

SYLLABUS
FOR
COMMON ENTRANCE TEST
MASTER'S DEGREE PROGRAMMES
OF
INDIRA GANDHI KRISHI
VISHWAVIDYALAYA, RAIPUR (C.G.)



**DIRECTORATE OF INSTRUCTIONS/
CONTROLLER OF EXAMINATIONS,
IGKV, RAIPUR**

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**Syllabus for Common Entrance Test for Admission to Master's Degree
Programmes in Session 2022-23**

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Syllabus for M.Sc Agriculture / M.Sc Horticulture / MBA (ABM) Entrance
Examination (For students having B.Sc. (Agriculture) Degree)

Agronomy

General: Fundamental of Agronomy, tillage, crop density and geometry, sowing of different crops. Plant ideotype, growth and development of crops, crop rotation, crop management technologies in problematic areas. Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, manures and fertilizers, principles and methods of fertilizer application, integrated nutrient management.

Field crops: Origin, distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of cereals (rice, wheat, maize, sorghum, pearl millet, finger millets, barley), pulses (chickpea, lentil, peas, pigeon pea, mungbean, urdbean), oilseeds (groundnut, soybean, rapeseed & mustard, sunflower), fiber crops (cotton, jute), sugar crops (sugarcane), fodder & forage crops (sorghum, cowpea, napier, berseem, lucerne, oats, cluster bean), and medicinal and aromatic crops (menthe, lemon grass, citronella).

Weed management: Principles of weed management, classification, biology and ecology of weeds, crop weed competition and allelopathy, concepts and methods of weed control. Classification, formulations and selectivity of herbicides. Concept of adjuvants, surfactant, bio herbicide, herbicide mixture, herbicide compatibility and herbicide resistance. Application methods and equipments. Special and problematic weeds and their management in cropped and non- cropped situations, weed management in field crops.

Water management: Principles of irrigation, water resources and irrigation development in India and Chhattisgarh. Water and irrigation requirements of different crops, concepts and approaches of irrigation scheduling, methods of irrigation, measurement of irrigation water. Water and irrigation use efficiencies, conjunctive use of water, irrigation water quality and its management, water management in major field crops. Agricultural drainage and watershed management.

Farming system: Types of farming system and factor affecting farming system. Farming system components, cropping system, cropping pattern, multiple cropping system, sustainable agriculture, indicators of sustainability, conservation agriculture (conservation strategy, HELA, LEIA and LEISA) integrated farming system (objective, characteristics, components & resource recycling)

Agricultural Economics

Importance of agriculture in national economy: Theory of consumer behavior, theory of demand, elasticity of demand, indifference of curve analysis, theory of firm, cost curves, theory of supply, price determination, market classification, concept of macro economics, money and banking, national income. Agricultural marketing-role, practice, institutions, problems and reforms, role of capital and credit in agriculture, crop insurance, credit institutions, cooperatives, liberalization and globalization, WTO & its impact on Indian Agriculture.

Basic principles of farm management, concept of farming system agricultural production economics- subject matter and analytical approaches analysis, factor-product, factor-factor and product-product relationship, marginal cost and marginal revenue, farm planning and budging, 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 7P's of credit, repayment plans. 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 Extension

Extension Education-concept, meaning, principle, philosophy, scope and importance. Extension Programme Planning and evaluation-step and principle, historical development of extension. Rural development, meaning, importance and problems; Rural development programmes in India- Pre-independence era to recent ones; Extension Teaching Methods-definition and concept of sociology, differences between rural & urban communities, social stratification, social groups, social organization, social institutions and social change. Social ecology- meaning, definition and its importance in agricultural extension. Rural leadership, Educational psychology-learning and teaching, role of personality in agricultural extension. Indian rural system-its characteristics; value system, caste and class; structure and customs, rural group organization and adult education.

Communication, principles, concept, process, elements and barriers in communication. Different kinds of communication methods and media and AV aids/materials. Media mix, Campaign, Cyber extension- internet, cybercafé, Kisan Call Centers, teleconferencing, expert system, agriculture journalism, Diffusion and adoption of innovations, adopter categories, capacity building of extension personnel and farmers. Training to farmers, women and rural youths. Type of training. Concept of entrepreneur and entrepreneurship. Traits and types of entrepreneurs.

Entomology

Crop Protection Principles in field and storage. Major insect pests of agricultural crops like rice, cotton, pulses (arhar, gram, blackgram), oilseed crops (groundnut, soybean and mustard, vegetables like tomato), Cole crops; fruit crops like mango and banana and their management practices.

Classification of animal kingdom up to class level and the distinguishing characters up to orders in class insecta and the general organization of an insect external morphology with special reference to lepidopteron larvae, coleopteran adults; and honeybee; metamorphosis and moulting; different physiological systems; insect plant relationship; insect pests of agricultural and horticultural crops, and stored/processed products, insect vectors of plant diseases- identification, biology, nature of damage, and their management tactics; and pests of household, medical and veterinary importance and their control; useful and beneficial insects like honeybee, lac insect, silkworm and pollinators. IPM : introduction, importance, concepts, principles and tools of IPM (Cultural, biological, insecticidal, quarantine, and regulatory aspects); insecticide classification and insecticide resistance management; and insect protective transgenic crops

Genetics & Plant Breeding

Mendelian principles of heredity. Cell and Cell Organelles. Chromosome, cell cycle and cell division- mitosis and meiosis. Chromosomal abnormalities. Epistatic interactions with examples. Linkage and its estimation. Crossing over and types. Mutations. Cytoplasmic inheritance. Genetic materials (DNA & RNA). Transcription and translational. Genetic codes. Gene concept.

Self-incompatibility and male sterility. Apomixis. Genetic basis and breeding methods in self and cross pollinated crops and asexually propagated crops. Population improvement.

Heterosis breeding. Polyploidy in relation to plant breeding. Mutation breeding-methods and uses. Breeding for important biotic and abiotic stresses. Biotechnological tools-DNA markers and marker assisted selection, Transgenic and GMOs. Polyploidy and applications. Mutation breeding-methods and uses.

Seed and seed technology, seed quality and classes of seeds. Seed testing, Seed certification, Seed Processing, Seed Act, GMO and Transgene and Seed Act enforcement. Grow out Test, Seed storage and seed marketing.

Plant genetic resources, its utilization and conservation; Hybrid seed production of major field and horticultural crops. Ideotype concept and climate resilient crop varieties for future uses.

Intellectual property, Various types of Intellectual Property Rights. PPV&FR Act 2001, International treaty on plant genetic resources for food and agriculture (ITPGRFA), TRIPS Agreement, UPOV, and Indian Biological Diversity Act, 2002.

Plant Pathology

Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Historical developments of chemicals, cultural and biological protection measures including classification of plant diseases. Physiologic specialization, Koch's postulates; Diseases and symptoms due to biotic and abiotic causes; reproduction, survival and dispersal of plant pathogen; Factors influencing infection, colonization and development of symptoms; Types of parasitism and variability in plant pathogens; Pathogenesis-Role of enzymes, toxins and growth regulators in disease development; Defense mechanism in plants; Epidemiology: factors affecting disease development, disease triangle and tetrahedron; General morphological characters, reproduction, nomenclature and classification of Fungi, Bacteria and mollicutes and Nematodes; Nature, structure, replication and transmission of Viruses; Study of phanerogamic plant parasites.

Crop diseases of cereals, pulses, oilseeds, vegetables, fruits, plantation and fiber crops caused by fungus, bacteria, viruses, viroids, phytoplasmas and other fastidious prokaryotes.

Soil Science & Agricultural Chemistry

Soil as a medium for plant growth, composition of earth's crust, weathering of rocks and minerals, components of soil-their importance, soil profile, soil particles-physical mineralogical and chemical nature. Mechanical analysis, Stokes law, assumptions, limitation and applications. Soil physical properties-density, porosity, texture, soil structure and their brief descriptions. Rheological properties in soils, calculations of porosity and bulk density. Soil Air-Aeration, causes of poor aeration, factors affecting aeration, it's importance for plant growth. Soil temperature-sources and losses of soil heat. Factors affecting soil temperature, its importance in plant growth. Soil water-structure of water, soil-water-energy relationship, classifications, surface tension and movement in soil. Soil colloids-classification, properties, structure of silicate clay minerals, sources of negative charges, kaolinite, illite, montmorillonite and vermiculite clay minerals, milli-equivalent concept, cation exchange capacity, anion exchange capacity, buffering of soils. Problem soils- acid, saline, saline-sodic, sodic and acid sulphate soils-their characteristics, formation, problems and management. Irrigation, water quality and its evaluation. Waterlogged soils- basic features, distinction with upland soils.

Essential plant nutrients- criteria of essentiality, their forms absorbed by plants,

functions for plant growth, mechanisms for movement and uptake of ions in soils and plants, Forms of nutrients in soils, deficiency symptoms on plants, luxury consumption, nutrient interaction and chelated micronutrients. Soil fertility, evaluation and management for plant growth, soil testing and fertilizer recommendations. Soil classification- diagnostic surface and sub-surface horizons, soil orders and associated specific features, soil survey- objectives, uses, land capability classification. Remote sensing and its application in agriculture, SIS, GIS and GPS- basic features and uses in agriculture, Soil micro- organisms, classification and their roles. Organic matter-decomposition, C:N ratio, mineralization and immobilization processes, humus, role of organic matter in soil quality. Soil erosion, types and control measures. Fertilizers and manures – classifications, NPK and micronutrient fertilizers, their reactions in soil, slow release fertilizers, nitrification inhibitors, nano-fertilizers and their role, green manuring, recycling of organic wastes, composting. Soil and water pollution- sources brief idea about different pollutants in soils and their managements.

Horticulture

Importance of vegetables and spices in human nutrition and national economy, status and scope. Classification of major vegetables and spices. Package of practices of vegetables (Tomato, Brinjal, Chilli, Capsicum, Cucumber, , Gourds, Melons, Pumpkin, French bean, Peas, Cowpea; Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb Crops such as Onion, Garlic; Root crops such as Carrot, Radish, Beetroot; Tubers crops such as Potato; Leafy vegetables such as Amaranth, Palak. Perennial vegetables.). Improved vegetable nursery technology, organic farming, post harvest technology, seed production and use of PGR in important vegetables, protected cultivation. Importance & scope of Spices crops. Production Technology of Ginger, Turmeric Coriander, Fenugreek, Black Pepper, Cardamom.

Importance and scope of horticulture, climatic zones of horticultural crops. Orchard establishment including high density planting, planting geometry and planting systems, propagation methods and root stocks of fruit crops, training and pruning methods, role of PGR in fruit crops, production technology of major fruit crops (mango, banana, papaya, guava, grapes, citrus, litchi, sapota), temperate fruit crops (apple, pear, peach, plum, strawberry), minor fruit crops (aonla, bale, ber, custard apple, pineapple, pomegranate, jackfruit). Production technology of tea, coffee and coconut. Importance and scope of post harvest technology of horticultural crops. Post harvest handling of fruits and vegetables. Maturity indices, grading, packing and storage of fruits and vegetables. Importance and scope of fruits and vegetable preservation. Principles of preservation by heat, low temperature, chemicals and fermentation. Preservation methods by canning, bottling, freezing, drying and dehydration. Preparation of jams, jellies, candies, chutney, pickle, ketchup, nectar and squashes. Preservatives and colours permitted and prohibited in India. FPO, HACCP, FSSAI.

Famous gardens of India & abroad; Importance, features & establishment of formal, Informal, Free style & Wild gardens; Xeriscaping-Principles & Practice; Bio-aesthetics Planning & Avenue Planting; Principles of landscape gardens; Scope & importance of Commercial Floriculture in India; Production techniques of commercial flower crops viz. Rose Marigold, Chrysanthemum, Gladiolus, Tuberosa and Gerbera for domestic and export market; Role of heterosis, production of F1 hybrids & utilization of male sterility; Floriculture industry importance, Area and Production of commercial flower crops viz., Rose, Marigold, Chrysanthemum, Gladiolus, Tuberosa and Gerbera; Importance, classification, design values and cultivation aspects of ornamental plants viz., annuals, perennials, grasses shrubs, climbers trees, indoor plants. Palms and cycads, ferns and cacti & Succulents; Establishment of garden features/components; Importance of garden adornments; Lawn- establishment & maintenance.

Plant Molecular Biology and Biotechnology

Importance of agriculture in national economy; principles of crop production: cultivation of rice, wheat chickpea pigeon-pea, sugarcane, groundnut, tomato and mango. Major soils of India role of NPK and their deficiency symptoms. General structure and function of cell organelles; mitosis and meiosis; Mendelian genetics. Elementary knowledge of growth, development, photosynthesis, respiration and transpiration: Elements of economic botany. General structure and function of carbohydrates, proteins, nucleic acids, enzymes and vitamins Major pests and diseases of rice, wheat cotton, chickpea, sugarcane and their management. Organic farming; bio-fertilizer; bio-pesticides. Recombinant DNA technology; transgenic crops. Important rural development programmes in India; organizational set up of agricultural research, education and extension in India. Elements of statistics.

Importance of biochemistry in agriculture Acid-base concept and buffers; pH. Classification, structure and metabolic functions of carbohydrates, lipids and proteins. Structure and function of nucleic acids. Enzymes: structure nomenclature mechanism of action; vitamins and minerals as coenzymes and cofactors metabolic pathways: Metabolic pathways: glycolysis, TCA cycle, fatty acid oxidation triglyceride biosynthesis. Electron transport chain; ATP formation. Photosynthesis: C-3 C-4 and CAM pathways. Nitrate assimilation; biological nitrogen fixation. Colorimetric and chromatographic techniques.

Characteristics of prokaryotic and eukaryotic organisms, differences between fungi, bacteria mycoplasmas and viruses. Physical and chemical basis of heredity; chromosome structure. DNA replication, transcription and translation; genetic code; operon concept. Genetic engineering; restriction enzymes; vectors gene cloning; gene transfer. Plant cell and tissue culture; micro-propagation; somaclonal variation. Transformation; recombination: heterosis General application of biotechnology Molecular and immunological techniques. Concept of bioinformatics, genomics and proteomics.

Plant physiology importance in agriculture. Seed germination viability and vigour. Photosynthesis – significance of C-3 C-4 and CAM pathway; photorespiration and its implications. Translocation of assimilates; dry matter partitioning: Harvest index of crops. Growth and development; growth analysis; crop- water relationship. Plant nutrients and their functions. Phytohormones and their physiological role. Photo-periodism, vernalisation; pollination / fertilization in flowering plants. Post- harvest physiology and its significance.

Agriculture Statistics

Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves. Measures of Central Tendency: Arithmetic Mean, Properties of Arithmetic Mean, Median, Mode, Merits and Demerits of Arithmetic Mean. Measures of Dispersion: Variance, Standard deviation, and Coefficient of Variation. Probability: Classical Definition of Probability and simple problems; Normal Distribution, its properties and simple problems; Introduction to Sampling: Random Sampling; the concept of Standard Error. Tests of Significance: Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom; Steps involved in testing of hypothesis; Small sample test for sample means: Students' t-test for single sample; Two sample t-tests and paired t-test; Chi-square test, goodness of fit test, test of independence of attributes, and t-test of population correlation; Yates correction for continuity; Correlation: Types of Correlation, Scatter Diagram, Computation of Correlation coefficient 'r'; Linear Regression : Of Y on X and X on Y and its properties, test of regression

coefficient. Introduction to Analysis of Variance (ANOVA); Experimental Designs: Principles of Design of Experiments; Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis.

Introduction to Computers; Input and output devices, Units of memory. Hardware, Software and Classification of computers; Elementary types of Processors. Booting of Computers, warm and cold booting, Operating System: DOS and DOS commands; Operating system WINDOWS; MS-WORD; Basic features of word processing; Creating, editing and saving MS-WORD documents and MS-EXCEL spreadsheets. Editing cell contents; Use of in-built Statistical functions like functions of mean, standard deviation, correlation and regression; Entering expressions; Creating graphs; Introduction to MS Power Point; Creating new presentation; Introduction to MS Access, concept of data base, creating data base. Creating tables in data base; Elements of Basic Programming., Flow charts. Algorithms, illustration through examples. Introduction to Internet. World wide web, information retrieval. Introduction to electronic mail. Advantages of E-mail; Basic tools of Information and communication Technology (ICT).

Plant Physiology

Plant cell: an Overview; function of different cell organelles, Absorption of water, transpiration and Stomatal Physiology, Essential nutrients for plants and their role in plant metabolism, Nutrient uptake mechanisms, Photosynthesis: Light and Dark reactions, C₃, C₄ and CAM plants, Respiration: Glycolysis, TCA cycle and electron transport chain, Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity, Introduction of plant stresses, types, mechanism of stress resistance, tolerance and avoidance. Seed dormancy, germination, types of dormancy and germination, Plant water relations, water potential, Osmotic potential, turgor pressure, Biochemical and physiological properties of water.

Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions. Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc. Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders, Balanced/ modified diets.

Agriculture Microbiology

History and Scope of Microbiology: The discovery of micro-organism, spontaneous generation conflict, germ theory of disease, 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 eukaryotic cells. Prokaryotic cell structure and functions. Types of culture media and pre-culture techniques. Sterilization methods- physics and chemical. Isolation of pure cultures and preservation of cultures, microbial growth in models of bacterial, yeast and mycelia growth curve. Measurements of bacterial growth. General properties of viruses and brief description of bacteriophages. Chemoautotrophy, photoautotrophy, growth.

DNA as genetic material. Genetic recombination- transformation, conjugation and transduction, plasmids. Antibiosis, symbiosis, intra-microbial and extra-microbial association. Plant growth promoting microorganisms and mushrooms – Economical importance,

industrially important microorganisms in large scale production and common microbial fermentation. Mushrooms – edible and poisonous types, nutritive values, Culturing and production techniques.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Silage production, biofertilizers, biopesticides. Biofuel production and biodegradation of agro-waste.

Agrometeorology

Atmosphere - composition and properties, structure of atmosphere, Air temperature – isotherms, horizontal and vertical temperature distribution of temperature, Cardinal temperatures – low and high air temperature and plant injury - soil temperature – importance and factors affecting soil temperature, Atmospheric pressure – general circulation, pressure patterns - wind – factors responsible, effects of wind on crops - cyclones and anticyclones, Atmospheric humidity – methods of measurement of atmospheric humidity, vapour pressure and saturation vapour pressure, process of condensation - dew, fog, mist, snow, rain and hail - clouds – cloud formation and classification - cloud seeding (artificial rain making).

Monsoon, origin and onset and withdrawal process of south west monsoon and north east monsoon, economic importance and influence of monsoon rains on Indian economy, Solar radiation – electromagnetic spectrum and functions of light, different kinds of transmission of heat and radiation, important radiation laws, solar constant and energy balance, Agroclimatic classification, Agro-climatic requirement of crops – Rice, Soybean, Maize, Sorghum, Sugarcane, Groundnut, Cotton, wheat and major Vegetables, Weather forecasting – types of weather forecast - applications and utility for agriculture, Weather hazards - different kinds of weather hazards for agriculture, Global warming and climate change – reasons and future projections – impact of climate change on agriculture.

Syllabus for M.Sc Agriculture / M.Sc Horticulture / MBA (ABM) Entrance
Examination (For students having B.Sc. (Horticulture) Degree)

Agronomy

Organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil amendments; integrated disease and pest management, biocontrol agents, biopesticides pheromones, Weed management; Certification.

Multiple cropping, mixed cropping, intercropping, relay and alley cropping, cultural practices for raising major cereals, pulses, oil seeds and fodder crops, crop rotation.

Weeds: Classification, crop weed competition and allelopathy; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: Herbicide classification, formulations, methods of application; Adjuvants; Weed management in major field and horticultural crops.

Agricultural Economics

Importance of agriculture in national economy: Theory of consumer behavior, theory of demand, elasticity of demand, indifference of curve analysis, theory of firm, cost curves, theory of supply, price determination, market classification, concept of macroeconomics, money and banking, national income. Agricultural marketing-role, practice, institutions, problems and reforms, role of capital and credit in agriculture, crop insurance, credit institutions, cooperatives, liberalization and globalization, WTO & its impact on Indian Agriculture.

Basic principles of farm management, concept of farming system agricultural production economics- subject matter and analytical approaches analysis, factor-product, factor-factor and product-product relationship, marginal cost and marginal revenue, farm planning and budgeting, 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 7P's of credit, repayment plans. 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 Extension

Extension Education-concept, meaning, principle, philosophy, scope and importance. Extension Programme Planning and evaluation-step and principle, historical development of extension. Rural development, meaning, importance and problems; Rural development programmes in India- Pre-independence era to recent ones; Extension Teaching Methods-definition and concept of sociology, differences between rural & urban communities, social stratification, social groups, social organization, social institutions and social change. Social ecology- meaning, definition and its importance in agricultural extension. Rural leadership, Educational psychology-learning and teaching, role of personality in agricultural extension. Indian rural system-its characteristics; value system, caste and class; structure and customs, rural group organization and adult education.

Communication, principles, concept, process, elements and barriers in communication. Different kinds of communication methods and media and AV aids/materials. Media mix, Campaign, Cyber extension- internet, cybercafé, Kisan Call

Centers, teleconferencing, expert system, agriculture journalism, Diffusion and adoption of innovations, adopter categories, capacity building of extension personnel and farmers. Training to farmers, women and rural youths. Type of training. Concept of entrepreneur and entrepreneurship. Traits and types of entrepreneurs.

Entomology

Importance of class Insecta, Insect dominance. Comparative account of external morphonology-types of mouth parts, antennae; legs wings and genitalia; Structure function of cuticle & moulting and body segmentation, Anatomy of digestive, Circulatory, Sensory, respiratory, glandular, excretory, nervous and reproductive systems; Classification of insects upto orders, sub-order and families of economic importance and their distinguished characters.

Pest surveillance of fruit, plantation, medicinal, and aromatic crops. Host range, Injury and integrated management of coconut, areca nut, cashew, tea, coffee, rubber, neem, pyrethrum, dhatura, mint, opium. Insecticides residue problems in fruit, plantation, medicinal and aromatic crops and their maximum residue limits (MRLs).

Introduction to beneficial insects; Species of honey bees, Rock bee, Little bee, Indian bee, European bee; Bee colony maintenance, bee colony activities, starting of new colony, location site; swarm prevention colony management in different seasons; Bee pasturage; Honey extraction, honey composition and value; silkworms kind and their hosts; lifecycles in brief, Mulberry silkworm-morphological features, rearing house and equipment, disinfection and hygiene; Silkworm rearing young age/chawki rearing and old age rearing of silkworm. Feeding, spacing, environmental conditions and sanitation; Defective cocoons and stifling of cocoons, use of silk and by-product; Economics of silk production, Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management; Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning inoculation, cropping, kinds of lac. Enemies of lac-insects.

Pest surveillance in important vegetable, ornamental and spice crops; Distribution, host range, bio-ecology, injury, integrated management of important insect-pests affecting vegetable, ornamental and spice crops; Important storage insect-pests of vegetable, ornamental and spice crops, their host range, bio-ecology, injury and integrated management, Insect-pests of processed vegetables and ornamental crops, their host range, bio-ecology, injury and integrated management; Insecticidal residue problems in vegetables and ornamental crops, tolerance limits etc.

Genetics & Plant Breeding

Mendelian principles of heredity. Cell and Cell Organelles. Chromosome, cell cycle and cell division- mitosis and meiosis. Chromosomal abnormalities. Epistatic interactions with examples. Linkage and its estimation. Crossing over and types. Mutations. Cytoplasmic inheritance. Genetic materials (DNA & RNA). Transcription and translational. Genetic codes. Gene concept.

Self-incompatibility and male sterility. Apomixis. Genetic basis and breeding methods in self and cross pollinated crops and asexually propagated crops. Population improvement. Heterosis breeding. Polyploidy in relation to plant breeding. Mutation breeding-methods and uses. Breeding for important biotic and abiotic stresses. Biotechnological tools-DNA markers and marker assisted selection, Transgenic and GMOs. Polyploidy and applications. Mutation breeding-methods and uses.

Seed and seed technology, seed quality and classes of seeds. Seed testing, Seed certification, Seed Processing, Seed Act, GMO and Transgene and Seed Act enforcement. Grow out Test, Seed storage and seed marketing.

Plant genetic resources, its utilization and conservation; Hybrid seed production of major field and horticultural crops. Ideotype concept and climate resilient crop varieties for future uses.

Intellectual property, Various types of Intellectual Property Rights. PPV&FR Act 2001, International treaty on plant genetic resources for food and agriculture (ITPGRFA), TRIPS Agreement, UPOV, and Indian Biological Diversity Act, 2002.

Plant Pathology

Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Terms and concepts in plant pathology. Historical developments of chemicals, principles and methods of plant disease management including classification of plant diseases. Physiologic specialization, Koch's postulates; Diseases and symptoms due to biotic and abiotic causes; reproduction, survival and dispersal of plant pathogen; Factors influencing infection, colonization and development of symptoms; Types of parasitism and variability in plant pathogens; Pathogenesis-Role of enzymes, toxins and growth regulators in disease development; Defence mechanism in plants; Epidemiology: factors affecting disease development, disease triangle and tetrahedron; General morphological characters, reproduction, nomenclature and classification of Fungi, Bacteria and Mollicutes; Nature, structure, replication and transmission of viruses; Study of phanerogamic plant parasites.

General characters of plant parasitic nematodes, morphology, Biology, Symptomatology, role of nematodes in plant disease complex and control of important plant parasitic nematodes of fruits (tropical, sub-tropical and temperate), Vegetables, Tuber crops, Ornamental crops, Spices and Plantation crops.

Etiology, symptoms, mode of spread, epidemiology and integrated disease management of diseases of Fruits, Vegetables, Plantation, Medicinal, Aromatic, Ornamental and Spices crops caused by fungus, bacteria, viroids, phytoplasmas and other fastidious prokaryotes.

Soil Science & Agricultural Chemistry

Soil as a medium for plant growth, composition of earth's crust, weathering of rocks and minerals, components of soil-their importance, soil profile, soil particles-physical mineralogical and chemical nature. Mechanical analysis, Stokes law, assumptions, limitation and applications. Soil physical properties-density, porosity, texture, soil structure and their brief descriptions. Rheological properties in soils, calculations of porosity and bulk density. Soil air-Aeration, causes of poor aeration, factors affecting aeration, its importance for plant growth. Soil temperature-sources and losses of soil heat. Factors affecting soil temperature, its importance in plant growth. Soil water-structure of water, soil-water-energy relationship, classifications, surface tension and movement in soil. Soil colloids-classification, properties, structure of silicate clay minerals, sources of negative charges, kaolinite, illite, montmorillonite and vermiculite clay minerals, milli-equivalent concept, cation exchange capacity, anion exchange capacity, buffering of soils. Problem soils- acid, saline, saline-sodic, sodic and acid sulphate soils-their characteristics, formation, problems and management. Irrigation, water quality and its evaluation. Waterlogged soils- basic features, distinction with upland soils.

Essential plant nutrients- criteria of essentiality, their forms absorbed by plants, functions for plant growth, mechanisms for movement and uptake of ions in soils and plants, Forms of nutrients in soils, deficiency symptoms on plants, luxury consumption, nutrient

interaction and chelated micronutrients. Soil fertility, evaluation and management for plant growth, soil testing and fertilizer recommendations. Soil classification- diagnostic surface and sub-surface horizons, soil orders and associated specific features, soil survey- objectives, uses, land capability classification. Remote sensing and its application in agriculture, SIS, GIS and GPS- basic features and uses in agriculture, Soil micro- organisms, classification and their roles. Organic matter-decomposition, C:N ratio, mineralization and immobilization processes, humus, role of organic matter in soil quality. Soil erosion, types and control measures. Fertilizers and manures – classifications, NPK and micronutrient fertilizers, their reactions in soil, slow release fertilizers, nitrification inhibitors, nano-fertilizers and their role, green manuring, recycling of organic wastes, composting. Soil and water pollution- sources brief idea about different pollutants in soils and their managements.

Floriculture & Landscape

Famous gardens of India & abroad; Importance, features & establishment of formal, Informal, Free style & Wild gardens; Xeriscaping-Principles & Practice; Development of gardens for public and private place; Bio-aesthetics Planning & Avenue Planting; Use of Auto CAD & Arch CAD in designing gardens; Principles of landscape gardens; Scope & importance of Commercial Floriculture in India; Production techniques of commercial flower crops viz. Rose marigold, chrysanthemums, gladiolus, tuberose and gerbera for domestics and export market; Post harvest technology of commercial flower crops Rose marigold, Chrysanthemum, gladiolus, tuberose and gerbera; Dehydration Techniques; Flower arrangement Practise & Bonsai; History of improvement, Centre of origin, objectives and Techniques of breeding in flower crops viz., Rose, marigold, chrysanthemums, gladiolus, tuberose, garbure, petunia, gaillardia and hibiscus; Breeding for disease resistance; Development of cultivars of above mentioned flower crops; Role of heterosis, production of F₁ hybrids & utilization of male sterility; Production of open pollinated seed; Storage of seed & seed certification; Floriculture industry importance, Area and Production of commercial flowercrops viz., Rose, marigold, chrysanthemum, gladiolus, tuberose and gerbera; Importance, classification, design values and cultivation aspects of ornamental plants viz., Annuals, perennials, grasses shrubs, climbers trees, indoor plants. Palms and cycads, ferns and cacti & succulents; Establishment of garden features/components; Importance of garden adornments; Lawn- establishment & maintenance.

Fruit Science

Crops; fruit zone of India and Chhattisgarh; Nursery techniques and management; Orchard management: planning and layout of orchard; Planting systems in fruit crops; Training and pruning in fruit crops; High density and ultra-high density planting in fruit crops; fruit based cropping systems, intercropping, multitier cropping; fruitfulness and unfruitfulness in fruit crops; Rejuvenation of old and senile orchards, top working.

Sexual and Asexual methods of propagation; Types of vegetative propagation; Apomixis, Polyembryony, monoembryony, chimera; selection and maintenance of mother trees, selection of scion; stock-scion relationship Graft compatibility; micro-grafting; Nursery registration nursery act; propagation structures: mist chamber Green House; Rootstock of fruit crops; use of plant growth regulators.

Production technology of tropical and subtropical fruits: mango, Guava, Papaya, banana, pomegranate, aonla, ber, beal, litchi, sapota, jackfruit annona and grapes; physiology disorders; crop regulation; postharvest management; use of plant growth regulators; Training and pruning; Disease and pest management.

Production technology of temperate fruits: Apple, Pear, Peach, Plum, Strawberry;

Training and pruning of temperate fruits; Disease & Pest Management; Post harvest management; Physiological disorders; Production technology of plantation crops (coconut, cashewnut, arecanut, Cocoa, Coffee, date palm, tea & rubber); Medicinal Plants- Ashwagandha, Sarpagandha, Safed musli, Brahmi Satarwed, Betalvine, Senna, neem, hemp, belladonna, and other species; Aromatic-Plants- Mint optimum Solanum Khasanum and Tephrosia. Lemon Grass, Grronella, Patchouli, Mentha and other speares; Post harvest management and processing, By-product utilization.

Post-harvest handling of horticultural crops-Pre-cooling, grading, waxing, packaging, storage; Principles and methods of preservation; Processed products of fruits and vegetables; Quality control of processed products; food safety standards. FPO, FSSAI, HACCP.

Vegetable Science

Importance, classification of horticultural crops, nutritive value, Nursery techniques, plant propagation and planting densities, Pruning and training, types and use of PGR organic tracing and cropping systems.

Varieties and hybrids. Production technology of major vegetable crops. Physiological disorders, disease, insect and post-harvest management and economics of tropical and subtropical vegetables. (Solanaceae, Cucurbitacy, Leguminaceae, Okra and leafy vegetables.)

Varieties and hybrids. Production technology and export potential of Cole crops, root crops, spinach lettuce, garlic, onion, peas, asparagus, Nutritional disease and post-harvest handling.

Role of spices, classification, soil and climate propagation, micropropagation. Production technology, mulching and cover cropping. Harvesting, shade regulation, economics and post-harvest technology (Oil extraction methods) of spices and condiments (Cardamom, Pepper, Betelvine, Ginger, Turmeric, Cinnamon, All spice, Curry leaf, Coriander, fencegreek, cumin etc.)

Economics, Importance, Varieties and hybrids, Production technology. Nutrient deficiencies harvest indices, cropping systems, harvesting practices, post-harvest handling and storage of potato, sweet potato, cassava, arrow root, colocasia, xanthosoma, amorphophallus, dioscorea and other under exploited tuber crops.

Types of Green houses, Planning and designing for cooling and heating purposes, Equipments, construction materials, growing media, nutrient film technique (NFT), hydroponics, Mulching, Irrigation and fertigation systems, weed management. Choice of crops, economics analysis, insect-pests and disease management, Problems and constraints of greenhouse cultivation.

Plant Molecular Biology and Biotechnology

Importance of agriculture in national economy; principles of crop production: cultivation of rice, wheat chickpea pigeon-pea, sugarcane, groundnut, tomato and mango. Major soils of India role of NPK and their deficiency symptoms. General structure and function of cell organelles; mitosis and meiosis; Mendelian genetics. Elementary knowledge of growth, development, photosynthesis, respiration and transpiration: Elements of economic botany. General structure and function of carbohydrates, proteins, nucleic acids, enzymes and vitamins Major pests and diseases of rice, wheat cotton, chickpea, sugarcane and their management. Organic farming; bio-fertilizer; bio-pesticides. Recombinant DNA technology; transgenic crops. Important rural development programmes in India; organizational set up of

agricultural research, education and extension in India. Elements of statistics.

Importance of biochemistry in agriculture Acid-base concept and buffers; pH. Classification, structure and metabolic functions of carbohydrates, lipids and proteins. Structure and function of nucleic acids. Enzymes: structure nomenclature mechanism of action; vitamins and minerals as coenzymes and cofactors metabolic pathways: Metabolic pathways: glycolysis, TCA cycle, fatty acid oxidation triglyceride biosynthesis. Electron transport chain; ATP formation. Photosynthesis: C-3 C-4 and CAM pathways. Nitrate assimilation; biological nitrogen fixation. Colorimetric and chromatographic techniques.

Characteristics of prokaryotic and eukaryotic organisms, differences between fungi, bacteria mycoplasmas and viruses. Physical and chemical basis of heredity; chromosome structure. DNA replication, transcription and translation; genetic code; operon concept. Genetic engineering; restriction enzymes; vectors gene cloning; gene transfer. Plant cell and tissue culture; micro-propagation; somaclonal variation. Transformation; recombination: heterosis General application of biotechnology Molecular and immunological techniques. Concept of bioinformatics, genomics and proteomics.

Plant physiology importance in agriculture. Seed germination viability and vigour. Photosynthesis – significance of C-3 C-4 and CAM pathway; photorespiration and its implications. Translocation of assimilates; dry matter partitioning: Harvest index of crops. Growth and development; growth analysis; crop- water relationship. Plant nutrients and their functions. Phytohormones and their physiological role. Photo-periodism, vernalisation; pollination / fertilization in flowering plants. Post- harvest physiology and its significance.

Agriculture Statistics

Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves. Measures of Central Tendency: Arithmetic Mean, Properties of Arithmetic Mean, Median, Mode, Merits and Demerits of Arithmetic Mean. Measures of Dispersion: Variance, Standard deviation, and Coefficient of Variation. Probability: Classical Definition of Probability and simple problems; Normal Distribution, its properties and simple problems; Introduction to Sampling: Random Sampling; the concept of Standard Error. Tests of Significance: Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom; Steps involved in testing of hypothesis; Small sample test for sample means: Students' t-test for single sample; Two sample t-tests and paired t-test; Chi-square test, goodness of fit test, test of independence of attributes, and t-test of population correlation; Yates correction for continuity; Correlation: Types of Correlation, Scatter Diagram, Computation of Correlation coefficient 'r'; Linear Regression : Of Y on X and X on Y and its properties, test of regression coefficient. Introduction to Analysis of Variance (ANOVA); Experimental Designs: Principles of Design of Experiments; Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis.

Introduction to Computers; Input and output devices, Units of memory. Hardware, Software and Classification of computers; Elementary types of Processors. Booting of Computers, warm and cold booting, Operating System: DOS and DOS commands; Operating system WINDOWS; MS-WORD; Basic features of word processing; Creating, editing and saving MS-WORD documents and MS-EXCELSpreadsheets. Editing cell contents; Use of in-built Statistical functions like functions of mean, standard deviation, correlation and

regression; Entering expressions; Creating graphs; Introduction to MS Power Point; Creating new presentation; Introduction to MS Access, concept of data base, creating data base. Creating tables in data base; Elements of Basic Programming., Flow charts. Algorithms, illustration through examples. Introduction to Internet. World wide web, information retrieval. Introduction to electronic mail. Advantages of E-mail; Basic tools of Information and communication Technology (ICT).

Plant Physiology

Plant cell: an Overview; function of different cell organelles, Absorption of water, transpiration and Stomatal Physiology, Essential nutrients for plants and their role in plant metabolism, Nutrient uptake mechanisms, Photosynthesis: Light and Dark reactions, C₃, C₄ and CAM plants, Respiration: Glycolysis, TCA cycle and electron transport chain, Plant growth regulators: Physiological roles and agricultural uses, Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity, Introduction of plant stresses, types, mechanism of stress resistance, tolerance and avoidance. Seed dormancy, germination, types of dormancy and germination, Plant water relations, water potential, Osmotic potential, turgor pressure, Biochemical and physiological properties of water.

Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions. Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc. Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders, Balanced/ modified diets.

Agriculture Microbiology

History and Scope of Microbiology: The discovery of micro-organism, spontaneous generation conflict, germ theory of disease, 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 eukaryotic cells. Prokaryotic cell structure and functions. Types of culture media and pre-culture techniques. Sterilization methods- physics and chemical. Isolation of pure cultures and preservation of cultures, microbial growth in models of bacterial, yeast and mycelia growth curve. Measurements of bacterial growth. General properties of viruses and brief description of bacteriophages. Chemoautotrophy, photoautotrophy, growth.

DNA as genetic material. Genetic recombination- transformation, conjugation and transduction, plasmids. Antibiosis, symbiosis, intra-microbial and extra-microbial association. Plant growth promoting microorganisms and mushrooms – Economical importance, industrially important microorganisms in large scale production and common microbial fermentation. Mushrooms – edible and poisonous types, nutritive values, Culturing and production techniques.

Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Silage production, biofertilizers, biopesticides. Biofuel production and biodegradation of agro-waste.

Agrometeorology

Atmosphere - composition and properties, structure of atmosphere, Air temperature – isotherms, horizontal and vertical temperature distribution of temperature, Cardinal temperatures – low and high air temperature and plant injury - soil temperature – importance and factors affecting soil temperature, Atmospheric pressure – general circulation, pressure patterns - wind – factors responsible, effects of wind on crops - cyclones and anticyclones, Atmospheric humidity – methods of measurement of atmospheric humidity, vapour pressure and saturation vapour pressure, process of condensation - dew, fog, mist, snow, rain and hail - clouds – cloud formation and classification - cloud seeding (artificial rain making).

Monsoon, origin and onset and withdrawal process of south west monsoon and north east monsoon, economic importance and influence of monsoon rains on Indian economy, Solar radiation – electromagnetic spectrum and functions of light, different kinds of transmission of heat and radiation, important radiation laws, solar constant and energy balance, Agroclimatic classification, Agro-climatic requirement of crops – Rice, Soybean, Maize, Sorghum, Sugarcane, Groundnut, Cotton, wheat and major Vegetables, Weather forecasting – types of weather forecast - applications and utility for agriculture, Weather hazards - different kinds of weather hazards for agriculture, Global warming and climate change – reasons and future projections – impact of climate change on agriculture.

Syllabus for M.Sc Forestry / M.Sc Agriculture (Plant Molecular Biology & Biotechnology) Entrance Examination (For students having B.Sc (Forestry) Degree

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. Role played by light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimate and micro climate effects. 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. Dieback in seedling with examples. Plant succession, competition and tolerance. Forest types of India and their distribution.

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 Shelterwood system, Selection system and its modifications. Accessory systems. Coppice systems, Pollard system. Choice of silvicultural system. Culm selection system in Bamboo. Tending operations.

Forest Mensuration

Introduction, definition, objectives. Units of measurement. Measurement of single tree - standard rules governing measurement at breast height. Measurement of tree diameter and girth, rulers, callipers and tapes. Bark measurements - objectives, thickness. Tree measurement instruments. Height measurements - direct and indirect methods. Height measurement employing geometric and trigonometric principles, height measuring instruments. Measurement of cross sectional area, basal 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, merchantable volume tables. 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, advantages, kinds of sampling, random sampling: (simple, stratified, multistage and multiphase sampling).

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. Rotation, Normal forest, Evenaged and unevenaged models. Yield regulation – general principles of even aged and unevenaged forest crop. Working Plan. Forest Policy- National Forest Policies. Forest Law: legal definition. Objects of special forest law. Indian Forest Act. Detailed study of IFA, 1927.

Principles of Cytology and Genetics

Physical basis of heredity, cell reproduction – mitosis - meiosis and its significance. Mendel's principles of heredity, deviation from Mendelian inheritance, pleiotropy, threshold characters, co-dominance, penetrance and expressivity. Chromosome theory of inheritance, gene interaction.

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. 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. Seed certification procedures in tree.

Silviculture of Indian Trees

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems and economic importance, *Cedrus deodara*, *Pinus roxburghii*, *Pinus wallichiana*, *Tectona grandis*, *Shorea robusta*, *Dalbergia sissoo*, *Eucalyptus spp.*, *Terminalia spp.*, *Santalum album*, *Pterocarpus santalinus*, *Diospyros melanoxylon*.

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 and non-essential oils. Gums and resins –definition, classification, sources, collection and uses. Resins and Oleoresins. Beedi leaves – sources, collection and processing.. Katha and Cutch – sources, extraction and uses. Spices, poisons.

Agroforestry System and Management

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. Analysis of fodder and fuel characteristics of tree/shrubs. Financial and socio-economic analysis of agroforestry systems.

Medicinal and Aromatic Plants

Opportunities and constraints in the cultivation and utilization of medicinal and aromatic plants in India. Importance, production, climatic and soil requirements, propagation and nursery techniques, nutritional and water requirements. Plant protection, harvesting, processing and economics of under mentioned important medicinal and aromatic plants. Medicinal Plants ginger, turmeric, *Rauvolfia*, isabgol. Aromatic Plants: *Citronella* grass, khus grass, *Mentha*, muskdana (musk mallow), *Ocimum*. Endangered medicinal and aromatic plants of India and their conservation.

Nursery Management

Propagation concept. Site selection, planning and layout of nursery area. Methods of seed sowing. pricking. watering methods, weeding, hoeing, fertilization, shading, root culturing techniques, lifting windows, grading, packaging. Vegetative propagation techniques. Study of important nursery pests and diseases and their control measures. Nursery practices for important tree species.

Forest Pathology

History and importance of forest pathology in India and the world, Classification of tree diseases. 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 Aphyllophoraeae and Agaricaceae that contain members causing tree diseases. 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. Definition and scope of disease management in forestry. Principles of disease management such as exclusion, cultural, chemical, biological and immunization. Nursery diseases of important forest species.

Forest Entomology

Taxonomic classification of class Insecta, diagnostic characters of the orders and major families of economic importance. Methods and principles of pest control. Principles and

techniques of Integrated Pest Management in forests. Classification of forest pests. Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest.

Principles of Plant Physiology

Photosynthesis, Structure and function of chloroplast, dark and light reactions, CO₂ fixation - C₃, C₄ and CAM plants, photorespiration, Respiration, Stomata, structure, distribution, guttation, transpiration, Photohormones, physiological role in controlling plant process. Environmental stimuli for plant development.

Tree Physiology: Tree structure, growth, development, differentiation and reproduction. Plant growth functions and growth kinetics, Physiological functions and processes in trees. Environmental effects on growth and development. Productivity of tropical deciduous and evergreen forests. Light use efficiency in forest species, canopy structure, plant phyllotaxis and its importance in translocation. Plant light relationship environment. Branching in isolated plants. Monoculture and mixed tree communities. LAI, Photosynthetic efficiency and respiratory losses, Factors affecting photosynthesis. Radiation interception, absorption of water, ascent of sap and water balance. Transport processes with special reference to long distance transport in trees and its impact on plant water relations and photosynthesis. Development of seeds and seedlings. Biocides and growth regulators in forest ecosystems. Senescence and abscission. Role of trees in pollution control.

Plantation Forestry

Definition, scope and impediments. Plantation forests - planting plan, plantation records, maps. 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. Intercultural operations. Effects of tending operations. Energy and industrial plantation - definition, scope, species, establishment, management and impact on environment. Site selection and site preparation. Use of fertilizers, weedicides for plantation management.

Introductory Botany

Introduction to Botany and general classification of plants. Parts of a typical flowering plant. Morphology of root, stem, leaf and flower. Structure and types of plant tissues. Internal structure of Dicot and Monocot Stems, Roots and a typical Leaf. Significance of life cycle, Pinus and a flowering plant.

Ethnobotany: Terms employed in relation to ethnobotany. 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. Mythology mainly from the following families, Malvaceae, Fabaceae, Mimosaceae, Palmaceae, Santalaceae.

Dendrology

Systems of classification of plants. Bentham and Hooker's, Engler and Prantles, and Hutchinson's Systems. Principles and International Code of Botanical Nomenclature. Peculiarities of tree stems, twigs, Morphology and description of barks of common trees. Morphology of leaf. Reproductive morphology of plants with reference to description and

identification of reproductive parts. Study of families, Sapotaceae, Caesalpiniaceae, Santalaceae, Mimosaceae, Papilionaceae, Meliaceae, Compositae, Liliaceae, Euphorbiaceae, and Combretaceae. Important Indian trees, native trees, exotic trees, endemism, allelopathy with respect to forest trees.

Wood Science

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 Wood preservation, Classification of timbers based on durability. 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. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

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. Physical properties of wood. Abnormalities in wood — deviation from typical growth form (leaning, bending, crook, fork, buttress), grain deviation, false and discontinuous growth rings.

Wood Products and Utilization: Pulp and paper industry. Introduction and raw material; pulping-mechanical, chemical, semichemical and semi-mechanical; 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. Impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood). Destructive distillation of wood. Production of wood molasses, alcohol and yeast.

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. Transport by road and railways. Transport by water. 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 test 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.

Soil Survey, Remote Sensing and Wasteland Development

Soil survey, sampling methods, landuse classes and planning. Aerial photography and remote sensing-definition, meaning, scope, merits and brief history. Photogrammetry: Vertical and oblique photography. Agencies involved in remote sensing. 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. Imagery and image analysis. Geographic Information systems. Salt affected soils, lateritic, marsh and swampy and rocky hills, rocky plains, murrummy and sandy soils, their characteristics and reclamation. Eroded ravines and gullies, various techniques of afforestation of adverse sites, trees suitable for adverse sites. Afforestation and reclamation of mine wastes. Sewage water as source of tree nutrients.

Forest Ecology and Biodiversity

Forest environment- Major abiotic and biotic components and their interaction, trophic levels, food webs, ecological pyramids and energy flow. Ecological succession, Autecology of important tree species. Biodiversity and conservation. Principles of conservation biology, Ex situ and In situ methods of conservation.

World Forestry Systems

Geographical distribution of forests and their classification. 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. Recent trends in forestry development in the world. International forestry organizations.

Fundamentals of Wildlife

Justification of wildlife conservation, 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. Indian Board for wildlife, CITES. Biological basis of wildlife management. Wildlife ecology.

Wild Life Management

Wildlife management and conservation in India. Habitat management. Wildlife census: Purpose, techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities. Wildlife (Protection) Act, 1972. Sanctuary, National Park and Biosphere Reserves. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Wildlife corridors.

Rangeland Management

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.

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; compass surveying, chain and compass traversing, magnetic and true bearings, prismatic compass, local attraction. 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. 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.

Introductory Forest Economics

Concept and types of demand, laws of demand and factors affecting demand of commodities. Elasticity – its kinds, measurement and factors affecting it. Factors of production, their definition and characteristics, Law of diminishing marginal returns. Supply– definition, law and elasticity. Market – its classification and price determination under different market situation. Marginal Productivity theory, risk taking and uncertainty bearing theories of profit. Concept and types of inflation.

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.

Environmental Science

Components of environment - interactions with organisms. Global and Indian environment - past and present status. Smog, acid rain, global warming, ozone hole, eutrophication. Impact of different pollutions on humans, organisms and environment. India, international and voluntary agencies for environmental conservation - mandates and activities. International conferences, conventions and summits.

Fundamentals of Geology and Soil Science

Composition of earth's crust, 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. Physical parameters texture, specific gravity/bulk density-factors influencing-field bulk density. Pore space-definition, soil structure, Soil air. Chemical properties-soil colloids organic- humus. Soil organic matter decomposition-pH-nutrient availability-soil buffering capacity, soil water-forms-hygroscopic capillary.

Forest Tribology and Anthropology

Anthropology – definitions, nature and scope of Anthropology. Branches of Anthropology & methods of anthropological study, Concepts of Culture, Society, Community, Groups and Institutions. Social Institutions: Family – forms and functions, Marriage – forms and functions, Kinship – descent, residence. Meaning, definitions and characteristics of Tribes. Socio-cultural and socio-economic problems of tribes with special reference to indebtedness, land alienation, shifting cultivation, migration, depopulation, un-employment, impact of urbanization and industrialization, education and forest problems. Social and cultural change – its meaning and characteristics and difference between social & cultural change and recent changes among the tribals. Forest and Tribes – their relationship. Role of Tribals in Forest protection, development & conservation. The role of anthropology in tribal development.

Plant Biochemistry and Biotechnology

Classification- carbohydrates, lipids - physical and chemical properties of carbohydrates- isomerism, optical activity, reducing property, reaction with acids and alkalis-osazone formation. Chemistry of amino acids, peptides, proteins, nucleic acids- bases, sugars.

Agrometeorology

Agrometeorology-definition, aim and scope. Factors and elements of weather and climate. Air and soil temperature regimes, atmospheric humidity, Precipitation, hails and frost. Solar radiations-components and effect on plant growth. Effect of weather and climate on the growth and development of crops. Climatic normals for crops. Evaporation and transpiration. Use of remote sensing techniques in agrometeorology.

Chemistry and Fertility of Forest Soils

Soil exchange phenomenon. Essential nutrient elements, soil fertility evaluation methods. nutrient cycling in forest soils. Transformation-carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio-fertilizers. Nitrogen fixation. Microbial transformation of phosphorous, sulphur and micro nutrients. Mycorrhizae. Rhizosphere.

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, runoff, factors affecting runoff, stream flow. Sedimentation. 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. 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.

Elementary Statistics and Computer Application

Measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadriles, for raw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poisson and normal distributions,

sampling, basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t- tests, chi-square test for application of attributes.

Experimental Designs: Basic concepts, completely randomized design, randomized block design, latin square designs, factorial experiments, basic concepts, analysis of factorial experiments up to 3 factors.

Computer application: Introduction to computers and personal computers, basic concepts, operating system, DOS and Windows 95, introduction to programming languages, BASIC language, concepts, basic and programming techniques, MS Office, Win Word, Excel, Power Point, introduction to Multi-Media and its application. VISUAL BASIC-concepts, basic and programming techniques, introduction to Internet.

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. 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.

Fundamentals of Horticulture

Economic importance, area and production, principles, planning and layout, planting densities, nursery techniques and their management. Principles and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, fertility management, multi-tier cropping, factors influencing the fruitfulness and unfruitfulness., principles of organic farming.

Entrepreneurship Development and Communication Skills

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. 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; Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry.

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.

Syllabus for M.Tech (Agricultural Engineering) / MBA (ABM) Entrance
Examination (for students having B.Tech Degree)

Farm Machinery & Equipment

Introduction to farm mechanization. Classification of farm machines. Unit operations in crop production. Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery. Calculation of field capacities and field efficiency. Calculations for economics of machinery usage, comparison of ownership with hiring of machines. Introduction to seed-bed preparation and its classification. Familiarization with land reclamation and earth moving equipment. Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft of tillage tools and calculations for power requirement for the tillage machines. Introduction to tillage machines like mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators, Identification of major functional components. Attachments with tillage machinery. Introduction to sowing, planting and transplanting equipment. Introduction to seed drills, no-till drills, strip-till drills, planters, bed-planters and other planting equipment. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Adjustments during operation.

Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers and chemical application rates. Introduction to intercultural equipment. Use of weeders – manual and powered. Study of functional requirements of weeders and main components. Familiarization of fertilizer application equipment. Study of harvesting operation–harvesting methods, harvesting terminology. Study of mowers – types, constructional details, working and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern. Study of reapers, binders and windrowers – principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning, and calculation of moisture content of hay. Introduction to threshing systems–manual and mechanical systems. Types of threshing drums and their applications. Types of threshers–tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, study of combine troubles and troubleshooting. Study of chaff cutters and capacity calculations. Study of straw combines – working principle and constructional details. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers. Study of Cotton harvesting and its mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools.

Introduction to materials used in construction of farm machines. Heat treatment processes and their requirement in farm machines. Properties of materials used for critical and functional components of agricultural machines. Introduction to steels and alloys for agricultural application. Identification of heat treatment processes specially for the agricultural machinery components.

Tractor & Automotive Engines

Study of sources of farm power—conventional and non-conventional energy sources. Classification of tractors and IC engines. Review of thermodynamic principles of IC (CI & SI) engines and deviation from ideal cycle. General energy equation and heat balance sheet. Study of mechanical, thermal and volumetric efficiencies. Study of engine components their construction, operating principles and functions. Study of engine strokes and comparison of 2-stroke and 4-stroke engine cycles and CI and SI engines. Study of Engine Valve systems, valve mechanism, Valve timing diagram, and valve clearance adjustment Study of Cam profile, valve lift and valve opening area. Study of importance of air cleaning system. Study of types of air cleaners and performance characteristics of various air cleaners. Study of fuel supply system. Study of fuels, properties of fuels, calculation of air-fuel ratio. Study of tests on fuel for SI and CI engines. Study of detonation and knocking in IC engines. Study of carburetion system, carburetors and their main functional components. Study of fuel injection system – Injection pump, their types, working principles. Fuel injector nozzles – their types and working principle. Engine governing – need of governors, governor types and governor characteristics. Study of lubrication system – need, types, functional components. Study of lubricants – physical properties, additives and their application. Engine cooling system – need, cooling methods and main functional components. Study of need and type of thermostat valves. Additives in the coolant. Study of radiator efficiency. Study of ignition system of SI engines. Study of electrical system including battery, starting motor, battery charging, cut-out, etc. Comparison of dynamo and alternator. Familiarization with the basics of engine testing

Tractor Systems & Control

Study of need for transmission system in a tractor. Transmission system – types, major functional systems. Study of clutch – need, types, functional requirements, construction and principle of operation. Familiarization with single plate, multi-plate, centrifugal and dual clutch systems. Study of Gear Box – Gearing theory, principle of operation, gear box types, functional requirements, and calculation for speed ratio. Study of differential system – need, functional components, construction, calculation for speed reduction. Study of need for a final drive. Study of Brake system – types, principle of operation, construction, calculation for braking torque. Study of steering system – requirements, steering geometry characteristics, functional components, calculation for turning radius. Familiarization with Ackerman steering. Steering systems in track type tractors. Study of Hydraulic system in a tractor – Principle of operation, types, main functional components, functional requirements. Familiarization with the Hydraulic system adjustments and ADDC. Study of tractor power outlets – PTO. PTO standards, types and functional requirements. Introduction to traction and its related terminology. Theoretical calculation of shear force and rolling resistance on traction device. Study of wheels and tyres – Solid tyres and pneumatic tyres, tyre construction and tyre specifications. Study of traction aids. Study of tractor mechanics – forces acting on the tractor. Determination of CG of a tractor. Determination and importance of moment of inertia of a tractor. Study of tractor static equilibrium, tractor stability especially at turns. Determination of maximum drawbar pull. Familiarization with tractor as a spring-mass system. Ergonomic considerations and operational safety. Introduction to tractor testing. Deciphering the engine test codes.

Familiarization with different makes and models of agricultural tractors. Identification of functional systems including fuels system, cooling system, transmission system, steering and hydraulic systems. Study of maintenance points to be checked before starting a tractor.

Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Driving practice of tractor. Practice of operating a tillage tool (mould-board plough/ disc plough) and their adjustment in the field. Study of field patterns while operating a tillage implement. Hitching & De-hitching of mounted and trail type implement to the tractor. Driving practice with a trail type trolley – forward and in reverse direction. Introduction to tractor maintenance – precautionary and break-down maintenance. Tractor starting with low battery charge. Introduction to trouble shooting in tractors. Familiarization with tools for general and special maintenance. Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety hints. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance of implements – adjustment of functional parameters in tillage implements. Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators. Maintenance of cutter bar in a reaper. Adjustments in a thresher for different crops. Replacement of V-belts on implements. Setting of agricultural machinery workshop.

Renewable Energy Sources

Concept and limitation of Renewable Energy Sources (RES), Criteria for assessing the potential of RES, Classification of RES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of renewable energy sources with non renewable sources. Solar Energy: Energy available from Sun, Solar radiation data, solar energy conversion into heat through, Flat plate and Concentrating collectors, different solar thermal devices, Principle of natural and forced convection drying system, Solar Photo voltaics: p-n junctions. Solar cells, PV systems, stand alone, Grid connected solar power station, Calculation of energy through photovoltaic power generation and cost economics. Wind Energy: Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Types of Windmill rotors, Determination of torque coefficient, Induction type generators, working principle of wind power plant. Bio-energy: Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Types of gasifier, various types of biomass cook stoves for rural energy needs. Fermentation processes and its general requirements, an overview of aerobic and anaerobic fermentation processes and their industrial application. Biogas: types of biogas plants, biogas generation, factors affecting biogas generation and usages, design consideration, advantages and disadvantages of biogas spent slurry. Biogas technology and mechanisms, generation of power from biogas, Power generation from urban, municipal and industrial waste. Design & use of different commercial sized biogas plant. Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization. Solar thermal and photovoltaic Systems for power generation. Central receiver (Chimney) and distributed type solar power plant, OTEC, MHD, hydrogen and fuel cell technology. Wind farms. Aero-generators. Wind power generation system. Power generation from biomass (gasification & Dendro thermal), Mini and micro small hydel plants. Fuel cells and its associated parameters. Chemistry of gasification. Gas producer – type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Application, shaft power generation, thermal application and economics. Trans-esterification for biodiesel production. A range of bio-hydrogen production routes. Environmental aspect of bio-energy, assessment of greenhouse gas mitigation potential.

Mechanics of Tillage & Traction

Introduction to mechanics of tillage tools, engineering properties of soil, principles and concepts, stress strain relationship, design of tillage tools principles of soil cutting, design equation, force analysis, application of dimensional analysis in soil dynamics and traction prediction equation. Introduction to traction and mechanics, off road traction and mobility, traction model, traction improvement, tyre size, tyre lug geometry and their effects, tyre testing, soil compaction and plant growth, variability and application of GIS in soil dynamics.

Human Engineering & Safety

Human factors in system development – concept of systems; basic processes in system development, performance reliability, human performance. Information input process, visual displays, major types and use of displays, auditory and factual displays. Speech communications. Biomechanics of motion, types of movements, Range of movements, strength and endurance, speed and accuracy, human control of systems. Human motor activities, controls, tools and related devices. Anthropometry: arrangement and utilization of work space, atmospheric conditions, heat exchange process and performance, air pollution. Dangerous machine (Regulation) act, Rehabilitation and compensation to accident victims, Safety gadgets for spraying, threshing, Chaff cutting and tractor and trailer operation etc.

Thermodynamics, laws of thermodynamics, Otto & diesel cycles. Equilibrium of forces. Frictional forces. Machine Elements. Determining velocity ratio, Drives, Bearings. Methods of projection. CAD. Design considerations of Agricultural Machines. Materials. Loads and stresses. Workshop tools and machines. Farm mechanization. Field capacities. Tillage; Tillage equipments. Forces acting on tillage tools. Draft measurement: Earth moving machinery. Sowing, planting, transplanting, Fertilizer application, Weed control and Plant protection equipments. Harvesting machineries. Threshers, combines. Testing of farm machines. Cost analysis of machinery. Selection of machinery. Sources of farm power. Tractors and IC engines. Engine components. & systems. Fuels & combustion, detonation and knocking, lubricants, Tractor & machine maintenance, Systems of Tractor.

Irrigation & Drainage

Surveying classification and basic principles, Linear measurements. Chain surveying. Compass survey, Plane table surveying. Leveling, Contouring, Computation of area and volume. Theodolite traversing. Introduction to setting of curves. Major and medium irrigation schemes of India, purpose of irrigation, sources of irrigation water, Measurement of irrigation water, water conveyance, design of irrigation field channels, underground pipe conveyance system, irrigation structures, soil water plant relationship, soil water movement, infiltration, evapo-transpiration, soil moisture constants, , irrigation efficiencies, methods of water application, border, check basin, furrow and contour irrigation; sprinkler and drip irrigation method, merits, demerits, selection and design; Participatory irrigation management. Economics of water resources utilization. Surface drainage, design of open channel, sub-surface drainage, investigations of design parameters, hydraulic conductivity, drainable porosity, water table, Design of surface drains, interceptor and relief drains. Design of subsurface drainage system. Vertical drainage. Bio-drainage. Salt balance, reclamation of saline and alkaline soils. Conjunctive use of fresh and saline waters. Economic aspects of drainage.

Fluid Mechanics

Properties of fluids: Ideal and real fluid. Pressure and its measurement, Pascal's law, pressure forces on plane, centre of pressure, buoyancy, metacentre and metacentric height, Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Bernoulli's theorem, venturimeter, orifice-meter and nozzle. Laminar and turbulent flow in pipes, general equation for head loss-Darcy, Equation, Moody's diagram, Minor and major hydraulic losses through pipes and fittings, hydraulic gradient and energy gradient. Dimensional analysis and similitude: Rayleigh's method and Buckingham's 'Pi' theorem.

Soil Erosion

Soil erosion - causes, types and agents of soil erosion; soil loss estimation - universal soil loss equation and modified soil loss equation, determination of their various parameters; erosion control measures – agronomical measures- mechanical measures. Gully control, factors affecting wind erosion, mechanics of wind erosion, soil loss estimation, wind erosion control measures, sedimentation - sedimentation in reservoirs and streams, estimation and measurement, land use capability classification; grassed water ways and their design; introduction to water harvesting techniques; introduction to stream water quality and pollution.

Soil Conservation Structures & Soil Mechanics

Functional requirements of soil erosion control structures; flow in open channels- types of flow, state of flow, regimes of flow, energy and momentum principles, specific energy and specific force, runoff measuring structures-parshall flume, H - flume and weirs; straight drop spillway, hydrologic and hydraulic design, structural design, design of diversions; small earth embankments-their types and design principles, farm ponds and reservoirs, cost estimation of structures. Introduction of soil mechanics, Soil classification based on particles size, textural classification. Shear strength mohr stress circle, Numerical exercise based on various types of tests. Compaction composition of soils standard and modified protector test. Consolidation of soil: Earth pressure: Plastic equilibrium in soils, active and passive states.

Ground Water Hydrology

Occurrence and movement of ground water, aquifer and its types, classification of wells, steady and transient flow into partially, fully and non-penetrating and open wells, design of open well, groundwater exploration techniques, methods of drilling of wells, groundwater hydraulics-determination of aquifer parameters by different method such as Theis, Jacob and Chow's etc. Theis recovery method, well interference, multiple well systems, surface and subsurface exploitation and estimation of ground water potential, quality of ground water, artificial groundwater recharge planning, modeling, ground water project formulation. Pumping Systems: Water lifting devices; different types of pumping machinery, classification of pumps, design of centrifugal pumps, hydraulic ram, propeller pumps, mixed flow pumps, deep well turbine pump and submersible pump. Remote Sensing: Definition, stage in remote sensing, modern remote sensing technology versus conventional aerial photography;

Operations-1

Principal of size reduction, size reduction machines; – Rittinger's, Kick's and Bond's equation, fineness modulus. Theory of separation, sieve analysis, effectiveness of screens, pneumatic separation. Study of different types of material handling systems; belt, chain and screw conveyor, bucket elevator, gravity conveyor, capacity and power requirement. Modes of heat transfer, thermal conductivity of materials. Heat transfer coefficient in convection. Combined free and forced convection. Introduction. Kirchoff's law, solid angle, intensity of radiation. Radiation exchange. Types of heat exchangers, fouling factor, log mean temperature difference. Flick's law, mass transfer coefficients. Reynold's analogy.

Operations-2

Unit operation of various dairy and food processing systems, pasteurization sterilization, homogenization,. Physical, chemical and biological methods of food preservation, Moisture content and methods for determination, importance of EMC and methods of its determination, principle of drying, mechanism of drying- falling rate, constant rate, thin layer, deep bed and their analysis, critical moisture content, functional requirements of storage, control of temperature and relative humidity inside storage, calculation of refrigeration load; modified atmospheric storage and control of its environment, air movement inside the storage, storage of grains: destructive agents, respiration of grains, moisture and temperature changes in stored grains; artificial drying, grain storage structures such as Bukhari, Morai, Kothar, silo, CAP.

Refrigeration, Air-conditioning & Packaging

Principles of refrigeration, second law of thermodynamics applied to refrigeration, Carnot cycle, reversed Carnot cycle, coefficient of performance, unit of refrigeration, types of refrigeration system, mechanical vapour compression, vapour absorption system, components of mechanical refrigeration, refrigerant, desirable properties of ideal refrigerant, ultra low temperature refrigeration, cold storages, insulation material. Thermodynamic properties of moist air, adiabatic saturation process, wet bulb temperature and its measurement, psychometric chart and its use, elementary psychometric process. Factors affecting shelf life of food material during storage; spoilage mechanism during storage; definition, requirement, importance and scope of packaging of foods. Different types of packaging materials used. Different forms of packaging, metal container, glass container, plastic container, flexible films, shrink packaging, vacuum & gas packaging. Packaging requirement & their selection for the raw & processed foods. Advantages & disadvantages of these packaging material. Printing, labeling and lamination. Economics of packaging, their merits and demerits.

Renewable Energy

Classification of energy sources; Introduction to renewable energy sources; characterization of biomass; types, construction, working principle, uses and safety/ environmental aspects of different renewable energy devices like gasifiers, biogas plants, solar passive heating devices, photovoltaic cells and arrays; Brief introduction to wind energy, hydroelectric energy, briquetting and baling of biomass, biomass combustion, biodiesel preparation and energy conservation in agriculture.

Engineering Properties of Biological Materials and Food Quality

Characteristics of biological materials like shape, size, volume, density, roundness,

sphericity, surface area, specific heat, thermal conductivity, thermal diffusivity, etc. measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition. Rheological characteristics like stress, strain time effects, rheological models and their equations. Aerodynamic characteristics and frictional properties. Application of engineering properties in handling processing machines and storage structures. Methods of quality control, sampling; purpose, sampling techniques, requirements and sampling procedures for liquid, powdered and granular materials, sensory quality control, TQM and TQC, consumer preferences and acceptance, GMP, HACCP (Hazard analysis and critical control point) and ISO 9000 Series.

Mathematics

Matrices, Eigen values. Fourier series. Gradient. Divergence and Curl. Stokes, Gauss and Green's theorems. Laplace transforms. Integration of trapezoidal and Simpson's rule.