

**Syllabus for Master Degree Entrance Examination (Agriculture;
Horticulture & Agricultural Engineering) -2016**

For M.Sc.(Ag.):

AGRONOMY

Meaning and scope of Agronomy: National and International Agricultural Research Institutes in India, Agro-climatic zones of India. Tillage, crops stand establishment, Planting geometry and its effect on growth and yield cropping systems.

Definition and objectives of agricultural water management. Development and Management of water resources in India. Irrigation potential created and utilization in India. Soil-plant-water relationships. Methods of scheduling irrigation with particular reference to surface irrigation. Concept of: Evapo-transpiration, consumptive use, water use efficiency. Water management of different field crops like rice, wheat, maize, groundnut and sugarcane. Concept of watershed hydrology. Concept and management of pressurized irrigation system. Integrated water management of fresh and polluted water. Definition, Characterization, Significance and Principal of Watershed. Factors influencing watershed operations.

Rabi crops: Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield. Management practices of some rabi crops viz. Wheat, Barley, Chick pea, Lentil, Peas, French bean, Pigeon pea, Mung bean, Urd bean, Rape seed, Mustard.; Groundnut, Sunflower, Linseed and Tobacco.

Kharif crops: Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield. Management practices of some kharif crops viz. rice, maize, sorghum, pearl millet, minor millets, Pigeon pea, Mung bean and Urd bean, Forage crops, Sorghum, Maize, Cowpea, Cluster bean and Napier.

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control. Role of Integrated Weed Management (IWM) and IPM. Advance techniques of weed management by using bio-herbicides. Advantages and efficiency of bio-herbicides. Use of botanicals, different types of Botanicals, Semiochemicals, Allelochemicals - examples and uses. Survey and surveillance of Invasive weeds; Type of invasive weed species; their origin; Estimation of harmful effect from these invaded weeds, management of invaded weeds and measures for preventing of

their invasion.

Sustainable agriculture: Introduction, definition, goal and current concepts, factors affecting ecological balance and ameliorative measures; Land degradation and conservators of natural resources, LEIA & HEIA; Irrigation problems, waste lands and their development; Organic farming: definition, principles and components; Farming systems: definition, principles and components, IFS models for wetland, irrigated dryland and dryland situations.

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of - fibre crops; commercial crops; tuber crop; forage crops; oil seed crops; medicinal and aromatic crops.

Fibre Crops: Jute, Cotton and Sun hemp; Commercial Crops: Sugarcane and Sugar beet;

Medicinal and Aromatic crops: Mentha, Lemon grass, Citronella, Palma rosa, Isabgul /Isabgool, Posta / Opium Poppy.

Tuber crop: Potato.

Oil seed crops: Sesame, Soybean, Safflower.

Forage crops: Berseem, Lucerne, Oat, Cowpea, Napier and Cluster bean.

Concept of organic farming, Requirement of organic production; Management of organic manures, vermicompost and vermicomposting, green manure and green manuring, recycling of organic residues, bio-fertilizers; Soil improvement and amendments through manures; concept of botanicals; use of bio-control agents, bio-pesticides; Weed management; Quality considerations, certification, labelling and accreditation processors, marketing, exports.

CROP PROTECTION

Introduction, Important Plant Pathogenic Organisms, different groups, fungi, bacteria, phytoplasmas, spiroplasmas, viruses, Iviriods algae, protozoa, and phanerogamic parasites with example of diseases caused by them. Prokaryotes: Classification of prokaryotes according to Bergey's Manual of Systematic Bacteriology. General character of fungi, Definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction in fungi (asexual and sexual). Nomenclature, binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions and sub-divisions.

Economic importance, symptoms, causes, disease cycle and management of disease of rice, jute, maize, wheat, sugarcane, turmeric tobacco, groundnut, sesame, sunflower, cotton, red gram, Bengal gram, black gram, green gram.

Economic Importance, symptoms, causes, disease cycle

and management of diseases of citrus, mango, banana, grapevine, pomegranate, papaya, guava, sapota, apple, chilli, brinjal, bhindi, potato, crucifers, cucurbits, tomato, beans, onion, coconut, oil palm, betelvine, mulberry, coffee, tea, rose, chrysanthemum, jasmine and tuberose.

Biofungicides of microbial origin: introduction and importance. Identity of *Trichoderma harzianum* and *Gliocladium virens*. Curriculum vitae of *T. harzianum* and *G. virens*. Isolation and maintenance of mother culture. Mass production practices and development of delivery systems. Application technology Economics & future prospects.

Plant Disease management: Management of Host, Pathogen and Environment. Principles of plant disease management: Exclusion, Avoidance, Eradication, Protection, Host resistance and Therapy. Procedures of Plant Disease Management. Different methods of cultural, Biological and Chemical control. Integrated Disease management Practices. Strategies for crop health management. Tolerable losses, Economic control, long range control, multiple disease control. IDM on Rice, Potato, Groundnut, Jute, Mustard, Wheat, Vegetable crops, Green gram & Black gram, Jute, major fruit trees.

History of Entomology in India. Factors for insects abundance. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and moulting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts and legs. Wing venation, modification and wing coupling apparatus. Structure of male and female genitalia. Sensory organs. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system in insects. Types of reproduction in insects. Systematics : Taxonomy - importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders. Orthoptera: Acrididae, Dictyoptera, Mantidae, Odonata, Isoptera, Termitidae, Thysanoptera: Thripidae, Hemiptera, Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Cicadeliidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Neuroptera, Chrysopidae, Lepidoptera, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Coleoptera, Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae, Hymenoptera, Tenthredinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Diptera, Cecidomyiidae,

Tephritidae, Tachinidae, Agromyziidae.

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors-temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors - food competition, natural and environmental resistance. Concepts of Balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem. Pest surveillance and pest forecasting. Categories of pests. IPM : Introduction, importance, concepts principles and tools of IPM- Host plant resistance, Cultural, Mechanical, Physical, Legislative, Biological (parasites, predators & pathogens such as bacteria, fungi and viruses) methods of control. Chemical control - importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Study of important insecticides.

Botanical insecticides - neem based products, Cyclo-diols, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotynyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, macrocyclic lactones, Oxadizimnes, Thiourea derivatives, pyridine azomethines, pyrroles, etc. Nematicides, Rodenticides, Acaricides and fumigants. Recent methods of pest control, repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Practices. Scope and limitations of IPM. Insecticides Act 1968 - Important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Beneficial insects: parasites and predators used in pest control and their mass multiplication techniques. Important groups of microorganisms, bacteria, viruses and fungi used in pest control and their mass multiplication techniques. Important species of pollinators, weed killers and scavengers, their importance. Non insect pests - mites, Nematology, rodents and birds. Vermiculture

Stored grain pests. Coleopteran and Lepidopteran pests, their biology and damage, preventive and curative methods. Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of rice, sorghum, maize, ragi (*Eleusine coracana*), wheat, sugarcane, jute, cotton, mesta, sunhemp, pulses, groundnut, castor, gingerly, safflower, sunflower, mustard, brlnjal, bhendi, tomato, cruciferous and cucurbitaceous vegetables, potato, sweet potato, colacasia, moringa, amaranthus, chili, mango, citrus, grapevine, cashew, banana, pomegranate, guava, sapota, ber, apple, coconut, tobacco, coffee, tea, turmeric, betelvine, onion, coriander, garlic, curry leaf; pepper, ginger and ornamental plants.

Introduction: History of phytonematology, Economic importance. General characteristics of plant pathogenic nematodes. Nematode general morphology and biology. Classification of nematodes upto family level with emphasis on groups containing economically important genera. Classification of nematodes by habitat. Identification of economically important plant nematodes upto generic level with the help of keys and description. Symptoms caused by nematodes with examples. Interaction between plant parasitic nematodes and disease causing fungi, bacteria and viruses. Different methods of nematode management. Cultural methods (crop rotation, fallowing, soil amendments, other land management techniques), physical methods (soil solarisation, hot water treatment) Biological methods, Chemical methods (fumigants, non fumigants). Resistant varieties, IDM.

Pesticides- definition, categories. Insecticides- definition, classification based on toxicity, mode of entry, mode of action and chemical composition Formulation of insecticides- types, uses , advantages; insecticide additives Consideration for insecticide application; factors influencing insecticide efficiency Types of insecticides- properties and

uses of important insecticides under different groups viz. Organophosphate. Carbamates, chlorinated hydrocarbons and synthetic pyrethroids with advantages and limitations New molecules in pest management insect growth regulators- types, uses and role in pest management. Other pesticides- types of acaricides, nematocides and rodenticides; properties and uses of important ones under each group. Insecticide appliances- classification and uses

Components of IPM - Physical, mechanical, biological, chemical and legislative methods. Biotechnological approaches in IPM. Pest surveillance and sampling. Ecological backlash and its management, resistance of population to pest management tactics, pest population resurgence and replacement. Problems and constraints in the implementation of IPM. IPM on rice, sugarcane, groundnut, brinjal, cabbage, black gram, mungbean, jute, mango.

Morphology of mites and ticks. Collection, cleaning and preservation of mites, Studies on symptoms of damage caused by phytophagous mites. Identification of major mites pests. Sampling techniques . Estimation of mite population by different methods. Identification of important rodent pests. Survey for assessment of rodent population in field and godown. Investigation on damage caused by rodents. Rodent control operations in field and godown. Identification of common species of slugs and snails. Evaluation of control measures against slugs and snails

Balance of nature- natural control. Biological control- definition, its advantages and disadvantages. Biocontrol agents- insects, arachnids, nematodes, fungi, bacteria, viruses, protozoa, vertebrates. Brief history of bio-control with examples of successful cases . Insects parasitoids and predators- types of parasitism. Methods of biological control- conservation, augmentation and importation. Predators and parasitoids of agricultural importance- Coleoptera (Coccinellids, Carabids, Staphylinids); Neuroptera (chrysopids); Hemiptera (Mirids, Reduviids, Pentatomids); Diptera (Syrphids, Tachinids); Lepidoptera (Pyralid- Epiricania melanolenca); Hymenoptera (Trichogrammatids, Eulophids, Scelionids, Mymarids, Braconids, Ichneumonids); Spiders (Arachina); Mites (Phytoseiids) and Weed feeding herbivores- Zygogramma bicoiorala. Bio-pesticides - Entomopathogenic microbes, Bacteria - Bascillus thuringensis, B popillae; Fungi - (Beauveria bassiana, Metarhizium anisopliae, Verticillium lecanii, Nomuraea rileyi. Viruses (NPV and GV); Nematodes (Heterohabidity idea, Steinernematidae and Protozoa). Methods of biological control - conservation, augmentation and importance.

Mass production of bio control agents.

Principles and Procedures of Plant Protection. Effect of Plant Protection on environment and Plant health. Plant Protection organization and its function in India . Quarantine and its function in India . Diagnostics symptoms due to pest and Diseases . Pest and disease assessment and crop loss assessment due to Pests and diseases. Different Pesticides and Their methods of application . Concept and application of IPM on different crops. Different weeds and its effect in crop health

Definition, history, classification (according to chemical nature and use pattern) of synthetic & botanical Pesticides; Common Name, IUPAC Name, Trade Name, type of formulation, Chemical Structure, Mode of Action and Use of some common pesticides; Insecticide act; Hazards of pesticides (as pollutant and contaminant) and their safety assessments: ADI, NOAEL, MRL, PHI, etc.; Stereo Isomerism with special reference to Pesticide Chemistry; Important Name Reaction encountered in Pesticide Chemistry: Diel's

Alder Reaction, Aldol Condensation, Perkin Reaction, Fried el Crafts' Reaction, Grignard Reaction, Michaelis-Arbuzov and Perkow Reaction; An Introduction to Heterocyclic Compounds encountered in various Agrochemicals.

Classification, brief Chemistry and synthesis of some popular pesticides: Insecticides (Organo-Chlorines, Organo-Phosphates, Carbamates, Synthetic Pyrethroids), Fungicides and Herbicides; Brief Chemistry, Synthesis and use of some Acaricide, Nematicide, Rodenticide and Molluscicide; Introduction to pesticide residues; Principles of pesticide residue analysis.

Brief Chemistry of pesticides of plant origin and their application in plant protection: Pyrethroids, Nicotinoides, Rotenoids, Azadirachtin; Chemistry of Plant Pigments, Terpenoides, Flavonoids and Alkaloids; Principle of extraction and purification of bio-active constituents from plant.

NATURAL RESOURCE MANAGEMENT (NRM)

Concept of pedology and edaphology, Origin of the earth, Earth's crust; Composition: Rocks and minerals Weathering, Soil formation factors and processes, Components of soils; Soil profile, Soil physical properties, Soil texture, Textural classes, Particle size analysis, Soil structure Classification, Soil aggregates, significance, Soil consistency, Soil crusting, Bulk density and particle density of soils & porosity, their significance and manipulation, Soil compaction, Soil Color, Elementary knowledge of soil classification and soils of India; Soil water, Retention and potentials, Soil moisture contents, Movement of soil water, Infiltration, percolation, permeability, Drainage, Methods of determination of soil moisture and Thermal properties of soils, Soil temperature, Soil air, Gaseous exchange, Influence of soil temperature and air on plant growth; Soil colloids, Properties, nature, types and significance; Layer silicate clays, their genesis and sources of charges, Adsorption of ions, Ion exchange, CEC & AEC factors influencing ion exchange and its Significance. Soil organic matter, Composition, Decomposability, Humus, Fractionation of organic matter, Carbon cycle, C: N ratio. Soil biology, Biomass, Soil organisms and their beneficial and harmful roles.

Irrigation: definition and objectives, water resources and irrigation development in West Bengal and India; Soil plant water relationships: flow of water, water availability, soil moisture content; Methods of soil moisture estimation, evapotranspiration and crop water requirement; Soil water loss, infiltration-definition, equations and measurement; permeability and seepage; Methods of irrigation: surface, subsurface, sprinkler and drip irrigation, Traditional methods of irrigation. Measurement of irrigation water. Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its appraisal, use of saline water for irrigation. Drainage - principles, methods, coefficient.

Microbial groups in soil - their occurrence, distribution, function; Ecological interrelationship-protocooperation, commensalisms, amensalism, competition, symbiosis, parasitism, predation, synergism; Nutrition of microorganisms; Microbial transformation of carbon - decomposition of organic matter, carbon assimilation, factors affecting organic matter decomposition; Microbial transformation of nitrogen - nitrogen cycle, mineralization, immobilization, nitrification, denitrification, nitrogen fixation; Microbial transformation of phosphorus - mineralization, solubilization, immobilization, oxidation and reduction of inorganic phosphate compounds; Microbial transformation of sulphur - mineralization, immobilization, oxidation and reduction; Basic concepts of bio fertilizers; Microbes in composting.

Soil as a source of plant nutrients. Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Measures to overcome deficiencies and toxicities. Problem soils - acid, salt affected and calcareous soils, characteristics, nutrient availabilities. Reclamation-mechanical, chemical and biological methods. Fertilizer and insecticides and their effect on soil water and air. Irrigation water - Quality of irrigation water and its appraisal. Indian standards for water quality. Use of saline water for agriculture. Soil fertility - Different approaches for soil fertility evaluation. Methods, Soil testing - Chemical methods. Critical levels of different nutrients in soil. Plant analysis - DRIS methods, critical levels in plants. Rapid tissue tests. Indicator plants. Biological methods of soil fertility evaluation. Soil test based fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe, Zn and B in fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

Concept of manure. Methods of composting, Mechanical compost plants, Vermicomposting, phosphocompost, Green manures. Oil cakes, Sewage and sludge - Biogas plant slurry, Plant and animal refuges. Fertilizers - classifications, Manufacturing processes and properties of major nitrogenous (ammonium sulphate, urea, calcium ammonium nitrate, ammonium nitrate, ammonium sulphate nitrate) phosphatic (single super phosphate, enriched super phosphate, di-ammonium phosphate, ammonium poly phosphate), Bone meal, potassic and complex fertilizers their fate and reactions in the soil, Secondary and micronutrients fertilizers, Amendments. Fertilizer Control Order, Fertilizer storage; Biofertilizers and their advantage.

Concepts of soil fertility and productivity, plant nutrients- functions, toxicity, deficiency, diagnosis, critical limits, hidden hungers, Soil physical properties and nutrient management, Soil water and nutrient management, Fertility constraints in problem soils and their managements, organic matter and soil fertility, Soil reactions and nutrient management. Integrated plant nutrient management including micronutrients, Soil fertility evaluation methods, Principles of determination of NPKS and micro- nutrients, nutrient interactions and chelates in nutrient management.

Meaning and scope of agroclimatology. Role of weather elements in agriculture- radiation, temperature, humidity, rainfall, wind, dew, fog, snow. Concept of crop phenology-agrometeorological indices important for studying crop development processes-GDD, HTU, PTU. Weather hazards in agriculture: drought, flood, cyclonic storm, frost, heat and cold waves. Rainfall climatology and assessment of regional climatic potential-types of rainfall divisions in India. Effective rainfall and rainfall variability in Indian agriculture. Studies of rainfall based crop production potential. Agroclimatic classifications and their application-concept, evolution of agroclimatic indices, methods of assessment. Agro-climatic normals for major crops of the state - Rice, wheat, mustard, potato, jute, pulses, oilseeds and vegetables. Application of remote sensing in agrometeorology.

Climatic classification, climatic regions of world. Characteristic features of climate of India and W.B. Salient features of earth surface wind system, General characteristics-modeling, cyclones & anticyclones, Tropical & extra tropical cyclones. Mesoscale wind-Land & sea breeze, mountain & valley breeze and other local winds. Monsoon: characteristics of Indian Monsoon. Dew, fog, frost, cloud - Their importance in agriculture. Classification of fog and cloud. Forms of precipitation - Rain, snow, hail and sleet and their importance in agriculture. Rainfall - convective, orographic, cyclonic & monsoon rain(frontal).Artificial rain making. Basic concept of water balance and its significance in agriculture. Evapotranspiration as an agrometeorological process. ET pattern during cropping period, factors affecting ET. Concept of potential evapotranspiration, empirical estimation of PET - Methods of Penman& Thornthwaite. Evapotranspiration & irrigation scheduling. Concept of SMGDD & WRSI - Their importance in agriculture Introduction to crop weather models - empirical and mechanistic models and their applications

Concept of Crop Phenology & its significance in crop production. Agroclimatic factors affecting crop phenology. Weather based estimation of phenological stages. Concept of GDD, HTU, PTU, T1R & their applications in agriculture. Influence of surface features on microclimate. Profiles of radiation, temperature, vapour, wind and CO₂ concentration within plant canopy and their significance in crop growth and production. Process of heat transfer in soils. Relationship between soil and air temperature. Influence of soil temperature in crop

growth and production. Effect of weather parameters on crop production. Weather hazards important for agricultural activities- Flood, drought, cold wave, heatwave, hail storm, thunderstorm, frost, cyclone, their time and frequency of occurrence. Crops and their growth stages critical to different weather hazards. Crop protection measures against weather hazards-Wind break and shelter belts, protective irrigation, shading and mulching, artificial rain making and other management options. Concept of contingent crop planning in relation to weather hazard. Weather forecasting for agriculture. Types of forecasting-Short, medium and long range. Methods of weather forecasting-synoptic, statistical and numerical approaches

Watershed- definition, concept approach - aims and objectives. Watershed selection criteria and methods of identification of watershed. Steps, procedure and planning of watershed management. Rainwater management in watershed. Watershed hydrology, rainfall-runoff relationship. Runoff harvesting, storage, recycling and estimation of runoff. Rainwater harvesting - location and design of a pond. Case studies of some identified watershed and their management under different agro-climatic situation. Selection of different conservation treatment and production systems and their use in watershed management.

PLANT SCIENCE

Mendel's laws of inheritance and exceptions to the laws. Types of gene action. Multiple alleles, pleiotropism, penetrance and expressivity. Quantitative traits, Qualitative traits and differences between them. Multiple factor hypothesis. Cytoplasmic inheritance, its characteristic features and difference between chromosomal and cytoplasmic inheritance. Mutation, its characteristic features, methods of inducing mutations and CLB technique. Gene expression, Structure of cell and cell organelles and their functions. Study of chromosome structure, morphology, number and types, karyotype and ideogram. Mitosis and meiosis, their significance and difference between them. DNA, RNA and their structure, function and types. Transcription, translation, genetic code and outline of protein synthesis. Crossing over, factors affecting it, mechanism of crossing over and cytological proof of crossing over. Linkage, types of linkage and estimation of linkage. Numerical chromosomal aberrations (polyploidy) and evolution of different crop species like cotton, wheat, rice, tobacco, triticale and Brassicas. Structural chromosomal aberrations.

Classification of plants, Botanical description, Floral biology, Emasculation and pollination techniques in cereals, millets, pulses, oilseeds, fibres, plantation crops etc. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification, significance in plant breeding. Modes of pollination, genetic consequences, difference between self and cross-pollinated crops. Methods of breeding - introduction and acclimatization. Selection- Mass selection, Johannson's pure line theory, genetic basis, pure line selection. Hybridization - aims and objectives, types of hybridization. Methods of handling segregating generations - Pedigree method, Bulk method, Back cross method and various modified methods. Incompatibility and male sterility and their utilization in crop improvement. Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour, development of inbred lines, single cross and double cross hybrids Population improvement programmes, recurrent selection, synthetics and composites. Methods for breeding for vegetatively propagated crops. Clonal selection, Mutation breeding-ploidy breeding. Wide hybridization, significance in crop improvement

Breeding objectives and important concepts of breeding self and cross pollinated and vegetatively propagated crops. Hardy-Weinberg law. Study in respect origin and distribution of species, wild relatives and forms for cereals like Rice, wheat, Maize Millets, Sorghum, bajra, ragi. Pulses like Red gram, green gram, black gram, soybean. Oilseeds like Ground nut, Sesame, safflower sunflower, Castor mustard etc. Fibres like Cotton, Kenaf, Jute etc. Major breeding procedures for development of hybrids / varieties of various crops. Plant Genetic resources their conservation and utilization in crop improvement. Ideotype concept in crop improvement. Breeding for resistance to biotic and abiotic stresses; variability in pathogens and pests. Mechanisms of resistance in plant to pathogen and pests. Genetic basis of adaptability to unfavourable environments. Definition of biometrics, assessment of variability i.e. additive, dominance and epistasis and their differentiation. Genotype X Environment interaction and influence in yield / performance. IPR and its related issues. PPV and FRA.

Beginning of genetics; early concepts of inheritance, Mendel's laws; Chromosomal theory of inheritance. Multiple alleles, Gene interactions. Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes, Extra chromosomal inheritance: ultrastructure and function of mitochondria, biological membranes, Chloroplast and other

organelles.. Male sterility and Incompatibility: application in crop improvement. Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters. -Frequencies of genes and genotypes- Causes of change: Hardy-Weinberg equilibrium. Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid Organization of DNA in chromosomes, Unique and repetitive sequences; DNA replication, transcription and their regulation – Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes –RNA editing, concept on operon. Principles of PCR, Methods of studying polymorphism at biochemical and DNA level.

Cell Cycle and cell division – mitosis and meiosis; Differences, 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. Structural and Numerical variations of chromosomes and their implications - Symbols and terminologies for chromosome numbers - euploidy -haploids, diploids and polyploids ; Utilization of aneuploids in gene location. Role of aneuploids in basic and applied aspects of crop breeding. Cytogenetic basis of origin: Wheat, Cotton, Sugarcane, Potato, Brassica. Apomixis.

Mendelian traits vs polygenic traits - nature of quantitative traits and its inheritance - Multiple factor hypothesis - analysis of continuous variation; Variations associated with polygenic traits - phenotypic, genotypic and environmental - non-allelic interactions; Nature of gene action - additive, dominance, epistatic and linkage effects. Correlation and Path analysis: direct and indirect effect, Principles of Analysis of Variance (ANOVA) - Expected variance components, random and fixed models; Comparison of means and variances for significance. Analysis of genotype x environment interaction - adaptability and stability; Models for GxE analysis and stability parameters;

Special approaches for crop improvement in self-pollinated crops: Population breeding approach; Rapid isolation of homozygous lines; Development of Multiline varieties; Development of hybrid variety in self pollinated crops (Rice, Sorghum). Special approaches for improvement of cross/often cross pollinated crops. Development and maintenance of inbred lines and production of hybrid seed in maize and cotton. Physiological concept of Plant Breeding. Physiological parameters to crop yield and their application in crop improvement programme with reference to cereals, pulses and oilseeds.

Breeding for biotic and abiotic stress, a) Biotic stress: Concept in insect and Pathogen resistance; Genetic mechanisms to biotic stresses-horizontal & vertical resistance. Adoption of classical and molecular breeding methods for resistance against biotic stress. b) Abiotic Stress: Classification, stress inducing factors – moisture stress, temperature stress, salinity and alkalinity stress, mineral toxicity. Breeding methodologies for development of resistant plants against abiotic stresses with reference to drought, salinity & alkalinity.

Importance of transgenic plants and their development. Breeding for improvement of Tree crops. Introduction to IPR, PPV & FRA. Preparation of passport data and registration of plant varieties.

Definition of Crop Physiology – it's Importance in agriculture and horticulture. Crop Water Relations - Physiological importance of water to plants -Water potential and its components. Transpiration - Definition, types of transpiration, mechanism, of opening and closing of stomata, transpiration in relation to crop productivity. Water Use Efficiency, WUE in C3, C4

and CAM plants. Growth and Development - Definition - Types of growth - Determinate and Indeterminate growth - Monocarpic and Polycarpic species with examples. Growth analysis, growth characteristics - Definitions and mathematical formulae. Photosynthesis - Photosynthetic pigments, mechanism of photosynthesis - cyclic and non-cyclic electron transfer. CO fixation mechanism - C3/ C4 pathway, CAM metabolism. Significance of C3, C4 and CAM - relationship of photosynthesis and crop productivity. Photorespiration - basic concept. Respiration and its significance - Importance of glycolysis, TCA cycle, Pentose phosphate pathway. Salt respiration, cyanide resistant respiration. Nutrient-physiology - Definition - Classification of plant nutrient. Functions of plant nutrients. Deficiencies and toxicity symptoms of plant nutrients. Control of flowering - Photoperiodism and Vernalization in relation to crop productivity - Classification of plants - Commercial application of photoperiodism in agriculture and horticulture. Plant Growth Regulators - Occurrence, biosynthesis, mechanism of action and physiological role of Auxins, Gibberellins, Cytokinins, ABA and Ethylene in plants. Novel plant growth regulators. Commercial application of plant growth regulators in agriculture and horticulture.

Crop growth analysis: Dry matter partitioning, Harvest index, Growth analysis formulae, Determination of LAI, Specific leaf weight, Crop growth rate, Relative growth rate and NAR.

Photosynthesis and Crop productivity: Photosynthetic efficiency of crops-C3 and C4 plants, Photorespiration and its significance, CAM pathway and its significance, Physiological determinants of crop yield, Source-sink relation.

Physiological basis of abiotic stress tolerance : General features of drought and salinity stress, Plants' responses to drought and salinity stress, Escape and tolerance mechanism, Physiological and biochemical changes associated with tolerance, morpho-physiological traits for selection of tolerant types. Growth and metabolic processes associated with tolerance to water logging.

Nutrient physiology: Solute transport, Plant nutrients and their functions, Deficiency and toxicity symptoms of nutrients, Detection of deficiency symptoms of different nutrients in crop plants.

Reproductive biology: Alternation of generation, Sporogenesis and gametogenesis, Pollen germination and pollination biology, Physiological changes associated with fruit ripening and seed development, Photoperiodism, Phytochrome and its role in plants.

Photosynthesis – photosynthetic pigments, light reactions and carbon linked reactions, photorespiration, C3, C4 & CAM pathways; Nitrate assimilation, Biological nitrogen fixation; DNA replication, transcription and translation.

Introduction to Seed and its importance *of in* Production system; Seeds structure and their development; Types of seed (Orthodox and Recalcitrant); Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality; Definition, Characters of good quality seed. Different classes of seed, Production of nucleus & breeder's seed; Seed Production, Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites); Foundation and certified seed production of rice (varieties & hybrids); Foundation and certified seed production of cotton and sunflower (varieties and hybrids); Foundation and certified seed production of castor (varieties and hybrids); Foundation and certified seed production of tomato and brinjal (varieties and hybrids); Foundation and certified seed production of chilies and bhendi (varieties and hybrids); Foundation and certified seed production of onion, bottle gourd and ridge gourd (varieties and hybrids); Seed certification, phases of certification,

procedure for seed certification, field inspection and field counts etc.; Seed Act, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Varietal Identification through different methods. Seed multiplication ratio(SMR) and seed replacement ratio (SRR) of different crops. Drying, Forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, building requirements, types of air distribution systems for seed drying, selection of crop dryers and systems of heated air drying, recommended temperature and depth of the seeds, management of seed drying, Seed processing: air screen machine and its working principle, different upgrading equipments and their use, Seed testing procedures for quality assessment- sampling methods & equipments, it's importance, test for germination, viability & vigour; Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist-O-matic treater), Seed packing and seed storage, stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, measures for pest and disease control, temperature control, Seed marketing, Factors affecting seed marketing.

Floral types, structures and biology of field crops, seed germination and dormancy, concept and importance of quality seeds, classes of seed and its production technologies, seed sampling; Seed Testing; Maintenance of Seed Purity and management of deterioration, Seed Certification and its utilization; Hybrid seed production technology, Isolation distance, synchronization of flowering, rouging etc., male sterility in seed production, Seed Multiplication Ratio (SMR), Seed Replacement Rate (SRR). Seed production of paddy, wheat, maize, sorghum, bajra, sesamum, mustard, green gram and black gram, Seed processing cleaning, grading, drying, treatment and packaging.

Biochemistry- Introduction and importance. Bio-molecules - Structure & applications: Amino acids, peptides and proteins. Enzymes - Factors affecting the activity, classification; Lipids - Acyl lipids. Carbohydrates; Nucleotides and Nucleic acids. Metabolism - Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. General reactions of amino acid degradation. Biosynthesis - carbohydrates, Lipids, and Nucleic acids. Metabolic regulation. Secondary metabolites: Terpenoids, Alkaloids and Phenolics.

SOCIAL SCIENCE

Economics: Meaning, Definition, Divisions of Economics, Importance of Economics. Agricultural Economics : Meaning, Definition; Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare. Wants: Meaning, Characteristics, Classifications of Wants, Importance. Theory of consumption: Law of Diminishing Marginal utility, Meaning, Definition, Assumption, Limitations, Importance. Consumer's surplus: Meaning, Definition, Importance. Demand: Meaning, Definition, Kinds of Demand, Demand schedule, Demand Curve, Law of Demand, Extension and Contraction Vs Increase and Decrease in Demand. Elasticity of Demand: Types of Elasticity of Demand, Degrees of price elasticity of Demand, Methods of Measuring Elasticity, Factors influencing elasticity of Demand, Importance of Elasticity of Demand. Welfare Economics: Meaning, Pareto's optimality. National Income: Concepts, Measurement. Public Finance: Meaning, Principles. Public Resource: Meaning, Services Tax, Meaning, and Classification of Taxes: Cannons of Taxation, Public expenditure: Meaning, Principles. Inflation: Meaning, Definition, Kinds of inflation

Agricultural finance: nature and scope. Time value of money, Compounding and Discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's 5C's and 7 P's of credit, repayment plans. 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, Insurance and Credit Guarantee Corporation of India. Assessment of crop losses, determination of compensation. Crop insurance, advantages and limitations in application, estimation of crop yields. Agricultural cooperation: philosophy and principles. History of Indian cooperative Movement, pre-independence and post independence periods, cooperation in different plan periods, cooperative credit structure: PACS, FSCS. Reorganisation of cooperative credit structure in Andhra Pradesh and single window system. Successful cooperative systems in Gujarat, Maharashtra. Punjab etc.

Agricultural Marketing : Concepts and Definition, Scope and subject matter, Market and Marketing: Meaning, Definitions, Components of a market, Classification. Market structure, Conduct, performance. Marketing structure, Market functionaries or agencies, Producer's surplus: Meaning, Types of producers surplus, marketable surplus. Marketed surplus, importance, Factors affecting Marketable surplus. Marketing channels: Meaning, Definition, Channels for different products. Market integration, Meaning, Definition, Types of Market Integration. Marketing efficiency: Meaning, Definition, Marketing costs, Margins and price spread, Factors affecting the cost of marketing, Reasons for higher marketing costs of farm commodities, Ways of reducing marketing costs. Theories of International Trade: Domestic Trade, Free trade, International Trade, GATT, WTO, Implications of AOA. Market access, Domestic support, Export subsidies, EXIM-Policy & Ministerial conferences. Cooperative Marketing. State Trading. Ware Housing Corporation; Central and State, Objectives, Functions, Advantages. Food Corporation of India: Objectives and Functions. Quality Control, Agricultural Products, AGMARK. Price Characteristics of agricultural product process, Meaning, Need for Agricultural Price Policy. Risk in Marketing: Meaning and importance, Types of Risk in Marketing. Speculations and Hedging, Futures trading, Contract farming.

Production Economics: Meaning, Definition, Nature and Scope of Agricultural Production Economics. Basic concepts and terms. Concepts of Production. Production Functions: Meaning, Definition, Types. Laws of returns: Increasing, Constant and decreasing. Factor Product Relationship. Determination of optimum input and output. Factor

relationship. Product relationship. Types of enterprise relationships. Returns to scale: Meaning, Definition, Importance. Farm Management. Economic principles applied to the organisations of farm business. Types and systems of farming. Farm planning and budgeting. Risk and uncertainty. Farm budgeting. Linear programming: Assumptions, Advantages and Limitations of Linear programming.

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

Definition of Marketing-concepts of marketing-consumer behaviour- marketing strategy-pricing. Advertising management- sales promotion- sales management - marketing information system. Rural marketing in India- profile and difficulties. Agricultural Marketing Management- planning-policies- marketing information system-marketing development and promotional activities- price decision-function of marketing-cost profit analysis- quality of product. Agricultural marketing-functions- marketing system- functional approach, commodity approach, Institutional approach, behavioral approach and Decision making approach. Co-operative Marketing-function-Structure, Regulated Markets- objectives .7 important features Agricultural Price Policy- International Trade in Agricultural Commodities- Modern theory of International trade.

Farm Planning (FP) - Purpose- Types of FP- Essential Elements of FP- Stages of FP- Principal Characteristics of good farm plan-Basic of FP and budgeting. Farm budgeting (FB) - Objectives of FB- Types of FB- Practical and Complete Budgeting- Elements of Partial Budgeting- Difference between Partial and Complete budgeting- Advantage of FB. Locating weak points in Existing Farm Plan-Alternate Farm Plan- Practicability of Alternate Plan. Farm environmental Pollution- estimation- cost benefits- farm project evaluation-plan, programme and appraisal- the present worth summing method- amortization method. Linear Programming (LP)-A Budgeting Technique- Definition-Requisites of LP-Assumptions of LP-Elements of LP- Disposal Activities- Solution of LP: Feasible and Optimal Feasible Solution, Geometric Method, Simplex Method, problem of cost minimization the dual problem, Solution to the dual problem.

Rural Sociology: Meaning, concept, importance in agricultural Extension; Social Group: Meaning, concept and classification. Social Stratification: Meaning, function, forms of stratification, Difference between class and caste system. Cultural concept: Culture,

customs, folkways, Mores, Taboos, Rituals, Tradition. Basic Social Institutions: Meaning, concept, Institutionalization process. Social Change: Meaning, concept, Intelligence: Meaning, concept, types, Factors affecting intelligence, intelligence Quotient. Teaching - Learning Process: Meaning, concept of teaching, learning, elements of learning. Personality: Meaning, concept, characteristics and factors influencing personality.

Education: Meaning, Definition, Types - Formal, Informal and Non-formal education and their Characteristics. Extension Education and Agricultural Extension: Meaning, Definition, Concepts, Objectives and principles. Rural Development: Meaning, Definition, Concepts, Objectives, Importance and problems in rural development.

Community Development Programme: Meaning, Definition, Concepts, Philosophy, Principles, Objectives, Differences between Community Development and Extension Education, National Extension service.

Panchayati Raj, 3-tiers of Panchayati Raj system Powers Functions and Organizational setup. Agricultural Development Programmes with reference to year of start, objectives and salient features: Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP), ATMA, ATIC, NAIP. Social Justice and Poverty alleviation programmes: Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarajgar Yojana (SJGSY), Prime Minister Employment Yojana (PMEY), new trends in extension, privatization, Women Development programmes : Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS), and Mahila Samridhi Yojana (MSY), NREGA. Reorganized extension system (T & V System): Salient features, Fort night Meetings, Monthly workshops, Linkages, Merits and Demerits, Emergence of Broad Based Extension (BBE).

Extension Teaching Methods: Meaning, Definition, Functions and classification. Individual Contact Methods; Farm and Home Visit, Result Demonstration, Office Call, Telephone Call -meaning, Objectives Steps, Merit and Demerits. Group Contact Methods: Group Discussion, Methods Demonstration, Farmers Day and Field Trips-, meaning, Objectives Steps, Merit and Demerits. Small Group Discussion Techniques- Lecture, Symposium, Panel, Buzz Group, Workshop, Brain Storming, Seminar and Conference. Mass Contact Method: Mass Meeting, Campiagn. Exhibition, Kisan Mela, Radio & Television-Meaning, Importance, Steps, Merit and Demerits. Factors influencing in selection and use of Extension Teaching.

Methods. Extension Teaching and Learning : Definition, Characteristics and steps. Learning- Definition, elements and principles of learning .Communication: Meaning, Definition, Function, Models, elements and their characteristics. Extension Programme Planning: Meaning definitions of Planning, Programme, Projects, importance, Principles, Types and steps of Extension Programme ,Planning, Monitoring and Evaluation of Extension Programme. Diffusion and Adoption of Innovation: Meaning, Definition, Models of Adoption process. Innovation - Decision process - Elements, Adopter Categories and their characteristics, and characteristics of Innovation. Innovation Information Sources: Internet, Cyber Cafes, Video and Tele Conference, Kisan Call centres. Capacities Building of Extension Personnel and Farmers: Meaning, Definition Importance, Types and Methods of training.

Entrepreneurship and Entrepreneurship Development: Definition, types, factors responsible for Entrepreneurship, models status of agri-horti entrepreneurship in India, globalization and emerging issues of managing agri-preneurship. Managing an enterprise: motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow-up, managing competition, entrepreneurship development programme, SWOT analysis, generation, incubation and commercialization of ideas and innovations. Government Scheme and Policy: Government Schemes and incentives for promotion of entrepreneurship, Government policy on Small and Medium Enterprise (SMEs) Export and important Policies relevant to horticulture sector. Venture capital. Role for Corporate Sector in Agriculture Horticultural development. Contract farming in horticultural crops. Public - private partnership. Communication Skills: nature and importance of effective communication in extension education. Modes of communications - verbal and non-verbal, elements of effective oral communication including use of verbal and non-verbal symbol. Principles and techniques of Writing: Development news, stories, popular articles, technical articles and extension bulletins. Presentation: Individual and group presentation. Group Discussion: techniques and organization; organization of seminars, conference etc.

Changing Scenario of Agriculture and human resource management; theory of personality and socialization, behaviour and enterpreneurship; enterpreneuria! motivation and skills in changing organization; personality profiling; experiential learning cycle and behaviour, ELC based training programme and methodology. Communication and behavioural skill. Simulation theory and processing.

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: Standard Deviation, Variance and Coefficient of Variation; Probability: Definition and concept of probability; 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 and Two Samples (all types); Small Sample Test for Means, Student's t-test for Single Sample, Two Samples and Paired t test. F test; Chi-Square Test in 2x2 Contingency Table, Yates' 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 equations. 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.

Frequency distribution: Construction of table and its graphical representation, histogram, frequency polygon, frequency curve, bar chart, pie chart, scatter diagram, line diagram. Measures of mean; mode, standard deviation, variance and coefficient of variation, percentiles, quartile, and median for raw and grouped data. Tests of Significance: Large sample and small sample test: Z test, Student's t-test, F test; Chi-Square test. 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 equations. Analysis of Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design.

Concept of production function, Demand and supply curves, Engel curve, Input-output analysis, Static and dynamic models of economics, Single and simultaneous equation models, Identification, Method of estimation of parameters: Maximum likelihood and least squares, Multi-collinearity, Autocorrelation, Time series analysis, and Index number.

Sampling versus complete enumeration, Sampling errors and non- sampling errors, Simple random sampling; with replacement and without replacement, Estimation of population mean and population proportion and their standard errors and Stratified Random Sampling.

For M.Sc.(Hort.):

Course out line for M.Sc. (Horticulture) Entrance Examination

Economic importance and classification of horticultural crops; Layout and establishment of orchards; training and pruning; planting systems; vegetable gardens; cropping systems; nursery management; propagation structures; methods of propagation; nutritive value of fruits, plantation, vegetables and spices and their role in human nutrition. Growth and development of horticultural crops; physiology of ripening in fruits and vegetables; important physiological disorders of different horticultural crops; manures and fertilizers; systems of irrigation; protected cultivation of horticultural crops; management of important pests and diseases of fruits, plantation crops, flowers, vegetable and spice crops; organic horticulture.

Seed germination; maintenance of genetic purity of a variety; seed quality; seed certification; seed storage; seed treatment; seed production; hybrid seed production.

Mendelian genetics; breeding system; DNA as genetic material; methods of crop improvement; male sterility and self-incompatibility; pure line and pedigree selection; backcross, mass selection; heterosis; mutation breeding; alteration of ploidy; clonal breeding; different *in vitro* culture; somaclonal variation; embryo culture; micro-propagation.

Propagation, climatic requirement and cultivation practices of fruits like mango, litchi, banana, citrus, guava, jack fruit, sapota, custard apple, bael, ber, aonla, pomegranate, grape, pineapple, papaya, apple, pear, peach, olive, plum, strawberry.

Propagation, climatic requirement and cultivation practices of major plantation crops like coconut, cashew nut, tamarind, betel vine, areca nut, cocoa, coffee, rubber, tea, bamboo.

Propagation, climatic requirement and cultivation practices of major vegetable crops like cole crops (cauliflower, cabbage, broccoli, Brussels sprouts, knol khol), cucurbits (pumpkin, bitter gourd, bottle gourd, ridge gourd, muskmelon, watermelon, cucumber, pointed gourd), root and tuber crops (radish, carrot, beet, tapioca, sweet potato, amorphophallus), leafy vegetables (leaf amaranth, fenugreek, palak, basella); solanaceous crops (tomato, chillies, sweet pepper, brinjal), leguminous crops (garden pea, cowpea, lablab bean, cluster bean) and others (okra, moringa, asparagus)

Propagation, climatic requirement and cultivation practices of major spice crops like, black pepper, coriander, turmeric, ginger, garlic, onion, garlic, fenugreek, fennel, black cumin, opium poppy, ajowan, dill, celery, vanilla, cinnamon, clove, nutmeg and medicinal crops like, Rauwolfia, Dioscorea, Isabgul, Datura, Cinchona, etc.

Different ornamental plants (trees, shrubs, climbers, creepers, palms, herbaceous perennials, annuals); ornamental planning; bonsai; propagation, climatic requirement and cultivation practices of 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, dry flowers; garden design; objectives and potential of agro-forestry.

Food and nutrients; physio-chemical properties of fruits and vegetables; maturity indices of different horticultural crops; ripening and storage factors affecting deterioration of horticultural produce; principles and methods of processing and preservation of horticultural crops; different products of fruits and vegetables; quality parameters and specifications; pre- and post- harvest treatment of fruits, vegetables and flowers for storage; storage system; packaging methods.

For M.Tech.(Ag. Engg.):

Code 10: MAJOR SUBJECT GROUP “K” - AGRICULTURAL ENGINEERING AND TECHNOLOGY

(Subjects: **K-1:** Soil & Water Conservation Engg., **K-2:** Irrigation & Drainage Engg./Irrigation & Water Management Engineering, **K-3:** Agri. Process & Food Engg./Processing & Agri. Structures/Process Engg./P.H.T., **K-4:** Farm Implements & Machinery/ Farm Power and Machinery,

K-5: Bio-energy including Renewable Energy Sources)

UNIT-I : Elementary Statistics and theory of probability, differential and integral calculus, linear algebra and Fourier series, differential equations, vector algebra & vector calculus, elementary numerical analysis.

UNIT-II: Electric motors: Types, performance, selection, installation and maintenance, measuring instruments, fundamentals of computers, power distribution.

UNIT-III: Thermodynamic principles; fluid mechanics, theory of machines

UNIT-IV: Soil mechanics, soil classification, compaction & shear strength of soils, engineering mechanics, strength of materials

UNIT-V:- Importance of farm equipment and role of mechanization in enhancing productivity & profitability of Indian agriculture; analysis of forces, design and production of farm machinery and power units; mechanics of tillage & traction operation, repair and maintenance of farm machines and equipment, farm engines; tractors and power tillers; tractor stability and operators comfort; field capacity and cost analysis; test codes and procedure; safety and ergonomic principles. Role of energy in economic development; solar, wind and bio-energy; biogas plants & gasifiers; biofuels from biomass; collection, characterization and storage of biomass, solar cookers & solar refrigerators.

UNIT-VI:- Biochemical and engineering properties of biological materials; quality control & safety of raw and finished products. Principles, practices and equipments for drying, milling, separation and storage of agricultural produce and by-products; material handling equipment and operations; farmstead planning; heating & cooling load calculation; seed processing practices and equipments; food preservation methods and products development; refrigeration and air conditioning; cold stores; waste management, cost analysis & food processing plants layout, feasibility reports

UNIT-VII: Surveying and leveling; hydrology, water resources in India; efficiency in water use; irrigation system and equipment; water conveyances and associated efficiency; soil-plant-water relationship; estimation of evaporation and water requirements of crop; water harvesting and use, farm ponds and reservoirs, command area development, land use capability classification, ground water development, wells and pumping equipment, soil erosion and its control, land shaping and grading equipment and practices, hydraulic structures, drainage of irrigated and humid areas; salt balance and reclamation of saline and alkaline soils.

Code 11: MAJOR SUBJECT GROUP “L” - WATER SCIENCE AND TECHNOLOGY

(Subject: **L-1:** Water Science and Technology)

Unit-I: Importance of Agriculture in national economy; basic principles of crop production; cultivation of rice,