guava, mango, custard apple, banana, papaya); Major breeding procedures for development of hybrids / varieties of various crops; Plant Genetic Resources their conservation and utilization in crop improvement; Ideotype concept

in crop improvement; Breeding for resistance to biotic and abiotic stresses variability in pathogens and pests; Mechanisms of resistance in plant to pathogens and pest; Genetic basis of adaptability to unfavourable environments; Definition of biometrics, assessment of variability i.e., additive, dominance and epistasis and their differentiation; Genotype x Environment interaction and influence on yield/performance. IPR and its related issues.

Diseases of field crops and their Management

Rice : Blast, Brown spot, Sheath Blight, Bacterial Leaf Blight and Streak, Tungro, False Smut, Khaira; **Sorghum** : Smuts; **Bajra**: Downy Mildew; **Maize**: Stalk rot, Leaf Blight; **Wheat**: Rusts, Smut, Leaf Blight, Karnal Bunt, Tundu; **Sugarcane**: Red rot, Whip Smut, Grassy Shoot; **Turmeric**: Rhizome rot, Leaf Blotch; **Tobacco**: Brown spot, hollow stalk, TMV;

Groundnut: Tikka, Collar rot, bud necrosis, rust; **Sesame**: Phyllody; **Mustard**: White rust, leaf spot; **Sunflower**: Rust, Downy mildew; **Cotton**: Angular Leaf Spot; **Jute**: Stem rot; **Red Gram**: Wilt, Phytophthora blight, Pigeon pea sterility mosaic; **Bengal Gram**: Ascochyta Blight, Wilt; **Black gram and Green gram**: Cercospora leaf spot, Anthracnose, Mung yellow mosaic, powdery mildew, web blight

Soil Science-I (Soil Chemistry, Soil Fertility and Fertilizer)

Soil as a source of plant nutrients, essential and beneficial elements, criteria of essentiality, forms of nutrients in soils, ion exchange and fixation of nutrients in soils, mechanism of nutrient transport to plants.; Macronutrients(N,P,K,Ca,Mg,S) – occurrence, sources, forms, transformation and availability in soil and plant nutrition, function in plants, problems on availability in soil and plants & corrective measures.; Micronutrients – sources, forms in soils, functions in plants, factors influencing availability in soil and its management, nutrient transformation under submerged soils.; Soil Fertility- different approaches for soil fertility evaluation-chemical and biological. Plant analysis-DRIS method, critical level in plants, rapid tissue tests, indicator plants.; Manures-Bulky and concentrated –FYM, composts-different methods. Vermicomposting, green manure, oil cakes, sewage & sludge, biogas plant slurry, plant and animal refuges.; Fertilizers-classification, manufacturing processes and properties of major nitrogenous, phosphate, potassic, complex fertilizers, their fate and reaction in soils, secondary and micronutrient fertilizers, bio-fertilizer and their usages.

Agricultural Marketing, Trade and Prices

Agricultural Marketing: Concepts and Definition, Scope and subject matter, Market and Marketing: Meaning, Definitions, Components of a market, Classification. Market structure, Conduct, performance. Marketing structure, Market functionaries or agencies, Producer's surplus: Meaning, Types of producers surplus, marketable surplus. Marketed surplus, importance, Factors affecting Marketable surplus. Marketing channels: Meaning, Definition, Channels for different products. Market integration, Meaning, Definition, Types of Market Integration. Marketing efficiency: Meaning, Definition, Marketing costs, Margins and price spread, Factors affecting the cost of marketing, Reasons for higher marketing costs of farm commodities, Ways of reducing marketing costs. Theories of International Trade: Domestic Trade, Free trade, International Trade, GATT, WTO, Implications of AOA. Market access,

Domestic support, Export subsidies, EXIM-Policy & Ministerial conferences. Cooperative Marketing. State Trading. Ware Housing Corporation; Central and State, Objectives, Functions, Advantages. Food Corporation of India: Objectives and Functions. Quality Control, Agricultural Products, AGMARK. Price Characteristics of agricultural product process, Meaning, Need for Agricultural Price Policy. Risk in Marketing: Meaning and importance, Types of Risk in Marketing. Speculations and Hedging, Futures trading, Contract farming.

Insect Ecology and Integrated Pest Management including Beneficial Insect

Insect Ecology: Introduction, Ecosystem and its components. Effect of abiotic factors-temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors- food, competition, natural and environmental resistance. Biotic potential and environmental resistance. Population group properties. Causes for outbreak of pests in agro-ecosystem. Pest surveillance and pest forecasting. Categories of pests.; **IPM :** Introduction, importance, concepts and tools of IPM-Host plant resistance, Cultural, Mechanical, Physical, Legislative, Biological methods of control. Chemical control- importance, hazards and limitations. Classification of insecticides, toxicity of insecticidal and formulations of insecticides. Study of important insecticides. cyclodiens, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazimes, Thiourea derivatives, Pyridine azomethines, Pyrroles, etc. Nematicides, Rodenticides, Acaricides and Fumigants. Botanical insecticides –neem based products, Recent methods of pest control- repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices, scope and limitations of IPM.; Insecticides Act 1968- Importance provisions. Application techniques of spray fluids. Phytotoxicity of insecticides; symptoms of poisoning, first aid antidotes.; Beneficial insects- Parasites and predators used in pest control and their mass multiplication technique. Important group of microorganism – bacteria, viruses and fungi used in pest control and their mass multiplication techniques.

Fundamentals of Soil, Water and Conservation Engineering

Surveying: survey equipment, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Levelling – levelling equipment, terminology, methods of calculation of reduced levels, types of levelling, contouring. Irrigation, classification of projects, flow irrigation and lift irrigation. Water source, Water lifting devices – pumps (shallow and deep well), capacity, power calculations. Irrigation water measurement – weirs, flumes and orifices and methods of water measurement and instruments. Water conveyance systems, open channel and underground pipeline. Irrigation methods – drip and sprinkle irrigation systems. Soil and water conservation – soil erosion, types and engineering control measures.

Crop Production Technology-IV (Rabi-II)

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices (including weed- water- and nutrient- management) and yield of: **Cereals** – wheat and barley; **Tuber crop**: Potato, **Pulse crops**: chickpea, lentil, lathyrus, peas, French bean, **Oilseed crops**: Rapeseed and Mustard, sunflower, linseed.

Organic Farming

Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, phosocomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management – use of biocontrol agents, biopesticides, pheromones, trap crops; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.

Diseases of Horticultural crops and their management – I

Study of symptoms, brief etiology, perpetuation, epidemiology and control of following diseases : **Citrus**: Canker, Tristeza*; **Mango**: Malformation*, Anthracnose, Black tip; **Banana**: Panama Wilt, Sigatoka, Bunchy top; **Grape**: Downy Mildew*; **Pineapple**: Fruit rot, heart rot; **Papaya**: Papaya Ring spot, Stem or foot rot; **Guava**: Guava Wilt*; **Apple**: Scab, Fire blight*; **Damping off of vegetables***; **Chilli**: Anthracnose*, leaf curl; **Bhindi**: Yellow vein mosaic; **Brinjal**: Wilt*, Phomopsis blight, Little leaf of brinjal; **Potato**: Late blight*, early blight, wilt, scab*, wart, leaf roll; **Tomato**: leaf curl; **Beans** : Anthracnose ; **Pea** : Rust, Powdery mildew ; **Crucifers**: club root*, black rot, Boron and Molybdenum deficiency; **Cucurbits**: Fruit rot, Downy mildew, mosaic; **Onion/ garlic**: Stemphyllium blight, rust; **Coconut**: Bud rot*; **Beetlevine**: Phytophthora leaf and fruit rot*; **Coffee**: Rust; **Tea**: Blister blight*, red rust; **Rose**: Dieback; **Chrysanthemum**: Septoria leaf spot; **Ginger**: Rhizome rot; **Coriander**: Stem gall

Principles of Plant Biotechnology

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of *in-vitro* cultures; Techniques of In-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above *in-vitro* culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in crop improvement.

Fundamentals of Farm-Business Management (Including Project Development, Appraisal and Monitoring)

Agribusiness: Meaning, Definition, Structure of Agribusiness, (Input, Farm, Product Sectors). Importance of Agribusiness in the Indian Economy, Agricultural Policy. Agribusiness Management, Distinctive features, Importance of Good Management, Definitions of Management. Management Functions, Planning, Meaning, Definition, Types of Plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, rules, programmes, Budget) characteristics of sound plan, Steps in planning, Organisation, Staffing, Directing, Motivation, Ordering, Leading, Supervision, Communication, control. Capital Management. Financial Management of Agribusiness: Importance of Financial Statements, Balance sheet, Profit and Loss Statement, Analysis of Financial statements. Agro-based Industries: Importance and Need, Classification of Industries, Types of Agro-based Industries, Institutional arrangement, Procedure to set up agro-based industries, Constraints in establishing agro-based industries. Marketing Management: Meaning, Definitions, Marketing Mix, 4Ps of Marketing. Mix, Market segmentation, Methods of Market, Product life cycle. Pricing policy, Meaning, pricing method. Prices at various stages of Marketing. Project, definitions, project cycle, Identification, Formulation, Appraisal, Implementation, Monitoring and evaluation, Appraisal and Evaluation techniques, NPW, BCR, IRR, N/K ratio, sensitivity analysis, characteristics of agricultural projects: preparation of project reports for various activities in agriculture and allied sectors: Dairying, poultry, fisheries, agro-industries etc.

Crop Pests and Stored Grain Pests and their Management

Stored grain pests- biology, damage, preventive and curative methods of management.; Distribution, biology, nature and symptoms of damage and management strategies of important insects and non insects pests of Rice, Maize, Wheat, Cotton, Jute, Mesta, Pulses, Oil seeds, Sugarcane, Vegetables, Fruits and Plantation Crops.

Biochemistry

Plant cell – cell wall and its role in live stock, food and paper industries.; Plant proteins and their quality.; Enzymes – immobilization and other industrial applications.; Acyl lipids – their industrial application in soaps, detergents, paints, varnishes, lubricants, adhesives, plastics, nylon, bio-diesel, biodegradable plastics etc.; Metabolic energy and its generation – metabolism – basic concepts.; Pentose phosphate pathway, general reactions of amino acid degradation.; Biosynthesis – carbohydrates, proteins and nucleic acids.; Metabolic regulation.; Secondary metabolites – terpenoids, alkaloids, phenolics and their applications in food and pharmaceutical industries

Agricultural Chemicals

Organic chemistry as prelude to agro-chemicals; Diverse types of agrochemicals – botanical insecticides – pyrethrum; Synthetic organic insecticides – major classes – synthesis and properties of some important insecticides under each class.; Herbicides – major classes – synthesis and properties of 2,4-D, atrazine, glyphosate, butachlor, benthio carb. Plant growth regulators.; Fungicides – major classes – synthesis and properties of carbendazim, carboxin, captan, tridemorph and copper oxychloride.; Insecticides Act.

Post Harvest Management and Value Addition of Fruits and Vegetables

Importance of post harvest technology in horticultural crops. Maturity indices, harvesting and post harvest handling of fruits and vegetables. Maturity and ripening process. Factors affecting ripening of fruits, and vegetables. Pre harvest factors affecting quality on post harvest shelf life of fruits and vegetables. Factors responsible for deterioration of harvested fruits and vegetables. Chemicals used for hastening and delaying ripening of fruits and vegetables. Methods of storage – precooling, prestorage treatments, low temperature storage, controlled atmospheric storage, hypobaric storage, irradiation and low cost storage structures. Various methods of packing, packaging materials and transport. Packing technology for export. Fabrication of types of containers, cushioning material, vacuum packing, poly shrink packing, specific packing for export of mango, banana, grapes kinnow, sweet orange, and mandarin etc. Importance and scope of fruit and vegetable preservation in India. Principles of preservation by heat, low temperature, chemicals and fermentation. Unit layout – selection of site and precautions for hygienic conditions of the unit. Preservation through canning, bottling, freezing, dehydration, drying, ultraviolet and ionizing radiations. Preparation of jams, jellies, marmalades, candies, crystallized and glazed fruits, preserves, chutneys, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials Spoilage of canned products, biochemical, enzymatic and microbial spoilage. Preservatives, Colours permitted and prohibited in India.

Extension Methodologies for Transfer of Agricultural Technology

Communication – Meaning, Definition, Models, Elements and their Characteristics, Types and Barriers in communication; Extension Programme Planning – Meaning, Definitions of Planning, Programme, Project, Importance, Principles and Steps in Programme Development Process, Monitoring and Evaluation of Extension Programmes; Extension Teaching methods – Meaning, Definition, Functions and Classification; Individual contact methods – Farm and Home visit, Result Demonstration, Field trials – Meaning, Objectives, Steps, Merits and Demerits; Group contact methods – Group discussion, Method demonstration, Field Trips – Meaning, Objectives, Steps, Merits and Demerits; Small group discussion techniques – Lecture, Symposium, Panel, Debate, Forum, Buzz group, Workshop, Brain Storming, Seminar and Conference; Mass contact Methods – Campaign, Exhibition, Kisan Mela, Radio & Television – Meaning, Importance, Steps, Merits & Demerits; Factors influencing in selection of Extension Teaching Methods and Combination (Media Mix) of Teaching methods; Innovative Information sources – Internet, Cyber Cafes, Video and Tele conferences, Kisan call centers, Consultancy clinics; Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Types, Merits and Limitations; Diffusion and Adoption of Innovations – Meaning, Definition, Models of adoption Process, Innovation – Decision Process – Elements, Adopter categories and their characteristics, Factors influencing adoption process; Capacity building of Extension Personnel and Farmers – Meaning, Definition, Types of training, Training to farmers, farm women and Rural youth.

Farming Systems and Sustainable Agriculture

Sustainable agriculture: Introduction, definition, goal and current concepts, factors affecting ecological balance and ameliorative measures; Conservation agriculture, Crop establishment technique, resource conservation technology, watershed management, precision farming,

Integrated Nutrient Management; Farming systems: definition, principles and components, IFS models for wetland, irrigated dryland and dryland situations.

Principles of Seed Technology

Introduction to Seed Production, Importance of Seed Production, Seed policy, Seed demand forecasting and planning for certified, foundation and breeder seed production, Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality; Definition, Characters of good quality seed, Different classes of seed, Production of nucleus & breeder's seed, Maintenance and multiplication of pre-release and newly released varieties in self and cross-pollinated crops; Seed Production, Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites); Foundation and certified seed production of rice (varieties & hybrids); Foundation and certified seed production of sorghum and bajra (varieties, hybrids, synthetics and composites); Foundation and certified seed production of cotton and sunflower (varieties and hybrids); Seed certification, phases of certification, procedure for seed certification, field inspection and field counts etc.; Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Seed control order: Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Varietal Identification through Grow-Out Test and Electrophoresis; Seed Drying: Forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, building requirements, types of air distribution systems for seed drying, selection of crop dryers and systems of heated air drying, recommended temperature and depth of the seeds, management of seed drying, Planning and layout of seed processing plant; Establishment of seed processing plant. Seed processing: air screen machine and its working principle, different upgrading equipments and their use, Establishing a seed testing laboratory. Seed testing procedures for quality assessment, Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist-O-matic treater), Seed packing and seed storage, stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, constructional features for good seed warehouse, measures for pest and disease control, temperature control, Seed marketing, marketing structure, marketing organization, sales generation activities, promotional media, pricing policy; Factors affecting seed marketing.

Production Economics and Farm Management

Production Economics: Meaning, Definition, Nature and Scope of Agricultural Production Economics. Basic concepts and terms. Concepts of Production. Production Functions: Meaning, Definition, Types. Laws of returns: Increasing, Constant and decreasing. Factor Product Relationship. Determination of optimum input and output. Factor relationship. Product relationship. Types of enterprise relationships. Returns to scale: Meaning, Definition, Importance. Farm Management. Economic principles applied to the Organisations of farm business. Types and systems of farming. Farm planning and budgeting. Risk and uncertainty. Farm budgeting. Linear programming: Assumptions, Advantages and Limitations of Linear programming.

Soil Science – II (Soil Physics, Soil genesis and Classification)

Particle size analysis –mechanical analysis of soil, Stock’s law, its assumption and limitations, specific surface ,factors affecting soil properties. Soil structure-genesis, factors, evaluation of soil structure, soil aggregation, aggregate stability. Soil crusting-formation, influence on productivity ,control of crust. Viscosity of colloidal clay, factors affecting it. Soil consistency-forces causing ,forms, factors affecting consistency, Atterberg’s limits and constants. Plasticity, factors affecting plastic limits, agricultural significance. Swelling and shrinkage .Soil compaction, agricultural significance, formation of compacted soil layers, control.; Soil water-soil water potential, soil moisture characteristic curves, Hysteresis, movement of water in soil-saturated flow, unsaturated flow, Poiseuille’s law, Darcy’s law, water infiltration into the soil, factors affecting infiltration rate, measurement of soil water potential, hydraulic conductivity. Evaporation from soil surface, evapotranspiration, factors affecting evapotranpiration, potential evapotranpiration.; Soil air-soil aeration, massflow of air, Fick’s and graham’s law of diffusion.; Soil temperature-thermal conductivity and diffusivity.; Soil classification- definition, concept, purpose, Soil genesis and morphology, USDA classification, land capability and irrigibility classification, Soil survey and mapping, Significance of land use planning. Soils of West Bengal and India. Soil degradation-concept. Development of problem soils (acid, saline ,alkali, saline –alkali and acid sulfate soil) and land degradation. GIS and SIS concept.

REMOTE SENSING, GLOBAL POSITIONING SYSTEM (GPS) & GEOGRAPHICAL INFORMATION SYSTEM (GIS)

Introduction – Historic overview – Indian space programmes – Remote sensing – definition, principles, Electromagnetic spectrum (EMR) – Interaction of EMR with atmosphere and earth surface- Spectral reflectance curve of different earth features - Aerial photography – Global Positioning System (GPS).; Imagery - Elements of image interpretation - Instruments - Ground truth collection - Digital Image Processing (DIP)– geo rectification – image enhancement -classification – supervised and unsupervised - accuracy assessment. Thermal infrared imagery, Radar imaging system - Application of remote sensing in different fields; Geographical Information System (GIS) – objectives, elements, data structures, errors. Applications of remote sensing and GIS.

Production Technology of Spices, Aromatics, Medicinal and Plantation Crops

Importance and cultivation technology of Spices – ginger, turmeric, pepper, cardamom, coriander, cumin, fenugreek; Aromatic crops – lemon grass, citronella, palmarose, vetiver, geranium, dawana; Plantation crops – coconut, arecanut, betelvine, cashew, cocoa, coffee, oilpalm; Medicinal plants – diascoria, rauwolfia, opium, ocimum, perwinkle, aloe, guggul, belladonna, nuxvomica, *Solanum khasiamum* , aonla,senna, plantago, stevia,coleus and Acorus.

Environmental Science

Scope and importance of environmental studies. Natural resources: Renewable and non-renewable resources. Forest, Water, Food, energy and land resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation. Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Causes, effects and management of soil nuclear hazards and industrial wastes. Disaster management, Floods, earthquakes, cyclones and land slides. Social issues and the environment, unsustainable to sustainable development. The Environment Protection Act, The Air Act, The water Act, The Wildlife Protection Act and Forest Conservation Act. Woman and child welfare, HIV/AIDS and Role of information technology on environment and human health.

Protected Cultivation and Post Harvest Technology

Green house technology, Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics. Threshing, threshers for different crops, parts, terminology, care and maintenance. Winnowing, manual and power operated winnowers, care and maintenance. Groundnut decorticators, hand operated and power operated decorticators, principles of working, care and maintenance. Maize shellers & castor shellers. Drying, grain drying, types of drying, types of dryers. Storage, grain storage, types of storage structures. Fruits and vegetables cleaning, machinery for cleaning of fruits and vegetables, care and maintenance. Grading, methods of grading, equipment for grading of fruits and vegetables, care and maintenance. Size reduction. equipment for size reduction care and maintenance. Evaporation, Principle, types of evaporators, quality standards – FAQ, ASTA, FPO, FDA. Practical: Study of different types of green houses based on shape, construction and cladding materials; Calculation of air rate exchange in an active summer winter cooling system; Calculation of rate of air exchange in an active winter cooling system; Estimation of drying rate of agricultural products inside green house; Testing of soil and water to study its suitability for growing crops in greenhouses; The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization; Visit to commercial green houses; Study of threshers, their components, operation and adjustments; Winnowers, their components, operation and adjustments; Study of different components of groundnut decorticator; Study of maize shellers; Study of castor shellers; Study of improved grain storage structure; Study of dryers; Study of cleaners & graders.

Entrepreneurship Development

Entrepreneur behaviour, Entrepreneur development, Entrepreneur management – Meaning, Concepts, Need for enterprise emergence and characteristics of an entrepreneur; Factors

affecting entrepreneurial growth– Economic, Social, Cultural, Technological, Situational and Legal requirements for establishment of a new unit; Entrepreneurial motivation and competencies; Establishment of a small business – Identification, selection, formulation and appraisal of a sound enterprise, Infrastructure and Policy support for entrepreneurship development; Management in small enterprise- basic concepts of capital management, inventory management, production and operation management, marketing and human resource management, production and orientation management. Technical Appraisal – Factors to be considered for personnel training; SWOT analysis, Network Analysis, Critical Path Method (CPM), PERT. Causes, consequences and corrective measures for industrial sickness.

Syllabus for Entrance Test for Admission to M.Sc (Horticulture)

Introduction to Soil Science

Pedological and Edaphological concept, origin of the earth, Earth's crust, Rocks and minerals-classification and composition, weathering of Rocks & Minerals, Parent Material and its classification, soil formation-factors and processes, soil profile.

Soil physical properties-Soil texture-importance, textural classes, Soil Structure-classification, soil aggregation & its significance. Soil densities and porosity-bulk density and particle density of soils, void ratio, porosity-their significance, Soil colour-causes, importance and determination. Soil water-properties and behaviour of water, importance of soil water, ideas of soil water potentials, soil moisture constants, soil water classification, available water, factor's affecting available water Thermal properties of soils-soil temperature. Soil air- composition, gaseous exchange, influence on plant growth, soil temperature – source, thermal properties of soil, influence on plant growth.

Soil colloids, properties, nature, type and significance, layer silicate clays, their genesis and sources of charges. Absorption of ions. CEC, AEC, pH and buffering, buffering capacity of soil. Characteristic and reclamation of acid soil and salt affected soil, soil organic matter, composition and function, decomposability and humus formation, fractionation of soil organic matter.

Crop Physiology

Introduction – Definition of Crop Physiology – Importance in Agriculture and Horticulture. Morphological, physiological and biochemical changes during seed development. Seed Physiology – Physiological maturity – Morphological and physiological changes associated with physiological maturity in crop with examples – Harvestable maturity – Utilization of seed reserves (carbohydrates, fats and proteins) during seed germination – Morphological, physiological and biochemical changes during seed germination – Factors affecting seed germination . Growth and Development – Definition – Types of growth – Determinate and Indeterminate growth – Monocarpic and Polycarpic species with examples Measurement of growth – Growth analysis Growth characteristics – Definitions and mathematical formulae. Crop Water Relations – Physiological importance of water to plants. – Water potential and its components, measurement of water status in plants. Transpiration – Definition – significance – Transpiration in relation to Crop productivity – Water Use Efficiency – WUE in C_3 , C_4 and CAM plants – Factors affecting WUE. Introduction to Photosynthesis. Photosynthesis – Energy synthesis – Significance of C_3 , C_4 and CAM pathway – Relationship of Photosynthesis and crop productivity – Translocation of assimilates – Phloem loading , apoplastic and symplastic transport of assimilates - Source and sink concept – Photorespiration-Factors affecting Photosynthesis and productivity-Management of Photosynthesis for productivity- Methods of measuring photosynthesis – Photosynthetic efficiency – Dry matter partitioning-Harvest index of crops. Introduction to respiration.

Respiration and its significance – Importance of glycolysis, TCA cycle, Pentose Phosphate Pathway – Growth respiration and maintenance respiration, Alternate respiration – Salt respiration – wound respiration – measurement of respiration. Nutriophysiology – Definition – Mengel's classification of plant nutrients – Physiology of nutrient uptake –Foliar nutrition – Hydroponics – solution and sand culture. Control of flowering – Photoperiodism and Vernalisation in relation to crop productivity – Classification of plants – Commercial application of photoperiodism Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators. Senescence and abscission – Definition – Classification – Theories of mechanism and control

of senescence – Physiological and biochemical changes and their significance. Abscission and its relationship with senescence. Post Harvest Physiology. Fruit ripening – Metamorphic changes – Climacteric and non-climacteric fruits – Hormonal regulation of fruit ripening (with ethrel, CCC , Polaris, paclobuterozole) – Use of hormones in increasing vase life of flowers.

Fundamentals of Horticulture

Economic importance and classification of horticultural crops and their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management of orchards, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops, nursery techniques and their management. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management, fertility management in horticultural crops, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

Plant Propagation and Nursery Management

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Seed dormancy (scarification & stratification) internal and external factors, nursery techniques, apomixes – mono-embryony, polyembryony, chimera & bud sport. Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, nursery (tools and implements), use of growth regulators in seed and vegetative propagation, methods and techniques of cutting, layering, grafting and budding physiological & bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship, and their influences, bud wood certification, techniques of propagation through specialized organs, corm, runners, suckers. Micrografting, hardening of plants in nurseries. Nursery registration act. Insect/pest/disease control in nursery.

Fundamentals of Extension Education

Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and selected programmes of leading national and international forest institutes. People's participation in forestry programmes. Motivation of women community, children, youth and voluntary organizations for forestry extension work. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR. Communication: meaning, definition, elements and selected models. Audio – visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA). Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD), rural leadership.

Growth and Development of Horticultural Crops

Growth and development-definitions, components, photosynthetic productivity, leaf area index (LAI) - optimum LAI in horticultural crops, canopy development; different stages of growth, growth curves, growth analysis in horticultural crops. Plant bioregulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalisation and its application in horticulture, pruning and training physiological basis of training and pruning-source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits-climatic and non-climacteric fruits.

Tropical and Sub-Tropical Vegetables

Area, production, economic importance and export potential of tropical and sub-tropical vegetable crops. Description of varieties and hybrid, climate and soil requirements, seed rate, preparation of field, nursery practices; transplanting of vegetable crops and planting for directly sown/transplanted vegetable crops. Spacing, planting systems, water and weed management; nutrient management and deficiencies, use of chemicals and growth regulators. Cropping systems, harvest, yield and seed production. Economic of cultivation of tropical and sub-tropical vegetable crops; post-harvest handling and storage. Marketing of tomato, brinjal, chillies, okra, amaranthus, cluster beans, cowpea, lab-lab, snap bean, cucurbits, moringa, curry leaf, portulaca and basella.

Structural Grammar and Spoken English (NC)

Structural Grammar: Introduction of Word Classes; Structure of Verb in English; Uses of Tenses; Study of Voice; Study of Conjunctions and Prepositions; Sentence Patterns in English. Spoken English: Conversations of different situations in everyday life; the concept of stress; stress shift in words and sentences; silent letters in words and pronunciation of words with silent letters, the basic intonation patterns.

Tropical and Sub-Tropical Fruits

Horticultural classification of fruits including genome classification. Horticultural zones of India, detailed study of area, production and export potential, varieties, climate and soil requirements, propagation techniques, planting density and systems, after care, training and pruning. Management of water, nutrient and weeds, special horticultural techniques including plant growth regulators, their solution preparation and use in commercial orchards. Physiological disorders. Post-harvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops. Mango, banana, bael, banana, grapes, citrus, papaya, sapota, guava, pineapple, jackfruit, avocado, mangosteen, litchi, carambola, durian and passion fruit. Bearing in mango and citrus, causes and control measures of special production problems, alternate and irregular bearing overcome, control measures. Seediness and kokkan disease in banana, citrus decline and casual factors and their management. Bud forecasting in grapes, sex expression and seed production in papaya, latex extraction and crude papain production, economic of production. Rainfed horticulture, importance and scope of arid and semi-arid zones of India. Characters and special adaptation of crops: ber, aonla,

annona, jamun, wood apple, bael, pomegranate, carissa, date palm, phalsa, fig, west Indian cherry and tamarind.

Principles of Genetics & Cytogenetics

Mendel's laws of inheritance and exceptions to the laws; Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits, Qualitative traits and differences between them; Multiple factor hypothesis; Cytoplasmic inheritance, its characteristic features and difference between chromosomal and cytoplasmic inheritance; Mutation and its characteristic features; Methods of inducing mutations and C / B technique. Gene expression and differential gene activation; Lac operon and Fine structure of Gene; Ultra structure of cell and cell organelles and their functions; Study of chromosome structure, morphology, number and types, Karyotype and Idiogram; Mitosis and meiosis, their significance and differences between them; DNA and its structure, function, types, modes of replication and repair. RNA and its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Crossing over and factors affecting it; Mechanism of crossing over and Cytological proof of crossing over; Linkage, Types of linkage and estimation of linkage; Numerical chromosomal aberrations (Polyploidy) and evolution of different crop species like Cotton, Wheat, Tobacco, Triticale and Brassicas; Structural chromosomal aberrations.

Introductory Economics

Nature and scope of economics, definition and concepts, divisions of economics, economic systems, approaches to the study of economics. Consumption – theory of consumer behaviour, laws of consumption, classification of goods. Wants – their characteristics and classification, utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory of demand, demand schedule and curve, market demand. Price, income and cross elasticities, Engil's law of family expenditure – consumer's surplus. Theory of firm, factors of production – land and its characteristics, labour and division of labour, theories of population. Capital and its characteristics – classification and capital formation. Enterprises – forms of business organization – merits and demerits. Laws or return – law of diminishing marginal return – cost concepts. Law of supply – supply schedule and curve elasticities. Market equilibrium, distribution – theories of rent, wage, interest and profit. Price determination and forecasting under various market structures.

Fundamentals of Food Technology

Food and its function, physico-chemical properties of foods, food preparation techniques, nutrition, relation of nutrition of good health. Characteristics of well and malnourished population. Energy, definition, determination of energy requirements, food energy, total energy needs of the body. Carbohydrates: classification, properties, functions, source, requirements, digestion, absorption and utilization. Protein, classification, properties, functions, sources, requirements, digestion, absorption, essential and non-essential amino acids, quality of proteins, PER/NPR/NPU, supplementary value of proteins and deficiency. Lipids – classification, properties, functions, sources, requirements, digestion, absorption and utilization, saturated and unsaturated fatty acids, deficiency, rancidity, refining of fats. Mineral nutrition: macro and micro-minerals (Ca, Fe and P), function, utilization, requirements, sources, effects of deficiency. Vitamins: functions, sources, effects of deficiency, requirements of water soluble and fat-soluble vitamins. Balanced diet:

recommended dietary allowances for various age groups, assessment of nutritional status of the population.

Water Management in Horticultural Crops

Importance of water, water resources in India. Area of different crops under irrigation, function of water for plant growth, effect of moisture stress on crop growth. Available and unavailable soil moisture – distribution of soil moisture – water budgeting – rooting characteristics – moisture extraction pattern. Water requirement of horticultural crops – lysimeter studies – Plant water potential climatological approach – use of pan evaporimeter – factor for crop growth stages – critical stages of crop growth for irrigation. Irrigation scheduling – different approaches – methods of irrigation – surface and sub-surface pressurized methods viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water. Water management problem, soils quality of irrigation water, irrigation management practices for different soils and crops. Layout of different irrigation systems, drip, sprinkler. Layout of underground pipeline system.

Fundamentals of Plant Pathology

Introduction to the science of phytopathology, its objectives, scope and historical background. Classification of plant diseases, symptoms, signs, and related terminology. Parasitic causes of plant diseases (fungi, bacteria, viruses, phytoplasma, protozoa, algae and flowering parasitic plants), their characteristics and classification. Non-parasitic causes of plant diseases. Infection process. Survival and dispersal of plant pathogens. Plant disease epidemiology, forecasting and disease assessment. Principles and methods of plant disease management. Integrated plant disease management.

Fundamental of Statistics-I

Concept of Statistics; Frequency Distribution of Ungrouped and Grouped data; Measures of Central Tendency: AM, GM, HM, Median, Mode, Quartiles, Percentiles; Measures of Dispersion: Range, Mean Deviation, Standard Deviation, Coefficient of variation, Coefficient of Mean Deviation, Coefficient of Quartile Deviation; Moments, Skewness, Kurtosis.

Elementary set Theory; theory of Probability: Probability: Definitions (Class, Axiomatic) of Probability; Theorem on Total and Compound Probability (For two events only with proof), Pair-wise and Mutual Independence of Events; Random variable: Probability Mass Function and Probability Density Function Expectation and Variance; Theoretical Distributions: Binomial Distribution, Poisson Distribution and Normal Distribution; Central Limit Theorem (Statement only).

Statistical Methods: Simple Correlation and Regression.

Elements of Computer Application

Definition and Characteristics of computer. Organization of computer. Computer generations, classifications of computers, data representation in computer, logic gates, Adder circuit, flip flops, Binary addition and subtraction, input/output units, Computer memory and permanent storage devices. Types of computer softwares, Programming languages, Flow charts, BASIC and FORTRAN programming, Introduction to Internet.

Plant Parasitic Nematodes and their Management

History of development of Phytonematology; Economic importance. General characteristics of Plant Parasitic Nematodes. Nematode- general morphology, biology, and classification upto family emphasising ones having economic important genera. Classification of nematodes by habitat. Association of Plant Parasitic nematodes with disease causing agents like fungi, virus and bacteria. Role of nematodes in plant disease complex; Important Plant Parasitic nematodes. Symptomatology. Integrated Management of nematode pests on crops.

Introductory Microbiology

History and Scope of Microbiology: The discovery of micro-organism, spontaneous generation conflict, germ theory of diseases, microbial effect on organic and inorganic matter. Development of microbiology in India and composition of microbial world. Microscopy and Specimen Preparation: The bright field microscope, fixation, dyes and simple staining, differential staining. Difference between prokaryotic and eucaryotic cells. Prokaryotic cell structure and functions. Types of culture media and pre-culture techniques. Microbial growth in models of bacterial, yeast and mycelial growth curve. Measurement of bacterial growth. General properties of viruses and brief description of bacteriophages. General principle of bacterial genetics, DNA as genetic material. Antibiosis, symbiosis, intra-microbial and extra-microbial association.

Fundamentals of Entomology

Entomology as a science- Importance of Entomology in agriculture. History of Entomology in India. Position of insects in animal kingdom; Dominance of insects.

General organization of insect body wall- its structure and function- cuticular appendages and processes. Body regions (morphological features)- insect head- mouth parts, compound eye, antenna. Thorax- legs, wings-structure and functional modifications. Abdomen- structure, abdominal appendages including external genitalia. Metamorphosis- post embryonic development; larvae, pupae types thereof.

Classification and nomenclature of insects- General characteristics of arthropods and Insecta. Classification of insects as per Imms' as revised by Richards and Devies. Salient taxonomic features of Orthoptera, Hemiptera, Thysanoptera, Coleoptera, Diptera, Hymenoptera, Lepidoptera, Isoptera and families thereof that is agriculturally important with example.

Structure and functions of digestive, respiratory, excretory, circulatory, nervous and reproductive systems in insects. Mode of Reproduction.

Temperate Vegetables

Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential, description of varieties and hybrids, origin, climate and soil, production technologies, seed production, post-harvest technology. Marketing of cabbage, cauliflower, knol-khol, sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach, garlic, onion, leek, radish, carrot, turnip, beet root, peas, broad beans, rhubarb, asparagus, globe artichoke.

Farm Power, Machinery and Renewable Energy

Farm power in India: sources, I.C engines, working principles, two stroke and four stroke engines, I.C. engine terminology, different systems of I.C. engine. Tractors, Types, Selection of tractor and cost of tractor power. Tillage implements: Primary and Secondary tillage implements, Implements for intercultural operations, seed drills, paddy transplanters, plant protection equipment and harvesting equipment;

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Producer gas and its utilization. Briquettes, Types of Briquetting machines, uses of Briquettes, Shredders. Solar energy, Solar air heaters, Solar space heating and cooling, Solar energy applications/Solar energy gadgets, Solar cookers, Solar water heating systems, solar grain dryers, Solar photo voltaic systems, solar lantern, Solar street lights, Solar pumping systems. Wind energy, Types of wind mills. Liquid Bio fuels, Bio diesel and Ethanol from agricultural produce, uses.

Temperate Fruits

Classification of temperate fruits, detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, after care training and pruning, self incompatibility and pollinisers, use of growth regulators, nutrient and weed management, harvesting, post-harvest handling and storage of apple, pear, peach, apricot, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecan nut, hazel nut and chest nut. Re- plant problem, rejuvenation and special production problems like pre-mature leaf fall, physiological disorders, important insect – pests and diseases and their control measures.

Ornamental Horticulture

History, scope of gardening, aesthetic values. Gardens in India, types of gardens. Landscaping, historical background, definition. Floriculture industry: importance, area and production, industrial importance in India. Landscaping, basic principles and basic components. Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents. Flower arrangement: importance, production details and cultural operations, constraints, post-harvest practices. Bio-aesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds. Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens.

Biochemistry

Biochemistry – Introduction and importance. Biomolecules – Structure, properties & applications: Carbohydrates (occurrence, classification, structure, optical isomerism and optical activity, physical and chemical properties – reducing property, reactions with acids and alkalis, osazone formation). Amino acids, peptides and proteins (classification and structure, essential amino acids, properties of amino acids, colour reactions, amphoteric nature and isomerism, structure of proteins – primary, secondary, tertiary and quaternary; properties and reactions of proteins). Enzymes (classification and mechanism of action, factors affecting enzyme action, vitamins and minerals as co-factors and co-enzymes). Nucleotides and Nucleic acids (structure and functions). Lipids (classification, important fatty acids and triglycerides, essential fatty acids, physical and chemical properties of oils, their rancidity, phospholipids, types and importance). Plant pigments – structure and function of chlorophyll and carotenoids, sterols, basic structure, role of brassinosterols in plants. Metabolism – glycolysis, citric acid cycle, oxidative phosphorylation, bioenergetics of glucose; fatty acid oxidation, bioenergetics of fatty acids and lipid biosynthesis; protein synthesis – replication, transcription and translation.

Potato and Tuber Crops

Origin, area, production, economic importance and export potential of potato and tropical, sub-tropical and temperate tuber crops; description of varieties and hybrids. Climate and soil requirement, season; seed rate; preparation of field; planting practices; spacing; water, nutrient and weed management; nutrient deficiencies. Use of chemicals and growth regulators; cropping systems. Harvesting practices, yield; seed production, economic of cultivation. Post-harvest handling and storage, field and seed standards, marketing. Crops to be covered – potato, tapioca, sweet potato, arrow root, cassava, colocasia, xanthosoma, amorphophallus, dioscorea, Jerusalem artichoke, horse radish and other under exploited tuber crops.

Principles of Plant Breeding

Floral biology, Emasculation and Pollination techniques in cereals, millets, pulses, oil seeds, fibers, plantation crops etc. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding – introduction and acclimatization. Selection, Mass selection Johannson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement.

Fundamentals of Statistics-II

Sample survey: Basic concept and preliminaries of sampling theory; Advantages of sample survey over census survey; Random sampling (SRS), SRSWR and SRSWOR; Estimates of population Mean, Total and their variances (formulae only) for SRS; Concepts of sampling Errors and non-sampling errors.

Concept of Statistical hypotheses, Critical region, Acceptance region, Level of Significance; Type-I Error, type-II Error, Power of a Test and Test of Significance; Application of T , t , X^2 and F statistics.

Design of experiment: concept and different terms of experimental designs; Fundamental principles, Uniformity trial, fertility countour map; Analysis of variance: one way and two way classified data (Equal observation / cell); Layout and Analysis of CRD, RBD and LSD.

Spices and Condiments

History, scope and importance, area and production, uses, export potential and role in national economy. Classification, soil and climate, propagation-seed, vegetative and micro-propagation systems and methods of planting. Nutritional management, irrigation practices, weed control, mulching and cover cropping. Training and pruning practices, role of growth regulators, shade crops and shade regulation. Harvesting, post-harvest technology, packaging, storage, value added products, methods of extraction of essential oil and oleoresins. Economics of cultivation, role of Spice Board and Pepper Export Promotion Council, institutions and research centers in R&D. Crops: Cardamom, pepper, ginger, turmeric, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary.

Commercial Floriculture

Scope and importance of commercial floriculture in India, production techniques of ornamental plants like rose, marigold, chrysanthemum, orchid, carnation, gladiolus, jasmine, dahlia, tuberose, bird of paradise, china aster and gerbera for domestic and export market, growing of flowers under protected environments such as glass house, plastic house etc., post harvest technology of cut flowers in respect of commercial flower crops, dehydration technique for drying of flowers, production techniques for bulbous.

Plantation Crops

History and development, scope and importance, area and production, export and import potential, role in national and state economy, uses, industrial importance, by products utilization, soil and climate, varieties, propagation: principles and practices of seed, vegetative and micro-propagation, planting systems and method, gap filling, systems of cultivation, mulching, shade regulation, weed and water management, training, pruning and handling, nutrition, foliar feeding, role of growth regulators, soil management, liming practices, tipping practices, top working, physiological disorders, harvesting, post-harvest handling and processing, packaging and marketing, yield and economics of coconut, arecanut, oil palm, palmyrah palm, cacao, cashew nut, coffee, tea and rubber.

Breeding of Fruit and Plantation Crops

Fruit breeding - History, importance in fruit production, distribution, domestication and adaptation of commercially important fruits, variability for economic traits, breeding strategies, clonal selection, bud mutations, mutagenesis and its application in crop improvement – policy manipulations – *in vitro* breeding tools (important fruit and plantation crops).

Orchard Management

Orchard management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems. Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties. Integrated nutrient and pest management. Utilization of resources constraints in existing systems. Crop model and crop regulation in relation to cropping systems.

Insect Ecology and IPM including beneficial insect

Insect Ecology: Introduction, Ecosystem and its components. Effect of abiotic factors-temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors- food, competition, natural and environmental resistance. Biotic potential and environmental resistance. Population group properties. Causes for outbreak of pests in agro-ecosystem. Pest surveillance and pest forecasting. Categories of pests.

IPM : Introduction, importance, concepts and tools of IPM-Host plant resistance, Cultural, Mechanical, Physical, Legislative, Biological methods of control. Chemical control-importance, hazards and limitations. Classification of insecticides, toxicity of insecticidal and formulations of insecticides. Study of important insecticides. cyclodiens, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazimes, Thiourea derivatives, Pyridine azomethines, Pyrroles, etc. Nematicides,

Rodenticides, Acaricides and Fumigants. Botanical insecticides –neem based products, Recent methods of pest control- repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices, scope and limitations of IPM.

Insecticides Act 1968- Importance provisions. Application techniques of spray fluids. Phytotoxicity of insecticides; symptoms of poisoning, first aid antidotes.

Beneficial insects- Parasites and predators used in pest control and their mass multiplication technique. Important group of microorganism – bacteria, viruses and fungi used in pest control and their mass multiplication techniques.

Environmental Science

Environment: introduction, definition and importance. Components of environment - interactions with organisms. Global and Indian environment - past and present status. Environmental pollution and pollutants. Air, water, food, soil, noise pollution - sources, causes and types. Smog, acid rain, global warming, ozone hole, eutrophication, sewage and hazardous waste management. Impact of different pollutions on humans, organisms and environment. Introduction to biological magnification of toxins. Deforestation - forms and causes, relation to environment. Prevention and control of pollution - technological and sociological measures and solutions - Indian and global efforts. India, international and voluntary agencies for environmental conservation - mandates and activities. International conferences, conventions and summits - major achievements. Environmental policy and legislation in India. Introduction to environmental impact assessment. Causes of environmental degradation - socio-economic factors. Human population growth and lifestyle.

Soil Science-I (Soil chemistry, Soil Fertility and Fertilizer)

Soil as a source of plant nutrients, essential and beneficial elements, criteria of essentiality, forms of nutrients in soils, ion exchange and fixation of nutrients in soils, mechanism of nutrient transport to plants.

Macronutrients(N,P,K,Ca,Mg,S) – occurrence, sources, forms, transformation and availability in soil and plant nutrition, function in plants, problems on availability in soil and plants & corrective measures.

Micronutrients – sources, forms in soils, functions in plants, factors influencing availability in soil and its management, nutrient transformation under submerged soils.

Soil Fertility- different approaches for soil fertility evaluation-chemical and biological. Plant analysis-DRIS method, critical level in plants, rapid tissue tests, indicator plants

Manures-Bulky and concentrated –FYM, composts-different methods. Vermicomposting, green manure, oil cakes, sewage & sludge, biogas plant slurry, plant and animal refuges.

Fertilizers-classification, manufacturing processes and properties of major nitrogenous, phosphate, potassic, complex fertilizers, their fate and reaction in soils, secondary and micronutrient fertilizers, bio-fertilizer and their usages.

Organic Farming

Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management – use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.

Introduction to Major Field Crops

Classification and distribution of field crops, definitions and concept of multiple cropping, mixed cropping, intercropping, relay and alley cropping, cultural practices for raising major cereals, pulses, oil seeds and fodder crops, green manuring, crop rotation.

Breeding and Seed Production of Ornamental Plants

History of improvements of ornamental plants, objectives and techniques in ornamental plant breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental plants. Breeding for disease resistance. Development of promising cultivars of important ornamentals. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting processing and storage of seeds, seed certification.

Introductory Agroforestry

Agroforestry – definition, objectives and potential. Distinction between agroforestry and social forestry. Status of Indian forests and role in India farming systems. Agroforestry system, sub-system and practice: agri-silviculture, silvipastoral, horti-silviculture, horti-silvipastoral, shifting cultivation, taungya, home gardens, alley cropping, intercropping, wind breaks, shelterbelts and energy plantations. Planning for agroforestry – constraints, diagnosis and design methodology, selection of tree crop species for agro-forestry. Agroforestry projects – national, overseas, MPTS – their management practices, economics of cultivation – nursery and planting (*Acacia catechu*, *Dalbergia sissoo*., *Tectona*, *Populus*, *Morus*, *Grewia*, *Eucalyptus*, *Quercus* spp. and bamboo, tamarind, neem etc.)

Breeding of Vegetable, Tuber and Spice Crops

Centres of origin, plant bio-diversity and its conservation. Models of reproduction, pollination systems and genetics of important vegetable, tuber and spice crops. Self-incompatibility and male sterility, its classification and application in crop improvement. Principles of breeding self-pollinated crops, pure line selection, mass selection, heterosis breeding, hybridization, pedigree method, mass pedigree method, bulk method, modified bulk method, single seed descent method and back cross method. Polyploidy breeding. Mutation breeding. Principles of breeding cross pollinated crops, mass selection, recurrent selection, heterosis breeding, synthetics and composites. Application of biotechnology in crop improvement. Crops: Solanaceous vegetables, cole crops, cucurbits, bulb crops, root crops, leafy vegetables, okra, leguminous crops.

Principles of Plant Biotechnology

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of *in-vitro* cultures; Techniques of In-vitro cultures, Micro propagation, Anther culture Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above *in-vitro* culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes –Basic concepts QTL Future prospects. and its application in crop improvement.

Post Harvest Management of Horticultural Crops

Importance of post-harvest technology in horticultural crops. Maturity indices, harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, medicinal and aromatic plants. Pre-harvest factors affecting quality, factors responsible for deterioration of horticultural produce, physiological and bio-chemical changes, hardening and delaying ripening process. Post-harvest treatments of horticultural crops. Quality parameters and specification. Structure of fruits, vegetables and cut flowers related to physiological changes after harvest. Methods of storage for local market and export. Pre-harvest treatment and pre-cooling, pre-storage treatments. Different systems of storage, packaging methods and types of packages, recent advances in packaging. Types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, grape guard packing treatments. Modes of transport.

Diseases of Horticultural crops and their management-I

Study of symptoms, brief etiology, perpetuation, epidemiology and control of following diseases : **Citrus:** Canker, Tristeza*, root rot; **Mango:** Malformation*, Anthracnose, Black tip; **Banana:** Panama Wilt, Sigatoka, Bunchy top; **Grape:** Downy Mildew*; **Pineapple:** Fruit rot, heart rot; **Papaya:** Papaya Mosaic, Papaya Ring spot, Papaya Leaf Curl; **Guava:** Guava Wilt*; **Apple:** Scab, fire blight*; **Damping off of vegetables*;** **Chilli:** Anthracnose*, leaf curl; **Bhindi:** Yellow vein mosaic; **Brinjal:** Wilt*, Phomopsis blight, Sclerotinia foot rot, Little leaf of brinjal; **Potato:** Late blight*, early blight, witl, scab*, wart, mosaic; **Tomato:** Late blight, early blight, wilt, leaf curl; Beans: Anthracnose; **Pea :** rust, Powdery mildew; **Crucifers :** Downy mildew, club root*, black rot, Boron and Molybdenum deficiency; **Cucurbits:** Powdery mildew, Downy mildew, anthracnose, mosaic; **Onion/ garlic:** Stemphyllium blight, rust; **Coconut:** Bud rot*, Ganoderma wilt; **Beetlevine:** Phytophthora fruit and root rot*; **Coffee:** Rust; **Tea:** Blister blight*, red rust, grey and brown blight; **Rose:** Dieback, blick spot; **Chrysanthemum:** Septoria leaf spot, Basal stem rots; **Ginger:** Rhizome rot; **Coriander:** Stem gall

Principle of Weed Management

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Apiculture

Importance and history of apiculture, different species of bees, morphology, anatomy, colony organization and life cycle, bee-keeping equipment, social behaviour, reproduction, queen rearing, bee pasturage, seasonal management, economics of bee-keeping. Bee enemies, diseases of bees, role of bees in increasing the productivity of horticultural crops in India economy, bee products and their uses. Recent trends in apiculture. Acquaintance with honey bee species, morphology, structural adaptation, biology-castes-bee-keeping equipment, bee forage plants. Collection and preservation of bee flora, enemies and diseases of bees. Handling of bee colonies and manipulation for honey production.

Insect Pests of Horticultural Crops and their Management-

Distribution, biology, nature and symptoms of damage and management strategies of important insects and non insects pests of Vegetables, Fruits, Plantation Crops, Medicinal plants, Aromatic crops, Spices and condiments and Ornamental plants.

Seed Production of Vegetable, Tuber and Spice Crops

Introduction and history of seed industry in India. Definition of seed. Differences between grain and seed. Importance and scope of vegetable seed production in India. Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production. Methods of seed production of cole crops, root vegetables, solanaceous vegetables, cucurbits, leafy vegetables, bulb crops, leguminous vegetables and exotic vegetables. Seed germination and purity analysis. Field and seed standards. Seed drying and extraction. Seed legislation.

Medicinal and Aromatic Crops

History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants. Study of chemical composition of a few important medicinal and aromatic plants, extraction, use and economics of drugs and essential oils in medicinal and aromatic plants. Therapeutic and pharmaceutical uses of important species. Medicinal Plants: Betelvine, periwinkle, Rauwolfia, Dioscorea, Isabgol, *Ammi majus*, Belladonna, Cinchona, Pyrethrum and other species relevant to local conditions. Aromatic Plants: Citronella grass, khus grass, *flag* (baje), lavender, geranium, patchouli, bursera, enthe, musk, *Ocimum* and other species relevant to the local conditions.

Processing of Horticultural Crops

Importance and scope of fruit and vegetable preservation industry in India, food pipe line, losses in post-harvest operations, unit operations in food processing. Principles and guidelines for the location of processing units. Principles and methods of preservation by heat pasteurization, canning, bottling. Methods of preparation of juices, squashes, syrups, cordials and fermented beverages. Jam, jelly and marmalade. Preservation by sugar and chemicals, candies, crystallized fruits, preserves chemical preservatives, preservation with salt and vinegar, pickling, chutneys and sauces, tomato and mushrooms, freezing preservation. Processing of plantation crops, products, spoilage in processed foods, quality control of processed products, Govt. policy on import and export of processed fruits. Food laws.

Horti- Business Management

Farm management - definition, nature, characteristics and scope. Farm management principles and decision making, production function, technical relationships, cost concepts, curves and functions – factors, product, relationship – factors relationship, product relationship, optimum conditions, principles of opportunity cost-equi-marginal returns and comparative advantages, time value of money, economic of scale, returns to scale, cost of cultivation and production, break even analysis, decision making under risk and uncertainty. Farming systems and types. Planning – meaning, steps and methods of planning, types of plan, characteristics of effective plans. Organizations – forms of business organizations, organizational principles, division of labour. Unity of command, scalar pattern, job design, span of control responsibility, power authority and accountability. Direction – guiding,

leading, motivating, supervising, coordination – meaning, types and methods of controlling – evaluation, control systems and devices. Budgeting as a tool for planning and control. Record keeping as a tool of control. Functional areas of management – operations management – physical facilities, implementing the plan, scheduling the work, controlling production in terms of quantity and quality. Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ). Personnel management – recruitment, selection and training, job specialization. Marketing management – definitions, planning the marketing programmes, marketing mix and four P's. Financial management – financial statements and ratios, capital budgeting. Project management – project preparation evaluation measures.

Entrepreneurship Development

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Diseases of horticultural Crops and their management-II

Study of symptoms, brief etiology, perpetuation, epidemiology and control of following diseases : **Jasmine:** Leaf blight, Rust; **Marigold:** Leaf spot and bud rot ; **Tuberose:** Foot and tuber rot, Blossom blight; **Gerbera :** Blossom blight, Powdery mildew ; **Gladiolus:** Corm rot, flower rot; **Anthurium:** Anthracnose, Anthurium bacterial blight; **Pomegranate:** Bacterial Leaf spot, Anthracnose; **Ber:** Powdery Mildew; **Sapota:** Leaf spot; **Jackfruit:** Rhizopus rot; **pear:** Fire blight; **Peach :** Peach leaf curl; **Almond:** Bacterial gummosis; **Walnut:** Die back ; **Strawberry:** one important disease; **Cashew :** Damping off, Die back; **Rubber:** Abnormal leaf fall, bark canker, stem rot ; **Cocoa:** Black pod, Stem canker, Vascular streak ; **Fenugreek:** Powdery midew, downy mildew, rust, **Black pepper:** Foot rot and quick wilt, anthracnose; **Cumin:** powdery mildew, Wilt; **Turmeric:** Rhizome rot, Leaf Blotch; **Cardamom:** Katte, Capsule rot, Chirke, Foorke; **Nutmegh:** Fruit rot; **Clove:** Leaf sopt and die back, Grey blight, **Senna:** Damping off; **Rauwolfia:** Cercospora leaf spot; **Pyrethrum:** Leaf blotch, Grey mould, **Cinnamon:** Leaf rot ; **Belladona;** **Ipecac,** **Stevia, Discoria ; Mint:** Powdery mildew, Leaf spot, **Opium:** downy mildew.

Syllabus for Entrance Test for Admission to M.Sc (Forestry)

SILVICULTURE & AGROFORESTRY

Principle and Practices of Silviculture

Definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. Definition, objectives and scope of Silviculture. Status of forests in India and their role. History of forestry development in India. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Role played by light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimate and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation. Soil profile - physical and chemical properties, mineral nutrient and their role, soil moisture and its influence on forest production. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Impacts of controlled burning and grazing. Influence of forests on environment. Trees and their distinguishing features. Growth and development. Forest reproduction - flowering, fruiting and seeding behaviour. Natural, artificial and mixed regeneration. Natural regeneration - seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. Plant succession, competition and tolerance. Forest types of India and their distribution.

Silviculture of Indian Trees

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems and economic importance of the following conifer and broad-leaved tree species of India. Conifers: *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Pinus roxburghii*, *Pinus wallichiana*, *P. gerardiana* and *Juniperus macropoda*. Broad leaved species: *Tectona grandis*, *Shorea robusta*, *Acacia* spp., *Dalbergia sissoo*, *D latifolia*, *Quercus* spp. *Robinia pseudoacacia*, *Alnus* spp. *Anogeissus* spp. *Populus* spp, *Eucalyptus* spp. *Casuarina equisetifolia*, *Terminalia* spp., *Santalum album*, *Swietenia mahagony*, *Albizia* spp, *Prosopis* spp. *Pterocarpus santalinus*, *Azadirachta indica*, *Diospyros melanoxylon*, *Madhuca indica*, *Leucaena leucocephala* and *Bamboos*.

Agroforestry System and Management

Indian agriculture - its structure and constraints. Land use definition, classification and planning. Agroforestry - definition, aims, objectives and need. Traditional agroforestry systems: Taungya system, Shifting cultivation, wind break, shelterbelts, Homestead gardens'. Alley cropping, high density short rotation plantation systems, silvicultural woodlots/energy plantations. Classification of agroforestry system - structural, functional, socio-economic and ecological basis. Multipurpose tree species and their characteristics. Tree architecture, canopy management - lopping, pruning, pollarding and hedging. Diagnosis and design. Agroforestry systems in different agroclimatic zones, components, production and management techniques. Nutrient cycling, soil conservation, watershed management and climate change mitigation. Economics of agroforestry systems. People participation, rural entrepreneurship through agroforestry and industrial linkages. Analysis of fodder and fuel characteristics of tree/shrubs. Financial and socio-economic analysis of agroforestry systems.

Plantation Forestry

Definition, scope and impediments. Plantation forests - planting plan, plantation records, maps. Plantation establishment - legal title of land, survey, site selection. Site preparation - purpose and methods. Planting - layout, time of planting, planting pattern, spacing, gap filling, planting methods, direct seedling. Choice of species on ecological aspects - afforestation of dry land, wet land, other adverse sites and taungya. Enrichment planting, nurse and cover crops. Intercultural operations. Plantation maintenance - weed control, climber cutting, staking, singling and pruning. Thinning - definition, objectives. Effects of thinning - physiological and mensurational. Effect of methods of thinning on stand development. Energy and industrial plantation - definition, scope, species, establishment, management and impact on environment. Plantation economics.

Silvicultural Systems

Silvicultural system - definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate and progressive strip systems. Shelterwood system - Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications. Accessory systems. Coppice system - Simple coppice system, Coppice of the two rotation system, Shelterwood coppice system, Coppice with standard system, Coppice-with-reserve, Coppice selection system, Pollard system. Conversion and its implications. Choice of silvicultural system. Dauerwald concept. Culm selection system in Bamboo. Tending operations - weeding, cleaning, thinnings, definitions, objectives and methods, increment felling and improvement felling. Pruning and lopping. Control of climbers and undesirable plants.

Nursery Management

Propagation concept, definition, methods and importance. Site selection, planning and layout of nursery area. Types of nursery, types of nursery beds, preparation of beds. Pre-sowing treatments. Methods of seed sowing. pricking. watering methods, weeding, hoeing, fertilization, shading, root culturing techniques, lifting windows, grading, packaging. Storing and transportation. Type and size of containers. Merits and demerits of containerized nursery. Preparation of ingredient mixture. Vegetative propagation techniques - macro and micropropagation. Study of important nursery pests and diseases and their control measures. Nursery practices for some important tree species.

World Forestry Systems

Geographical distribution of forests and their classification. Critical examination of the world forest sources, productivity potential and increment of world forests. Forest resources and forestry practices in different regions of the world – North and South America, Europe, Africa, China, Japan, Russia, South-East Asia and Australia. Forest development and economy – forest based industries of the world. Recent trends in forestry development in the world. International forestry organizations.

Livestock Management

Important breeds of cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity – breeding systems, estrous cycle, heat detection and artificial insemination. Feeding management – types of feedstuffs available for feeding livestock. Feed nutrients and their functions in animal body. Assessing nutritive value of feed – estimation of feed nutrients by proximate and Van Soest methods, estimation of digestible

nutrients and energy in feedstuffs. Principles of rationing. Milk – definition, composition and nutritive value. Factors affecting quantity and quality of milk. Prevention and control of diseases.

Forest Mensuration

Introduction, definition, objectives and scope of forest mensuration. Scales of measurement (nominal, ordinal, interval and ratio scale). Units of measurement, standards of accuracy implied in their expression. Measurement of single tree - objectives, standard rules governing measurement at breast height. Measurement of tree diameter and girth using rulers, callipers and tapes. Comparison between tape and calliper measurements. Measurements of upper stem diameter and instruments such as Ruler, Finish Parabolic Calliper, Relaskop, Pentaprism. Bark measurements - objectives, thickness, surface area and volume. Crown measurements - objectives, diameter, height, surface area and volume. Height measurements - direct and indirect methods. Height measurement employing geometric and trigonometric principles, height measuring instruments, errors in height measurement. Measurement of cross sectional area, basal area, bole surface area, leaf area. The tree stem form, taper and classification of form factors and form quotient. Volume estimation of felled and standing trees and formulae involved. Volume tables-definition and their classification, (general, regional and local volume tables), merchantable volume tables. Preparation of volume tables. Stand growth, site quality, site index, stand structure, yield tables and preparation of yield tables. Biomass measurement. Determination of age of trees. Tree growth measurements, objectives increment, determination of increment, stump analysis, stem analysis and increment boring. Measuring tree crops - objectives, diameter, diameter and girth classes, height measurement of crop, crop age and crop volume. Stand tables. Forest inventory- definition, objectives, kinds of enumeration. Sampling - definition, advantages, kinds of sampling, random sampling: (simple, stratified, multistage and multiphase sampling). Non random sampling (selective, systematic and sequential sampling) sampling design, size and shape of the sampling units. Point sampling - horizontal and vertical point sampling. Introduction to remote sensing and its application in forestry.

Environmental Science

Environment: introduction, definition and importance. Components of environment - interactions with organisms. Global and Indian environment - past and present status. Environmental pollution and pollutants. Air, water, food, soil, noise pollution - sources, causes and types. Smog, acid rain, global warming, ozone hole, eutrophication, sewage and hazardous waste management. Impact of different pollutions on humans, organisms and environment. Introduction to biological magnification of toxins. Deforestation - forms and causes, relation to environment. Prevention and control of pollution - technological and sociological measures and solutions - Indian and global efforts. India, international and voluntary agencies for environmental conservation - mandates and activities. International conferences, conventions and summits - major achievements. Environmental policy and legislation in India. Introduction to environmental impact assessment. Causes of environmental degradation - socio-economic factors. Human population growth and lifestyle.

Fundamentals of Horticulture

Economic importance and classification of horticultural crops and their culture and nutritive value, area and production, exports and imports, fruit and vegetable zones of India and of different states, nursery management practices, soil and climate, vegetable gardens, nutrition and kitchen garden and other types of gardens – principles, planning and layout, management

of orchards, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops, nursery techniques and their management. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management, weed management, fertility management in horticultural crops, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic farming.

FOREST BIOLOGY AND TREE IMPROVEMENT

Forest Ecology and Biodiversity

Historical development of ecology as a science. Concept of levels of biological organization. Ecosystem – classification and distribution. Forest environment- Major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology - Species interaction, Ecological succession, terminology, basic concepts, climax vegetation types, Methods to study effects of forest management on succession. Island Biogeography. Autecology of important tree species. Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology, Ex situ and In situ methods of conservation, Genetical and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

Dendrology

Introduction – importance and scope of dendrology, Morphology of woody plants and range of variation. Principles and systems of classification of plants. Bentham and Hooker's, Engler and Prantles, and Hutchinson's Systems. Plant Nomenclature – objectives, principles and International Code of Botanical Nomenclature. Role of vegetative morphology in identification of woody forest flora. Peculiarities of tree stems, twigs, general form of woody trunk and deviations like buttresses, flutes, crooks, etc. Morphology and description of barks of common trees. Characteristics of blaze on bark, colour, gums, latex, etc. Morphology of leaf, description of different types of leaves, colour of young and old leaves in some species as (regular) features of identification. Reproductive morphology of plants with reference to description and identification of reproductive parts. Floristics and procedures; herbarium techniques, collection, processing and preservation of plant material. General study of herbarium, arboretum and xylarium. Description of the plant in scientific terms, study of sport characteristics of plants, naming and classifying based on adopted system. Study of families, as survey of forest resources: Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Caesalpiniaceae, Santalaceae, Mimosaceae, Elaeagnaceae, Papilionaceae, Meliaceae, Salicaceae, Apocynaceae, Betulaceae, Verbenaceae, Fagaceae, Compositae, Moraceae, Poaceae, Tiliaceae, Liliaceae, Euphorbiaceae, Pinaceae, Dipterocarpaceae, Cupressaceae, Guttiferae, Taxaceae, Myrtaceae and Combretaceae. Geographical distribution of important Indian trees, native trees, exotic trees, endemism, allelopathy with respect to forest trees.

Principles of Tree Improvement

Introduction, history and development of tree improvement, its relation to other disciplines for forest management. Reproduction in forest trees – anthesis and pollination – their importance in tree breeding. Quantitative inheritance, heritability, genetic advance, genetic gain, combining ability and their application. Genetic, environmental and phenotypic expression of trees. Genetic basis of tree breeding and selection practices in forest trees. Patterns of environmental variation- species and provenance trials in forest trees. Seed stands (seed production areas) Plus tree selection, progeny trials and establishment of seed orchard. Genetic consequences of hybridization. Back cross breeding, heterosis breeding, breeding for resistance to insect pest, diseases, air pollution and for wood properties. Conservation of forest tree germplasm. Recent techniques in tree improvement. Vegetative propagation and tree improvement.

Tree Seed Technology

Introduction – Seed and its importance – afforestation activity and seed requirements in India and HP. Role of seed technology in nursery stock production. Production of quality seed, identification of seed collection areas-seed orchards – maintenance of genetic purity-isolation and roguing, seed source provenance and stands. Selection of seed tree, genotypic and phenotypic selection, plus tree – pure stands, elite seed tree, isolated tree and their location. Locality factors. Seed Collection – Planning and Organization, Collection methods, Factors affecting seed collection, Seed maturity and tests. Seed processing – Seed extraction, drying, blending, cleaning, grading, treating, bagging, labeling and storage. Storage – orthodox and recalcitrant seeds, precautions of handling of recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity – storage conditions, methods and containers. Seed testing, sampling, mixing and dividing, determination of genuineness, germination, moisture, purity, vigour, viability, seed dormancy and breaking of seed dormancy. Different viability and vigour tests, seed pelleting, seed health. Classes of tree seeds, certification procedures of tree seeds.

Fundamentals of Wildlife

Introduction : Definition of wildlife, free living, captive, domesticated and feral animals. Justification of wildlife conservation, uses, values and negative impact of wildlife. Zoogeographic regions and biomes of the world. India's uniqueness in biodiversity, reasons and causes of wildlife depletion. Biogeographic classification of India. Status and distribution of wildlife in India. Scientific and common names of important mammals, birds and reptiles. Rare, endangered and threatened species of mammals, birds and reptiles of India. Agencies involved in wildlife conservation, Govt. and NGO's. BNHS, WWF, Indian Board for wildlife, CITES. Biological basis of wildlife management. Basic requirements of wildlife – food, water, cover and space, limiting factors. Wildlife ecology : Relevance of basic ecological concepts such as foodchain, foodweb, ecological pyramids, habitat, ecological niche, carrying capacity, density, prey-predator relations and population dynamics.

Forest Pathology

History and importance of forest pathology in India and the world. Relation of plant pathology with forest pathology and other sciences, classification of tree diseases. Role of microbes and fungi in a natural forest ecosystem. Broad classification of different pathogens

causing tree diseases. General characteristics of fungi, bacteria, viruses, phytoplasma and phanerogames. Important characters of ascomycetes and basidiomycetes. Important orders and families of Hymenomycetes with a special reference to Aphyllophorales and Agaricaceae that contain members causing tree diseases. Growth and reproduction of plant pathogens, infection and factors influencing disease development. Dissemination and survival of plant pathogens. Distribution, economic importance, symptoms, etiology and management of the following. Diseases of important tree species like teak, *Dalbergia* sp., *Acacia* spp., neem, cassia, sal, *Albizia*, *Terminalia*, mango, jack, pines, deodar, eucalyptus, bamboo, casuarina, rubber, sandal wood, medicinal and aromatic plants grown in different agroforestry systems. Biodegradation of wood in use. Types of wood decay, gross characters of decay, sapstain, different types of rots in hardwoods, softwoods and their prevention. Graveyard test and decay resistant woods. Principles of forest disease management. Definition and scope of disease management in forestry. Importance of disease cycle and economic threshold in disease management. Principles of disease management such as exclusion, cultural, chemical, biological and immunization. Nature of disease resistance. Fungicides and their use in nurseries and plantations. Integration of cultural, chemical, biological and host resistance in disease management, Meristem and tissue culture techniques in disease management. Nursery diseases of important forest species.

Wild Life Management

History of wildlife management and conservation in India; cultural background. Habitat management: Purposes, principles, practices and tools-fire, cutting, grazing. Habitat interspersions and edge effect. Provision of water, saltlicks and food. Zoning – core, buffer, tourism and multiple use in protected areas. Wildlife damage control : Mitigating human – wildlife conflict: fences, trenches, walls, lure crops, repellents, translocation and compensation. Captive wildlife : Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife census : Purpose, techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities. Wildlife (Protection) Act, 1972. Protected areas – Sanctuary, National Park and Biosphere Reserves. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, Red Data Book, Category of threat, CITES. Conservation : Meaning, principles and strategies, in-situ and ex-situ conservation, conserving biodiversity. Politics-socioeconomics, role of education and extension.

Forest Entomology and Nematology

Definition, importance and scope of Entomology. Definition of insect and its position in the Animal Kingdom. Important characters of phylum arthropoda and class insecta. External morphology of generalized insect. Insect growth and development, Reproduction in insects, immature stages (Egg, Larvae/Nymph and Pupae); metamorphosis in

Insects Taxonomic classification of class Insecta, diagnostic characters of the orders and major families of economic importance. History and importance of Forest Entomology in India. Methods and principles of pest control: Mechanical, physical, silvicultural, legal, biological and chemical. Principles and techniques of Integrated Pest Management in forests. Classification of forest pests : types of damages and symptoms; factors for outbreak of pests. Nature of damage and management: Insect pests of forest seeds, forest nursery and standing

trees of timber yielding species of natural forest (Tectona, Dalbergia sp., Sal, Albizia spp., Sandal, Ailanthus, Gmelina, Terminalia, Deodar, Pines); Plantation forest species (Eucalyptus, Bamboo, Casuarina, Neem, Acacia) Fruit trees (Emblica, Ber, Eugenia, Tamarind). Insect pests of freshly felled trees, finished timbers and their management. Morphology of plant parasitic nematodes, brief classification of important genera of nematodes. Important diseases caused by different genera and their management practices.

FOREST PRODUCTS AND UTILIZATION

Wood Anatomy

Introduction to Wood Anatomy. The plant body – Cell and organelles, meristems, promeristem, primary meristem, secondary meristem, apical and intercalary meristems. Simple tissues- parenchyma, collenchyma, sclerenchyma. Complex and vascular tissues. Anatomy of stems and roots of dicots and monocots. The secondary growth in woody plants. Mechanism of wood formation. Formation of early and late wood, growth rings, transformation of sapwood to heartwood. The macroscopic features of wood, bark- sapwood, heartwood, pith, growth rings, wood rays, resin or gum-canals. Cell inclusions. Physical properties of wood; colour, hardness, weight, texture, grain, lusture, etc. Abnormalities in wood -- deviation from typical growth form (leaning, bending, crook, fork, buttress), grain deviation, false and discontinuous growth rings. Reaction wood-compression and tension wood. Disruption of continuity of inner wood, shakes, included bark, resin pockets, pith flecks, knots (live and dead).

Logging and Ergonomics

Definition and scope of logging, logging plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction. Implements used in logging operation- traditional and improved tools. Felling rules and methods. Conversion, measurement and description of converted material. Means of transport of timber- carts, dragging, skidding, overhead transport, ropeways, skylines. Transport by road and railways. Transport by water- floating, rafting and concept of booms. Grading and Storage of timber in the depots for display and disposal, temporary and final storage. Timber Depots- types, lay out and management. Systems of disposal of timber. Size of material in logging operation. Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids. Plants, animals and insect infestations; diseases and their prevention.

Wood Products and Utilization

Pulp and paper industry. Introduction and raw material; pulping-mechanical, chemical, semi-chemical and semi-mechanical; pulp bleaching; stock preparation and sheet formation; types of paper; manufacture of rayon and other cellulose derived products. Manufacture, properties and uses of Composite wood- plywood, fiberboard, particleboard and hard board. Adhesives used in manufacture of composite wood. Improved wood-definition, types (impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood). Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast.

Wood Science and Technology

Wood as raw material, kinds of woods– hardwood, softwood; bamboos and canes. Merits and demerits of wood as raw material. The physical features of wood. Mechanical properties of wood like tension, compression, bending, shearing cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Electrical and acoustic properties of wood. Wood water relationship – shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning – merits, principles and types – air seasoning, kiln seasoning and chemicals seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control. Wood preservation – principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.), Classification of timbers based on durability. General idea about fire retardants and their usage. Non-pressure methods – steeping, dipping, soaking open tank process, Boucherie process. Pressure methods – full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing – techniques, kinds of saws – cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

Ethnobotany

Definition and scope of ethnobotany. Man and biological resource of earth with respect to plants. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic - people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc. Symbolic relationships including mythology mainly from the following families. Guttiferae (Clusiaceae), Rosaceae, Malvaceae, Fabaceae, Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae.

Utilization of Non-Timber Forest Products

Introduction, methods of collection, management and importance of Non-Timber Forest Products (NTFP). Fodder (grasses and tree leaves), canes and bamboos. Essential Oils - methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch – sources, extraction and uses. Drugs, wild fruits, spices, poisons and bio-pesticides.

Medicinal and Aromatic Plants

History, scope, opportunities and constraints in the cultivation and utilisation of medicinal and aromatic plants in India. Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and aftercare, training and pruning, nutritional and water requirements. Plant protection, harvesting, processing and economics of under mentioned important medicinal and aromatic plants. Medicinal Plants : pepper, cardamom, clove, ginger, turmeric, betelvine, periwinkle, *Rauvolfia*, *Dioscorea*, isabgol, *Ammi majus*, belladonna, *Cinchona*, pyrethrum and other species relevant to local conditions. Aromatic Plants : Citronella grass, khus grass, sweet flag (bach), lavender, geranium, patchouli, bursera, *Mentha*, muskdana (musk mallow), *Ocimum* and other species relevant to the local conditions. Endangered medicinal and aromatic plants of India and their conservation. Study of chemical composition of a few important medicinal and aromatic plants, their extraction and use. Therapeutic and pharmaceutical uses of important species.

NATURAL RESOURCE MANAGEMENT

Principles of Hydrology, Soil and Water Conservation

Definition and importance of Hydrology, Hydrological cycle, weather and hydrology, rainfall measurement and analysis, hydrologic properties, infiltration, runoff, water holding capacity of soils, free water, capillary water, hygroscopic water, ground water, evapotranspiration, water yield, interception by stemflow through fall, study of hydrographs. Recharging of water wells and springs. Wasteland Management: Objectives, components, runoff, factors affecting runoff, stream flow and stream gauging. Sedimentation, factors affecting sedimentation, flood and its control measures. Afforestation and forest management in wasteland areas. Soil erosion, universal soil loss equation, soil and water conservation practices and soil conservation structure like contour and graded bunding. Bench terracing and bench bank stabilization. Waterways their design, layout, construction, stabilization and maintenance. Methods of land leveling, its cost estimation, their location and design. Water harvesting structures and farm ponds. Irrigation Source: Water wells, aquifers, water application methods; surface, subsurface, drip and sprinkler irrigation system. Drainage: types of drainage systems, their selection, design, installation and maintenance.

Soil Survey, Remote Sensing and Wasteland Development

Scope and objective; soil survey, sampling methods; planning, inventory, permanent sample plots; sample size allocation, landuse classes and planning. Aerial photography and remote sensing-definition, meaning, scope, merits and brief history. Electromagnetic spectrum; radiations, differential reflections by surfaces, active and passive remote sensing, earth observation satellites. Equipment and materials-aerial bases, cameras, filters, stereoscopes, computers, radars. Photogrammetry: Vertical and oblique photography. Photographs and images, scales, resolution, photo interpretation, photogrammetry, image analysis, mapping. Agencies involved in remote sensing and acquiring information from them. Remote sensing; principles, uses in forestry, status monitoring, fire, vegetation/cover classification and mapping, species identification, height and volume – estimation. Identification of tree species and their form stand delineation. Interpretation of land forms and soils; use of micro-level survey of farm forests, large scale photos in forest inventory, site selection. Imagery and image analysis – video satellite, computer and radars. Geographic Information systems-

Computer softwares used. Characterization of wasteland, present status and extent of non-arable lands and their productivity. Salt affected soils, lateritic, marsh and swampy and rocky hills, rocky plains, murrummy and sandy soils, their characteristics and reclamation. Sites with superficial impervious hard pan. Eroded ravines and gullies, various techniques of afforestation of adverse sites, trees suitable for adverse sites. Afforestation and reclamation of mine wastes. Stabilization of tailing dumps and prevention of dust pollution. Sewage water as source of tree nutrients.

Fundamentals of Geology and Soil Science

Composition of earth's crust, soil as a natural body-major components by volume-pedology-rocks-types- Igneous-sedimentary and metamorphic-classification-soil forming minerals-definition-classification-silicates-oxides carbonates – sulphides - phosphates-occurrence. Weathering of rocks and minerals-weathering factors-physical-chemical-biological agents involved, weathering indices-factors of soil formation, land forms-parent material-climate-organism-relief-time-soil forming processes-eluviations and illuviation-formation of various soils. Problem soils: salted soils, permeable, flooded, sandy soils properties. Physical parameters texture-definition-methods of textural analysis-Stock's law-assumption-limitations-textural classes-use of textural triangle, absolute specific gravity-definition-apparent specific gravity/bulk density-factors influencing-field bulk density. Relation between BD.PD-Practical Problem. Pore space-definition-factors affecting capillary and non-capillary porosity-soil colour-definition-its significance-colour variable-hue, value, chroma, Munsell colour chart-factors influencing-parent material-soil moisture-organic matter, soil structure-definition-classification-clay prism like structure-factors influencing genesis of soil structure, soil consistency plasticity-Atterberg's constants. Soil air-air capacity-composition-factors influencing-amount of air space-soil air renewal, soil temperature-sources and distribution of heat-factors influencing-measurement, chemical properties-soil colloids-organic-humus-inorganic-secondary silicate-clay-hydrous oxides. Soil organic matter decomposition-pH-nutrient availability-soil buffering capacity, soil water-forms-hygroscopic capillary and gravitational-soil moisture constants-hygroscopic coefficient-wilting point-field capacity-moisture equivalent, maximum water holding capacity, energy concepts-pF scale-measurement-gravimetric-electric and tensiometer methods-pressure plate. and pressure membrane apparatus-Neutron probe-soil water movement-saturated and unsaturated-infiltration and percolation-soil survey – classification–aerial photography–satellite–their interpretation, soil orders-land capability-classification, soils of different eco-systems and their properties; water quality parameters and assessment.

Rangeland Management

Introduction and definition. Relationship with other disciplines. History and development. Types and distribution around world. Grasses : characters and classification. Characteristics of rangelands: components of vegetation, nutrient value of forages and environmental factors. Importance of rangelands. Indian rangelands : origin, distribution, characteristics, status and management. Ecology in relation to grazing – Ecological concepts relevant in rangeland management, animal – plant interactions, effect on vegetation and plant succession. Plant morphology and physiology in relation to grazing factors – factors influencing food synthesis and reproduction. Range inventory – mapping, methods of sampling and evaluation, purposes and principles, Carrying capacity. Range utilization. Intensity and frequency of use. Range management – topography, animal species, forage preference, density. Grazing –

grazing intensity, season of grazing, types – their merits and demerits. Animal unit (A.U.). Fire – controlled burning, effect of fire on vegetation and fauna. Weed control – types, their characteristics, chemical and biological control. Range improvement – range seeding, introduction of grasses and legumes, fertilization, soil and water conservation strategies. Multiple use.

Forest Management, Policy and Legislation

Introduction: definition and scope. Peculiarities of forest management. Principles of forest management and their applications. Objects of management, purpose and policy. Sustained and progressive yield concept and meaning. General definitions – management and administrative units, felling cycle, cutting section. Rotations: definition, kinds of rotations, choice of rotations, length of rotations and conversion period. Normal forest: definition and concept. Evenaged and unevenaged models. Estimation of growing stock, density, quantity and increment. Yield regulation – general principles of even aged and unevenaged forest crop. Yield regulation based on area, volume, area and volume, increment and number of trees. Working Plan – definition, objects and necessity. Forest Policy: definition, necessity and scope. Legal and institutional approaches to forest resource management. National Forest Policies. Forest Law: legal definition. Objects of special forest law. Indian Forest Act. Detailed study of IFA, 1927. Himachal Pradesh State Forest Acts and Rules.

Agrometeorology

Agrometeorology-definition, aim and scope. Factors and elements of weather and climate. Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. Cyclones, anticyclones and thunderstorms. Solar radiations-components and effect on plant growth. Wind as a source of energy. Effect of weather and climate on the growth and development of crops. Climatic normals for crops. Agroclimatic zones of India and Himachal Pradesh. Evaporation and transpiration. Use of remote sensing techniques in agrometeorology. Agriculture weather forecasting.

Marketing and Trade of Forest Produce

Nature and scope of marketing. Approaches to marketing and the study of marketing functions with special reference to forestry. Classification of market, market structure and conduct of important timber and non-timber markets. Marketing channels, costs, margins and price spread – concepts and applications. Concepts of market integration and marketing efficiency. Role of public and private agencies in marketing of forest produce. Market inefficiencies in the trade of forest produce and measures to check the same. Fundamentals of international trade. Domestic and international trade in timber and non-timber forestry outputs. Demand forecasts – concept and methods. WTO – background, structure, functions and decision making process. IPRs and their implications for forestry and allied sectors in the country.

Principles of Forest Economics, Project Planning and Evaluation

Nature and scope of forest economics, importance of forestry in economic development. Concepts of demand, derived demand and supply with special reference forestry outputs. Basics of marginal analysis and its applications in economic analysis of forestry production systems. Basics of Linear Programming. Financial and economic rotations. Fundamentals of project planning and evaluation and network scheduling techniques. Valuation of timber and non-timber forest products.

Chemistry and Fertility of Forest Soils

Introduction; Forest soils Vs. cultivated soils. Properties of soils under different forest ecosystems. Soil colloids and exchange phenomenon. Essential nutrient elements-occurrence, availability and their functions. Diagnosis of nutrient deficiencies-visual symptoms, soil fertility evaluation methods. Site productivity and nutrient cycling in forest soils. N,P and K, Macro and micronutrient fertilizers and their uses. Brief history of Microbiology. Forest soil environment-distribution of various microorganisms in soil ecosystem and their interaction effects. Mineral Transformation-carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio-fertilizers – their importance. Nitrogen fixation-Rhizobium-tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N₂ fixation. Nitrification and denitrification in forest ecosystems. Microbial transformation of phosphorous, sulphur and micro nutrients. Mycorrhizae: types, biology and importance with specific relevance to tree crops and mobilization of phosphorus and micro-nutrients. Rhizosphere and phyllosphere concept.

Forest Engineering

Engineering survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of slopy grounds, chaining across obstacles; cross staff surveying, compass surveying, chain and compass traversing, magnetic and true bearings, prismatic compass, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying; plane table and its accessories, methods of plane table surveying. Leveling: terms used, types of levels, dumpy level and its adjustments, booking of staff readings, calculation of reduced levels. Theodolite and its uses. Contour surveying. Building materials – types, strength and characteristics, site selection for building construction. Forest roads – alignment, construction and drainage; retaining walls, breast walls, waterways and culverts; bridges – types, selection of site, simple wooden beam bridges, check dams, spurs, farm ponds, earth dams.

Organic Farming

Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management – use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.