AGRONOMY

Agron. 1.1 : Introductory Agriculture and Principles of Agronomy 3 (2+1)

Theory

Art, Science and business of crop production, Basic elements of crop production; Factors affecting crop production; History of Agricultural Development; Ancient India Agriculture in Civilization Era, Chronological Agricultural Technology development in India. Indian Agriculture, balance sheet, liabilities; Assets and Contrasting trends (DATA), Agril. growth, contrasting food chains, Diversity in physiography, Soil groups, marine, livestock and water; Liabilities: Soil factors, weather factors, Economic ecology, dry and irrigation agriculture, Farming Systems approach, value addition, requirements in new technology; Women in Agriculture: multifaceted roles and tasks, work stress factors, Nutritional and rural life standards, role in house hold design making, drudgery reduction for farm women, women friendly agricultural technology; Empowerment of women; Group dynamics for farm women, rural women; The nucleus of Agricultural Extension and Training.

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

Practical

Study of tillage implements; Practice of ploughing; Practice of puddling; Study of seeding equipments. Different methods of sowing; Study of manures, fertilizers and green manure crops / seeds (including calculations); Study of intercultivation implements and practice; Practice of methods of fertilizer applications; Participation in ongoing field operations.

Agron. 1.2 : Field Crops-I (Kharif) 3 (2+1)

Theory

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of kharif crops, Cereals – rice, maize, sorghum, pearl millet and minor millets; Pulses : pigeonpea, mungbean and urdbean; Oilseeds: groundnut, sesame and soybean; Fibre crops: cotton, jute and sunhemp; and Forage crops: sorghum, maize, cowpea, cluster bean and napier.

Practical

Rice nursery preparation and transplanting/seed bed preparation and sowing of Kharif crops; Calculations on seed rate; Sowing of soybean, pigeonpea, mungbean, maize, groundnut, and cotton; Effect of seed size on germination and seedling vigour of soybean/groundnut; Effect of sowing depth on germination of soybean; Identification of weeds in rice, maize and soybean fields and study of weed control experiments in these crops; Top dressing of nitrogen in maize and rice and study of fertilizer experiments on rice, maize, sorghum and millets; Study of yield contributing characters, yield calculations, harvesting and yield estimation of above crops; Study of crop varieties and important agronomic experiments; Study of forage experiments.

Agron.2.3 : Field Crops- II (Rabi) 3 (2+1)

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops; Cereals: wheat, barley; Pulses: chickpea, lentil, peas, french bean; Oilseeds: rapeseed and mustard, sunflower, safflower and linseed; Sugar crops: sugarcane and sugarbeet, Medicinal and aromatic crops such as citronella, palma rosa and isabgol; Commercial crops: potato and tobacco, Forage crops: lucerne and oat.

Practical

Seed bed preparation and sowing of wheat, sugarcane and sunflower; Calculations on seed rate; Top dressing of nitrogen in wheat and study of fertilizer experiments on wheat and mustard; Identification of weeds in wheat and grain legumes, application of herbicide and study of weed control experiments; Morphological characteristics of wheat, sugarcane, chickpea and mustard; Yield contributing characters of wheat; Yield and quality analysis of sugarcane; Crop

distribution in the state and the region; Important agronomic experiments of rabi crops and visit to research stations related to rabi crops.

Agron.3.4 : Practical Crop Production-I (Kharif Crops) 1 (0+1)

Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

Agron.3.5 : Weed Management 2 (1+1)

Theory

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. 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; 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. Herbicide resistant crops.

Practical

Terminology used in weed management. Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, parthenium, tiger and jhonson grass; Economics of weed control practices; Tours and visits of problem areas.

Agron.4.6 : Practical Crop Production II (Rabi Crops) 1 (0+1)

Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect-pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

Agron.5.7 : Water Management Including Micro Irrigation 3 (2+1)

Theory

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

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection

and flushing of laterals; Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, biocarbonates, Ca++ and Mg++ in irrigation water (quality parameters).

Agron.6.8 : Organic Farming **2 (1+1)**

Theory

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

Practical

Raising of vegetable crops organically through nutrient, diseases and pest management; vermicomposting; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management.

Agron.6.9 : Farming Systems and Sustainable Agriculture **2 (1+1)**

Theory

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.

Practical

Preparation of cropping scheme for irrigated situations; Preparation of cropping scheme for dryland situations; Study of existing farming systems in nearby villages; Preparation of integrated farming system model for wetlands; Preparation of integrated farming system model for drylands; Preparation of enriched Farm Yard Manure; Preparation of Vermicompost; Visit to urban waste recycling unit; Study of profitable utilization of agricultural wastes; Visit to poultry and dairy units to study resource allocation, utilization and economics; Visit to an organic farm to study various components and utilization; Study of degraded lands.

PLANT BREEDING AND GENETICS

PBG 1.1 : Economic Botany **2 (1+1)**

Theory

Introduction and history of economic plants, Classification and importance of economic plants. Agriculturally important crop plants: Cereals, pulses and oilseeds, vegetables, spices and condiments, fruits and nuts; fibre yielding plants, forage crop plants. Industrially important plants: Sugar, starch and cellulose plants; fumitory and masticatory plants; beverages, dyes ad tannins, gums and resins, rubber; drug plants – medicinal plants, plant insecticides, wood and timber plants. Ethnobotany, common adulterants, toxins and teratogens.

Practical

Taxonomic status of food plants, industrial plants and drug plants; Identification and extraction of Phytochemicals and valuable plant products; Propagation of Plants; Agricultural and Industrial uses of plants.

PBG 2.2 : Principles of Genetics 3 (2+1)

Theory

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

Practical

Microscopy (Light microscopes and electron microscopes; Preparation and use of fixatives and stains for light microscopy; Preparation of micro slides and identification of various stages of mitosis; Preparation of micro slides and identification of various stages of meiosis; Monohybrid ratio and its modifications; Dihybrid ratio and its modifications; Trihybrid ratio; Chi-square analysis and Interaction of factors; Epistatic factors, Supplementary factors and Duplicate factors; Complementary factors, Additive factors and Inhibitory factors; Linkage – Two point test cross; Linkage – Three point test cross; Induction of polyploidy using colchicines; Induction of chromosomal aberrations using chemicals.

PBG 3.3 : Principles of Plant Breeding 3 (2+1)

Theory

Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding – introduction and acclimatization. Selection, Mass selection Johannson's pure line Theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, Hardy-Weinberg Law; recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement. Plant Genetic Resources, their conservation and utilization in crop improvement; ideotype concept in crop improvement; breeding resistance to biotic and abiotic stresses, variability in pathogens and pests; Mechanisms of resistance in plant pathogens 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 on yield/ performance, IPR and its related issues.

Practical

Study of megasporogenesis and microsporogenesis; Fertilization and life cycle of an angiospermic plant; Plant Breeder's kit; Hybridization techniques and precautions to be taken; Study of male sterility and incomapribility in field plots. Handling of segregating generations, Problems on Hardy Weinberg Law; back cross methods; Field lay out of experiments; Field trials, maintenance of records and registers; Estimation of heterosis and inbreeding depression; Estimation of heritability, GCA and SCA; Estimation of variability parameters.

PBG 4.4 : Breeding of Field / Horticulture Crops 3 (2+1)

Theory

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Study in respect of origin, distribution of species, wild relatives and forms, Cereals, (rice, wheat, maize, millets, sorghum, bajra, ragi); Pulses (redgram, greengram, blackgram, soybean, chickpea); Oilseeds (Groundnut, sesame, sunflower, safflower, castor, mustard) etc. Fibers (Cotton, kenaf, roselle, jute) etc. Vegetables (Tomato, bhindi, chilli, cucumbers); Flowers crops (Chrysanthemum, rose, galardia, gerbera & marigold); Fruit crops (aonla, guava, sapota, mango, custard apple, banana, papaya) vegetatively propagated crops(sugarcane,potato); Major breeding procedures for development of hybrids / varieties of various crops. Classification of plants, Botanical description, Floral biology, Emasculation and Pollination techniques in cereals, millets, pulses, oilseeds, fibres, plantation crops etc.

Practical

Emasculation and Hybridization techniques; Parentage of released varieties/hybrids; Study of quality characters; Sources of donors for different characters; Visit to seed production and certification plots; Visit to AICRP trials and programmes; Visit to grow out test plots; Visit to various research stations; Visit to other institutions. Handling of segregating generations, pedigree methods; Handling of segregating generations, bulk methods. Botanical description and floral biology; Floral morphology, selfing, emasculation and crossing techniques in following crops : Rice and Sorghum; Maize and Wheat; Bajra and Ragi; Sugarcane and Coconut; Groundnut, Castor, Safflower and Sesamum; Redgram, Bengal gram and Greengram; Soybean, Gram and Blackgram; Chilies, Brinjal and Tomato; Bhindi, Onion, Bottle gourd and Ridge gourd; Cotton and mesta; Jute and Sunhemp.

PBG 5.5 : Principles of Seed Technology 3 (2+1)

Theory

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

storage and conditions required for good storage, General principles of seed storage, constructional features for good seed warehouse, measures for pest and disease control, temperature control, Seed marketing, marketing structure, marketing organization, sales generation activities, promotional media, pricing policy; Factors affecting seed marketing.

Practical

Seed sampling principles and procedures; Physical Purity analysis of Field and Horticultural crops; Germination analysis of Field and Horticultural crops; Moisture tests of Field and Horticultural crops; Viability test of Field and Horticultural crops; Seed health test of Field and Horticultural crops; Vigour tests of Field and Horticultural crops; Seed dormancy and breaking methods; Grow out tests and electrophoresis for varietal identification; Visit to Seed production plots of Maize, Sunflower, Bajra, Rice, Sorghum, Cotton, Chillies and Vegetables. (Add or delete crops of the region); Visit to Seed processing plants; Visit to Seed testing laboratories; Visit to Grow out testing farms; Visit to Hybrid Seed Production farms; Varietal identification in seed production plots; Planting ratios, isolation distance, roguing etc.

PBG 6.6 : Principles of Plant Biotechnology **3 (2+1)**

Theory

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

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoricsis techniques.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Ag.Chem.1.1 : Introduction to Soil Science **3 (2+1)**

Theory

Soil: Pedological and edaphological concepts, 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 Colour, Elementary knowledge of soil classification and soils of India; Soil water, Retention and potentials, Soil moisture constants, Movement of soil water, Infiltration, percolation, permeability, Drainage, Methods of determination of soil moisture 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.

Practical

Determination of bulk density and particle density, Aggregate analysis, Soil strength, Soil moisture determination, Soil moisture constants – Field capacity Inflitration rate, water holding capacity, soil texture and mechanical analysis – Soil temperature. Analytical chemistry – Basic concepts, techniques and calculations – Collection and processing of soil for analysis – Organic carbon, pH, EC, soluble cations and anions – Study of a soil profile – Identification of rocks and minerals.

Ag.Chem.2.2 : Soil Chemistry, Soil Fertility and Nutrient Management 3 (2+1)

Theory

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. Irrigations 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 method 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 and Zn fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

Practical

Principles of analytical Instruments and their calibration and applications, Colorimetry and flame photometry. Estimation of available N, P, K, S, and Zn in oils, pH, EC, soluble cations and anions in soil water extracts. Lime requirement and gypsum requirement of problem soils. Estimation of N, P and K in plants.

Ag.Chem.6.3 : Manures, Fertilizers and Agro-Chemicals 3 (2+1)

Theory

Introduction – Raw materials – Manures – Bulky and concentrated – FYM, Composts – Different methods, Mechanical compost plants, Vermicomosting, 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, diammonium phosphate, ammonium poly phosphate), 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, Organic chemistry as prelude to agro chemicals, Diverse types of agrochemicals, Botanical insecticides (Neem), Pyrethrum, Synthetic pyrethroids. Synthetic organic insecticides, Major classes, Properties and uses of some important insecticides under each class. Herbicides – Major classes – Properties and uses of 2, 4-D, atrazine, glyphosate, butachlor benthiocarb; Fungicides – Major classes – Properties and uses of carbendazim, carboxin, captan, tridemorph and copper oxychloride – Insecticides Act, Plant growth regulators.

Practical

Total nitrogen and phosphorus in manures / composts – Ammoniacal and nitrate nitrogen – Water soluble P2O5, potassium, calcium, sulphur and zinc contents of fertilizers COD in organic wastes – Adulteration in fertilizer. Argentimetric and iodometric titrations – their use in the

analysis of lindane metasystox, endosulfan, malathion, copper and sulphur fungicides – Compatibility of fertilizers with pesticides.

ENTOMOLOGY

Ag.Ento.3.1 : Insect Morphology and Systematics 3(2+1)

Theory

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, modifications and wing coupling apparatus. Structure male and female genetalia. 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, Blatidae, Odonata, Isoptera, Termitidae, Thysanoptera, Thripidae, Hemiptera, Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae, Neuroptera, Chrysopidae Lepidoptera, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Coleoptera, Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae, Hymenoptera, Tenthridinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae, Diptera, Cecidomyiidae, Trypetidae, Tachinidae, Agromyziidae.

Practical

1. Methods of collection and preservation of insects including immature stages.
2. External features of Grasshopper/Blister beetle.
3. Types of insect antennae, mouthparts and legs.
4. Wing venation, types of wings and wing coupling apparatus
5. Types of insect larvae and pupae.
6. Dissection of digestive system in insects
7. Dissection of male and female reproductive systems in insects
8. Study of characters of orders Orthoptera, Dictyoptera, Odonata and their families of agricultural importances
9. Study of characters of orders Isoptera, Thysanoptera and their families of agricultural importances
10. Study of characters of orders Hemiptera and their families of agricultural importances
11. Study of characters of orders Lepidoptera, Neuroptera and their families of agricultural importances.
12. Study of characters of orders Coleoptera and their families of agricultural importances.
13. Study of characters of orders Hymenoptera and their families of agricultural importances.
14. Study of characters of orders Diptera and Neuroptera and their families of agricultural importances.

Ag.Ento.4.2 : Insect Ecology and Integrated Pest Management Including Beneficial Insects 3 (2+1)

Theory

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 & transgenic plant 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, Cyclodiens, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazimes, Thiourea derivaties, 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.

Practical

Study of terrestrial and pond ecosystems of insects; Studies on behaviour of insects and orientation (repellency, stimulation, deterancy); Study of distribution patterns of insects, sampling techniques for the estimation of insect population and damage; Pest surveillance through light traps, pheremone traps and field incidence; Practicable IPM practices, Mechanical and physical methods; Practicable IPM practices, Cultural and biological methods; Chemical control, Insecticides and their formulations; Calculation of doses/concentrations of insecticides; Compatibility of pesticides and Phytotoxicity of insecticides; IPM case studies; Identification of beneficial insects – Pollinators, weed killers and scavengers.

Ag.Ento.5.3 : Pests of Field Crops and Stored Grain and their Management 3 (2+1)

Theory

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 (Eleucine coracana), wheat, sugarcane, cotton, sunhemp, pulses, groundnut, castor, gingerly, safflower, sunflower, mustard, cumin, fennel, spinch, amaranthus and tobacco,. Common phytophagous mites, rodents and bird pests

Practical

Identification of pests, their damage symptoms and management of rice and pearl millet; sorghum, maize and wheat; sugarcane; cotton; pulses; tobacco; cumin, fennel and spinach; groundnut, sesamum, sunflower; castor, mustard and safflower; Identification of common phytophagous mites and their morphological characters; Identification of rodents and bird pests.

Ag.Ento.6.4 : Pests of Horticultural Crops and their Management 2 (1+1)

Theory

Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of vegetable crops viz., brinjal, okra, tomato, potato, cruciferous and cucurbitaceous vegetables, leafy vegetables sweet potato, colacasia, morinage spcies crops viz., chillies, onion, turmeric garlic, ginger, coriander and curry leaf; fruit tress viz., mango, sapota, citrus, banana, cashew pomegranate, custard apple, aonla, ber, guava and plantation crops viz. coconut and date palm and ornamental plants.

Practical

Identification and nature of damage of pests of solanaceous crops; malvaceous vegetables; cruciferous crops; cucurbitaceous crops; chillies, onion and garlic ; turmeric ginger and colacasia; curry neem, leafy vegetable and coriander; mango and sapota; guava, pomegranate

and custard apple; citrus, ber moringo and aonla; coconut and date palm; banana and cashew; ornamental plants.

AGRICULTURAL ECONOMICS

Ag.Econ.2.1 : Principles of Agricultural Economics 2 (2+0)

Theory

Economics: Meaning, Definition, Subject matter, Divisions of Economics, Importance of Economics; Agricultural Economics: Meaning, Definition; Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare. Wants: Meaning, Characteristics, Classifications of Wants, Importance. Theory of consumption: 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. National Income: Concepts, Measurement. Public Resource: Meaning, Services Tax, Meaning, Classification of Taxes: Cannons of Taxation, Inflation: Meaning, Definition, Kinds of inflation.

Ag.Econ.3.2 : Agricultural Marketing, Trade and Prices 2(1+1)

Theory

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, GATT, WTO. 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.

Practical

Identification of marketing channels; Study of Rythu Bazars, Regulated markets; Study of unregulated markets; Study of livestock markets; Price spread analysis; Visit to market institutions, NAFED; Analysis of information of daily prices; Marketed and marketable surplus of different commodities.

Ag.Econ.4.3 : Agricultural Finance and Co-operation 2 (1+1)

Theory

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, World Bank, Insurance and Credit Guarantee Corporation of India. Assessment of crop losses, determination of compensation. Crop insurance, advantages and limitations in application. Agricultural cooperation: philosophy and principles. History of Indian cooperative Movement, pre-independence and post independence

periods, cooperative credit structure: PACS, FSCS. Reorganisation of single window system. Successful cooperative systems in Gujarat, Maharastra, Punjab etc.

Practical

Factors governing use of Capital and identification of credit needs; Time value of money, Compounding and discounting; Tools of financial management, Balance sheet, Income statement and cash flow analysis; Estimations of credit needs and determining unit costs; Preparations and analysis of loan proposals; Types of repayment loans; Study of financial institutions: PACS, DCCB, Apex Banks, RRBs, CBs, NABARD.

Ag.Econ.5.4 : Fundamentals of Agril. Business Management (Including Project Development, Appraisal and Monitoring) 2(1+1)

Theory

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, Polices, 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.

Practical

Study of input markets: seed, fertilizers, pesticides. Study of output markets, grains, fruits, vegetables, flowers. Study of product markets, retail trade commodity trading, and value added products. Study of financing institutions cooperatives commercial banks, RRBs, Agribusiness Finance Limited, NABARD; Preparations of projects, Feasibility reports; Project appraisal techniques; Case study of agro-based industries.

Ag.Econ.6.5 : Production Economics and Farm Management 2 (1+1)

Theory

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 Organizations of farm business. Types and systems of farming. Farm planning and budgeting. Risk and uncertainty. Farm budgeting.

Practical

Computation of cost concepts; Methods of computation of depreciation; Analysis of Net worth statement; Farm inventory analysis; Preparation of farm plans and budgets; Types of farm records and accounts; Preparation of profit and loss account; Break, Even analysis; Economics analysis of different crop and livestock enterprises; Application of Farm Management Principles.

AGRICULTURAL ENGINEERING

Ag.Engg.2.1 : Fundamentals of Soil-Water Conservation Engineering 3 (2+1)

Theory

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

Practical

Acquaintance with chain survey equipment; Ranging and measurement of offsets; Chain triangulation; Cross staff survey; Plotting of chain triangulation; Plotting of cross staff survey; Levelling equipment – dumpy level, levelling staff, temporary adjustments and staff reading; Differential leveling; Profile leveling; Contour survey – grid method; Plotting of contours; Study of centrifugal pumping system and irrigation water measuring devices; Study of different components of sprinkler irrigation systems; Study of different components of drip and sprinkler irrigation systems; Uniformity of water application in drip and sprinkler systems; Study of soil and water conservation measures.

Ag.Engg.3.2 : Farm Power and Machinery 2 (1+1)

Theory

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

Practical

Study of different components of I.C. Engine; Study of working of four stroke engine; Study of working of two stroke engine; Study of M.B. plough, measurement of plough size, different parts, horizontal and vertical suction, determination of line of pull etc.; Study of disc plough; Study of seed–cum-fertilizer drills-furrow opener, metering mechanism, and calibration; Study, maintenance and operation of tractor; Learning of tractor driving; Study, maintenance and operation of power tiller; Study of different parts, registration, alignment and operation of mower. Study of different inter cultivation equipment in terms of efficiency, field capacity; Repairs and adjustments and operation of sprayers; Repairs and adjustments and operation of dusters; Study of paddy transplanters

Ag.Engg.5.3 : Protected Cultivation and Post Harvest Technology 2 (1+1)

Theory

Green house technology, Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air green house heating systems, green house drying. Cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems / constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT) / hydroponics. Threshing, threshers for different crops, parts, terminology, care and maintenance. Winnowing, manual and power operated winnowers, care and maintenance. Groundnut decorticators, hand operated and

power operated decorticators, principles of working, care and maintenance. Maize shellers & castor shellers. Drying, grain drying, types of drying, types of dryers. Storage, grain storage, types of storage structures. Fruits and vegetables cleaning, machinery for cleaning of fruits and vegetables, care and maintenance. Grading, methods of grading, equipment for grading of fruits and vegetables, care and maintenance. Size reduction. equipment for size reduction care and maintenance. Evaporation, Principle, types of evaporators, quality standards – FAQ, ASTA, FPO, FDA.

Practical

Study of different types of green houses based on shape, construction and cladding

materials; Calculation of air rate exchange in an active summer winter cooling system; Calculation of rate of air exchange in an active winter cooling system; Estimation of drying rate of agricultural products inside green house; Testing of soil and water to study its suitability for growing crops in greenhouses; The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization; Visit to commercial green houses; Study of threshers, their components, operation and adjustments; Winnowers, their components, operation and adjustements; Study of different components of groundnut decorticator; Study of maize shellers; Study of castor shellers; Study of improved grain storage structure; Study of dryers; Study of cleaners & graders.

Ag.Engg.6.4 : Renewable Energy **2 (1+1)**

Theory

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

Practical

Constructional details of KVIC & Janatha type biogas plants; Constructional details of Deen Bandu type biogas plants; Field visit to biogas plants; Constructional details of different types of gasifiers; Testing of gasifiers; Briquette preparation from biomass; To study and find the efficiency of solar cooker; To study and find the performance of a solar still; To study and find the performance of a solar dryers; Study and working of solar photovoltaic pumping system; Study and performance evaluation of domestic solar water heater; Study and performance evaluation of solar lantern; Study and performance evaluation of solar street light; To study the performance of different types of wind mills; Field visit to wind mills; To study the processing of Bio-diesel production from Jatropha.

AGRICULTURAL METEOROLOGY

Ag.Met. 2.1 : Agricultural Meteorology **3 (2+1)**

Theory

Earth's atmosphere, Composition, division of atmosphere. Sun-earth relationship, season, weather and climate. Pressure and wind systems, cyclone and anticyclone. Condensation, precipitation, clouds, Indian monsoon. Meaning and scope of Agricultural meteorology. Importance of weather and climate in agricultural production. Microclimate, crop-weather-pest disease relationship. Climatic hazards in crop production-Droughts and frost. Hear unit concept

and its application in India. Potential evapotranspiration and its estimation. Weather forecasting. Agro-climatic zones of India in general and Gujarat in particular.

Practical

Study of meteorological observatories, its site selection and layout. Study of different types of thermometers and psychrometers. Study of rainfall and evaporation measurement instruments. Study of radiation measurement instruments. Study of wind measurement instruments. Calculation of RH, VP and dew point temperature. Estimation of heat indices. Analysis of rainfall data for climatological studies. Estimation of PET by Thornthwaite and Penman methods. Estimation of net radiation using weather parameters.

PLANT PATHOLOGY

Pl.Path.1.1 : Introductory Plant Pathology 2 (1+1)

Theory

Introduction, Important plant pathogenic organisms, different groups, fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viriods, algae, protozoa and phanerogamic parasites with examples of diseases caused by them. Prokaryotes: classification of prokaryotes according to Bergey's Manual of Systematic Bacteriology. General Characters 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.

Practical

Acquaintance to plant pathology laboratory and equipments; Preparation of culture media for fungi and bacteria; Isolation techniques, preservation of disease samples; Study of Pythium, Phytophthora and Albugo; Study of Sclerospora, Peronosclerospora, Pseudoperonospora, Peronospora, Plasmopara and Bremia; Study of genera Mucor and Rhizopus. Study of Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula and Podosphaera; Study of Puccinia (different stages), Uromyces, Hemiliea; Study of Sphacelotheca, Ustilago and Tolyposporium; Study of Agaricus, Pleurotus and Ganoderma; Study of Septoria, Colletotrichum, Pestalotiopsis and Pyricularia; Study of Aspergillus, Penicillium, Trichoderma, and Fusarium; Study of Helminthosporium, Drechslera, Alternaria, Stemphyllium, Cercospora, Phaeoisariopsis, Rhizoctonia and Sclerotium.

Pl.Path.3.2 : Principles of Plant Pathology 2 (1+1)

Theory

Introduction: Definition and objectives of Plant Pathology. History of Plant Pathology. Terms and concepts in Plant Pathology. Survival and Dispersal of Plant Pathogens. Phenomenon of infection – pre-penetration, penetration and post penetration. Pathogenesis – Role of enzymes, toxins, growth regulators and polysaccharides. Defense mechanism in plants – Structural and Bio-chemical (pre and postinfection). Plant disease epidemiology. Plant Disease Forcasting – Remote sensing – General principles of plant diseases management – Importance, general Principles – Avoidance, exclusion, protection – Plant Quarantine and Inspection – Quarantine Rules and Regulations. Cultural methods – Rougeing, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage. Role and mechanisms of biological control and PGPR. Physical Methods – Heat and Chemical methods – Methods of application of fungicides. Host plant resistance – Application of biotechnology in plant disease management –Development of disease resistant treansgenic

plants through gene cloning. Integrated plant disease management (IDM) – Concept, advantages and importance.

Practical

Demonstration of Koch's postulates; Study of different groups of fungicides and antibiotics; Preparation of fungicides – Bordeaux mixture, Bordeaux paste, Chestnut compound; Methods of application of fungicides – seed, soil and foliar; Bio-assay of fungicides – poisoned food technique, inhibition zone technique and slide germination technique; Bio-control of plant pathogens – dual culture technique, seed treatment. Visit to quarantine station and remote sensing laboratory.

Pl.Path.5.3 : Diseases of Field Crops and their Management 3 (2+1)

Theory

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of diseases of rice, sorghum, bajra, maize, wheat, sugarcane, turmeric, tobacco, groundnut, sesamum, sunflower, cotton, redgram, bengalgram, blackgram, greengram, soybean, castor, mustard, hill millet and jatropha.

Practical

Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases. Presentation of disease samples survey and collection of Diseases of rice, sorghum; Diseases of wheat, bajra & maize; Diseases of sugarcane, turmeric & tobacco; Diseases of groundnut, castor & sunflower; Diseases of sesamum & cotton; Diseases of redgram, greengram, blackgram, bengalgram & beans; Field visits at appropriate time during the semester

Note : Students should submit 50 pressed, well mounted diseased specimens in three installments during the semester.

Pl.Path.6.4 : Introductory Nematology 2 (1+1)

Theory

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.

Practical

Methods of survey – sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following combined Cobb's decanting – sieving and Baermann funnel technique, counting and estimation of plant parasitic nematodes; Preparation of temporary and permanent mounts; Method of preparation of perineal patterns for identification of species of Meloidogyne; Study and identification of most important plant parasitic nematodes with special reference to their characteristics and symptomtolgy – Meloidogyne, Pratylenchus; Heterodera, Ditylenchus, Globodera, Tylenchulus, Xiphinema, Radopholus, Rotylenchulus, and Helicotylenchus. Experimental techniques used in pathogenicity studies with root knot nematode.

Pl.Path.6.5 : Diseases of Horticultural Crops and their Management 3 (2+1)

Theory

Economic Importance, symptoms, cause, disease cycle and integrated management of diseases of: ber, cumin, fennel, coriander, cluster bean, marry gold, garlic, citrus, mango, banana, grapevine, pomegranate, papaya, guava, sapota, apple, chilli, brinjal, bhendi, potato, crucifers, cucurbits, tomato, beans, onion, coconut, coffee, tea, rose and chrysanthemum

Practical

Diseases of beans, citrus, guava, & sapota; Diseases of papaya, banana, pomegranate & ber; Diseases of mango, grapes & apple; Diseases of chilli, brinjal & bhendi; Diseases of potato, tomato & crucifers; Diseases of cucurbits, onion & betelvine; Diseases of oil palm, coconut, tea, coffee & mulberry; Diseases of rose, chrysanthemum and jasmine. Field visits at appropriate time during the semester.

Note : Students should submit 20 pressed, well mounted diseased specimens in three installments during the semester.

HORTICULTURE

Hort.1.1 : Production Technology of Fruit Crops **3 (2+1)**

Theory

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

Practical

Study of horticultural tools and implements and their uses; Containers, potting mixture, potting, depotting and repotting; Plant propagation, seed propagation, scarification, and stratification; Propagation by cuttings (soft wood, hard wood and semi-hardwood) layering (simple layering, Air layering, stooping in guava); Layout and planting systems (Traditional system and high density planting methods); Methods of pruning and training; Training of ber, grape and pomegranate; Pruning of ber, grape, phalsa, fig, apple, pear, peach; Description and identification of varieties of mango, guava, grape, papaya, apple and sapota; Description and identification of varieties of banana, citrus, (lime lemon, sweet orange, mandarin, grape fruit) pomegranate, ber, pear and cherries; Irrigation methods in fruit crops including drip – Micro irrigation methods of establishment of orchard; Methods of Fertiliser application methods in fruit crops including fertigation technology; Visit to local commercial orchards; Preparation of growth regulators, powder, solution and lanolin paste for propagation; Application of growth regulators for improving fruit set, fruit size, quality, delaying ripening and hastening ripening. Budding and Grafting in concede crop.

Hort.3.2 : Production Technology of Vegetables and Flowers **3 (2+1)**

Theory

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

Practical

1 Planning and layout of kitchen garden; 2 Identification of important vegetable seeds and plants; Raising of vegetable nurseries; Identification of ornamental plants (trees, shrubs,climbers,house plants,palms etc.,) and development of garden features; Transplanting of vegetable seedlings in main field; Layout of lawns and maintenance; Depotting, repotting and maintenance of house plants; Visit to commercial vegetable farms; Training and pruning of rose (standards, hybrid 'T' roses cented roses) and chrysanthemum (pinching and disbudding); Planning and layout of gardens and garden designs for public and private areas; Intercultural operations in vegetable plots; Seed production in vegetable crops; Harvesting indices of different vegetable crops; Grading and packing of vegetables; Prolonging the shelf life of cut flowers.

Hort.4.3 : Production Technology of Spices, Aromatic, Medicinal and Plantation Crops 3 (2+1)

Theory

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

Practical

Botanical description and identification of aromatic plants; Identification of varieties in spices and plantation crops; Identification of medicinal plants; Propagation techniques in aromatic and spice crops; Selection of mother palm, and seed nuts in coconut and oil palm; Study of identification of aromatic plants; Distillation procedures for aromatic crops; Propagation methods in plantation crops; Propagation and planting methods in turmeric; Propagation and planting techniques in ginger; Harvesting procedures in aromatic plants; Processing and curing of spices (ginger, turmeric and black pepper); Training methods in betelvine; Rejuvenation practices in cashewnut; Products – byproducts of spices and plantation crops; Procedures for oleoresin extraction; Visit to local commercial plantations. Aromatic & medicinal plant nurseries and seed spices field.

Hort.5.4 : Post Harvest Management and Value Addition of Fruits and Vegetables 2 (1+1)

Theory

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

Practical

Practice in judging the maturity of various fruits and vegetables. Conservation of zero energy cool chambers for on farm storage. 3& 4. Determination of physiological loss in weight (PLW), total soluble solids (TSS), total sugars, acidity and ascorbic and content in fruits and vegetables. Packing methods and types of packing and importance of ventilation. Pre cooling packing

methods for export or international trade. Methods of prolonging storage life. Effect of ethylene on ripening of banana, sapota, mango, sapota. Identification of equipment and machinery used is preservation of fruits and vegetables. Preservation by drying and dehydration. Preparation of jam, jelly and marmalades. Preparation of squash, cordials and syrups. Preparation of chutneys, pickles sauces and ketchup. Visit to local processing units. Visit to local market yards and cold storage units. Visit to local market and packing industries.

AGRICULTURAL EXTENSION

Ag.Extn.3.1 : Dimensions of Agricultural Extension 2 (1+1)

Theory

Education – Meaning, Definition, Types – Difference between Formal education and Informal education and their Characteristics. Extension Education and Agricultural Extension – Meaning, Definition, Concepts, Objectives and Principles. Rural development – Meaning, Definition, Objectives, Importance and Problems in rural development. Developmental programmes of pre-independence era (Only Name of the programme, Year of starting and Name of Initiators) – Sriniketan, Marthandam, Gurgaon experiment and Gandhian constructive proprogramme. Community Development Programme and Development programmes of Post independence era- (Only Name of the programme, Year of starting and Name of Initiators) Firka Development, Etawah – Pilot project and Nilokheri Experiment, Community Development and Extension Education and National Extension service. Agricultural Development Programmes – (Only Name of the programme and Year of starting) Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP). Panchayat Raj system – Meaning of Democratic – Decentralization and Panchayat Raj, Meaning of Three tiers of Panchayat Raj system. Social Justice and Poverty alleviation programmes (Only Name of the programme, Year of starting and Beneficiaries of programmes) – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarojgar Yojana (SGSY), Chief Minsiter Employment Yojana (CMEY). Women Development programmes – (Only Name of the programme, Year of starting and Beneficiaries of programmes)- Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS) and Mahila Samriddi Yojana (MSY). Reorganized extension system (T&V System) – objectives, Key features, Organizational structure and limitations Meaning, objectives, needs and principles of Broad Based Extension (BBE) ATIC - Year of starting , Objectives and Major Activities ATMA- Year of starting , Objectives, Organizational Structure and role Extension Programme Planning – Meaning, Definitions of Planning, Programme, Project, Importance and Steps in Programme planning Process. – This topic is included in this course and deleted from course “Extension methodologies for transfer of agricultural technology”

Practical

Visits and study of a village Panchayat, Participation in bi-monthly workshops of Training and Visit (T & V) System. Visit to a village to study the Self Help Groups (SHGs). Visit to a voluntary organization to study the developmental activities. Visit to Sardar Smruti Kendra – As a Farmers’ Training, Information cum Communication centre. Visit to ATIC run by university. Preparation of Interview Schedule to collect information from farmers : Personal Information, Social Information, Extension Contacts, Economic, Crop Grown, Problems of Agriculture, Information of Milch animals, Problems in Animal husbandry

Ag.Extn.4.2 : Fundamentals of Rural Sociology and Educational Psychology 2 (2+0)

Theory

Sociology and Rural Sociology-Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society-Important characteristics, Differences and Relationship between Rural and

Urban societies. Social Groups – Meaning, Definition and types of social groups Social Stratification, Meaning and Definitions, Forms of Social Stratification Definitions of Class & Caste System. Definitions of Cultural concepts – Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions. Definitions of Social Values and Attitudes Types and importance of Social Values and Attitudes in Agricultural Extension. Social Institutions – Meaning, Definition, Major institutions in Rural society, Functions and their Role in Agricultural Extension. Social Organizations – Meaning, Definition. Social Control – Meaning, Definition and mechanism Social change – Meaning, Definition. Leadership – Meaning, Definition, Classification, Roles of a leader, Different methods of Selection of Professional and Lay leaders. Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension. Intelligence, Personality, Perception, Instincts, Emotions and Frustrations – Meaning, Definition and importance in Agricultural Extension. Motivation – Meaning, Definition, Motivation cycle, Types, Classification of Motives, Techniques of motivation and Role of Motivation in Agricultural Extension. Teaching – Learning process – Meaning and Definition of Teaching, Learning, Learning experience and Learning situation, Elements of learning situation and its characteristics.

Ag.Extn.5.3 : Extension Methodologies for Transfer of Agricultural Technology 2 (1+1)

Theory

Communication – Meaning, Definition, Models, Elements and their Characteristics, Types and Barriers in communication. Extension teaching methods – Meaning, Definition, Functions and Classification. Individual contact methods – Meaning and definition of Farm and Home visit, Result Demonstration

Group contact methods – Meaning and definition of Group discussion, Method demonstration, Field Trips. Small group discussion techniques – Meaning and definition of Lecture, Symposium, Panel, Debate, Forum, Buzz group, Workshop, Brain Storming, Seminar and Conference. Mass contact Methods – Meaning and definition of Campaign, Exhibition, Kisan Mela, Radio & Television – Meaning. Factors influencing in selection of Extension Teaching Methods. Innovative Information sources – Definitions of Internet, Cyber Cafes, Video and Tele conferences, Kisan call centers. Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Types, Merits and Limitations. Diffusion and Adoption of Innovations – Meaning, Definitions, Steps of adoption Process, Adopter categories and their characteristics, Factors influencing adoption process. KVK in Capacity building of Extension Personnel and Farmers

Practical

Simulated exercises on communication. Identification of farming needs. Study and Visit to KVK. Study and Visit to Information Communication Centre. Preparation of scripts for Radio and Television. Identification, Meaning, Importance and Classification of Audiovisual aids – Organization of Group discussion and Method demonstration, Selection, Planning and Preparation of visual aids - Charts, Posters.

Selection, Planning and Preparation handling - Over Head Projector (OHP), Transparencies, Power Point. Preparation of Agricultural Information materials – Leaflet, Folder, Pamphlet, News Stories, Success Stories. Handling of Public Address Equipment (PAE) System, Still camera, Video Camera and Liquid Crystal Display (LCD) Projector.

Ag.Extn.6.4 : Entrepreneurship Development 2 (1+1)

Theory

Entrepreneur behaviour, Entrepreneur development, Entrepreneur management – Meaning, Concepts, Need for enterprise emergence and characteristics of an entrepreneur. External Environmental factors – Economic, Social, Cultural, Technological, Situational and Legal requirements for establishment of a new unit Establishment of a small business – Identification of a sound enterprise, Feasibility report and Project proposal, Availability of raw materials, technology, skills and Record keeping. Knowledge, Skill, Infrastructure and Policy support for entrepreneurship development. Marketing plan, market survey, methods of data collection, forecasting market demand, sustainability of enterprise. Technical Appraisal – Factors to be

considered for technical appraisal and Personnel training. Financial Appraisal – Estimation of financial requirements, financial viability, cost benefit analysis, preparation of balance sheet

Project formulation- Project description, physical infrastructure, plant layout, pollution control, communication system, transportation, requirement of machinery and equipment, licensing procedures, tax assessment. Special issues relating to potentials and failure of enterprise in production, finance, marketing and SWOT analysis

Practical

1, 2 & 3	Exercise on Project – identification, preparation, management, implementation and evaluation
4 & 5	Identification of emerging enterprises in agricultural sector
6	Exercise on preparation of balance sheet
7	Exercise on cost benefit analysis
8, 9 & 10	Visit to two public sector enterprises to analyze and draw lessons
11 & 12	Visit to two private sector enterprises to analyze and draw lessons
13 & 14	Preparation of individual business plan
15 & 16	Presentation of enterprise and business plans

BIO-MATHEMATICS

Maths.1.1 : Bio-Mathematics 2 (2+0)

Theory

Continuous functions. Point of discontinuities of the function. Differentiation and integration of function and its applications like in making grain silo and water tank, to use minimum fencing material, to decide number of plants to get maximum yield etc. maxima and minima of one and two variables. Length of the arc of a Cartesian and Parametric co-ordinate curve, Area under the curve. Variable-Separable differential equations. Applications in pest control using specific growth and decay rate equations. Vector integration and differentiation giving applications of velocity and acceleration of a moving particle.

MICROBIOLOGY

Ag.Micro.2.1 : Agricultural Microbiology 3 (2+1)

Theory

History of Microbiology: Spontaneous generation theory, Role of microbes in fermentation, Germ theory of disease, Protection against infections, Applied areas of Microbiology Metabolism in bacteria: ATP generation, chemoautotrophy, photo autotrophy, respiration, fermentation. Bacteriophages: structure and properties of Bacterial viruses – Lytic and Lysogenic cycles: viroids, prions. Bacterial genetics; Gene expression; Genetic recombination: transformation, conjugation and transduction, genetic engineering, Plasmids, episomes, genetically modified Organisms. Soil Microbiology: Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting. Microbiology of Water. Microbiology of food: microbial spoilage and principles of food preservation. Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases, Biodegradation, Biogas production, Biodegradable plastics, Plant – Microbe interactions.

Practical

General instructions, Familiarization with instruments, materials, glassware etc. in a microbiology laboratory: Practice of Aseptic methods: I - Evaluation of aseptic technique with Nutrient broth tubes. II- Evaluation of aseptic technique with a Nutrient agar plate. Methods of Sterilization and Preparation of media I- Preparation of nutrient broth, nutrient agar plates, nutrient agar slant and nutrient agar stabling; II- Sterilization of glassware by Dry heating; III - Sterilization of nutrient broth by Filtration. Plating methods for Isolation and Purification of bacteria I - Isolation of bacteria by Streak plate method. II - Isolation of aerobic spore forming bacteria by Enrichment using Streak plate method. III - Checking of

purity of a bacterial culture by Streak plating method. Identification of bacteria by staining methods and Biochemical tests: I– Morphological examination of bacteria by Simple and Differential staining. II – Different biochemical tests for identification of bacterial culture; Enumeration of bacteria: I - Enumeration of bacteria by Stain slide method. II- Enumeration of bacteria by Most probable number method. III - Enumeration of bacteria by Pour plate method and Spread plate method.

PHYSIOLOGY

Pl.Phy.3.1 : Crop Physiology-I **3 (2+1)**

Theory

Introduction, Definition of Crop Physiology, Importance in Agriculture and Horticulture. Growth and Development – Definition, Types of growth, determinate and indeterminate growth, monocarpic and polycarpic species with examples, Measurement of growth, Growth analysis, growth characteristics, definitions and mathematical formulae. Photosynthesis – Energy synthesis, significance of C3, C4 and CAM pathway relationship of photosynthesis and crop productivity – Translocation of assimilates, phloem loading, apoplastic and symplastic transport of assimilates, source and sink concept, photorespiration – Factors affecting photosynthesis and productivity, Management of photosynthesis for productivity, methods of measuring photosynthesis, photosnthetic efficiency, dry matter partioning, harvest index of crops. Respiration and its significance, importance of glycolysis, TCA cycle, Pentose phosphate pathway. Growth respiration and maintenance respiration, alternate respiration, salt respiration, wound respiration, measurement of respiration. Control of flowering – Photoperiodism and Vernalisation in relation to crop productivity, classification of plants, commercial application of photoperiodism. Plant growth regulation – occurrence, biosynthesis, mode of action of auxins, gibberellings, cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture and horticulture. Senescence and abscission – Definition, classification, theories of mechanism and control of senescence, physiological and biochemical changes and their significance. Abscission and its relationship with senescence. Post harvest, physiology – Fruit ripening, metamorphic changes, climateric and non-climacteric fruits, hormonal regulation of fruit ripening (with etherel, CCC, Polaris, Paclobuterozole) – use of hormones in increasing vase life of flowers

Practical

Growth analysis: Claculation of growth parameters. Measurement of water potential by Chardakov's method. measurement of absorption spectrum of chloroplastic pigments and fluorescence. Measurement of leaf area by various methods. Stomatal frequency and index. Leaf anatomy of C3 and C4 plants. Plant growth regulators and their effect on plant growth. Yield analysis. Effect of ehylene on regulation of stomata. To demonstrate that the light is necessary for photosynthesis. To demonstrate that the CO2 is essential for photosynthesis (Moll's half leaf experiment).

Pl.Phy.4.2 : Crop Physiology-II **2 (1+1)**

Theory

Seed Physiology – Seed structures, Development of embryo, endosperm, perisperm and seed coat, Morphological, Physiological and biochemical changes during seed development.

Physiological maturity, morphological and physiological changes associated with physiological maturity in crop with examples, harvestable maturity, seed viability and vigour, factors affecting seed viability and vigour. Methods of testing seed viability and vigour, germination, utilization of seed reserves (carbohydrates, fats and proteins) during seed germination, morphological, physiological and biochemical changes during seed germination, factors affecting seed germination. Crop water relations including absorption, translocation, active and passive absorption of water, list of factors, ascent of sap with theories. Transpiration – Definition, significance, transpiration in relation to crop productivity-antitranspirant, list of factors. Nutriophysiology – Definition, Mengel's classification of plant nutrients, physiology of nutrient uptake, functions of plant nutrients, deficiency and toxicity symptoms of plant nutrients, foliar nutrition, hydroponics, solution and sand culture. Post harvest physiology – Seed dormancy, definition, types of seed dormancy advantages and disadvantages of seed dormancy, causes and remedial measures for breaking seed dormancy with examples – Optimum conditions of seed storage, factors influencing seed storage (ISTA standards).

Practical

Preparation of solutions. Methods of measuring water status in roots, stems and leaves. Imbibitions of seed. Optimum conditions for seed germination. Breaking seed dormancy : i) Chemical method ii) Mechanical methods. Seed viability and vigour tests.

BIOCHEMISTRY

Biochem.4.1 : Biochemistry **3 (2+1)**

Theory

Biochemistry – Introduction and importance. Plant cell, cell wall and its role in live stock, food and paper industries. Bio-molecules – Structure, properties & applications: Amino acids, peptides and proteins –Plant proteins and their quality. Enzymes –Factors affecting the activity, classification, Immobilistion and other industrial applications. Lipids –Acyl lipids, Their industrial application in soaps, detergents, paints, Varnishes, lubricants, adhesives, plastics, nylon, Bio-diesel, Biodegradable plastics etc. Carbohydrates; Nucleotides and Nucleic acids. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. General reactions of amino acid degradation. Biosynthesis – carbohydrates, Lipids, Proteins and Nucleic acids. Metabolic regulation. Secondary metabolites, Terpenoids, Alkaloids, Phenolics and their applications in food and pharmaceutical industries.

Practical

Amino acid models (atomic); Paper electrophoresis for the separation of plant pigments; Protein denaturation – heat, pH, precipitation of proteins with heavy metals, Protein estimation by Lowry method; Enzyme kinetics, competitive inhibition, enzyme immobilization; Extraction of nucleic acids, column chromatography of RNA hydrolysate; Characterization of lipids by T.L.C.; Extraction of oil from oil seeds; Estimation of fatty acids by G.L.C.; Models of sugars, sucrose & starch; Quantitative determination of sugars; Paper chromatography for the separation of sugars; Determination of phenols.

ENVIRONMENTAL SCIENCES

Envs.6.1 : Environmental Science **2 (1+1)**

Theory

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Forest, Water, Food, energy and land resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow

in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation. Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Causes, effects and management of soil nuclear hazards and industrial wastes. Disaster management, Floods, earthquakes, cyclones and land slides. Social issues and the environment, unsustainable to sustainable development. The Environment Protection Act, The Air Act, The water Act, The Wildlife Protection. Act and Forest Conservation Act. Woman and child welfare, HIV/AIDS and Role of information technology on environment and human health.

Practical

Collection, processing and storage of effluent samples; Determination of Bio-Chemical oxygen demand (BOD) in effluent sample; Determination of chemical oxygen demand (COD) in effluent sample; Estimation of dissolved oxygen in effluent samples; Determination of sound level by using sound level meter; Estimation of respirable and non respirable dust in the air by using portable dust sampler; Determination of total dissolved solids (TDS) in effluent samples; Estimation of species abundance of plants; Estimation of nitrate contamination in ground water; Analysis of temporary and total hardness of water sample by titration; Estimation of pesticide contamination in Agro-Ecosystem; Visit to Social Service Organization / Environmental Education Centre; Crop adaptation to environmental variables, soils conditions; Study of transpiration and water balance in plants; Visit to a local polluted site. Observations and remedial measures; Assessment of chlorophyll content of fresh water / sea water ecosystem.

STATISTICS AND COMPUTER APPLICATION

Ag.Stat.1.1 : Introduction to Computer Applications 2 (1+1)

Theory

Introduction to Computers, Anatomy of Computers, Input and Output Devices. Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Types of Processors, booting of computer, warm and cold booting. Computer Viruses, Worms and Vaccines. Operating System – DOS and WINDOWS. Disk Operating System (DOS): Some fundamental DOS Commands, FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE, Rules for naming files in DOS and Types of files. WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders; setting time and date, starting and shutting down of WINDOWS. Anatomy of a WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. Applications – MSWORD: Word, processing and units of document, features of word-processing packages. Creating, Editing, Formatting and Saving a document in MSWORD; MSEXCEL: Electronic Spreadsheets, concept, packages. Creating, Editing and saving a spreadsheet with MSEXCEL. Use of in-built Statistical and other functions and writing expressions. Use of Data Analysis Tools, Correlation, Regression, t-test for two-samples and ANOVA with One-way Classification. Creating Graphs. MS Power Point: Features of Power Point Package. MSACCESS: Concept of Database, Units of database, creating database; Principles of Programming: Flow Charts and Algorithms, illustration through examples. Internet: World Wide Web (WWW), Concepts, Web Browsing and Electronic Mail.

Practical

Study of Computer Components; Booting of Computer and its Shut Down; Practice of some fundamental DOS Commands, TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PATH; Practicing WINDOWS Operating System, Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars; WINDOWS Explorer, Creating Folders, COPY and PASTE functions; MSWORD: Creating a Document, Saving and Editing; MSWORD, Use of options from Tool Bars, Format, Insert and Tools (Spelling & Grammar) Alignment of text; MSWORD, Creating a Table, Merging of Cells, Column and Row width; MSEXCEL: Creating a Spreadsheet, Alignment of rows, columns and cells using Format tool bar; MSEXCEL: Entering Expressions through the formula tool bar and use of inbuilt functions, SUM,

AVERAGE, STDEV; MSEXCEL: Data Analysis using inbuilt Tool Packs, Correlation & Regression; MSEXCEL: Creating Graphs and Saving with & without data; MSACCESS: Creating Database, Structuring with different types of fields; MS Power Point: Preparation of slides on Power Point; Transforming the data of WORD, EXCEL and ACCESS to other formats; Internet Browsing: Browsing a Web Page and Creating of E-Mail ID.

Ag.Stat.2.2 : Agricultural Statistics **3 (2+1)**

Theory

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: 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.

Practical

Construction of Frequency Distribution Tables and Frequency Curves; Computation of Arithmetic Mean for Un-Grouped and Grouped data; Computation of Median for Un-Grouped and Grouped data; Computation of Mode for Un-Grouped and Grouped data; Computation of Standard Deviation, Variance and Coefficient of Variation for Un-Grouped and Grouped data; SND test for Means, Single Sample; SND test for Means , Two Samples; Student's t-test for Single Sample; Student's t-test for Two Samples; Paired t test and F test; Chi-Square Test in 2x2 Contingency Table, Yates' Correction for continuity; Computation of Correlation Coefficient 'r' and its testing; Fitting of regression equations- Y on X and X on Y; Analysis of Completely Randomized Design (CRD); Analysis of Randomized Block Design (RBD); Analysis of Latin Square Design (LSD).

ANIMAL PRODUCTION

LPM .4.1 : Principles of Livestock Production and Management **2 (1+1)**

Theory

General discourse on origin, domestication and utility of farm animals and their role in Indian economy, Animal Husbandry methods in India and abroad, Definitions of common terms pertaining to various species of livestock, Introduction to common feeds and fodders, their classification and utility, Utility classification of breeds of cattle, Study of important breeds of indigenous and exotic cows and buffaloes, Selection and Pairing of bullocks, breaking for work , hours of work for bullocks, various types of work to which they can be put, care of neck and hoof care and management of bullocks.

Practical

Study of external anatomy of cattle and its importance in selection. Judging and Pairing of bullocks. Measuring and weighing. Use of common restraints used in different animals. System of identification of livestock. Determination of age of cattle. Methods of securing and casting of animals. Identification of common feeds and fodders.

LPM.5.2 : Dairy Cattle & Buffalo Production & Management 3 (2+1)

Theory

Importance of dairy industry in India, Importance of co-operative movement of dairy industry in India, Impact of WTO on Indian dairy Industry, concepts of feeding standards, ration, balanced ration, feeds and water requirements of the herd. Preservation and storage of forages as silage and hay. Scarcity feeding of bovines, Management of pastures, Calf rearing, Care Management, feeding and housing of various classes of dairy cattle and buffaloes. Summer management of buffalo, Mammary gland, milking and clean milk production. Problems of supply and demand of milk in India, Introduction to processing, preservation and marketing of milk, Systems of mating, Selection, Aids to selection and methods of selection for improving dairy cattle and buffaloes. Artificial insemination and breeding policies, project planning, loans and subsidies, Economics of dairy farming and atomization.

Practical

Visit to a dairy farm, judging dairy cattle by outward appearance and scorecard. Selection by pedigree, performance and progeny testing methods, Preparing animal for show, Identification and evaluations of feeds, Calculation of water and feed requirement for dairy herd, Computation of ration, Hay and silage making, study of records on a dairy farm, Housing of dairy cattle and buffalo, dairy herd health calendar, calving event and related things, Sampling and testing of milk for fat and total solids, Separation of milk, Visit to modern commercial dairy plant and cattle feed factory.

ENGLISH

Eng.1.1 : Comprehension and Communication Skills in English 2(1+1)
(Non- credit course)

Theory

Comprehension: Text for comprehension, Current English for Colleges, By N. Krishnaswamy & T.Sriraman, Macmillan India Limited, Madras, 1995; War Minus shooting – The sporting spirit George Orwell (a) Reading Comprehension (b) Vocabulary – Synonyms – Antonyms – Often confused words and (c) Two exercises to help the students in the enrichment of vocabulary based on TOEFL and GRE and other competitive examinations. A Dilemma – A layman looks at science Raymond B. Fosdick (a) Reading Comprehension (b) Vocabulary – Homonyms and Homophones (c) Exercises on Figurative Language & Idiomatic Language (E.g.: dust and ashes, doorstep of doom, boundaries of knowledge, Apple of one's eye, in a fix etc). 5&6 You and Your English – Spoken English and Broken English G.B.Shaw (a) Reading Comprehension (b) Language study, Functional Grammar, Agreement of verb with subject. Written Skills: Mechanics of good letter, Effective business correspondence, Personal Correspondence, Preparation of Curriculum vitae and Job applications. The Style, Importance of professional writing –Choice of words and Phrases, precision, conciseness clichés, redundancy, jargon, foreign words, Precis writing and synopsis writing. Interviews, Types of interviews, purpose, different settings, as interviewer, interviewee, physical makeup and manners, appearance, poise, speech, self reliance, Evaluation process, Review or feedback.

Practical

Listening Comprehension: Listening to short talks, lectures, speeches (scientific, commercial and general in nature) Practical: listening to at least two tape, recorded conversations aimed at testing the listening comprehension of students; Communication: Spoken English, oral communication, importance stress and intonation. Practical: Spoken English practice by using audiovisual aids, the essentials of good conversations, oral exercises in conversation practice (At the Doctor, at the Restaurant, at the Market Yard); Oral Presentation of Reports: Seminars and conferences, features of oral presentation, regulating speech, physical appearance, body language posture, eye contact, voice, audience, preparation of visual aids. Practical: One presentation by individual on the given topic related to agriculture like W.T.O, Developing new technologies in Agriculture, Bio fertilizers etc.; Evaluation of a Presentation: evaluation sheet,

other strategies to be considered for evaluating a presentation, Practical: Mock evaluation of a presentation; Dyadic communication, face to face conversation, Telephonic conversation, rate of speech, clarity of voice, speaking and listening politeness, telephone etiquette, Practical: Practice of Telephonic conversation; Reading skills, using Dictionary, reading dialogues, rapid reading, intensive reading, improving reading skills; Meetings: purpose, procedure participation, chairmanship, physical arrangements, recording minutes of meeting; Practice of Presentation by using power point and LCD projector; Conducting Mock interviews – testing initiative, team spirit, leadership, intellectual ability – potential for development, memory, motivation, objectives, aptitude etc., Group Discussions and Debates on current topics; Review or Feed Back; Practical examination.

A Text-book as per the recommendation of the course teacher to give the students structural exposure in writing.

Listening Comprehension - Listening and writing, Filling in the blanks – Listening and answering the questions

Reading Comprehension and Vocabulary

Filling in the blanks - Cloze Exercises – Vocabulary building – Reading and answering questions.

Speaking:

Phonetics: Intonation – Ear Training – Correct Pronunciation – Sound recognition exercises - Common Errors in English

Conversations: Face to Face Conversation - Telephone conversation –

Structuring the resume / report – Letter writing / E-mail communication

Eng.4.2 : English for Special Purpose (Non- credit course) 2 (1+1)*

Presentation Skills

Elements of an effective presentation – Structure of a presentation –

Presentation tools – Voice Modulation – Audience analysis – Body

Language – Video Samples

Soft Skills

Time Management – Articulateness – Assertiveness – Psychometrics –

Innovation and Creativity – Stress Management & Poise – Video Samples

Group Discussion

Why is GD part of selection process? – Structure of a GD – Moderator-led

and other GDs – Strategies in GD – Team work – Body Language – Mock GD – Video Samples

Interview Skills

Kinds of Interviews – Required Key Skills – Corporate culture – Mock

Interviews – Video Samples

NON-CREDIT COURSES

PE 1.1 & 2.2 : Physical Education-I 1 (0+1)

Definition, aims and objectives and principles of Physical Education, Definition Tournament, Bye and various types. Drawing lots for fixtures in various tournaments viz., Knockout, Knockout-cum-league and League-cum-knock-out, Track and field events such as sprint and throwing. Compulsory participation in any one of the games viz., Out door games – Volleyball, Basketball, Cricket, Football, Kabaddi, Khp-Kho, etc. and Indoor games- Table Tannis, Chess and badminton.

Warming up and conditioning exercise are compulsory for each student.

OR

National Cadet Core (NCC) **1 (0+1)**

Introduction and aim of NCC, Military history and Organization, System of NCC Training. Foot Drill, Arm Drill, Guard of Honour, Ceremonial Parade, Weapon Training – Rifel, LMG, Stem machine Carbine. Field Training – Field Craft, Battle Craft, Fire control and Fire discipline orders Tactices.

OR

National Service Scheme **1 (0+1)**

NSS Historical Back Ground, Emblem history, Aim and objectives of NSS; NSS volunteer; Duties of NSS volunteers, Education and Recreation; Programmes for working during emergencies; Environment enrichment and Conservation; Health; Family Welfare and Nutrition programme.

PE 3.3 & 4.3 Physical Education-II **1 (0+1)**

Definition of single and double league tournaments and drawing of lots, indoor games, importance of weight and circuit training exercise. Yogasenes, Tract and field – long distance and jumping events. Preparation of running tracks, Vollyball and Kabaddi, Knowledge exercise in Physiothereaphy, First aid and health education.

Warming up and conditioning exercise are compulsory for each student

OR

National Cadet Core (NCC) **1 (0+1)**

Map readings, Civil defense, Self defense, First aid, Hygiene and Sanitation, Leadership traits, Adventure training. National integration in India, Aim, NI camps, Social service-aim, major social service, Nature awareness/ ecology – Forest, Wide life, Pollution.

OR

National Service Scheme **1 (0+1)**

Production oriented programme, Social service programme, Preserving environment free from pollution, other activities undertaken depending on local needs and priorities, songs and National Integrity Songs, One day camps, Annual camp

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. RAWE

During RAWE Programme the students will undergo internship in any one of the following industries / companies / institutes for a period of twelve weeks (the list is only suggestive and need based / location specific industries may be included).

- Seed industries / companies
- Fertilizer industries
- Pesticides industries
- Biotechnological industries (Tissue Culture labs)
- Bio pesticides industries
- Commercial nurseries / landscaping units
- Sericulture units
- Food processing units
- Agricultural finance Institutions / Banks / Credit Societies etc.
- Non – Governmental organizations

Rural Agricultural Work Experience (RAWE) (0+20) - 7th Semester- As Per following Model

Sr. No	Subject	CREDITS	Phase wise work (period-days)								TOTAL
			P_1	P_2	P_3	P4	P_5	P_6	P_7	P_8	
1	Agron.7.10	0+2	1	4	0	3	1	-	0		9
2	Hort.7.5	0+2	1	1	2	2	0	-	3		9
3	Ag.Chem.7.4	0+2	1	3	0	2	0	-	3		9
4	PBG.7.7	0+2	1	3	2	2	0	-	1		9
5	Ag. Engg.7.5	0+1	1	1	1	1	0	-	2		6
6	Pl. Path.7.6	0+2	1	3	0	3	0	-	1		8
7	Ag. Ento.7.5	0+2	1	3	0	3	0	-	1		8
8	LPM.7.3	0+1	0.5	0	0	2	1	-	1		4.5
9	Ag.Extn.7.5	0+2	1	1	1	1	3	-	1		8
10	Ag.Econ.7.6	0+1	1	1	0	1	0	-	2		5
11	Ag.Stat.7.3	0+1	0.5	0	4	0	0	-	0		4.5
12	Educational Tour	0+2						21			21
13	Exam. Evaluation									7	7
Total working days			10	20	10	20	5	21	15	5	106
Total Saturday for missed & extra work			2	4	2	4	1	-	3	1	17
Holidays			2	4	2	4	1	-	3	1	17
Total days			**14**	**28**	**14**	**28**	**7**	**21**	**21**	**7**	**140**

P_1 = Orientation, P_2 = Research Station, P_3 = High Tech Cell, P_4 = Village Exposure, P_5= NGO
P_6 = Educational Tour P_7 = Industries and Cooperatives P_8 =Report and Evaluation

Evaluation of RAWE Programme

Attendance
Minimum attendance for this programmme - 85%.

Records
Students shall complete the record work based on daily field observation notebooks and weekly diaries maintained by them.

Evaluation Procedure
The students shall be evaluated by Course Coordinator as well as by a designated evaluation Committee.

Note
i) The duration of the RAWEP is 20 weeks with a weightage of 20 credits;

ii) Wherever facilities are not available for industrial training and / or agri-clinics, the duration of vocational training may be increased to that extent;

iii) RAWEP is to be implemented in the VIII semester.

Features of New Curriculum
- Six semesters coursework, one semester electives in interdisciplinary courses for entrepreneurship development and one semester RAWEP. In the electives, students have flexibility to choose courses. These courses have higher practical exercises for skill updating. The proportion of theory and practical is nearly 50:50.
- Adequate expertise for agri-clinic embedded.
- Curriculum redundancy removed.
- Course curricula reoriented to develop needed knowledge skills, entrepreneurial mindset of the student to take up self employment.
- Three non-credit courses viz., Comprehension and Developing Communication Skills in English and NSS/ NCC / Physical Education are included.
- Each University may provide specialization in 4 or 5 areas keeping in view the facilities and the need.
- Introduced few new courses like Introductory Agriculture, Renewable Energy, Organic farming, Biotechnology, Agribusiness, Project Development Appraisal and Monitoring and Entrepreneurship Development.

COURSES FOR EXPERIENTIAL LEARNING
(INTER DISCIPLINARY COURSES)

A student has to register total 20 credits from following any one group in the Eighth semester B.Sc. (Hons.) Agri.

GROUP- I

CROP PRODUCTION AND COMMERCIAL AGRICULTURE

Agron.8.11 : Seed Production Technology 3 (1+2)

Theory

Introduction and importance of seed production. Seed structure and morphology. Seed viability and dormancy-types, methods to breaking seed dormancy. Maintenance of genetic purity during seed production, isolation and roughing techniques, selfing. Seed quality-concepts, importance and characteristics-Physical and genetic. Characteristic of good quality seeds. Classes of seeds-Hybrid seed (F1), Nucleus see, Breeder seed, Foundation seed, Certified seed. Genetic and agronomic principles of seed production. Production of hybrid seeds of important crops-maize bajra, cotton, castor, jowar. Seed production of self pollinated crops. Seed classification-Phases of seed production-procedure, field inspection and seed law. Seed processing, post harvest processing, seed blending, seed storage- Problems of storage- Seed testing and certification, quality control, seed treatment.

Practical

Field visit of seed production plot, Field visit of seed testing laboratory, Study of roughing and isolation, Methods of seed production-Bajra, Wheat, Maize, Castor, Vegetable crops, Study of seed germination, seed vigour and seed viability. Study of seed Sampling-Principles and procedure. Study of seed purity analysis, germination test, moisture test and conventional purity tests of different crops. Seed treatment, methods of breaking seed dormancy. Identification of seed certification tags and its importance.

Agron.8.12 : Cultivation of Commercially Important Medicinal and Aromatic Plants. 2 (1+1)

Theory

Importance of medicinal plants, historical account, origin, distribution, present status and future prospects, active principles, crop improvement, cultivation practices, organic farming techniques, GAP, GMP, protected cultivation of high value crops. Integrated pest and disease management, post harvest handling, extraction of active principles, bioprospection and uses of Clinchona, Senna, Catharanthus, Dioscorea, Solanum, Datura, Atropa, Rauvolfia, Acorus, Digitalis, Ephedra, Aconitum, Opium Poppy, Cannabis, Neem, Kaempferia, Plumbago, Artemesia, Long pepper, Alpinia, Adhatoda, Asparagus, Indigofera, Holostemma, Isabgol, Liquorice, Aloe, Safed musli, Sapan wood and Withania. Emerging plant drugs-future and prospects of medicinal plants. Plants used in local health traditions. Role of aromatic plants in Indian economy-important aromatic plants in India. Origin, distribution, Botany & crop improvement, cultivation practices, GAP, GMP organic farming techniques, integrated pest and disease management, protected cultivation of high value crops, post harvest handling, extraction of essential oil and active principles, bioprospection and uses of Lemon grass, Java citronella, Palmarosa, Vetiver, Japanese mint, Artemisia, Rose, Tuberose, Basil, Eucalyptus, Sandalwood, Geranium, Jasmine, Patchouli, Abelmoscus moschatus and under exploited and miscellaneous essential oil yielding plants.

Practical

Medicinal plants-Identification of species and varieties of medicinal plants - maintenance of herbal garden-propagation techniques-post harvest handling, techniques of extraction of active principles-study of field problems. Visit to national and regional institutes dealing with research and development of medicinal plants. Aromatic plants-Identification of species and varieties of major aromatic plant-planting and maintenance of garden-propagation techniques-post harvest handling, techniques of extraction of active principles-study on field problems. Visit to national and regional institutes dealing with R & D of aromatic plants.

Agron.8.13 : Commercial Spices Production 3 (1+2)

Theory

Importance, origin, distribution, botany, crop improvement, varieties, agro-ecological requirements, nursery techniques, establishment and maintenance of spice gardens-cultural practices- water and nutrient management, protected cultivation of seed and herbal spices-shade regulation-weed control, organic spices, integrated pest and disease management, GAP, protected cultivation of high value crops, harvesting and post harvest handling, grading, packing and marketing, commercial products, value addition, quality control in spices, problems and prospects of cultivation, medicinal and other properties, bioprospection, problem & prospects of cultivation of the following crops: Ginger, turmeric, chilli, seed spices, (coriander, cumin, fennel, fenugreek, mustard) and herbal spices.

Practical

Morphology and floral biology of various spices. Propagation techniques and maintaining nursery of pepper, vanilla and tree spices. Lay out and planting-maintenance of spice gardens-harvesting- on farm processing-grading-estimation of oil and oleoresin-identification of field patterns and their control. Visit to Regional and National Institutes. Visit to Plantation and factories.

Agron.8.14 : Integrataed Farming system 3 (2+1)

Theory

Farming system-Definition, scope and characteristics-classification-Historical development of F.S's in India under different situations- concepts and components of farming system-Interaction between components- cropping system-complementary and competitive interaction-Effect of preceding crops and associated crops-Indices for evaluation for cropping system-Agronomic requirements in management of cropping system, cropping scheme-Sustainable agriculture, role of farming systems in sustainable agriculture-Integrated farming systems, factors governing choice and size of enterprises and resource allocation in Integrated farming system- Models of integrated farming systems for irrigated coastal ecosystems and rainfed ecosystems. Importance and role of IFS's in organic farming, low Input sustainable agriculture and low cost agricultural technologies.

Practical

1. Preparation of cropping system for different farming situations having varying resource availability.
2. Working out input requirement and preparation of calendar of operations
3. Case studies on Integrated Farming Systems (IFS) and development of IFS for different resource situations.
4. Visit to different units of IFS.

Agron.8.15 : Water Management (Watershed Micro-Irrigation and Problematic Water) 3 (1+2)

Theory

Watershed concept-objectives of watershed management-Erosion-Types of erosion-Land use capability classification-Soil and water conservation-Engineering measures-Delineation of watershed, Inventory of natural resources in watershed, Rainfall analysis, Estimation of runoff, Contour bunds, Graded bunds, Terracing, Water Harvesting structures-Recycling of run off water-Protective and supplemental irrigations.

Agronomic measures-Suitable cropping systems, Conservation tillage techniques- In situ conservation measures.

Micro irrigation-Introduction, scope, Different types of micro irrigation systems, conventional surface and micro irrigation systems, Principles, Advantages, limitation and adoptability to crops, soil water availability, irrigation, frequency and irrigation scheduling in micro irrigated crops, Wetting pattern and wetted area under sprinklers and emitters, Fustigation -Water soluble fertilizers-Specialty fertilizers. Components of micro-irrigation system. Design and installation of systems, operation and maintenance of systems, Fustigation equipment, Uniformity coefficient, monitoring and evaluation of the systems.

Problematic water – quality of water, classification of water, Management of saline and sewerage alkaline water. Crop responses to problem waters conjunctive use of water.

Practical

1. Analysis of rainfall
2. Study of agronomic measures of soil and moisture conservation
3. Demonstration of land treatments for moisture conservation
4. Study on erosion resistant and erosion permitting crops
5. Evaluation of treatment effect on moisture conservation
6. Estimation of run off
7. Estimation of soil loss
8. Study and design of conservation structures – Contour bunds
9. Study and design of graded bunds and terrace system
10. Study of Water harvesting structures
11. Visit to CRIDA watershed
12. Visit to ICRISAT watershed
13. Estimation of crop water requirement for different vegetable crops
14. Estimation of crop water requirement for different orchard crops
15. Study of different components of sprinkler irrigation
16. Study of layout of sprinkler irrigation
17. Field determination of distribution pattern and uniformity coefficient of sprinkler system
18. Field visit to study the operation and maintenance of sprinkler system
19. Study of different components of drip irrigation
20. Study of layout of drip irrigation
21. Calculation of application rate
22. Field study of wetting patterns under an emitter in different soil types
23. Calculation of fertilizer nutrient requirement
24. Calculation of acid requirement for acid treatment
25. Calculation of chlorine requirement for chlorination
26. Field visit to study the operation and maintenance of drip system
27. Assessment and interpretation of water quality data for use in irrigation
28. Analysis of water for EC, PH
29. Determination of chemical properties of water
30. Study of economic of micro irrigation

31. Field visit to study the operation of sewerage irrigation systems
32. Practical Examination

Ag.Met.8.2 : Remote Sensing GIS and Land Use Planning 3 (1+2)

Theory

Introduction – Historic overview – Indian space programmes – Remote sensing – definition, principles, Electromagnetic spectrum (EMR) – Interaction of EMR with atmosphere and earth surface- Photogrametry -Aerial photography – types, elements of visual interpretation, phases of aerial photo interpretation. Factors affecting aerial photographic task.

Sensors – types, platforms – Features of different satellites – Imagery – Factors governing quality of images – Elements of image interpretation - Instruments - Ground truth collection - Digital Image Processing (DIP)– geo rectification – image enhancement -classification – supervised and unsupervised - accuracy assessment. Thermal infrared imagery, Radar imaging system - Application of remote sensing in different fields – meteorology, oceanography, forestry, water resources and aquaculture, urban, environmental studies – agriculture – crop inventory – acreage estimation and yield forecasting, crop condition assessment, monitoring pests and disease problems. Salinity assessment, wasteland mapping and monitoring, prioritization of watersheds and soil mapping.

Geographical Information System (GIS) – objectives, elements, data structures, errors. Applications of remote sensing and GIS – resource inventory, mapping and land use planning. Land suitability evaluation – FAO method.

Practical

Study of aerial photographs (optional) – study of photo scale – identification of cultural features using mirror stereoscope, study of heights of objects etc.

Introduction of remote sensing and GIS softwares – ERDAS/ENVI/PCI Geomatica/IDRISI/ARC info/ARC View/ARC GIS– topographic sheets – map language - reference systems – study of boarder information of satellite images - Browsing National Data Centre (NDC) website to select satellite data of study area – Loading of satellite data and preprocessing – Instruments for interpretation and transfer of data -geo rectification – image enhancement techniques – band ratioing - filtering techniques – Principle Component Analysis (PCA) – Unsupervised classification - ground truth collection (optional) - Instruments – Handling of Global Position System (GPS) - Use of Spectral radiometer –Measurement of spectral reflectances of crops and soils – calculation of spectral indices - Use of Infrared thermometer – calculation of thermal indices. Supervised classification methods – Fusion techniques - accuracy assessment .

Using arc tool box of Arc GIS -onscreen digitization, map projection, transformation, overlaying analysis, buffer analysis. Map preparation – legend, graticules, index. Linking of spatial and nonspatial data. Net work analysis. Field visit to study different land uses. Using RS and GIS in land cover analysis and mapping – Visit to any remote sensing unit (optional).

Ag.Chem.8.5 : Soil Management 3 (2+1)
(Conservation, Problematic Soil, Soil Quality)

Theory

Soil conservation: Introduction – Need for soil conservation – Soil erosion – Agents – wind and water – basic processes and types of erosion – Factors affecting soil erosion. Estimation of soil loss – USLE – SYI. Control of wind and water erosions – Mechanical, agronomical and engineering measures – Alternate land use systems for important agro ecological regions.

Problematic soils: Introduction – Soil constraints – physical, chemical and biological. Management of soil physical problems. Nature and distribution of acid and salt affected (saline, saline-alkali, alkali and calcareous) soils - Management – Agronomical and use of amendments - Quality of irrigation water – use of saline and sewage waters for agriculture. Soil pollution

problems due to use of fertilizers and agricultural chemicals for crop production. Biological degradation – soil sickness.

Soil quality: Introduction – Definition – Concept. Indexing soil quality – Agricultural sustainability index, environmental quality index and soil quality index. Potential biological, chemical and physical indicators of soil quality.

Practical

Visit to watershed area. Estimation of soil loss. Estimation of runoff. Determination of important physical properties. Determination of soil pH, EC water soluble ions, CEC and contents of exchangeable Na+ and CaCO3 . Lime requirement and gypsum requirement for management of problem soils. Irrigation water analysis for soluble cations and anions. Determination of COD and BOD of waters. Assessment of soil quality.

GROUP- II

CROP PROTECTION

Cr.Prot.8.1 : IPM and IDM (Pest Disease Scouting) 4 (2+2)

Theory

History and development of pest management. Economic decision levels for pest populations. Concepts of economic levels – dynamics of economic injury levels. Concepts of pest management – development of pest management programmes. Ecological management of the crop environment – reducing average favourability of the ecosystem, disrupting continuity of pest requisites, diverting pest population away from the crop, reducing the impact of insect injury. Components of IPM – Physical, mechanical, biological, chemical and legislative methods. Bio rational, biotechnological and other innovative approaches in IPM. Pest surveillance and sampling. Common sampling techniques in insect pest management, sampling programmes. Chemical modifiers of development and behavior – Disrupting normal growth and development, modifying behavior patterns. Ecological backlash and its management - resistance of population to pest management tactics, pest population resurgence, and replacement. IPM of rice, sugarcane, cotton, redgram, chickpea, groundnut, castor, bhendi, brinjal, cabbage, grapevine, citrus etc. Problems and constraints in implementation of IPM

Practical

1. Study of physical and mechanical methods of control
2. Study of biological control of insects
3. Study of chemical insecticides
4. Calculation of dosages of different formulation of insecticides
5. Sampling techniques of different pests
6. Estimation of population of different pests
7. Preparation and application of NPV.
8. Efficacy of BT and fungal pathogen formulations under field conditions
9. Study of pheromone and light traps
10. Preparation of poison baits
11. Study of IPM practices of Rice.
12. Study of IPM practices of cotton
13. Study of IPM practices of Groundnut
14. Study of IPM practices of coconut

15. Study of IPM practices of cabbage
16. Study of IPM practices of Chilli and Grape vine

Cr.Prot.8.2 : Management of Post Harvest Insect- Pests and Diseases 3 (1+2)

Theory

Importance of stored grain pests. Source and kinds of infestation and types of damage of stored product insects. Distribution, commodities attacked, systematic position, marks of identification, nature of damage, biology and management practices of pests associated with stored seeds/grains of cereals, pulses, vegetables, condiments, spices and dried fruits viz., Angoumois grain moth, rice moth, potato tuber moth, ware house moth, Indian meal moth, lesser grain borer, Khapra beetle, pulse beetle, groundnut bruchid, long headed flour beetle, cigarette beetle, drug store beetle, rice weevil, maize weevil, sweet potato weevil, grain lice and flour grain mite. Important species of rodents, marks of identification, nature and extent of damage and their management. Methods of household and bulk storage of food grains. Storage structures – methods of disinfection – preventive and curative measures.

Importance, nature and causes of post harvest diseases of fruits, vegetables, flowers and seeds. Diagnostic symptoms associated with post harvest diseases. Factors influencing post harvest diseases. Management of post harvest diseases of perishables and seeds.

Practicals

1. Estimation of pest damage
2. Methods of monitoring of storage pests
3. Estimation of moisture content of grains
4. Methods of testing germination of seeds
5. Identification of damage to stored grain/seed by Lepidopteran pests and Psocopteran pests

6 &7 Identification of damage to stored grain/seed by Coleopteran pests

8-9. Visit to NSC/ FCI/ WHCG

10. Study of important species of rodents
11. Storage structures for household and bulk storage of food grains
12. Calculation of concentration/dosages of pesticide fumigants for treatment in godowns.
13. Acquaintance with handling of equipment used in post harvest pathology.
14. Methods of preparation of media, isolation and identification of fungi and bacteria of post harvest importance.
15. Study of the symptoms, etiology of post harvest diseases of seeds, fruits, vegetables and flowers
16. Demonstration of different methods used in the management of post harvest diseases

Cr.Prot.8.3 : Bio-Control Agencies and Bio-Pesticide 3 (1+2)

(Mass Multiplication and Uses)

Theory

Introduction, history, concepts and principles of biological control. Parasitoids – Attributes of an effective parasitoid. Host selection by parasitoids. Enhancing parasitoid activity in crops – Habitat manipulation, behaviour controlling chemicals. Predators – strategies of insect predation – random searching, hunting, ambush, trapping. Promising biological control systems in India. Pathogenicity, virulence and factors that control the use of microorganisms. Characteristics of bacterial pathogens of insects – protein crystal toxin of Bt, mode of action, factors influencing the effectiveness, practical application, transgenic Bt plants and current status. Fungi for microbial control of insects – mode of action, current status. Viruses for microbial control of insects, viral diseases, mode of action, current status, potential of genetically

engineered baculoviruses. Safety of insect pathogens to beneficial insects, man and other vertebrates. Safety testing and registration of biological control agents. Scope and limitations of microbial control in IPM. Advantages and limitations of biological control in pest management. Role of biological control in IPM – future needs.

Definition, history, importance and concepts of biocontrol. Components of biological control – pathogen, host, antagonists, biotic and abiotic environment. Different biocontrol agents and their characteristics. Improvement of biocontrol agents by various methods. Mechanisms of biological control. Interactions of harmful and beneficial rhizospheric microbes, VAM for biocontrol. Mass multiplication of biocontrol agents by various fermentation methods like solid, liquid and semi solid methods. Quality control parameters in the production of various biopesticides used in crop disease management.

Practicals

1. Basic insectary facilities and equipment to promote biological control
2. Characters of important orders and families of parasitoids
3. Characters of important orders and families of predators
4. Mass rearing techniques of important host insects of parasitoids and predators.
5–6. Mass rearing techniques of important parasitoids
7. Mass rearing techniques of important predators
8. Collection, preservation, shipment of biotic agents and storage of natural enemies.
9. Methods of releasing parasitoids and predators.
10. Natural enemies of insect pests in rice and cotton ecosystems
11. Field trip for collection of natural enemies
12. Visit to biological control laboratory
13. Visits to mass production and biological control programme centers.
14. Description of the principal groups of infectious organisms
15. Collection of diseased insects and mites from field and Study of symptoms
16-17. Isolation and identification of pathogens
18. Preparation of culture media for fungi and culturing the fungi
19. Preparation of culture media for bacteria and culturing them
20-22. Production of NPV of *Helicoverpa armigera* and *Spodoptera litura* – extraction and purification, standardization and storage counting of PIB and larval equivalents. Formulation of microbial insecticides.
24-26. Basic techniques of isolation and testing of bioagents. A) Dilution phase technique B) Isolation of antibiotic producing organisms 1) testing antibiotic production in culture 2) Antibiotics in culture filtrate 3) Antibiotic production in soil.
27. Quantitative and qualitative analysis of rhizosphere and phyllosphere microflora.
28. In-vitro screening of fungal and bacterial antagonists
29. Mechanisms of biological control – antibiosis, lysis – parasitism – competetion
30. Mass multiplication of biocontrol agents a) For soil treatment b) For seed treatment
31. Mass multiplication by liquid, solid and semisolid fermentation technologies.
32. Measuring various quality parameters of biopesticides.

Ag.Ento.8.6 : Non-Insect Pests and Their Management 3 (1+2)

Theory

Rodents: Introduction and history of rodents in Indian Agriculture. Role of rodents in the economy of Country. Rodent pests of agricultural importance. Field and storage losses due to rodents. Taxonomy, distribution, habitat behavior, burrowing pattern, breeding potential, territoriality , activity pattern, host range, adaptation to various environments, population dynamics including population cycles. IPM- Factors controlling rodents, availability of food, cropping patterns harbourage migration, pest damage assessment and monitoring pest population. Methods of rodent management - mechanical, physical, biological, chemical bait shyness, bait preferences, placement of baits, evaluation of efficacy of bait. Poisons - anticoagulant rodenticides , fumigants antifertility agents etc. Other methods - sanitation, rodent proof structures, electromagnetic repellents etc. Rodent management in crops like rice,

sugarcane, coconut and threshing floors, industrial premises and godowns. Organization of rodent management campaigns.

Agricultural Ornithology: Introduction and importance of birds in Indian Agriculture, phytophagous bird species, yield losses, seasonal activity, host range, feeding behavior and management of bird pests.

Fruit Bats: Seasonal activity, host range, nature of damage and management .

Snails and Slugs: Important species of agricultural importance, nature of damage, host range, seasonal activity, chemical and biological methods of control.

Crabs: Important species of agricultural importance, nature of damage, host range and management.

Phytophagous Nematodes: Importance and systematic position of nematode. General morphology and biology. Important species of phytophagous nematodes, nature and extent of damage and management .

Phytophagous Mites: General morphology and biology in brief. Important species of mites of Agricultural importance, nature and extent of damage and their management.

Practicals

1. Identification of important rodent species in different habitats.
2. Burrow patterns and feeding habits of important rodent species.
3. Pre baiting and baiting with poisons.
4. Fumigation of burrows.
5. Rodent management in rice and sugarcane field.
6. Identification of birds associated with agricultural crops.
7. Breeding biology and food habits of birds.
8. Crop protection measures –traditional and modern methods.
9. Study of external morphology of phytophagous mite species.
10. Diagnostic study of symptoms caused by different groups of mites on different crops.
11. Assessment of efficacy of acaricides.
12. Soil sampling methods and storage of soil samples for nematode extraction.
13. Extraction of nematodes from soil – Baermann funnel.
14. Study of important species of nematodes.
15. Study of symptoms caused by nematode species .
16. Study of snails , slugs and crabs.

Ag.Ento.8.7 : Apiculture **2 (0+2)**

Practicals

1 & 2. Study of important species of honey bees
3. Study of Langstroth's bee hive and Newton's bee hive
4. Study of the equipment for handling of bees
5. Method of honey extraction by using honey extractor

6& 7 Study of nectar and pollen yielding flora

8 Starting of a new Apiary
9 Study of management of bee colonies in dearth period
10 Study of management of bee colonies in winter season
11 Division and uniting of colonies
12 Rearing of new queens by artificial queen grafting technique
13 Methods of Queen introduction into a new colony and Queen replacement
14 Method of artificial queen bee insemination
15 Transport of bee colonies and migratory bee keeping

16,17 &18. Study of effect of honey bees as pollinators on the yield of crops
19.&.20. Study of effect of pesticides on honey bees
21. Methods of honey analysis
22. Study of bacterial diseases of honey bees
23 & 24. Study of viral and fungal diseases of honey bees
25. Study of parasitic mites on honey bees
26. Study of wax moths, bee eater birds and other enemies of bees
27. Method of collection of Royal Jelly
28. Method of collection of Bee Venom
29. Economics of bee keeping
30. Visit to honey processing unit
31.&.32. Visit to apiaries

Ag.Ento.8.8 : Pesticides and Plant Protection equipment 3 (1+2)

Theory

Pesticides- History, Production and Consumption of pesticides in India and world. Types of pesticides-insecticides, fungicides, herbicides, nematicides, rodenticides, Acaricides, fumigants etc. Registered/banned/ restricted pesticides. Groups of insecticides and their mode of action-cyclodienes, organo phosphates, carbamates, synthetic pyrethroids, other novel insecticides. Groups of fungicides and their mode of action-copper, sulphur, hetero cyclic nitrogen compounds, miscellaneous,systemic fungicides. Groups of herbicides and their mode of action. Biopesticides – plant and animal origin, microbial pesticides – bacteria, fungi, viruses and entomo pathogenic nematodes. Pesticide formulations, mixtures and adjuvants. Factors affecting toxicity of pesticides-abiotic & biotic. Resistance to pesticides, resurgence of insects and residues of pesticides. Methods of application of insecticides- Seed treatment, stem application, seedling root dip, root zone placement, whorl application. Methods of application of fungicides- Foliar sprays, dusts ,seed treatment, soil treatment and post harvest application. Methods of application of herbicides – Foliar and soil application. Pesticide application technology- Types of sprays on basis of droplet size and volume of spray fluid. Pesticides and Environment- Effect on soil, water, air and biota. Safe handling and use of pesticides, symptoms of poisoning and First aid. Pesticide use in Agriculture, Veterinary, Public Health and Forestry.

Practicals

1. Study of contact, stomach and fumigant toxicity of insecticides.
2. Preparation of dust and EC formulation of insecticides
3. Demonstration of methods of application of insecticides
4. Calculation of concentration/doses of different formulations of insecticides.
5. Demonstration of methods of application of fungicides
6. Calculation of concentration/doses of fungicides and herbicides
7. Preparation of Bordeaux mixture, Bordeaux paste and Chestnut compound
8. Bioassay of fungicides/herbicides-demonstration of poisoned food technique
9. Bioassay of fungicide-demonstration of slide germination and inhibition zone methods
10. Biocontrol of plant pathogens- demonstration of dual culture technique using Trichoderma viride, T. harzianum against any soil borne plant pathogen
11. Demonstration of seed treatment with biocontrol agent and fungicide
12. Demonstration of methods of application of herbicides
13. Study of types of herbicide treatments
14. Demonstration of non-selective control of weedy vegetation in non-cropped areas
15. Methods of treating bush and trees by herbicides
16. Visit to pesticide manufacturing units.

Pl.Path.8.7 : Mushroom Cultivation **2 (0+2)**

Practical :

1. Importance of Mushrooms and types of cultivated Mushrooms
2. Morphology of types of Mushrooms.
3. Materials required for Mushrooms cultivations and their functions .
4. Preparation of media and slants
5. Isolation and maintenance of Mushrooms cultures
6. Spawn preparation
7. Preparation of materials for Mushrooms beds
8. Hot water treatment, shade dry and Mushrooms bed laying
9. Cultivation of different species of pleurotus
10. Cultivation of paddy straw Mushroom
11. Casing soil preparation and cultivation of temperature tolerant button Mushroom (Agaricus bitorquis)
12. Disease and pests of Mushroom identification and their management
13. Post harvest handling of Mushrooms different methods of drying and packing of Mushrooms.
14. Collection of locally available Mushrooms and their identification
15. Enumeration of microbial population of Spawn, Compost, Casing soil of Mushrooms
16. Mushrooms culture preservation Techniques
17. Problem in Spawn preparation and their management
18. Machinery, Equipment and Instruments in the Mushrooms production and processing
19. Preparation of spore prints of Mushrooms
20. Visit to private Mushrooms firm.

GROUP- III

HORTICULTURE AND POST HARVEST TECHNOLOGY AND VALUE ADDITION

Hort.8.6 : Commercial Vegetable Production 3 (1+2)

Theory

Importance of Vegetables in human diet. Vegetable regions and climatic requirement. Seed treatment, preparation of germination media, containers and growing of nurseries of different vegetables. Hardening of seedlings. Soil requirement, planting and after care, manures, fertigation, irrigation, inter cultural operations such as weeding, mulching, training and pruning, use of plant growth regulators, harvesting, post harvest handling, curing, storage, marketing and exports in vegetable crops like tomato, brinjal, chillies, sweet pepper, okra; cucurbitaceous crops like cucumber, gherkins, gourds, watermelon and muskmelon; leguminaceous vegetables like beans and peas; cole crops like cabbage and cauliflower; root crops like radish, carrot and onion; leafy vegetables like palak and lettuce.

Practical

1. Identification and description of different varieties of vegetables.
2. Planning and layout of Commercial vegetable garden.
3. Preparation of nursery beds and raising of nursery of different solanaceous vegetables.
4. Raising nursery of cole crops.
5. Sowing of cucurbitaceous vegetables .
6. Sowing of leguminous vegetables.
7. Hardening of vegetable seedlings.
8. Methods of transplanting of vegetable seedlings.
9. Preparation and application of starter solutions.
10. Different methods of fertilizer application.
11. Study of different irrigation practices.
12. Attending the weed management practices in different vegetables.
13. Harvesting of different vegetable crops.
14. Grading sorting & packing of different vegetables.
15. Visit to Commercial vegetable gardens.
16. Evaluation of vegetable crops raised by the students.

Note: Each student will be allotted one plot for raising vegetable crop.

Hort.8.7 : Commercial Floriculture 3 (1+2)
(To be prepared later on by the department)

Theory

Selection of varieties, commercial propagation methods, preparation of field and bed, Spacing for different commercial flowers, Special horticultural techniques like stalking, pinching, disbudding, bending. Nutrition, water requirements through open as well as drip irrigation. Weed control, mulching, Use of growth regulators for higher quality production. Pre harvest treatments, harvesting techniques, post harvest management, grading and packing for internal and export markets and storage of major flower crops like rose, chrysanthemum, carnation, gladiolus, gerbera, tuberose, marigold, gaillardia, jasmin, spiderlily, golden rod etc.

Practical

1. Identification of various cultivars of rose, chrysanthemum, carnation, gladiolus, gerbera, tuberose, marigold, gaillardia, jasmin, spiderlily, golden rod etc.

2. Commercial propagation methods in of rose, chrysanthemum, carnation, gladiolus, gerbera, tuberose, marigold, gaillardia, jasmin, spiderlily, golden rod etc.
3. Manure and fertilizer application in commercial flower crops.
4. Irrigation and fertigation practices in commercial flower crops.
5. Special horticultural techniques like stalking, pinching, disbudding, bending for commercial flower crops.
6. Use of growth regulators in commercial flower crops for higher quality production.
7. Different harvesting techniques, grading, packing for commercial flower crops.
8. Post harvest management for important flowers.
9. Working out benefit cost ratios for important flowers.
10. Visit to local commercial floriculture farm.

Hort.8.8 : Commercial Fruit Production **3 (1+2)**

Theory

Selection of varieties, commercial propagation methods, root stocks for different purposes, preparation of field, digging and filling of pits, role of high density planting, training and pruning, nutrition, water requirements through open as well as drip irrigation. Weed control, mulching, flowering and fruit set. Use of growth regulators for various purposes, harvesting indices, harvesting techniques, pre harvest treatments, post harvest management, grading and packing for internal and export markets and storage of major fruit crops like mango, banana, citrus, guava, sapota, papaya, pomegranate, ber, litchi and apple.

Practicals

1. Commercial propagation methods in mango, citrus, sapota and guava.
2. Fertilizer application and field observation of deficiency symptoms of micro nutrients in major fruit crops.
3. Irrigation and fertigation practices in fruit crops.
4. Canopy management in mango (pruning, training, application of paclobutrazol etc.)
5. Training and pruning studies in grape, ber and pomegranate.
6. Studies on flower and fruit drop and their control in mango and citrus.
7. Papain extraction in papaya.
8. Hormonal application to improve fruit set, fruit thinning, fruit size and quality in major fruit crops.
9. Study of harvesting indices in mango, banana, sapota, papaya, and grape.
10. Studies on harvesting methods in fruit crops.
11. Harvesting, desaping, pre cooling, grading and palletisation and storage in mango.
12. Ripening methods in mango, banana and sapota.
13. Cold storage studies for different fruits.
14. Visit to commercial orchards to study cultural practices of important fruit crops.
15. Working out benefit cost ratios for mango, citrus, banana and grape.
16. Visit to local cold storage and export units of fruits.

Hort.8.9 : Nursery Management of Horticultural Crops **4 (1+3)**

Theory

1. Introduction to plant propagation, basic genetical concepts concerning to plant propagation.
2. Choice of propagation methods, structure of vascular plants.
3. Importance of commercial nurseries in India and abroad.
4. Planning of a commercial ornamental plants nursery and its execution.
5. Planning and execution of commercial fruit plants nursery.

6. Study of different methods of propagation including micropropagation.
7. Propagation by specialized vegetative structures specially in flower crops.
8. Seed and vegetative propagation. Commercial methods of multiplication of flowers and fruit crops.

9&10 Plant propagating structures their importance in propagation - shade houses, tunnels, poly houses, fan and pad type of poly houses.

11. Propagation media, characteristics, types of media, natural and synthetic.
12. Use of plant growth regulators in rooting of cuttings.
13. Study of tools, accessories and other equipment necessary for nursery production of ornamental and fruit crops.
14. Micropropagation of plants, aseptic cultures advantages and disadvantages, preparation of different types of media and explants.

15&16 Propagation methods of some important plants. Indoor ornamental plants, ornamental bulbous plants, shrubs and trees, fruits and nuts, medicinal and aromatic plants, succulents and cacti.

Practicals

1. Preparation of lay out in establishing of commercial nurseries for fruit plants.
2. Preparation of lay out in establishing of commercial nurseries for ornamental plants.
3. Preparation of lay out for estabhilisment of mother plant block.
4. Study of pre germination treatment of seeds- scarification and stratification.
5. Study of seed viability tests.
6. Preparation of raised and flat seed bed to test germination parentage of seeds treated with pre germination treatments.
7. Preparation of potting mixtures and study of characteristics of individual items of media.
8. Study of different types of containers.
9. Preparation of different types of cuttings (ornamental and fruits)
10. Study of different types of bulbs, tubers, and corms.
11. Study of dormancy breaking techniques in bulbs, tubers, and corms.
12. Different methods of multiplication of bulbs, tubers and corms.
13. Study of different methods of layering in ornamental and fruit crops.
14. Raising of root stocks through seeds/ nuts and clonal propagation.
15. Pre curing techniques and preparation of root stocks for budding and grafting of important ornamental and fruit crops.

16 to 22. Commercial propagation - practice of important methods of propagation of the following crops.

Fruits: (1) mango (2) guava (3) chiku (4) sweet orange & mandarins (5)litchi (6) fig (7) ber (8) anona (9) pomegranate

Ornamental plants: (1) roses (2) indoor decorative plants (3) shrubs and bushes

23. Planning and execution / study of construction of shade houses and poly tunnels.
24. Study of poly houses and development of furnitures suitable for propagation in poly houses and tunnels.

25 to 28 Visit to commercial nurseries and study of different methods of propagation in and around the location of study.

29. Preparation of media for micropropagation.
30. Preparation of aseptic cultures for propagation of important ornamental plants like gerbera and chrysanthemum and fruit crops like banana.
31. Hardening of plants propagated through tissue culture.
32. Visit to tissue culture labs for study of multiplication of plants.

Hort.8.10 : Protected Cultivation of Horticultural Crops 3 (1+2)

Theory

Introduction, history, definition, world scenario, greenhouse effect, uses of greenhouses, status and scope of greenhouse technology in India, choice of crops for cultivation under greenhouses, problems/constraints of greenhouse cultivation and future strategies. Planning and designing for greenhouses-site selection, greenhouse orientation, plan, layout. Greenhouse utilities-water, electricity, etc.

Types of greenhouses – classification based on the shape, material, utility and covering material. Consideration for greenhouse establishment. Design load calculations. Materials for construction. Construction of greenhouse – fabrication of frame, covering/cladding of frame and environmental control system. Management of greenhouse – temperature, light, relative humidity, ventilation, carbondioxide, irrigation, nutrition, pests and diseases. Methods of greenhouse cooling-ventilation, methods of ventilation - natural ventilation and forced ventilation. Roof shading, lathe shades and evaporative-cooling with fan and pad system, high pressure misting system, low pressure misting system and fog cooling system and maintenance of greenhouse equipment. Greenhouse heating-heating systems, heat distribution system, and heat conservation practice. Carbon dioxide enrichment – methods of enrichment – combustion, liquid carbon dioxide solid and carbon dioxide. Light control in greenhouse – shading, and selection of light source. Growing media – soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization, organic matter, PH control, pre-crop (base) fertilizer application, and cultivation in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT)/hydroponics. Detailed production technology of vegetables – tomato, capsicum, lettuce and cucumber. Cut flowers – rose, chrysanthemum, carnation, gerbera and anthurium. Major diseases and insect pests and their management in greenhouse crops. Marketing of greenhouse crops.

Practicals

1. Study of various types of greenhouses/ poly house and their suitability for different crops.
2. Study of various framework materials used in the greenhouse construction
3. Study of various cladding materials used for covering the greenhouse
4. Study of various equipments used in the greenhouses
5. Study of various growing media used in raising of greenhouse crops and their preparation and pasteurization/ sterilization.
6. Testing of soil to study its suitability for growing crops in greenhouse
7. Testing of water to study its suitability for growing the crops in greenhouse

8,9 & 10. Light, humidity and temperature management in greenhouse

11&12. Nutrient requirement calculations for different crops for fertigation

13,14&15. Study of fertigation requirements for greenhouse crops

16. Working and requirement for reducing the water PH
17. Estimation of E.C. in the fertigation solution

18,19,20, 21&22. Practicing training and pruning in rose, carnation, tomato, cucumber etc.

23,24&25. Study of post-harvest handling of greenhouse crops

26,27&28. Visit to commercial greenhouses.

29&30. Visit to flower markets

Ag.Pros.8.1 : Unit Operation for Quality Value Addition Processing and Development of New Products 4 (1+3)

Theory

Introduction to unit operations size reduction – Equipment. Crushers, Hammar mills, Ball mills. Mixing- Mixing of solids, pastes and liquids. Mechanical separation – Filtration, sedimentation,

cyclone separators, centrifugal separator. Distillation – Stage distillation, steam, vacuum and batch distillation equipment. Evaporation equipment – open pan, short and Long Tube Evaporators – Drum dryer and Spray Dryer and their working, operation and maintenance.

Practicals

1,2,3,4	Study of different size reduction equipment
5,6,7,8	Study of different mixing equipment
9,10	Study of filtration equipment
11,12	Study of sedimentation equipment
13,14	Study of cyclone separator
15,16	Study of centrifugal separator
17,18,19	Study of storage distillation equipment
20,21,22	Study of steam distillation equipment
23,24,25,26	Study of vacuum distillation equipment
27,28,29,30	Study of batch distillation equipment
31,32	Practical examination

GROUP- IV

SOCIAL SCIENCES AND AGRI-BUSINESS MANAGEMENT

Ag.Extn.8.6 : Agricultural Journalism **3 (2+1)**

Theory

Journalism – Meaning, Nature, Scope and Importance.

Agril. Journalism – Meaning, Concept, Nature, History, Scope and Importance.

Journalist – Meaning, Roles, Qualities, Types.

Print Media – Concept, Role, Trends, Principles, Laws, Ethics, History of Print media in India

Readership analysis- Meaning, Importance, Methods

Writing New stories, Feature articles and Success stories- Planning & Writing

Agricultural Information materials – Planning, Preparation and Evaluation of information materials- Leaflet, Pamphlet, Folder, Bulletin

Electronic media – Concept, Types, Trends, Principles, Ethics, History of Electronic Media in India

Listeners / Viewers analysis- Meaning, Importance, Methods

Report writing – Gathering of news, Forms of reporting, Principles for creative writing, Editing and Proof reading.

Radio – Scope and Importance, History, Script writing for Radio, Treatment, Recording and Broad Casting

Television – Scope and Importance, History, Script writing for TV, Planning, Recording and Telecasting.

Photo Journalism – Concept, Scope and Importance, Principles, Selection and Editing of photographs, writing photo features and captions.

Video Production Technology – Concepts, Types of Cameras & Parts, Different formats, Techniques of Planning, Production and Editing, Types of Shots, Audio & Video mixing.

Public Relations – Meaning, Concept, Scope and Dimensions, Scenario in Organizations.

Practicals

1. Designing of layout and Preparation of Agricultural Information Materials
2. Testing the readability of prepared Agricultural Information materials.
3. Gathering of news by using different methods.
4. Exercise on writing of different forms of news reports in print media.
5. Editing Process in Print Media.
6. Testing the readability of printed literature.
7. Visit to a newspaper office.
8. Visit to All India Radio Station / a TV Studio.
9. Script Writing for Radio.
10. Rehearsal, Recording, Editing and Evaluation of Radio Programme.
11. Preparation of Story board for TV
12. Method of holding and Exposing a Still camera.
13. Writing captions for Photographs.
14. Writing Photo features for photographs.
15. Studying various parts of video camera and Handling of video camera.
16. Audio & Video mixing.

Ag.Extn.8.7 : Visuals and Graphic Communications 3 (2+1)

Theory

1. Meaning, Definitions and the Role of Visuals in communication
2. Characteristics of Visual aids
3. Classification of visual aids

4& 5. Principles and Production of visuals

6 Contribution of visual perception in learning process

7& 8 Planning, Preparation, Presentation and evaluation of visual aids

9& 10 Designing of messages and titles for visuals

11 Layout of visual aids

12 Selection and use of graphic formats

13& 14 Preparation and use of low cost visuals based on the local situation

15& 16 Preparation and use of photographs and pictures

17 Reprographic visuals

18-20 Computer based visuals and digitized video materials

21-23 Use of drawing techniques for different visuals

24-27 Selection and use of animation tools in transfer of technology

28&29 Preparation and use of resource maps for extension work

30-32 Designing of visuals for print and electronic media

Practicals

1–3 Preparation of low-cost visuals

4. Designing and layout of visual aids

5&6 Generating computer aided presentation of graphics

7 Scanning of visuals

8&9 Image editing and script writing for telecasts

10 Development of agricultural video films

11& 12 Editing of video visuals

13 Visit to animation production center

14 &15 Visit to print and electronic media centers

16. Presentation and evaluation of low cost visuals

Ag.Extn.8.8 : Behavioral Skills **3 (2+1)**

Theory

Behaviour – Meaning, An Overview of knowledge, Understanding, Attitude & Skills.

Factors influencing Behaviour – Personal, Psychological, Social, Cultural and Environmental factors.

Reading skills – Meaning, Importance, Techniques

Writing Skills – Meaning, Importance, Techniques

Listening skills- Meaning, Importance, Techniques

Presentation skills - Meaning, Importance, Techniques

Transactional Analysis and Interpersonal Communication Skills – Meaning, Importance, Methods, Strategies.

Conflict Management skills – Meaning, Role of conflicts, Sources of Conflicts, Management of Conflicts.

Negotiation Skills – Meaning, Need for Negotiation, Types.

Human Relations Skills – Meaning, Importance, Techniques.

Problem Solving Skills – Meaning, Identification of Causes of Problem, Alternative Solutions, Methods of Problem Solving.

Planning skills – Meaning, Importance, Types and Techniques

Decision making skills – Meaning, Importance, Steps, Techniques of Decision making.

Observation Skills – Meaning, Importance, Types.

Facilitation skills – Meaning, Importance, Techniques

Counseling Skills - Meaning, Importance, Techniques

Leadership skills - Meaning, Importance, Techniques

Time Management skills – Meaning, Importance, Techniques.

Stress Management skills – Meaning, Sources, Coping mechanisms.

Motivation skills – Meaning, Importance, Needs, Techniques of Motivation.

Emotional intelligence – Meaning, Importance, Dimensions.

Team building skills – Meaning, Characteristics, Formation of Teams, Factors affecting team work.

Creativity Development Skills - Meaning, True creativity, Creative thinking, Seven habits of Successful creative thinkers

Preparation for Examinations – written and oral examinations.

Practicals

1. Exercise on Reading, Listening, Writing, Presentation, (2)
2. Exercise of Interpersonal Communication Skills (1)
3. Exercise on Conflict Management and Negotiation skills (2)
4. Exercise on Planning Skills (1)
5. Exercise on Problem Solving Skills (1)
6. Exercise on Leadership development Skills (1)
7. Exercise on Decision Making Skills (1)
8. Identification of skills through mutual observation (1)
9. Exercise on Time Management skills (1)
10. Stress Relaxation Techniques (1)
11. Team building Exercise (1)
12. Exercise on facing interviews (1)

Ag.Econ.8.7 : Management of Agro-based industry 4 (1+3)

Theory

Types of Agribusiness input sector, seed industry world scenario, Indian scenario, seed production marketing, supply demand, quality standards, various agencies involved, public-private sector role, distribution network, seed policy, fertilizer industry scenario role, trends, demand supply condition, subsidies, pesticides and chemicals industry scenario types and benefits of pesticides, role of bio-pesticides, supply-demand conditions. Farm machinery and equipment, various types, industry growth –Government policy, taxes and subsides. Agricultural credit structure, magnitude of agricultural credit, components of credit profile, various schemes under NABARD and commercial banks, various promotional activities in agri input sector-impact of WTO on agri input industries, changing strategies of agri input sector. Agri output marketing and processing industry, raw material procurement, problems, marketing of the processed foods, distribution logistics, value addition, promotional tools, pricing techniques, packaging, branding.

Practicals

1. Study of functioning of fertilizer industry
2. Study of functioning of pesticide industry
3. Study of functioning of seed industry
4. Study of functioning of farm machinery and equipment industry
5. Study of functioning of food processing industry
6. Study of functioning of livestock and poultry industry
7. Study of functioning of sugar industry
8. Study of functioning of horticulture based industries
9. Study of functioning of processing industry
10. Study and functioning of various institutional agencies financing agro based Industries.

Ag.Econ.8.8 : Financial Management of Agri-Business 4 (1+3)

Theory

Financial resources of an organization, importance and need for financial resources. Financial Management, scope of finance, finance functions, financial manager's role, financial goal, profit versus wealth. Agribusiness financial management, role of the financial manager, Recording Agribusiness transactions, Accounting definition and meaning, users of accounting information, forms of business organization, the accounting equation. Accounts, classification of commonly used accounts, the double entry system, recording transactions, journals and ledgers, trail balance, basic accounting considerations, assets and liabilities, capital and owners equity, revenue, cost of sales and net profit. Operating and incidental expenses, inventory, depreciation, Accounting cycle. Income measurement, the adjustment process, preparing financial statements from the adjusted trial balance. Preparing an income statement and balance sheet, profit and loss statement. Financial ratio analysis, users of financial analysis, Nature of financial ratios - types of ratios. Financial planning, objectives of profit planning (or budgeting), essential of profit planning, types of budgets, preparation of profit plan or budgets.

Practicals

1. Accounting equation.
2. Classification of accounts
3. Double entry system
4. Journals and ledgers
5. Trail balance
6. Preparing income statement
7. Preparing balance sheet
8. Profit and loss statement
9. Financial ratio analysis
10. Case studies

Ag.Econ.8.9 : Farm Planning and Budgeting **3 (2+1)**

Theory

Farm Planning – Objectives - Characteristics of good farm plan - Components of farm plan - Statement of the objective function - Inventory of scarce resources and constraints.

Planning Technique-Steps in farm planning – Planning – Implementation - Control

Budgeting -Types of Farm Budgeting - Partial Budgeting - Enterprise Budgeting - Cash Flow Budgeting - Complete Budgeting - Limitations.

Linear Programming- Assumptions – Concepts - Estimation of optimal solution by linear programming – Illustrations - Limitations

Practicals

1. Preparation of Partial budgets for different activities
2. 2. Preparation of alternative plans
3. Identification of Planning techniques
4. Preparation of Cash flow statement
5. Exercise on Enterprise budgeting-Partial budgeting
6. Exercise on Complete budgeting
7. Exercise on Linear Programming Techniques for optimal solution
8. Balance Sheet and Income Statement

GROUP- V

BASIC SCIENCES

PBG.8.8 : Molecular Breeding **3 (1+2)**

Theory

Introduction – Nucleic acids as genetic material – DNA structure – types – replications –Restriction endonucleases – Molecular analysis of Nucleic acids – Molecular analysis of genes and chromosomes – amplification of DNA by polymerase chain reaction – Molecular markers – RFLP, AFLP, RAPD, SSR, DNA finger printing – DNA probes – mapping QTLS – Marker assisted selection

Practicals

1. Isolation of plant DNA
2. Quantification of DNA
3. Isolation of mitochondrial DNA and quantification
4. Isolation of chloroplast DNA and quantification
5. Restriction enzyme digestion
6. Polymerase chain reaction technique
7. RAPD analysis
8. AFLP analysis
9. SSR analysis

PBG.8.9 : Plant Tissue Culture **4 (1+3)**

Theory

in-vitro selection of mutants for biotic and abiotic stress resistance, accomplishments – somatic embryogenesis and synthetic seed production technology – protoplast isolation – culture manipulation – fusion – products of somatic hybrids and cybrids – applications in crop

improvement – germplasm conservation – freeze preservation – slow growth cultures – DNA clones – Dessicated somatic embryos – artificical seeds – advantages and limitations

Practicals

1. Micro-propagation of important crops
2. Anther culture
3. Pollen culture
4. Ovary culture
5. Ovule culture
6. Embryo culture
7. Endosperm culture
8. Protoplast culture
9. Hardening / Acclimatization of regenerated plants

PBG.8.10 : Recombinant DNA Technology **3 (1+2)**

Theory

DNA molecule – structural and functional analysis – gene cloning – recombinant DNA – transgenic plants and their applications – gene constructs and vectors – indirect and direct methods of transformation – agro-bacterium mediated gene transfer method – particle bombardment method – confirmation of transgene integration – examples of useful gene transfer – insect and disease resistance – seed protein quality – transfer of genes controlling quality traits in crop plants

Practicals

1. DNA extraction
2. Restriction enzyme digestion
3. Gel electrophoresis
4. Southern Hybridization
5. Extraction of proteins and isozymes
6. Polymerase chain reaction and its application in molecular analysis
7. Techniques for plant gene transfer
8. Detection of transgenes

PBG.8.11 : Bio informatics **3 (1+2)**

Theory

Historical introduction on Bioinformatics as a science and overview, Bioinformatics and computing for innovative scientific discovery, Data application and management, Use of data bases in biology, Sequence data base, Structural data bases, Sequence analysis- protein and nucleic acid, Structural comparisons, Alignment of pairs of sequences, Multiple sequence alignment, Primer design tools, Repeat regions and domain identification, Phylogenic and gene prediction, Database searching for similar sequences.

Practicals

Basic principles of computing in Bioinformatics, Drawing Bar charts and presenting data in different formats, Making spread sheets and doing transformations, scoring for similarity index data, Collecting and storing sequences in the laboratory, BLAST search, Identification of consensus sequences and domain identification, ORF finding, Microarray data analysis.

Biochem.8.2 : Molecular Diagnostics **3 (1+2)**

Theory

1. Introduction-Molecular make-up of cell structure-Ultra structure of cell wall memebranes.
2. Molecular organelle- Chloroplast and mitochondrial genomes, microsatillites, micro assays

3. Plant cell interaction with environment-Abiotic stresses: drought, flooding heat and cold stress,salinity, heavy metal and oxidative and anaerobic stress leading to molecular changes
4. Impact of stresses on plant growth , development and productivity potential
5. Physiology and biochemical markers in crop plants tolerant to salt stress (glycine betaine aldehyde, betaine aldehyde dehydrogenase)-cold stress, heat shock, (heat shock proteins), high moisture stress, oxidative stress (PPO, PO, SOD), herbicide stress (acetate lactate synthase, Glutathione-S-transferase, heavy metal stress, deficient nutrient stress, herbivore stress (methyl jasmonate).
6. Diagnosis of stresses by specific molecular proteins or isozyme profiles: Salt stress – glycine, proline BADHase, drought dehydration, starch (in roots); Oxidative stress – PPO, POD, SOD, IAAOase; Heat shock – heat shock proteins (protein profiles); Cold stress - dehydrogenases, specific proteins, herbivour stress – astringent alkalide, flavinoids; Herbicide stress – methyl jasmonates , acetolactate synthetase, GSTetc; Excess carbondioxide stress – starch granules in chloroplast; disease susceptibility – ABA accumulation in leaves, peroxidases; Nutrient deficiency – tissue tests, biochemical markers; Molecular responses to flooding , anaerobic conditions and defence against plant pathogens and pests
7. Molecular signatures of abiotic and biotic stress.
8. Signal transduction molecules in plants, mechanism of conformational changes of organic molecules in membranes.
9. Molecular Diagnostics application to Plant Health, Molecular identificatin tools for pests and diseases, Molecular Markers (SSRs,RFLPs,AFLP, RAPDs, CAPS)-Mitoichondrial DNA, nuclear DNA, DNA finger printing, Bio-sensors, DNA Biosensor chips.

Practicals

1. Diagnosis for drought tolerance in crop plants.
2. *In vitro* salt tolerance in crop plants using glycine betaine(GB).
3. Salt tolerance in crop plants through physiological and biochemical markers.
4. Herbicide tolerance in crop plants through physiological and biochemical markers.
5. Identification of physiological and biochemical markers under water deficient and high moisture stress in crop plants.
6. Oxidative stress and identification of Isozyme variation for SOD
7. Oxidative stress and identification of Isozyme variation for POD
8. Oxidative stress and identification of Isozyme variation for Catalase
9. Oxidative stress and identification for betaine aldehyde dehydrogenase
10. Identification of low photo respiring plants based on glycolate oxidase activity
11. Screening of photosynthetic inhibitor herbicide by Hill reaction method
12. Nitrogen-use-efficient crop plant based on nitrate reductase activity
13. Diagnostics for identification of high protein quality cultivars.
14. Techniques on
    a. Electrophoresis
    b. Blotting methods
    c. ELISA
    d. Immuno-assays.
    e. PCR techniques.

Ag.Micro.8.2 : Microbial & Environmental Technology **4 (1+3)**

Theory

(a) Microbial Technology

1. History and Development of Microbial Technology
2. Typical fermentation and types of fermentations
3. Microbial production of Biofuel, alcohol and alcoholic beverages

4. Production of microbial inoculants such as Biofertilizer, Biocontrol agents, Microbial pesticides, Integrated nutrient, pest and disease management
5. Role of Microorganisms in production of Antibiotics, Organic acids, Amino acids, Vitamins, food and feed supplements such as Spirulina
6. Microbial degradation of pesticides and bioremediation
7. Treatment of industrial waste and sewage
8. Biogas production
9. Microbiology of fermented foods: -Curd, Idli, Saurecraut, etc.

(b) Environmental Technology

Introduction, history and concepts of Environmental Technology

Air Pollution: clean air definition – sources of air pollution. Air quality standards. Effect of air pollution on biological organisms. Ozone layer depletion. Air pollution

control technologies. Management of air pollution.

Water Pollution: Water quality standards. Technologies for purification in the public water supply system. Sources of waste water. Waste water treatment technologies and recycling. Soil Pollution: Sources and treatment technologies

Industrial wastes: Wastes from primary industries (Agriculture, live stock & mining) primary industries (Food & chemicals) and from hospitals. Management of Industrial Wastes: Treatment technologies and 3 R's Golden Rule of industrial waste management. Preventing industrial waste and pollution through cleaner production technology.

Hazardous wastes: Definition, characterization and sources. Environmental toxicity and threat to human health. Occupational health hazards of workers in industries. Management of hazardous wastes: safe storage, transport and disposal. The 3 R's Golden Rule by reduction, reuse and recycling.

Bio remediation: Production of value added products (single cell protein and Biofuels) by waste recycling.

Green technologies and environmental protection.

Environmental Protection Act: Air, water, wild life protection and forest conservation acts

Practicals

(a) Microbial Technology

1. Isolation and purification of microbial cultures
2. Isolation of bacterio phages
3. Microbial examination of water
4. Production of wine
5. Production of microbial inoculants with Rhizobium, PSB, Trichoderma, Pseudomonas, BGA, Bacillus thuringeneses and Evaluation of quality of microbial inoculants
6. Ethanol production from agricultural waste
7. Measurement of organic matter decomposition in soil
8. Demonstration of pesticides degradation activity
9. Bio degradation of crop residues
10. Biogas production
11. Microbiological examination of fermented foods

(b) Environmental Technology

1. Physical characterization of industrial sludge
2. Estimation of Bio-chemical Oxygen Demand (BOD) of an effluent sample.
3. Estimation of fluorides in ground water
4. Estimation of alkalinity of water
5. Estimation of total inorganic phosphate in water
6. Visit to Sewage Treatment Plants

7. Pit method of composting by using farm waste
8. Compost maturity test – physical and chemical
9. Understanding loss of biodiversity in crop plants by Electrophoretic technique
10. Response to seasonal variation (temperature) in species composition by biotechnology application
11. Determination of respirable and non respirable dust in the air.
12. Assessing the comparison between TDS and EC of an effluent sample and fresh water sample.
13. Visit to Effluent treatment plants.
14. Preparation of Biopesticide (Neem seed kernel extract)
15. Learning of techniques of inoculation of Biofetilizers

Visit to sanitary land fill site incineration site of an industry