## Syllabus for Entrance Examination for Admission to Master’s /PhD Programmes likely to be conducted from 2014-15

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

Agronomy

General: Basic principles of crop production; cultivation of rice, wheat, chickpea, pigeon-pea, sugarcane, groundnut, rapeseed mustard and potato.


Field crops: Origin, distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of cereals (rice, wheat, maize, sorghum, pearl millet, minor millets, barley), pulses (chickpea, lentil, peas, pigeon pea, mungbean, urdbean), oilseeds (groundnut, sesame, soybean, rapeseed & mustard, sunflower, safflower, linseed), fiber crops (cotton, jute, sunhemp), sugar crops (sugarcane), fodder & forage crops (sorghum, maize, napier, berseem, Lucerne, oats), and commercial crops (potato, tobacco). Weed management: Principles of weed management, classification, biology and ecology of weeds, crop weed competition and allelopathy, concepts and methods of weed control, integrated weed management, classification, formulations, selectivity 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, water and irrigation requirements, concepts and approaches of irrigation scheduling, methods of irrigation, measurement of irrigation water, application distribution and use efficiencies, conjunctive use of wheat, irrigation water quality and its management, water management in major field, crops (rice, wheat, maize, groundnut, sugarcane) Agricultural drainage.

Soil fertility and fertilizer use: Essential plant nutrients and their deficiency symptoms, concept of essentiality of plant nutrients, indicators of soil fertility and productivity, fertilizer materials and their availability to plants, slow release fertilizers, nitrification inhibitors, principles and methods of fertilizer application, integrated nutrient management, site specific nutrient management.


Sustainable land use systems: Sustainable agriculture: parameters and indicators, conservation agriculture, safe disposal of agri-industrial waste for crop production, Agro-
forestry systems, shifting cultivation, Alternate land use systems, Wastelands and their remediation for crop production.

**Agricultural Economics & Farm Management**

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, problem and reforms, role of capital and credit in agriculture, crop insurance, credit institutions, cooperatives, capital formation in agriculture, agrarian reforms, globalization, WTO & its impact on Indian agriculture.

Basic principles of farm management, concept of farming system and economics of farming systems, agricultural production economics-scope and analysis, factor-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. History of financing agriculture in India. Commercial banks, nationalization of commercial banks. Lead bank scheme, regional rural banks, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank, role of capital and credit in agriculture; credit institutions, co-operatives and agrarian reforms in India.

**Extension Education**

Extension Education-concept, meaning, principle, philosophy, scope and importance. Extension Programme Planning and evaluation-step and principle, models of organizing agricultural extension; 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 and social change. 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 teaching methods. Different kinds of communication methods and media and AV aids/materials. Media mix, Campaign, Cyber extension- internet, cybercafés, Kisan Call Centers, teleconferencing, agriculture journalism, diffusion and adoption of innovations, adopter categories, capacity building of extension personnel and farmers- training to farmers, women and rural youth.

**Entomology**

Crop Protection Principles in field and storage. Major insect pests and diseases of agricultural crops like rice, cotton, pulses, oilseed crops like groundnut, soybean and mustard, vegetables like tomato, Cole crops; fruit crops like mango and banana and their management principles.
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 their 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. Cultural, biological, insecticidal, quarantine, and regulatory aspects; insecticide classification and insecticide resistance management; and insect protective transgenic crops

Plant Breeding & Genetics

Structure and function of cell organelles; mitosis and meiosis; Mendelian genetics; structure and functions of nucleic acids, Characteristics of prokaryotic and eukaryotic organisms, physical and chemical basis of heredity; chromosome structure; genes/operon concept; protein biosynthesis; transformation, recombination, Heterosis; elements of economic botany, Seed germination and dormancy; pollination/fertilization in flowering plant; methods of seed testing; breeders, foundation and certified seeds; seed production in self and cross pollinated crops, DUS testing & PPV & FR.

Plant Pathology


Major diseases of rice, wheat, sugarcane, red gram, cotton, potato, chilli, onion and cucurbits.

Sterilization, disinfection and pasteurization; Koch’s postulates; History of Microbiology, Protection against infections. Characteristics of prokaryotic and eukaryotic organism, differences between fungi, bacteria, mycoplasma and viruses; Bacteriophages, viroids and prions.

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 partials-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, 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-properties, structure of silicate clay minerals, sources of negative charges, properties, kaolinite, illite,
montmorillonite and vermiculite clay minerals, milli-equivalent concept, cation exchange capacity, anion exchange capacity, buffering of soils. Problem soils- acid, saline, 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. Pesticides.


Horticulture

Importance & scope of horticulture. Climatic zones of horticulture crops. Orchard establishment including high density planting. Propagation methods & root stocks. Training & pruning methods, use of PGR. Production technology of fruit crops (Mango, Banana, Papaya, Ber, Apple, Guava, Citrus, Custard apple)


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, mycoplasms 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.


Food Science & Technology

General chemistry of food constituents, physical properties of foods, properties of conttoldal systems, gels and emulsions. Minerals in foods physicochemical changes in foods during processing and storage, functions of food nutrients, dietary allowances and nutritional requirements. Metabolism of carbohydrates. lipids and protein. Biological value and PER. Food additives. Contaminants and anti-nutritional factors, Food flavors and puff-flavors National and international food standards modern analytical techniques in food analysis.

Engineering properties of food materials. System analysis. mass and energy balance. Principles operations and equipment for food materials flow handling, clearing dehusking sorting and grading; peeling size reduction, mixing and forming, bakery foods manufacture, extrusion, separation, filtration and membrane. Processes expression baking roasting, frying, extraction and leaching crystallization distillation Blanching pasteurization, sterilization evaporation drying freezing packing heat exchange dairy specific operation. Process equipment design heat and mass transfer, equipment for steam generation compressed air, refrigeration and air conditioning, water and waste water treatment biochemical engineering

Preparation and manufacturing technology of cereals and bakery products, beef, pork, poultry, fish & sea foods and egg sausages and table ready meats, dairy products fresh fruits, fresh vegetables processed fruits processed vegetables. Post Harvest Handling and storage of Fruits and Vegetables, Sugars, sweets fats and oils, fermented foods. alcoholic and non-alcoholic beverages indigenous foods fast readymade and fashion foods. Dehydration and concentration methods, irradiation microwave and solar processing of foods, food by-products & downstream processing,. flavoring and pigment technology Judging of food products, food plant management and legal aspects. Food plant safety, risk and hazards. Effluent treatment and environment pollution waste solids upgrading and treatment food storage function of packaging, packaging operations types of containers, FFS, heretics closures, conning packing materials and package testing, transportation and marketing food products.

Role intrinsic and extrinsic properties of food in relation to microbial growth. Microbiology of fruits, fruit products, vegetables, soft drinks, bakery products, milk and milk products, milk, fish, egg and marine produces. Spoilage of foods, food pathogens and their toxins in relations in relation to human health. Food preservation by sugar salt, chemicals, heat, cold, irradiation, dehydration and packaging. Microbiology of fermented foods and beverages and factors affecting their quality. Methods for microbiological examination of foods, food hygiene and safety regulations. water quality and waste disposal in food industry.

Mathematics and Statistics

Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves. Measures of Central Tendency : Characteristics of ideal Average, Arithmetic Mean, Median, Mode, Merits and Demerits of Arithmetic Mean. Measures of Dispersion: Variance, Standard deviation, and Coefficient of Variation. Probability: Concept of probability and definition; Normal Distribution and its Properties. 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; Large sample Test : SND test for means, Single Sample an Two Samples (all types); Small Sample Test for means ; Students t-test for Single sample, Two Samples and paired t test, F test : Chi-Square Test in 2x2 Contingency Table, Yate’s correction for continuity. Correlation : Types of Correlation and identification through Scatter Diagram, Computation of Correlation coefficient ‘r’ and its testing. Linear Regression : Of Y on X and X on Y, inter-relation between ‘r’ and the Regression coefficients, fitting of regression equation. Experimental Designs : Basic Designs; Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis, Latin Square Design (LSD), Layout and analysis.

Introduction to Computers, Input and output Devices, Units of Memory. Hardware, Software and Classification of computers. Types of Processors. Booting of Computers, warm and cold booting, computer viruses, worms and Vaccines Operating System – DOS and DOS commands. Operating system WINDOWS and its elements. MS-WORD, features of word processing. Creating, Editing document in word MS-EXCEL-Electronic spreadsheet,

Plant Physiology


Seed dormancy, Storage physiology, Fruit ripening –Climacteric and non climacteric fruits. Hormonal regulation of fruit ripening with ethral, CCC, paleobuterozole and Polaris. Scope and importance of environmental studies. Multidisciplinary nature of environmental studies and need for public awareness. Natural resources and associated problems Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources Concept Structure and function of an ecosystem Producers, consumers and decomposers. Energy flow, Ecological succession. Food chain, food webs and ecological pyramids. Structure and function of the various ecosystem: Cropland ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem


**Syllabus for entrance exam for M.Sc (Ag.), M.Sc (Horti)/ MBA**

**For student having B.Sc (Horticulture Degree)**

**Horticulture**

Layout and establishment of orchards; pruning and training; propagation, climatic requirement and cultivation of fruits like mango, banana, citrus, guava, grape, pomegranate, ber, pineapple, papaya, sapota, pear, peach, jackfruit, avocado, Mangoesteen, litchi, Carambola, durian, passion fruit, almond, walnut, cherry, persimmon, strawberry, kivi, Queensland nut, Pecan nut, chestnut, apple, tamarind and plum; basic physiology of ripening in fruits and products, type of fruits and products, orchard management, role of growth regulators in fruit crops, nursery management, Post harvest Technology of major fruit Crops.

Cultivation of plantation crops like coconut and cashew nut, coffee, tea, oilpalm, cacao, arecanut, rubber etc. and spices; like black pepper, coriander, turmeric Cardamom, ginger, clove, nutmeg, cinnamon, all spice, curry leaf, coriander, fenugreek, fennel, cumin, dill, celery, bishops weed, saffron, vanilla, thyme and rosemary etc. Medicinal crops Safed Musli, Isabgoal, Opium, Chandrasoor, Ashwagandha, Kalmeg, Tulsi, Betelvine, periwinkle, Rauvolfia, Dioscorea, ammi majus, Belladonna, Cinchona, Pyrethrum etc., Aromatic Plants Citronella grass, khus grass, flag (baje), lavender, geranium, patchouli, bursera, musk, Ocimum etc.

Important physiological disorders; major vegetable crops of tropical, subtropical and temperate regions like cole crops (cauliflower, cabbage and knol khol, sprouting broccoli etc.), cucurbits (pumpkin, bottlegourd, bittergourd, luffa, muskmelon and watermelon, cucumber etc.), root crops (radish, tapioca, sweet potato and potato), leafy vegetables (fenugreek and spinach); solanaceous crops (tomato, chillies and brinjal); techniques for raising the nursery; nutritive value of fruits and vegetables and their role in human nutrition; basic physiology of ripening in vegetables and their products; type of vegetable products; protected cultivation of high value crops, Post harvest Technology of major vegetable Crops.

Major floricultural crops grown in India for commercial purposes like rose, carnation, chrysanthemum, marigold, tuberose, gladiolus, orchids; establishment and maintenance of lawns, trees, shrubs, creepers, hedges and annuals; type of gardens, Post harvest Technology of flower Crops. Gardens in India, type and style of gardens, principles and elements of landscape gardening, vase life for important cut flowers, dehydration of flowers,

Methods of crop improvement; male sterility and incompatibility; pure line and pedigree selection; backcross, mass selection and heterosis.
Plant health, plant nutrients, role and deficiency symptoms of nutrients, manures and fertilizers, systems of irrigation, important insect pests and diseases and their management in fruits, Plantation, Spices, vegetables, Medicinal, Aromatic and Ornamental crops.

Importance of horticulture in national and state economy; economics of horticultural crops, plant physiology; respiration, photosynthesis, transpiration, translocation, absorption of nutrients, methods of extension education, rural development programmes, methods of breeding and role of biotechnology in horticultural crops.
Forestry

UNIT- 1 Introductory Forest Economics

UNIT- 2 Principles of Cytology and Genetics

UNIT- 3 Principles of Plant Physiology

UNIT- 4 Fundamentals of Geology and Soil Science

UNIT- 5 Agrometeorology
UNIT- 6 Introductory Botany


UNIT- 7 Plant Biochemistry and Biotechnology

Classification-structures of glucose, fructose, ribose, maltose, lactose, starch and cellulose, physical and chemical properties of carbohydrates-isomerism, optical activity, reducing property, reaction with acids and alkali-osazone formation. Lipids classification

UNIT- 8 Tree Physiology


UNIT- 9 Principle and Practices of Silviculture


UNIT- 10 Dendrology

and Combretaceae. Important Indian trees, native trees, exotic trees, endemism, allelopathy with respect to forest trees.

UNIT- 11 Forest Ecology and Biodiversity

UNIT- 12 Chemistry and Fertility of Forest Soils

UNIT- 13 Principles of Hydrology, Soil and Water Conservation

UNIT- 14 Forest botany & 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.

UNIT- 15 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.

UNIT- 16 Wood Anatomy
properties of wood; colour, hardness, weight, texture, grain, lusture, etc. Abnormalities in wood — deviation from typical growth form (leaning, bending, crook, fork, buttress), grain deviation, false and discontinuous growth rings. Reaction wood-compression and tension wood. Disruption of continuity of inner wood, shakes, included bark, resin pockets, pith flecks, knots (live and dead).

UNIT- 17 Logging and Ergonomics

UNIT- 18 Soil Survey, Remote Sensing and Wasteland Development

UNIT- 19 Forest Mensuration
UNIT- 20 Principles of Tree Improvement

UNIT- 21 Tree Seed Technology
Introduction – Seed and its importance – afforestation activity and seed requirements in India and HP. Role of seed technology in nursery stock production. Production of quality seed, identification of seed collection areas-seed orchards – maintenance of genetic purity-isolation and roguing, seed source provenance and stands. Selection of seed tree, genotypic and phenotypic selection, plus tree – pure stands, elite seed tree, isolated tree and their location. Locality factors. Seed Collection – Planning and Organization, Collection methods, Factors affecting seed collection, Seed maturity and tests. Seed processing – Seed extraction, drying, blending, cleaning, grading, treating, bagging, labeling and storage. Storage – orthodox and recalcitrant seeds, precautions of handling of recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity – storage conditions, methods and containers. Seed testing, sampling, mixing and dividing, determination of genuineness, germination, moisture, purity, vigour, viability, seed dormancy and breaking of seed dormancy. Different viability and vigour tests, seed pelleting, seed health. Classes of tree seeds, certification procedures of tree seeds.

UNIT- 22 Forest Tribology and Anthropology

UNIT- 23 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 sloppy 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.

UNIT- 24 Livestock Management


UNIT- 25 Wood Science and Technology


UNIT- 26 Wood Products and Utilization

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

UNIT- 27 Silviculture of Indian Trees


UNIT- 28 Nursery Management

Propagation concept. Site selection, planning and layout of nursery area. Methods of seed sowing, prickling. 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 some important tree species.

UNIT- 29 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.

UNIT- 30 Fundamentals of Extension Education

UNIT- 31 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 Aphylllophoraeae and Agaricaeae 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, deodor, eucalyptus, bamboo, Casuaria, 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.

UNIT- 32 Forest Business Management
Forest / agro forest business
Importance nature, scope (input and product sector Forest Policies)

UNIT- 33 Forest business Management
Distinctive features, importance of good management Definition of management. Management functions - (1) Planning - Meaning, definition types of plan, characteristics of sound plan. Steps in planning. (2) Organization -definition, meaning importance (3) Staffing - means definition and importance (4) Directing, Motivation ordering Leading supervision, communication control.
UNIT- 34 Capital Management

UNIT- 35 Agro forest based and forest based industries
Definition, classification: importance and need types of agro forestry / forest business industries constraints in establishing forest / Agro forest product based industries

UNIT- 36 Marketing Management
Meaning: Definition, Marketing mix 4Ps of marketing mix, Market segmentation. Product life cycle marketing channels.

UNIT- 37 Agro forestry / forest product price policies
Definition, importance, need.
Project Meaning, Definition project cycle and concepts Types, Phases in project cycle - conception or identification, (ii) formulation or preparation (iii) Appraisal (iv) Implementation (v) monitoring, and, Evaluation - Appraisal and evaluation techniques - NPW, BCR,IRR sensitivity analysis, criteria for selection of Agro forest projects. Characteristics of forest / agro forest based projects, and constraints

UNIT- 38 Elementary Statistics and Computer Application
Measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, 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, poison 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 and test for goodness of fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, test of significance of correlation and regression coefficient. Experimental Designs: Basic concepts, completely randomized 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.

UNIT- 39 Rangeland Management
UNIT- 40 Silvicultural Systems

UNIT- 41 Plantation Forestry

UNIT- 42 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.

UNIT- 43 Wild Life Management

UNIT- 44 Principles of Forest Economics, Project Planning and Evaluation
UNIT- 45 Environmental Science


UNIT- 46 Forest Management, Policy and Legislation


UNIT- 47 Utilization of Non-Timber Forest Products


UNIT- 48 Agroforestry System and Management


UNIT- 49 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.
UNIT- 50 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.

UNIT- 51 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. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to forestry sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

UNIT- 52 Marketing and Trade of Forest Produce
Syllabus for M.Tech (Agricultural Engineering) / MBA Entrance Examination

UNIT 1

UNIT 2

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 - 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.
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.

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;

UNIT 3


UNIT 4

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.

UNIT 5

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, psychrometric 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.

UNIT 6
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.

UNIT 7
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.

UNIT 8
SYLLABUS FOR ENTRANCE EXAMINATION ADMISSION IN PH.D
AGRICULTURE. DEGREE PROGRAMME, 2014-15

Agronomy

Unit-1
Crop growth analysis in relation to environment; agro-ecological zones of India. Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit. Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield. Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

Unit-2
Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states. Water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; micro-irrigation system; fertigation; management of water in controlled environments and poly-houses. Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency. Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage.

Unit-3
Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use. Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems. Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture. Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Plant ideotypes for dryland; plant growth regulators and their role in sustainability.

Unit-5
Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry. Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers. Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides. Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.
Unit-6

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

Unit-7

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

Unit-8

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture. Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions. Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions. Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); anti-transpirants; soil and crop management techniques, seeding and efficient fertilizer use. Concept of watershed resource management, problems, approach and components.
Agricultural Economics

Unit-1

Unit-2

Unit-3

Unit-4

Unit-5
Agricultural marketing issues, and enhance expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities. Characteristic of Agricultural product and Production-Problems in Agricultural Marketing from Demand and Supply and Institutions sides. Market intermediaries and their role-Need

Unit-6

Unit-7

Unit-8

Unit-9
Role and Importance of Agricultural Finance. Financial Institutions and credit flow to rural/priority sector. Agricultural lending-Direct and Indirect Financing-Financing through
Entomology

UNIT – 1

External morphology of the insect’s body i.e., head, thorax and abdomen, their appendages and functions. Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation. Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites. Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications. Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemoreceptors). Structure, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands. Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause. Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.

UNIT – 2


UNIT – 3

Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions-
Basic factors governing the interspecific interactions- Classification of interspecific interactions – The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of niche, ecological homologues, competitive exclusion. Prey-predator interactions-

UNIT – 4
History and origin, scope and need for IPM, definition and evolution of various related terminologies. Concept and philosophy, ecological principles, economic threshold concept, and economic consideration. Tools of pest management and their integration-legislative, cultural, physical and mechanical methods; pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting: case studies of successful IPM programmes. History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation. Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects. Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation. Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

UNIT – 5
Definition and scope of insecticide toxicology; history of chemical control, Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrazoles, insect growth regulators, microbials, botanicals, new promising compounds, etc. Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity. Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence. Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

UNIT – 6
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors. Insect pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.). Insect pests of pulses, tobacco, oilseeds and their management.
Extension Education

UNIT-1

UNIT-2
Communication and communication process, Communication skills, fidelity of communication, communication competence and empathy, communication effectiveness and credibility. Methods of communication: Meaning and functions, classification. Forms and types of communication, organizational communication. Key communicators – Meaning, characteristics and their role. Agricultural Journalism, Techniques of writing scripts for Radio and TV.

UNIT-3
The adoption and Diffusion process, covert and overt processes at stages. Adopter categories and their rate of adoption, factors influencing rate of adoption. Diffusion effect and concept of over adoption, opinion leadership- measurement and Characteristics of opinion leaders, multi-step flow of innovation; concepts of homophile and heterophily.

UNIT-4

UNIT-5
ICTs- Concept, definition, tools and application in extension education. Reorganizing the extension efforts using ICTs, advantages, limitations and opportunities. ICTs projects, case studies in India and developing world. Different approaches (Models) to ICTs, ICT use in field of extension- Expert systems, Agricultural web sites and portals related crop production and marketing etc. Community Radio, Web, Tele, and Video Conferencing, Computer Aided Extension, Knowledge management, Information kiosks, Multimedia, Online, Offline Extension, Tools-Mobile technologies, e-learning concepts.

UNIT-6
Management, Planning and Decision making, Steps in DM Process, Meaning of Organization, Concept, Principles, Span of Management, Departmentalization, Authority and responsibility, Delegation and decentralization, line and staff relations, Coordination, Staffing, Training and Development and Direction, Supervision, Managerial Control, Budgeting, Observation, PERT and CPM, MIS.

UNIT 7

Plant Breeding & Genetics

UNIT –1

Beginning of genetics; Cell structure and cell division; Mendel's laws; Multiple alleles. Sex determination, sex-linkage, Sex-influenced and sex-limited traits; in eukaryotes, Somatic cell genetics, Extra chromosomal inheritance. Population Genetics; Hardy-Weinberg equilibrium. Structural and numerical changes in chromosomes; Central Dogma; Genetic fine structure analysis, Jumping gene theory; Overlapping genes, seudogenes, Oncogenes, Gene Regulationin Prokaryotes an eukaryotes; mutation; Bacterial plasmids, Molecular chaperones and gene expression. RNA editing. Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCR based cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro-RNAs (miRNAs).Genomics and proteomics; Metagenomics. Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts. Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioural genetics.

UNIT-2

Architecture of chromosome in prokaryotes and eukaryoties; Chromonemata, chromosome matrix, chromomereres, centromere, secondary constriction and telomere; artificial chromosome construction and its uses; Special types of chromosomes. Synapsis, structure and function of synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over-mechanisms and theories of crossing over- recombination models, cytological basis, - Variation in chromosome structure: Evolutionary significance – Introduction to techniques for karyotyping; Chromosome banding and painting – in situ hybridization and various applications. Utilization of aneuploids in gene location somatic segregation and chimeras – Endomitosis and somatic reduction ; Evolutionary significance of chromosomal aberrations – balanced lethal and chromosome complexes. Inter- varietal chromosome substitutions; Polyploidy and role of polyploids in crop breeding allopolyploids utilization in gene mapping and gene blocks transfer – Alien addition and substitution lines – creation and utilization; Apomixis Reversion of autopolyploids to diploids; Genome mapping in polyploids – Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica) Gene transfer using amphidiploids – Bridge species. Fertilization barriers in crop plants at pre- and post- fertilization levels- In vitro techniques to overcome the fertilization barriers in crops; of haploids, dihaploids and doubled haploids in genetics and breeding.

UNIT –3

History & objectives of plant breeding, patterns & characteristics of evolution of crop plants; centres of Origin-biodiversity; Genetic basis of breeding self- and cross - pollinated crops; components of variation; Heritability and genetic advance, genotype environment interaction; General and specific combining ability; gene actions and implications in plant breeding; Plant introduction and role of plant genetic resources in plant breeding. Self-incompatibility and male sterility; Pure line theory, pure line election and mass selection methods; Line breeding, pedigree, bulk, backcross, single seed descent and multiline method; Population breeding; Breeding methods in cross pollinated crops; Heterosis& Hybrid breeding ; seed production of hybrid and their parent arieties/inbreds. Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection. Self-incompatibility and male sterility; Concept of plant ideotype and its role in crop improvement; Transgressive breeding. Mutation breeding; Breeding for abiotic and biotic stresses. Cultivar development- testing, release and notification, maintenance breeding,
Participatory Plant Breeding, Plant breeders’ rights and regulations for plant variety protection and farmers rights.

UNIT 4
Mendelian traits vs polygenic traits; Multiple factor hypothesis - analysis of continuous variation; Variations associated with polygenic traits - phenotypic, Models of G X E; non-allelic interactions; Nature of gene action - additive, dominance, epistatic and linkage effects. ANOVA; MANOVA, biplot analysis; Experimental Designs; Genetic diversity analysis; D2 analyses; correlations; Path analysis and Parent - progeny regression analysis; Discriminant function and principal component analyses; Selection indices; Simultaneous selection models heritability and genetic advance. Generation mean analysis; Mating designs; Concepts of combining ability and gene action; adaptability and stability; Models for GxE analysis and stability parameters; AMMI analysis – principles and interpretation. QTL mapping; Marker assisted selection (MAS).

UNIT 5
Ultrastructure of the cell; eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles Bioenergetics; Ultrastructure and function of mitochondria and biological membranes; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Cell division and physiology of cell division. Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation – Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes – ribosomes, t-RNAs and translational factors. Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes – DNA content variation, types of DNA sequences; organelle genomes; Gene amplification and its significance; Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging.

UNIT 6
Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation. Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc.), mapping populations (F2s, back crosses, RILs, NILs and DH). Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding. Molecular breeding; Genomics and geno-informatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs. Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases. Biotechnology applications in male sterility/hybrid breeding, molecular farming. MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights.
UNIT-7
Variety Development and Maintenance; Definition- variety, cultivar, extant variety, essentially derived variety, independently derived variety, reference variety, farmers’ variety, hybrid and population; Variety testing, release and notification systems in India and abroad. DUS testing- Genetic purity concept and maintenance breeding. genetic deterioration of varieties - safeguards during seed production; Maintenance of varieties; Principles & methods of seed production; Generation system of seed multiplication -nucleus, breeders, foundation, certified, - Quality seed production technology; of self and cross-pollinated crop varieties viz. cereals & millets (wheat, barley, paddy, pearlmillet, sorghum, maize and ragi etc.); Pulses (greengram, blackgram, cowpea, pigeonpea, chickpea, fieldpea, lentil); Oilseeds (groundnut, soybean, sesame, castor, sunflower, safflower, linseed, rapeseed and mustard); fibres (cotton, jute) and forages (guar, forage sorghum, teosinte, oats, berseem, lucerne).; Seed certification procedures; Seed laws and plant variety protection regulations in India and international systems.
Plant Pathology

UNIT 1
Classification of fungi, economic mycology, edible fungi and entomogenous fungi mycorrhizal association, cell organelles, their morphology, functions and chemical composition.

UNIT 2

UNIT 3

UNIT 4
Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Genetics of resistance; ‘R’ genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. Disease management strategies.

UNIT 5
Pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of haemo-cytometer, micrometer, centrifuge, pH meter, camera lucida. Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

UNIT 6
Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens.
Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection. Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

**UNIT 7**


**UNIT 8**

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. Development of IDM- basic principles, biological, chemical and cultural disease management. IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed, mustard, pearl millet, kharif pulses, vegetable crops and fruit crops.
Soil Science & Agricultural Chemistry

UNIT-1

Chemical (elemental) composition of the earth’s crust and soils. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics. Soil colloids: inorganic and organic colloids – origin of charge, concept of point of zero-charge (PZC) surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter – fractionation of soil organic matter and different fractions, clay- organic interactions. Ion exchange processes in soil, cation exchange – theories based on law of mass action adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand exchange – innersphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, AEC, CEC; experimental methods to study ion exchange phenomena and practical implication in plant nutrition. Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation – dissolution equilibria; step and constant-rate K; management aspects. Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. Chemistry of salt-affected soils and amendments; soil pH, ECE, ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils.

UNIT – 2

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism. Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate mineral and their identification; clay minerals in Indian soils. Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformation; soil profile; weathering sequences of minerals with special reference to Indian soils. Concept of soil individual; soil classification system, soil mineralogy and soil maps – usefulness. Soil survey and its types; soil survey techniques – conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretation; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps. Landform – soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) – concepts and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

UNIT – 3

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interaction; un-cultururable soil biota. Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin activities and importance; soil characteristics influencing growth and activity of microflora. Microbial transformation of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients. Biodegradation of pesticides, organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the

UNIT – 4
Introduction and history of remote sensing; sources, propagation of radiations in atmosphere; interactions with matter. Sensor system – camera, microwave radiometers and scanners; fundamentals of aerial photographs and image processing and interpretations. Application of remote sensing techniques – land use soil surveys, crop stress and yield forecasting, prioritization in watershed and drought management, wasteland identification and management. Significance and sources of the spatial and temporal variability in soils; variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability. Introduction to GIS and its application for spatial and non – spatial soil and attributes.

UNIT – 5
Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage – basic concepts. Soil structure – genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting – mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation. Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil moisture characteristic curve; hysteresis, measurement of soil-moisture potential. Water flow in saturated and unsaturated soils, Poiseuille’s law, Darcy’s law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum. Composition of soil air; renewal of soil air – convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

UNIT – 6
Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants – their CPC standers and effect on plants, animals and humen beings. Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal. Pesticides – their classification, behavior in soil and effect on soil microorganisms. Toxic elements – their sources, behavior in soils, effect on nutrients availability, effect on plant and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases – carbon dioxide, methane and nitrous oxide. Remediation/amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

UNIT – 7
Soil fertility and soil productivity; nutrient sources; essential plant nutrients – functions and deficiency symptoms. Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation –
(Horticulture) Fruit Science

UNIT-1
Importance and management of tropical sub tropical temperate and dry land fruits grown in India. Commercial varieties of regional, national and international importance. Recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bio-regulators. Physiological disorders- causes and remedies, quality improvement by management practices; maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential. Agri. Export Zones (AEZ) and industrial supports. Crops Mango, Banana, Citrus, Papaya, Guava, Sapota, Jackfruit, Aonla, Pomegranate, Ber, Apple, Pear, Grapes, Plums, Peach, Nuts- walnut, Almond Minor fruits- Bael, Fig and Jamun.

UNIT-2

UNIT-3

UNIT-4
Principles and practices of breeding of fruit crops. Breeding systems, breeding objectives, approaches for crop improvement-introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses in the following selected fruit crops. Crops Mango, banana, citrus, grapes, guava, papaya.

UNIT-5
Principles and practices in canopy management of fruit crops. Canopy management-importance and advantages; factors affecting canopy development. Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Canopy management through plant growth inhibitors, training and pruning and management practices in temperate fruits, grapes, mango, guava, citrus and ber. Role of hormones in different horticultural crops- fruit thinning, fruit drop, ripening, dormancy breaking and propagation.
(Horticulture) Vegetable Science

UNIT-1
Production technology of vegetable crops. Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties / hybrids, sowing / planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures and seed production of vegetable crops like - solanaceous crops, root crops, bulb crops, cucurbitaceous crops, sweet potato, okra and leafy vegetables.

UNIT-2
Breeding methods (introduction, selection, hybridization, mutation) of vegetable crops. Resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics like - Potato, tomato, okra, peas, cabbage, cauliflower, carrot, radish, melons and pumpkins.

UNIT-3
Role of auxins, gibberellins, cytokinins and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

UNIT-4
Genetical and agronomical principles of seed production; methods of seed production; use of growth regulators and chemicals in vegetable seed production, methods of hybrid seed production. Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control. Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, cole crops, bulb crops, okra and leafy vegetables.

UNIT-5
Production technology of underutilized vegetable crops. Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties / hybrids, sowing / planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and production of: Asparagus, Elephant foot yam, lima bean, Sweet gourd, spine gourd and pointed gourd.

UNIT-6
Biotechnology

UNIT 1

History, scope and importance; DNA structure, function and metabolism. DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications. Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics. General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

UNIT 2

Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA. Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms. Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases. Translation and post-translational modifications; Operon concept; Attenuation of trp operon; important features of gene regulation in eukaryotes.

UNIT 3

General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions. Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes. Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc. Organellar genomes and their manipulation; Ribosomes in relation to cell growth and division; Cyto-skeletal elements. Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

UNIT 4

History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; In vitro differentiation: organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on in vitro culture and regeneration; Molecular basis of plant organ differentiation. Micropropagation; Anther and microspore culture; Somaclonal variation; In vitro mutagenesis; In vitro fertilization; In vitro germplasm conservation; Production of secondary metabolites; Synthetic seeds. Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc. Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

UNIT 5

Introduction, scope and historical developments; Isolation, screening and genetic improvement (involving classical approaches) of industrially important organisms. Primary metabolism products, production of industrial ethanol as a case study; Secondary
metabolites, bacterial antibiotics and non ribosomal peptide antibiotics; Recombinant DNA technologies for microbial processes; Strategies for development of industrial microbial strains with scale up production capacities; Metabolic pathway engineering of microbes for production of novel product for industry. Microbial enzymes, role in various industrial processes, production of fine chemicals for pharmaceutical industries; Biotransformations, Bio-augmentation with production of vitamin C as a case study; Bioreactors, their design and types; immobilized enzymes based bioreactors; Microencapsulation technologies for immobilization of microbial enzymes. Industrial biotechnology for pollution control, treatment of industrial and other wastes, biomass production involving single cell protein; Bio-remediation of soil; Production of eco-friendly agricultural chemicals, bio-pesticides, bio-herbicides, bio-fertilizers, bio-fuels, etc.

UNIT 6

Principles of plant breeding; Breeding methods for self and cross pollinated crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding. Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits. QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding. Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding; MAS for specific traits with examples.
Plant Physiology

UNIT 1

UNIT 2
Plant Biodiversity, evolution in plants. General Aspects – Plant growth and development; Analysis of plant growth. Mobilization of food reserves during seed germination; Hormonal control of seed germination and seedling growth. Shoot, Leaf and Root Development –Floral Induction and Development – Photoperiodism and Vernalization, Molecular genetics of floral development and floral organ differentiation; Sex determination. Seed Development and Dormancy – Molecular and genetic determinants; Seed maturation and dormancy. Senescence and Programmed Cell Death (PCD) – PCD in the life cycle of plants. Light Control of Plant Development. Phytochromes and cryptochromes, Molecular mechanisms of light perception, signal transduction and gene regulation; Biological clocks Embryonic Pattern Formation –Maternal, Zygotic and Homeotic gene effects in Drosophila; Embryogenesis and early pattern formation in plants. Regeneration and totipotency; Organ differentiation and development; Pollen germination and pollen tube guidance; Phloem differentiation; Sex determination in plants. Self-incompatibility and its genetic control; Heterosis and apomixis.

UNIT 3

UNIT 4
Definition and classification of plant growth regulators- Hormones, endogenous growth substances and synthetic chemicals Site of synthesis, biosynthetic pathways and metabolism and the influence on plant growth development of individual group of hormones- Auxins, Gibberlins, cytokinins, Abscisic acid and Ethylene Brassinosteroids. Hormone

UNIT 5

UNIT 6

UNIT 7
photo oxidation, excitation energy dissipation mechanisms, photochemical and no-
photochemical quenching of chlorophyll fluorescence. Photosynthesis and transpiration
interaction, significance of WUE, carbon isotope discrimination concept. Nitrogen
assimilation in photosynthesizing cells – NO$_3$ -NO$_2$ - reduction, GS-GOGAT pathway.
Photorespiration loss of Ammonia and its re-assimilation and NUE.
SYLLABUS FOR ENTRANCE EXAMINATION ADMISSION IN Ph.D FORESTRY DEGREE PROGRAMME, 2014-15

Forestry

SILVICULTURE

Forest ecosystem concept, stand dynamics-forest succession, competition and tolerance, classification of world’s forest vegetation. Productivity and vegetation forms of India, forest composition and structure. Ecophysiology of tree growth, effect of radiation & water relationship, mineral nutrients and temperature. Natural regeneration of species and types including unevenaged silviculture. Intermediate treatments

FOREST BIOMETRY


FOREST MANAGEMENT

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

FORESTS AND PEOPLE

Forests and its importance, forest societies, interactions between forests and people, importance of forests in traditional farming systems, livestock economy and forests, social and cultural factors of forest management, man in ecosystem in relation to eco-philosophy. Afforestation programmes and forest conflicts, wildlife and human conflicts, important forest movements like Chipka Movement, Gender dimension of forest management, tribal economy and forests. Pastoralists and their dependence on forests. Forests and economic security of tribals. Management of Commons and Common Property Resources (CPRs) and open access resources, forest management and sustainable livelihood strategies, forests and food security, eco-tourism and local development, land use change and forestry. Forest rights, customary rights of people, community participation, biodiversity and ethnobotany, Joint Forest Management, global environmental change and land use; dams, forests and resettlement of tribals and non-tribals - case study, poverty alleviation and forests, tourism and forest management, role of NGOs and other CBOs community based organization in forest management.

GENERAL STATISTICAL METHODS & RESEARCH METHODOLOGY

Introductory: Statistics scales of measurement, concept of graphical, exploratory and inferential data analysis, important variables of forestry sector. Probability and probability distributions: Review of probability theory, concept of random variable and expectation, probability distributions (Binomial, Poisson, Normal, Weibull). Correlation and regression: Simple, Rank, Partial, Multiple, Infraclass correlations, Furnivall Index and coefficient of determination. Linear and nonlinear regressions, parabolic, exponential, power and logarithmic functions Estimation and Testing of Hypotheses, Concept of point and interval estimation, estimators and estimates, properties of good estimators –
un-biasedness and minimum variance, tests of significance - t, F, z, and $\chi^2$, testing significance of correlation and regression coefficients, analysis of variance (ANOVA) - one way and two way classification with single and more than one cell frequency.


AGROFORESTRY SYSTEMS
Agroforestry objectives, importance, potential and impediments in implementation. Land capability classification and land evaluation. Overview of global agro-forestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, shelter-belts and windbreaks, energy plantations and homestead gardens. Production potential of different silvi-pasture system. Concepts of community forestry and social forestry, linear strip plantations. Diagnosis and Design - Trends in Agroforestry systems research and development.

SOIL AND WATER MANAGEMENT IN AGROFORESTRY

SEED COLLECTION, STORAGE AND TESTING

MODERN NURSERY TECHNOLOGY
Introduction and importance of nursery. Types of nurseries. Bare root, containerized and vegetatively produced nursery. Bare root nursery- nursery soil and water management, bed preparation, pre-sowing seed treatments, seed sowing and intermediate operations viz., pricking, watering, fertilization, weeding and hoeing. Physiology and nursery environment interaction affecting seedling growth. Root culturing techniques. Lifting windows, grading, packaging and storing and out-planting. Containerized nursery - Type and size of container including root trainers, selection of growing medium. Types of green

FOREST PRODUCTS - CHEMISTRY AND INDUSTRIES

FOREST POLICY AND LAWS AND INTERNATIONAL CONVENTIONS

TREE IMPROVEMENT


FOREST PROTECTION
Important diseases and insect pests of nurseries, farm forestry, plantations, avenue trees and their management. Assessment of losses due to diseases, insect pests, vertebrate pests, adverse weather, forest fires and weeds. Insect pests and mycoflora of seeds of forest trees and their management. Biodegradation of wood - microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration. Heart rots - factors affecting heart rots, damage caused, compartmentalization of decay in trees and management of heart rots. Role of mycorrhiza in tree health.
Theories of natural regulation of insect populations. Wildlife damage in nurseries, plantations and their management. Weed problems in nurseries, plantations and their control. Adverse climatic factors, acid rains and air pollutants in relation to forest tree health. Biological control of insect pests and diseases of forest trees. Molecular tools for developing disease resistance trees.

REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM
The use of aerial photography, satellite imagery and geographic information system for the collection, storage and spatial analysis for geo-referenced forest resources data and information. The integration of spatial data analysis systems with knowledge-based systems and/or simulation systems for the development of information/decision support systems for forest management; satellite systems; satellite imageries - techniques, uses and limitation; Future prospects of remote sensing in India; softwares used in remote sensing ; GIS versus remote sensing; GIS Software used in forestry and environments; Analysis of data; Application of GIS in forestry.

ECONOMICS OF AGROFORESTRY SYSTEMS
Basic principles of economics applied to agro-forestry. Optimization techniques-Planting, budgeting and functional analysis. Role of time, risk and uncertainty in decision making Financial and socio-economic analysis of agro-forestry projects. Principles of financial management and harvesting, post harvest handling marketing of agro-forestry products including benefit sharing.

RANGE LAND AND PARTIAL MANAGEMENT
Concept of watershed management. Ideo-types of watershed development plans and activities for the watershed. Criterion for watershed size determination. Principles and practices of range land management. Improvement of range productivity by vegetation manipulation through control of undesirable vegetation, burning, fertilization, soil and water conservation and protection. Range improvement and livestock management. Feeding habits and grazing behavior of range livestock. Optimal livestock and range utilization, fodder from trees/shrubs and their nutritive values, propagation techniques, Micro climatic studies, root behavior, crown architecture including methods for minimizing unfavorable interactions. Production potential of different silvi-pasture systems. Characteristics of a watershed and their role in watershed management. Quantification of the benefits and effectiveness of the package of practices adopted for management of watershed, Dynamics vis-à-vis plant growth and post harvest processing for evaluation of chemical constituents Biological and engineering approach in the management of degraded and denuded habitats as an integrated and multiple approach. SPP Testing. Provenance trials. Seed certification and storage. Elite trees selection.

NUTRIENT AND WEED MANAGEMENT IN NURSERY AND PLANTATION
control. Methods of weed control-cultural, biological, mechanical and chemical. Herbicide/weed side classification, properties and their application.

**MANAGEMENT OF INSECT-PESTS AND DISEASES**


**FOREST ECOLOGY AND BIODIVERSITY CONSERVATION**

Advanced topics in forest ecology including forest population, forest community dynamics, forest community structure and analysis, forest productivity on a global scale, ecology of forest landscapes spatial heterogeneity; Hierarchy issues in ecology. Conservation of natural resources (hotspot areas, wildlife sanctuaries, national parks, biosphere reserve). Global warming and forests. Green House Effect and its consequences. Ozone depletion. Conservations laws and acts. Forest genetics resources of India: timber and non timber species. Survey exploration and sampling strategies. Documentation and evaluation of forests genetical resources (FGR), in situ and ex situ conservation of gene resources. Biological diversity and its significance to sustainable use. Handling and storage of FGR. Intellectual property rights. Quarantine laws and FGR exchange.

**FOREST RESOURCE MANAGEMENT AND ECONOMICS**

Application of microeconomics in solving forest resource problems. Emphasis on forest products demand and supply analysis, forest products marketing, forest capital theory. Inter-regional and international trade in forest products. Impact of economics and physical variables upon forest appraisal and management decisions. Externalities and property rights. Natural and environmental resource accounting -methods and implications. Application of operations research tools in evaluating forest management alternatives in public and private forest planning.

**FRUIT PLANTS, TREES AND SHRUBS FOR AGROFORESTRY**

Introduction, importance of woody elements in agro-forestry systems, their role in biomass production. Suitability of species for different purposes. Multipurpose trees in agro-forestry systems. Fodder from trees/shrubs and their nutritive value propagation techniques. Fruits crop and their need and relevance in Agroforestry fruits tree suitable for various assemblage and then planting plan in different agro climatic situation and Agroforestry system. Modification in tending and pruning floor. Fertility management, yield and quality improvement. Role of nitrogen fixing trees/ shrubs. Choice of species for various agro climatic zones for the production of timber, fodder, fuel wood, fibre, fruits, medicinal and aromatic plants. Generic and specific characters of trees and shrubs for Agroforestry. Generic and specific characters of trees and shrubs for agro-forestry.

**ENERGY PLANTATIONS AND BIO-FUELS**

Farm Machinery and Power Engineering

UNIT 1

UNIT 2

UNIT 3
Linear programming and integer programming models and applications, Network terminology, shortest route and minimal spanning tree problems, maximal flow problem, project planning and control with PERT and CPM. System approach in farm machinery management and application of programming techniques to the problems of farm power and machinery selection. Maintenance and scheduling of operations. Inventory control of spare parts, work study, productivity, method study. Time and motion study

UNIT 4

UNIT 5
Modern trends in tractor design. Parameters affecting design of tractor engine. Design of fuel efficient engine components and tractor systems like transmission system, clutch, gearbox, differential, final drive, steering system, hydraulic system & hitching – fundamental of fluid power transmission, hydraulic system of tractor, design of hydraulic cylinder, hydraulic control in tractor, automatic hydraulic control, automatic position control, automatic draft control, design requirement of three point hitch system, three point linkage and hitching arrangements provided for different implements. Chassis, drivers seat, workplace area and control, tire selection. Mechanics of tractor chassis and stability static equilibrium of tractor, weight transfer,. Centre of gravity of tractor. Computer aided design and its application in agriculture benefits of CAD, introduction to CAD.

UNIT 6
Types of tests test procedure code. Test equipments. Prototype feasibility testing and field evaluation. Laboratory and field testing of selected of farm equipments- M.B. plough, Disc harrow, puddler, seed-cum-fertilizer drill, Manual paddy weeder, cereal harvesting
machines, thresher, sprayer and duster, chaff cutter and potato planter. Tractor performance testing, evaluation and interpretation of results

UNIT 7

Study of transmission system Clutch, Gear box, Differential. Final drive mechanism, brake mechanism
Post Harvest Process and Food Engineering

UNIT I
Principles of fluid flow, Psychrometry, dehydration, EMC, Thermal processing operations; Evaporation, blanching, pasteurization, distillation, Refrigeration principles and Food freezing. Mechanical separation techniques, size separation equipments; Filtration, sieving, centrifugation, Material handling equipment, conveyors and elevators; Size reduction processes; Grinding and milling. Homogenization; Mixing- mixers, kneaders and blenders. Membrane technology. Food plant design; Food plant hygiene- cleaning, sterilizing, waste disposal methods. Food packaging: Function materials, technique, machinery and equipment.


UNIT II
Introduction to heat and mass transfer and their analogous behavior, steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations. Applications in food processing including freezing and thawing of foods. Convective heat transfer in food processing heat transfer between fluids and solid foods. Functional design of heat exchangers: Shell and tube, plate and scraped surface heat exchangers, jacketed vessels. Radiation heat transfer and its governing laws, its applications in food processing.

Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; terms, physical states of materials, classical ideal material, rheological models and equations, viscoelasticity, creep-stress relaxation, Non-Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behaviour. Contact stresses between bodies, firmness and hardness, mechanical damage, temperature, and surface roughness. Friction in agricultural materials, rolling resistance, angle of internal friction, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity. Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, Electrical properties; Dielectric factor, A.C. conductivity and dielectric constant, method of determination. Application of engineering properties in design and operation of agricultural equipment and structures.

UNIT III
Energy forms and units, energy perspective, norms and scenario; energy auditing, data collection and analysis for energy conservation in food processing industries. Sources of energy, sun drying and use of solar energy, biomass energy and other non-conventional energy sources in agro-processing industries. Reuse and calculation of used steam, hot water, chimney gases and cascading of energy sources. Economics of energy use. Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions; grain quality standards and BIS standard. Pre-milling treatments and their
effects on milling quality; parboiling conventional, modern and integrated rice milling operations; wheat roller flour milling; processes for milling of corn, oats, barley, gram, pulses, paddy. Dal mills, handling and storage of by-products and their utilization.

Storage of milled products, Expeller and solvent extraction processing. Packaging of processed products. Storage of grains, biochemical changes during storage, storage factors affecting losses, storage requirements. Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking. cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation. Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, principles of fluidization;

UNIT IV

Applications of engineering principles; mass and energy balance, fluid flow principles, unit operations of process engineering. Fundamentals of growth kinetics, maintenance energy and yield concepts, principles of media sterilization, media formulations of industrial fermentation. Aerobic and agitated Rheology of fermentative fluids, design and scale-up of bioreactors, enzyme reactors. Principles of recovery of fermented products in bio-processing, instrumentation, transport phenomenon. Power and Energy measuring techniques. Humidity measurement – Dry and Wet bulb, Hair hygrometer and Humister. Soil and Grain moisture transducers, pressure measurement–

UNIT V

Nature and concepts of food analysis; Rules and regulations of food analysis, Safety in laboratory, sampling techniques. Principles and methodology involved in analytical techniques: PH Meter and use of ion selective electrodes–Spectroscopy, Ultra violet visible, florescence, Infrared spectro, Atomic absorption and emission, Chromatography – Adsorption, Column, Partition, Principles and methodology involved in analysis of foods ; Rheological analysis, Textural profile analysis of foods. Immunoassay techniques in food analysis; Isotopic and Non-isotopic immunoassay, Evaluation of analytical data ; Accuracy and precision. Sensory analysis of food; Objective method, Objective method. Introduction to neural network and its comparison with biological system. Perception and linear separable functions, multi-layers perceptions.
Soil and Water Engineering

UNIT I

UNIT 2

UNIT 3

UNIT 4
UNIT 5


UNIT 6