Syllabus

B. Sc. (Ag.) Hons

Part-I: Core Courses
Part-II: Experiential Learning

Palli-Siksha Bhavana
(Institute of Agriculture)
Visva Bharati
Sriniketan

Part-I: Core Courses

AGR AGRONOMY

AGR 111 Introductory Agriculture (Ancient Heritage, Agricultural Scenario and Gender Equity in Agriculture) 1(1+0)

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), Agricultural growth, contrasting food chains, Diversity in physiographic, 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.

AGR 112 Principles of Agronomy and Agricultural Meteorology 3(2+1)

Meaning and scope of Agronomy: National and International Agricultural Research Institutes in India, Agro-climatic zones of India and West Bengal. Essential nutrients, manures, fertilizers and biofertilizers; Tillage – types, objectives, concept of conservation tillage, Crops stand establishment, Planting geometry and its effect on growth and yield, classification of crops, cropping systems, crop maturity and harvesting. Agricultural meteorology: Earths' atmosphere, Composition and structure, weather and climate, micro-climate, weather elements, solar radiation : nature, properties, distribution, solar constant and energy balance, Atmospheric temperature, factors affecting, horizontal and vertical distribution, variations and global warming, Air pressure variations; Wind: factors affecting, cyclones and anticyclones and general circulation, Atmospheric humidity, vapour pressure and saturation, Process of condensation, formation of dew, fog, mist, snow, rain and hail; formation and classification of clouds, introduction to monsoon, Basics of weather forecasting.

Practical: Study of tillage implements; Practice of ploughing and puddling; Study of seeding/planting equipments, Different methods of sowing; Study of manures, fertilizers and green manure crops / seeds (including calculations); Study of inter-cultivation implements and practice; Methods of fertilizer applications; Participation in ongoing field operations. Site selection for Agromet observatory; Measurement of temperature, rainfall, evaporation (atmospheric/soil), atmospheric pressure, sunshine duration and solar radiation, wind direction and speed and relative humidity; Study of weather forecasting and synoptic charts, tabulation and calculation of meteorological data, visit to meteorological observatory.

AGR 121 Water Management Including Micro Irrigation 3(2+1)

Irrigation: definition and objectives, water resources and irrigation development in India and West Bengal; 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, pigeon pea, rapeseed-mustard, sugarcane, potato, and jute); Excess water and agricultural drainage; Rain water management - water harvesting, moisture conservation and utilization.

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).

AGR 211 Weed Management 2 (1+1)

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 management: physical, cultural, chemical and biological methods. Biotechnology in weed management. Integrated weed management; Herbicides: advantages and limitations of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity and mode of action 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 management.

Practical: Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of weed herbarium; Study of seed production potential of major 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; Herbicide inventory; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, *Parthenium*, *Echinocloa* and parasitic weeds; Economics of weed management practices; Tours and visits of problem areas.

AGR 212 Field Crops-I (*Kharif*) 3(2+1)

Origin, geographic distribution, morphology, classification, economic importance, soil and climatic requirement, varieties, cultural practices and yield of *kharif* crops, Cereals : rice, maize, sorghum, pearl millet and finger millets; Pulses: pigeonpea, mungbean and urdbean; Oilseeds: groundnut, sesame, soybean and castor; Fibre crops: cotton, jute, mesta and sunhemp; and Forage crops: sorghum, maize, cowpea, cluster bean, napier, rice bean, pasture grasses and legumes; preservation of forage crops.

Practical: Rice nursery preparation and transplanting/seed bed preparation and sowing of *kharif* crops; Calculations on seed rate and fertilizer dose; Studies on germination/sprouting and seedling vigour; Effect of sowing depth on germination and emergence; Identification of associated weeds in *kharif* crops; Top dressing of nitrogen in major *kharif* crops and study of fertilizer experiments; Study of growth attributes, yield components, harvesting and yield estimations; Study of crop varieties and agronomic experiments; Study on nodulation in legumes.

AGR 221 Field Crops- II (*Rabi*) 3(2+1)

Origin, geographical distribution, morphology, classification, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *rabi* crops; Cereals: wheat, barley; Pulses: chickpea, lentil, peas and lathyrus; Oilseeds: rapeseed-mustard, sunflower, safflower and linseed; Sugar crops: sugarcane; Commercial crops: potato and tobacco, Forage crops: berseem, lucerne and oats.

Practical: Seed bed preparation and sowing of *rabi* crops; Calculations on seed rate and fertilizer dose; Top dressing of nitrogen in *rabi* crops and study of fertilizer experiments; Identification of crop associated weeds in *rabi* crops; Study of growth attributes, yield components, harvesting and yield estimations; Yield and quality analysis of sugarcane; Study of crop varieties and agronomic experiments and visit to research stations related to *rabi* crops.

AGR 311 Organic Farming 3(2+1)

Introduction, concept, principles, components, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manure, vermicompost, green manure, 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; Concept of bio-village.

Practical: Preparation of enriched Farm Yard Manure and vermicompost; Visit to urban waste recycling unit; Study of profitable utilization of agricultural wastes; Raising of vegetable crops organically through nutrient, diseases and pest management; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management. Visit to an organic farm to study various components and utilization.

AGR 312 Practical Crop Production I (*Kharif* Crops) 1(0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient, water and 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.

AGR 321 Practical Crop Production II (*Rabi* Crops) 1(0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient, water and 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.

AGR 322 Farming Systems and Sustainable Agriculture 2(1+1)

Sustainable agriculture: Introduction, definition, goal and current concepts, factors affecting ecological balance and ameliorative measures; Land degradation and conservation of natural resources, Low External Input Agriculture (LEIA) & High External Input Agriculture (HEIA); Irrigation problems, waste lands and their development; Farming systems: definition, principles, components and types; Farming systems in India; Agroforestry systems; IFS for wetland, irrigated land and dryland situations.

Practical: Preparation of cropping scheme for irrigated and dryland situations; Study of existing farming systems in nearby villages; Preparation of integrated farming system model for wetlands, drylands and irrigated lands; Visit to different farm enterprises to study resource allocation, utilization and economics. Studies on agroforestry systems.

GPB GENETICS AND PLANT BREEDING

GPB 211 Principles of Genetics 3 (2+1)

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; Sex determination and sex linkage, sex limited and sex influenced traits: Mutation and it's characteristic features; Methods of inducing mutations and C l 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); 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.

GPB221 Principles of Plant Breeding 3(2+1)

Historical development of plant breeding, plant breeding concept, nature and role of plant breeding, major achievements and future prospects, Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Domestication, centres of origin, centres of diversity, acclimatization; components of genetic variations; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding – introduction and acclimatization. Selection, Mass selection Johannson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Clonal selection;Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement.

Practical: Botanical description and floral biology; Study of megasporogenesis and microsporogenesis; Fertilization and life cycle of an angiospermic plant; Plant Breeder's kit; Hybridization techniques and precautions to be taken; Floral morphology, selfing, emasculation and crossing techniques; Study of male sterility and incomapribility in field plots; Rice Maize and Wheat; Sugarcane, Groundnut, and Sesamum; Redgram, Bengalgram and Greengram; Soybean and blackgram; Chillies, Brinjal and Tomato; Bhendi.

GPB 311 Principles of Plant Biotechnology 3(2+1)

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 methodof gene transfer – Transgenic plants and their applications. Molecular 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; Study of different micropropagation approaches viz. meristem shoot tip culture *etc*. Anther, Embryo and Endosperm culture;

GPB 321 Breeding of Field and Horticulture Crops 3(2+1)

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Hardy-Weinberg Law; Study in respect of origin, distribution of species, wild relatives and forms, Cereals (rice, wheat, maize); Pulses (redgram, greengram, blackgram, soybean); Oilseeds (Groundnut, sesame, sunflower, rapeseed-mustard) etc. Fibers (Cotton and jute); Vegetables (Tomato, bhindi, chilli, cucumbers); Flowers crops (Chrysanthemum, rose, & marigold); Fruit crops (guava, mango, banana, papaya); Major breeding procedures for development of hybrids / varieties of various crops; Plant Genetic Resources their conservation and utilization in crop improvement; Ideotype concept in crop improvement; Breeding for resistance to biotic and abiotic stresses variability in pathogens and pests; Mechanisms of resistance in plant to pathogens and pest; Genetic basis of adaptability to unfavourable environments; Definition of biometrics, assessment of variability i.e., additive, dominance and epistasis and their differentiation; Genotype x Environment interaction and influence on yield/performance, IPR and its related issues.

Practical: Emasculation and Hybridization techniques; Handling of segregating generations, pedigree methods; Handling of segregating generations, bulk methods; Handling of segregating generations, 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; Parentage of released varieties/hybrids; Problems on Hardy-Weinberg Law; 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

SST SEED SCIENCE AND TECHNOLOGY

SST 321 Principles of Seed Technology 3(2+1)

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, Seed health; 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 certification, phases of certification, procedure for seed certification, field inspection and field counts etc.; Seed Production, Foundation and certified seed production in maize, rice, sorghum and bajra, cotton and sunflower, castor, tomato and brinjal, chillies and bhendi, onion, bottle gourd and ridge gourd; 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 different 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, rouging, etc

SSC SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

SSC 111 Introduction to Soil Science 3(2+1)

Theory: 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.

SSC 121 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. 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.

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.

SSC 211 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. Effect of insecticides on soil, water and air.

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.

AEN Agricultural Entomology

AEN 211 Insect Morphology and Systematics 3 (2+1)

The scope of Entomology, brief history of Entomology in India, insect as Arthropods and its relationship with Phylum Annelida and other classes of Arthropod. Origin of insect, major points related to dominance of insect in Animal Kingdom. Taxonomy: Broad classification of class Insecta, insect orders, salient taxonomic and morphological features of the sub class- Apterygota (includes orders- Thysanura, Collembola and Protura) and Pterygota (includes Exopterygot order- Odonata, Orthoptera, Dictyoptera, Thysanoptera, Hemiptera, Homoptera, Isoptera and Endopterygot order- Coleoptera, Lepidoptera, Diptera, Hymenoptera). Infra-ordinal characteristics of some agriculturally importantant insect families. Ultra structure of insect integument and its various processes. Body segmentation, Phragmata, Furca. Head, Tentorium, Thorax (basic structures and associated appendages), Abdomen (with special reference to genitalia and accessory organs), Mouthparts (biting and chewing, piercing and sucking, chewing and lapping, sponging, siphoning and rasping & sucking types), Antennae & their modifications, Legs & their modification, Wings (hypothetical wing venation & their modifications). Mechanism of wing and leg movement. Wing coupling apparatus (Hamuli, Frennulum, Amplexiform, Retinaculum, Fibula, Jugate). Metamorphosis:-Ametabola, Metabola, Hemimetabola, Holometabola and Hetero/Hypo-metabola. Physiological mechanism of metamorphosis- apolysis, ecdysis. Types of immature

forms. Significance of pupal stage. Diapause. A brief out line on insect anatomy.

Practical: Methods of collection, killing, pinning, and mounting of insects. External morphology of grasshopper. Insect mouth parts and their dissection. Identification of different types of antennae, legs and wings. Wing venation. Preparation of key for the identification of agriculturally important orders. Preparation of permanent slides of mouthparts, antennae, legs and wings. Studies on different types of eggs, larvae & pupae. Dissection and study of alimentary canal (cockroach). Collection box for different groups of insects with special reference to agriculturally important insect orders.

AEN 221: Insect Ecology and Integrated Pest Management (including Beneficial Insects) (2+1)

Insect ecology - Definition, basic outline of ecosystem, niche, habitat, guild, population dynamics, community and its interaction with ecological factors. Effect of biotic factors – food competition, natural and environmental resistance. Concepts of Balance of life in nature, biotic potential and environmental resistance. Beneficial and harmful role of insects. Introductory idea of insect-pests and their classification based on GEP. Causes of outbreak and resurgence. Pest surveillance and pest forecasting. Utility knowledge of pest-host complexes as egg laying, sites of oviposition, food finding behaviour and tritrophic relationship. Insect-virus relationships. Principles and methods of pest control, viz., physical, mechanical, cultural, legal, host plant resistance, chemical, botanical, biological (parasitoid, predators, microbial insect pathogens) and biorational (insect hormones, pheromones, insect growth regulators), autocodal. Use of non-toxic compounds like semiochemicals (attractants, repellants, antifeedants, antimetabolites, chemosterilants). Role of biotechnology in insect-pests management and its practical feasibility. IPM practice, scope and its limitations. Vermiculture and role played by Annelids & Spiders in agriculture. Classification of toxicity of pesticides. Insecticides- their classification, generations and mode of action. Synergism. Principles and methods of insecticidal application, formulations and their appliances. Insecticides Act 1968 – Important provisions. Phytotoxicity of insecticides. Acquaintance with the commonly used and newer molecule of insecticides viz. Cyclodiens, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazimes, Thiourea derivaties, pyridine azomethines, pyrroles, etc. Acquaintance with the commonly used Nematicides, Rodenticides, Acaricides and fumigants. Safety measures during handling of pesticides. Symptoms of poisoning, first aid and antidotes. Environmental hazards posed by the insecticides.

Practical: Visit to meteorological observatory / automatic weather reporting station. Study of terrestrial and pond ecosystems of insects; Studies on behaviour of insects and orientation. 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. Lincoln index. Calculation for determining EIL and ETL. Identification of commonly available natural enemies. Identification of earthworms in vermiculture – visit to vermiculture unit. Compatibility of pesticides and Phytotoxicity of insecticides. Identification of commonly used insecticides and categories of their toxicity. Insecticide formulations, application equipments, their

handling and maintenance. Estimation of exact quantity of required commercial formulation, determination of doses from the total requirement of pesticide in a particular area. Bioefficacy studies of some new generation insecticides against some major lepidopteran pests and beneficial coleopteran predators.

AEN 321 Crop Pests and Stored Grain Pests and Their Management 3(2+1)

Nature and extent of damage and injury caused by insect-pest. Life cycle, seasonal history, host range, distribution and management of the major insect pests attacking field crops: Cereals (rice, wheat and maize); Pulses (gram, green gram, arahar pea); Oilseeds (mustard, sesame, sunflower, ground nut); Fibre crops (jute, cotton), Sugar crops (sugarcane); Vegetable crops (brinjal, okra, tomato, chilli, potato, cole crops, cucurbits); Fruit crops (citrus, banana, mango, coconut, litchi, jack fruit, papaya, guava, pomegranate, apple, pineapple, cashew nut); Spices and condiments (zinger, turmeric, black pepper and cardamom) and Plantation crops (tea, coffeae). A brief introduction, importance (National and International), life cycle, major species observed and extent of damage of the polyphagous pests like Locust and Termite. Economic importance and general control of plant parasitic mites & rodents and their general control measures. A brief out line on economic importance of Molluscs, Aves, Amphibian and higher Vertebrates in agriculture. Stored grain insect-pests, taxonomic position & identification, their biology, nature of damage and their management.

Practical: Identification of insect pests of field, vegetable & fruit crops and the damage symptoms produced by them, estimation of extent of damage by direct and indirect methods. Studies on seasonal cycle of insect-pests on field, vegetable and fruit crops. Life cycle study of any important insect-pest. Identification of stored product insects and their peculiarity in damage. Damage symptoms produced by non-insect pests of agricultural crops. Identification of common phytophagous mites and other non-insect pests.

AEC AGRICULTURAL ECONOMICS

AEC 121 Principles of Agricultural Economics 2 (2+0)

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, and classifications of wants, importance. Theory of consumption: Law of Diminishing Marginal utility- Meaning, definition, assumption, limitations, and 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. Supply: Meaning, definition, supply curve, law of supply, elasticity of supply, determinants of supply. Production: Meaning, factors of production. Distribution: Meaning, wage, rent, interest, profit. National Income: Concepts, measurement. Public Finance: Meaning, principles. Public Resource: Meaning, sources. Tax:

Meaning, classification of taxes: cannons of taxation. Public expenditure: Meaning, principles. Inflation: Meaning, definition, kinds of inflation. Welfare Economics: Meaning and basic concepts.

AEC 211 Agricultural Finance and Co-Operation 2(1+1)

Agricultural finance: nature and scope. Time value of money- compounding and discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's 5C's and 7P's of credit, repayment plans. Sources of finance-History of financing agriculture in India. Commercial banks- nationalization of commercial banks. Lead bank scheme. Regional Rural Banks. Scale of finance. Higher financing agencies- RBI, NABARD, AFC, Asian Development Bank, World Bank, Insurance and Credit Guarantee Corporation of India. Assessment of crop losses- determination of compensation. Crop insurance- advantages and limitations in application, estimation of crop yields. Agricultural cooperation: philosophy and principles. History of Indian cooperative movement- pre-independence and post independence periods, cooperation in different plan periods. Cooperative credit structure: PACS, FSCS. Reorganisation of cooperative credit structure in West Bengal and 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.

AEC 221 Agricultural Marketing, Trade and Prices 2 (1+1)

Agricultural Marketing: Concepts and definition, scope and subject matter. Market and Marketing: Meaning, definitions, components of a market, classification. Market structure: conduct, performance, market functionaries or agencies. Producer's surplus: Meaning, types of producer's 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. Risk in Marketing: Meaning and importance, types of risk in marketing, speculations and hedging, futures trading, contract farming. International Trade: Meaning, need and importance, Theories of international trade, free trade, trade protection, WTO, GATT, Implications of AOA, Market access, Domestic support, Export subsidies, EXIM-Policy & Ministerial conferences. Cooperative Marketing, State Trading, Ware Housing Corporation (Central and State)- Objectives, functions, advantages. Food Corporation of India: Objectives and functions. Quality control of agricultural products- AGMARK, FPO, ECOMARK, etc. Agricultural Price Policy: Meaning, objectives, need for agricultural price policy, role of CACP.

Practical: Identification of marketing channels; Study of regulated markets; Study of unregulated markets; Price spread analysis; Visit to market institutions; Study of SWC, CWC and STC; Analysis of information of daily prices; Estimation of marketed and marketable surplus, cost of cultivations.

AEC 311 Fundamentals of Farm Business Management (Including Project Development, Appraisal and Monitoring) 2(1+1)

Agribusiness: Meaning, definition and importance of agribusiness in the Indian economy. Agribusiness Management- definition, types, distinctive features and importance. Management Functions: Planning, organising, directing, motivation, ordering, leading, supervising, staffing and controlling. Capital Management: Financial management of agribusiness, financial statements, balance sheet, profit and loss statement. Agro-based Industries: Importance and need, classification of industries, types of agro-based industries, procedure to set up agro-based industries, constraints in establishing agro-based industries. Marketing Management: Meaning, definitions, marketing mix, 5Ps of marketing, Pricing strategies- meaning and techniques. Project: Definitions, project cycle and characteristics of agricultural projects. Project Appraisal and Evaluation Techniques: NPW, BCR, IRR, PBP, sensitivity analysis.

Practical: Preparation of projects in agriculture and allied sectors. Analysis of financial statements. Study of agro-based industries and financing agencies- visit and survey. Project appraisal techniques- case study of agro-based projects.

AEC 321 Production Economics and Farm Management 2 (1+1)

Production Economics: Meaning, definition, nature and scope of agricultural production economics. Basic concepts and terms: Firm, industry, technical unit, plant. Production Functions: Meaning, definition, types, characteristics. Laws of returns: Increasing, constant and decreasing. Factor Product Relationships- determination of optimum input and output level. Factor Factor Relationships, Product Product Relationships. Returns to scale: Meaning, definition, importance. Farm Management: concept and meaning. Economic principles applied to the organizations of farm business. Farm business analysis- depreciation of farm assets, efficiency measures, farm inventory and records. Types and systems of farming. Risk and uncertainty in agriculture. Farm planning and budgeting. Linear programming: Definition, assumptions, advantages and applications in farm planning.

Practical: Estimation of production function. Application of farm management principles. Methods of computation of depreciation, efficiency indicators, break-even and shut down points, cost of cultivations. Preparation of net worth statement and income statement. Linear Programming.

AEG AGRICULTURAL ENGINEERING

AEG 121 Fundamentals of Soil, Water and Conservation Engineering 3(2+1)

Surveying - survey equipment, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Compass surveying; Plane table surveying. Levelling – levelling equipment, terminology, methods of calculation of reduced levels, types of leveling, contouring. Irrigation – water resources, classification of projects, flow irrigation and lift irrigation. Irrigation water measurement – methods and instruments such as weirs, flumes and orifices; Water conveyance systems - open channel and underground pipeline. Irrigation methods – drip and sprinkle irrigation systems. Water lifting devices – pumps (shallow and deep well), capacity, power calculations. Soil and water conservation- soil erosion, types, soil conservation techniques 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; Plotting compass survey; Plotting plane table 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 drip and sprinkler irrigation systems; Uniformity of water application in drip and sprinkler systems; Study of soil and water conservation measures.

AEG221 Farm Power and Machinery 2(1+1)

Farm power and its sources in India; 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 sowing implements - seed drills, paddy transplanters; Plant protection equipment and harvesting equipment; Threshing equipment - threshers for different crops, parts, terminology, care and maintenance. Winnowing, manual and power operated winnowers, care and maintenance. 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, maintenance and operation of tractor; Learning of tractor driving; Study, maintenance and operation of power tiller; Study of M.B. plough, measurement of plough size, different parts, horizontal and vertical suction; Study of disc plough; Study of seed–cum-fertilizer drills-furrow opener, metering mechanism and calibration; Study of paddy transplanters; Study of different inter cultivation equipment in terms of efficiency, field capacity; Repairs, adjustments and operation of sprayers and dusters; Study of different parts, registration, alignment and operation of mower; Study of threshers, their components, operation and adjustments. Estimation of operation cost of farm equipment.

AEG311 Protected Cultivation and Post-Harvest Technology 2(1+1)

Green house technology - Introduction, types of green houses; Planning and design criteria of greenhouse for cooling and heating purposes; Green house equipment, materials of construction for low cost green houses; Passive solar green house, hot air green house for heating systems, green house drying; Choice of crops or plants response to green house environment; Irrigation systems used in greenhouses; Cost estimation and economic analysis; Constraints/problems of greenhouse cultivation and future strategies. Importance of post harvest technology; Engineering properties of agricultural materials; Measurement of grain moisture content – methods, equilibrium moisture content; Seed processing – unit operations such as cleaning, grading, separation and its equipment; Grain drying – theory of grain drying, types of grain dryers; Grain storage practice – bag and bulk storage structures; Paddy processing – parboiling, merits, demerits, methods of parboiling; Milling of paddy, equipment for milling; Size reduction, equipment for size reduction care and maintenance.

Practical: Study of different types of green houses based on shape, construction and cladding materials; Calculation of rate of air exchange in an active summer and winter cooling system; Testing of soil and water to study its suitability for growing crops in greenhouses; Study of fertigation requirements for greenhouses crops. Visit to commercial green houses. Determination of engineering properties of agricultural products- such as angle of repose, coefficient of friction, hardness, etc; Measurement of grain moisture content by direct and indirect methods; Study of seed cleaners, graders and separators; Study of different grain driers; Study of improved grain storage structure; Study of milling equipment- rubber roll dehusker, engleburg huller; Visit to seed processing plant.

AEG321 Renewable Energy 2(1+1)

Energy sources - classification, energy from biomass, agricultural wastes, biogas plants and their constructional details, biogas production and its utilization; Principles of combustion, pyrolysis and gasification, types of gasifiers, producer gas and its utilization. Briquetting- machines for briquetting, uses of briquettes; Solar energy - solar flat plate and focusing 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 windmills, constructional details & application of windmills. Liquid bio fuels-bio diesel and ethanol from agricultural produce and 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.

CPH CROP PHYSIOLOGY

CPH 121 Crop Physiology 3(2 + 1)

Introduction, Importance in Agriculture. Seed Physiology, Seed structures, Morphological, physiological and biochemical changes during seed development, Physiological maturity – Morphological and physiological changes associated with physiological maturity in crop, Harvestable maturity, Seed viability and vigour, Factors affecting seed viability and vigour. Methods of testing seed viability and vigour, Germination, Utilization of seed reserves during seed germination, Morphological, physiological and biochemical changes during seed germination, Factors affecting seed germination. Post Harvest Physiology – Seed dormancy – Definition – types of seed dormancy – Advantages and disadvantages of seed dormancy – Causes and remedial measures for breaking seed dormancy, Optimum conditions of seed storage – Factors influencing seed storage (ISTA standards). Crop Water Relations, Physiological importance of water to plants, Water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water Use Efficiency, WUE in C_3, C_4 and CAM plants, Factors affecting WUE. Photosynthesis, Significance of C_3, C_4 and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting Photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops. Respiration and its significance, Brief account of Growth respiration and maintenance respiration, Alternate respiration – Salt respiration – wound respiration – measurement of respiration. Growth and Development, Definition, Determinate and Indeterminate growth, Monocarpic and Polycarpic species with examples. Measurement of growth, Growth analysis, Growth characteristics, Definitions and mathematical formulae. Nutriophysiology – Definition – Mengel's classification of plant nutrients – Physiology of nutrient uptake – Functions of plant nutrients – Deficience and toxicity symptoms of plant nutrients – Foliar nutrition – Hydroponics. Introduction of Photoperiodism and Vernalisation in relation to crop productivity – Photoperiodism. Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Senescence and abscission – Definition – Classification – Theories of mechanism and control of senescence – Physiological and biochemical changes and their significance. Fruit ripening – Metamorphic changes – Climacteric and non-climacteric fruits – Hormonal regulation of fruit ripening (with ethrel, CCC, Polaris, paclobuterozole).

Practical: Preparation of solutions; Measurement of water potential by Chardakov's method and Gravimetric method; Measurement of Osmotic potential by Plasmolytic method, Measurement of photosynthetic rate; Measurement of photosynthetic pigments: chlorophyll and carotenoids; Stomatal frequency and index; Measurement of respiration; Leaf anatomy of C_3 and C_4 plants; Measurement of transpiration, Imbibition of seed; Optimum conditions for seed

germination; Breaking seed dormancy; (a) Chemical method (b) Mechanical method; Seed viability and vigour tests. Measurement of leaf area by various methods; Growth analysis - study of growth parameters: LAI, LAD, CGR, RGR, LAR, NAR; Preparation of Hoagland's solution for hydroponics and to study mineral deficiency, Study of mineral nutrient deficiency in field crops; Effect of ABA on regulation of stomata of stomatal movement.

PPC PLANT PATHOLOGY

PPC 111 Agricultural Microbiology 3(2+1)

History of Microbiology- Applied areas of Microbiology. Origin of life, Spontaneous generation theory, Role of microbes in fermentation, Germ theory of disease, Protection against infections. Bacteria -Classification, Morphology, Cell structure, Growth, Binary fission, Phases of growth and dyanamics, Factors affecting growth. Premiliminary ideas of metabolism in bacteria. Bacteriophages - structure and properties of Bacterial viruses – Lytic and Lysogenic cycles. Bacterial genetics: Gene expression; Genetic recombination: transformation, conjugation and transduction, genetic engineering, Plasmids, episomes, genetically modified Organisms. Fungus and Fungus like organisms- somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction in fungi (asexual and sexual). Virus and sub-viral particles –TMV, viroids, prions. Soil Microbiology- Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere, microbes in composting. Plant – Microbe interactions and Phyllosphere microflora. Microbiology of Water, Microbiology of food: microbial spoilage and principles of food preservation. Beneficial microorganisms in Agriculture - Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial insecticides. Biodegradation, Biogas production, Biodegradable plastics.

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.
Isolation of soil microflora:
i) Isolation of fungi and bacteria from soil.
ii)Isolation of fungi from infected plant tissue, preparation of PDA.
iii) Identification of common fungi and their characterization.

PPC121 Introductory Nematology 2 (1+1)

Introduction: History of phytonematology. Economic importance. General characteristics of plant pathogenic nematodes. Nematode general morphology and biology. Digestive and reproductive system in nematode. 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. Nematode diseases: Root knot of vegetables, ufra disease of rice, tundu or ear cockle of wheat, golden nematode of potato; List of other important nematode diseases in India. Basic knowledge of nematode management.

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; Study and identification of most important plant parasitic nematodes with special reference to their characteristics and symptomatolgy–Meloidogyne, Pratylenchus; Heterodera, Ditylenchus, Globodera, Tylenchulus, Xiphinema, Radopholus, Rotylenchulus, and Helicotylenchus. Experimental techniques used in pathogenicity studies with root knot nematode.
Note: Students should submit pressed, well mounted diseased specimens (at least 5) during the semester end practical examination.

PPC 211 Plant Pathogens and Principles of Plant Pathology 4(3+1)

Definition and objectives of Plant Pathology; History of Plant Pathology; Concept of disease. Important plant pathogenic organisms-different groups,fungi, bacteria, fastidious vascular 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. Classification of fungi - General Characters of fungi Nomenclature, Binomial system of nomenclature, rules of nomenclature, Key to divisions and sub-divisions. Introduction: 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 post-infection). 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 – Rogueing, 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: 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, Plasmoparaand Bremia;* Study of *Mucor and Rhizopus.* Study of *Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula and Podosphaera;* Study of *Puccinia (*different stages*), Uromyces, Hemilea*; 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*; 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.

PPC 221 Diseases of Field Crops and Their Management 3 (2+1)

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of the following crop diseases: Rice- BLB,BLS, Brown spot, Blast , Sheath Blight, Rice tungro, False smut, Stem rot, Khaira disease. Wheat: Rust, Smuts, Bunts, *Helminthosporium* and A*lternaria* leaf blight. Barley: Covered smut of barley. Maize: Stalk rot of maize, *Helminthosporium* leaf blight. Bajra: Green ear and ergot disease. Sorghum: Smuts. Sugarcane: Red rot , Whip smut ,Sugarcane mosaic, ratoon stunting , grassy stunt , Mustard : Club root , *Alternaria* leaf spot ,downy mildew , white rust Groundnut : Tikka , rust , groundnut rosette. Sesamum: Phyllody, *Macrophomina* rot. Sunflower: Alternaria leaf spot, collar rot. Tobacco: Mosaic, leaf curl, black shank. Jute: Stem rot of jute, wilt .Cotton: Angular leaf spot. Redgram: Wilt, mosaic and sterility mosaic. Bengalgram: Wilt, grey blight. Blackgram and greengram: Mosaic and crinkle. Soybean: Rust, Bacterial pustule. Diseases caused by phanerogamic plant parasite of different field crops.

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 pressed, well mounted diseased specimens during the semester end practical examination.

PPC 311: Diseases of Horticultural Crops and Their Management 3(2+1)

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of the following crop diseases :
Citrus: Canker, die-back, Greening, anthracnose, gummosis, shooty mould.
Mango: Anthracnose and die-back, malformation, Black tip, Red rust. shooty mould
Banana; Panama disease, Sigatoka leaf spot, moko disease, bunchy top.
Grapevine: Downy mildew, anthracnose.
Pomegranate: Bacterial blight.
Papaya: Anthracnose, stem and foot rot, papaya mosaic (ring spot), leaf curl.
Apple: Fire blight, scab
Guava: Anthracnose, wilt.
Coconut: Leaf spot, root wilt, fruit rot, stem bledding.
Turmeric: Leaf spot
Sapota: shooty mould
Chilli: Damping –off of vegetables, anthracnose and ripe fruit rot, mosaic, leaf curl
Brinjal: Bacterial and fungal wilt, *Macrophomina* rot, *Phomopsis* blight, little leaf
Bhindi: Yellow vein mosaic
Potato : Late blight ,early blight ,scab, wart , black scurf and wire stem , bacterial soft rot , mild mosaic ,severe mosaic , rugose mosaic , acuba mosaic , leaf roll, hairy sprout.
Crucifers: Alternaria leaf spot, black vein, boron and molybdenum deficiency.
Cucurbits: Powdery mildew, downy mildew, mosaic
Tomato: Early blight, bacterial and fungal wilt, mosaic, leaf curl.
Beans: Mosaic, anthracnose, rust
Onion: Alternaria leaf spot, potash deficiency.
Betel vine: Stem and foot rot, bacterial leaf spot
Mulberry: Powder mildew, leaf spot.
Coffee: Rust.
Tea: Rust, blister blight, red rust of tea.
Rose: Die-back, black spot.
Crysanthemum: Leaf spot
Jasmine: Leaf spot
Tube rose: Collar rot and leaf blight.
Marigold: Leaf spot and bud rot

Practical: Diseases of citrus, guava, sapota, papaya, banana, pomegranate, mango, grapes & apple; Diseases of chilli, brinjal, beans, bhendi, potato, tomato, crucifers, cucurbits & onion. Diseases of betelvine, coconut, tea, coffee & mulberry; Diseases of rose, chrysanthemum, tube rose & jasmine. Field visits at appropriate time during the semester.
Note: Students should submit pressed, well mounted diseased specimens during the semester end practical examination.

HOR HORTICULTURE

HOR 111 Production Technology of Fruit Crops 3(2+1)

Definition and importance of horticulture. Divisions of horticulture. Climatic zones of horticulture crops. Area and production of different fruit crops. Selection site, fencing, planting systems, planning and establishment methods. 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, apple, litchi. Minor fruits – papaya, pineapple, custard apple, pomegranate, ber, jackfruit.

Practical:

1. Study of horticultural tools and implements and their uses.
2. Containers, potting mixture, potting and repotting.
3. Plant propagation- seed propagation, scarification, and stratification.
4. Propagation by cuttings, layering and grafting.
5. Layout and planting systems.
6. Methods of pruning and training.
7. Description and identification of important major fruit crops.
8. Irrigation methods in fruit crops.
9. Methods of Fertilizer application methods in fruit crops.
10. Visit to local commercial orchards.
11. Preparation of growth regulators – powder, solution and lanolin paste for propagation.

HOR 121 Production Technology of Vegetables and Flowers 3(2+1)

Importance of Olericulture, vegetable gardens, vegetable classification. Origin, area, production, varieties, package of practices for Solanaceous fruit vegetables and Bhindi.; Cucurbitaceous vegetables, Cole crops, Bulb crops, Peas and beans, Tuber crops, Root crops, Leafy vegetables and Perennial vegetables.

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, marigold and tuberose.

Practical

1. Planning and layout of kitchen garden
2. Identification of important vegetable seeds and plants
3. Raising of vegetable nurseries / seed beds.
4. Identification of ornamental plants (trees, shrubs, climbers, house plants, palms etc.).
5. Transplanting of vegetable seedlings in main field, intercultural operations & other practices
7. Seed extraction in tomato and brinjal
8. Visit to commercial vegetable farms
9. Planning and layout of gardens and garden designs for public and private areas.

10. Intercultural operations in vegetable plots.

HOR 221 Production Technology of Spices, Aromatic, Medicinal and Plantation Crops 3 (2+1)

Importance and cultivation technology of Spices – ginger, turmeric, black pepper, cardamom, coriander, cumin, fenugreek; Aromatic crops – lemon grass, citronella, palmarosa; Plantation crops – coconut, arecanut, betelvine, cashew; Medicinal plants – diascoria, rauvolfia, opium, ocimum, periwinkle, *Solanum khasiamum*, aonla, senna and plantago.

Practical

1. Botanical description and identification of aromatic plants.
2. Identification of spices and plantation crops.
3. Identification of medicinal plants.
4. Propagation techniques in aromatic and spice crops.
5. Study of identification of aromatic plants.
6. Distillation procedures for aromatic crops.
7. Propagation methods in plantation crops.
8. Propagation and planting methods in ginger and turmeric.
9. Harvesting procedures in aromatic plants.
10. Processing and curing of spices.
11. Visit to local commercial plantations.

HOR 321 Post Harvest Management and Value Addition of Fruits and Vegetables 2(1+1)

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 life of fruits and vegetables. Factors responsible for deterioration of harvested fruits and vegetables. Chemicals used for hastening and delaying ripening of fruits and vegetables. Methods of storage – pre-cooling, pre-storage 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. Importance and scope of fruit and vegetable preservation in India. Principles of preservation by heat, low temperature, chemicals and fermentation. 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

1. Practice in judging the maturity of various fruits and vegetables.
3. Determination of physiological loss in weight (PLW), total soluble solids (TSS), total sugars, acidity and ascorbic acid content in fruits and vegetables.
4. Different packing methods and methods of prolonging storage life.

5. Effect of ethylene on ripening.
6. Identification of equipment and machinery used is preservation of fruits and vegetables.
7. Preservation by drying.
8. Preparation of jam, jelly and marmalades.
12. Preparation of squash, cordials and syrups.
13. Preparation of chutneys, pickles sauces and ketchup.
14. Visit to local processing units / market yards / cold storage units / market and packing industries

AEX AGRICULTURAL EXTENSION

AEX 211 Fundamentals of Rural Sociology and Educational Psychology 2(2+0)

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

AEX 221 Dimensions of Agricultural Extension 2(1+1)

Education – Meaning, Definition, Types – Formal, Informal and Non-formal education and their Characteristics. Extension Education and Agricultural Extension – Meaning, Definition, Concepts, Objectives and Principles. Rural development – Meaning, Definition, Concepts, Objectives,

Importance and Problems in rural development. Developmental programmes of pre-independence era–Sriniketan, Marthandam, Gurgaon experiment and Gandhian constructive proprogramme. Development programmes of Post independence era, Firkin Development, Etowah – Pilot project and Nilokheri Experiment. Community Development Programme – Meaning, Definition, Concepts, Philosophy, Principles, Objectives, Differences between Community Development and Extension Education, National Extension service. Panchayat Raj system – Meaning of Democratic – Decentralization and Panchayat Raj, Three tiers of Panchayat Raj system, Powers, Functions and Organizational setup. Agricultural Development Programmes with reference to year of start, objectives & sailent features – Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP), ATMA, ATIC. Social Justice and Poverty alleviation programmes – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarojgar Yojana (SGSY), Prime Minsiter Employment Yojana (PMEY). New trends in extension, privatization. Women Development programmes – Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS) and Mahila Samriddi Yojana (MSY). Reorganized extension system (T&V System) – Salient features, Fort night Meetings, Monthly workshops, Linkages, Merits and Demerits, Emergence of Broad Based Extension (BBE).

Practical: Visits to a village and kisan mandal to study the ongoing development programmes. Visits to Panchayat Raj Institutions to study the functioning of Gram Panchayat (GP). Participation in monthly workshops of Training and Visit (T & V) System. Visit to Watershed Development Project area. Visit to a village to study the Self Help Groups (SHGs) of DWCRA. Visit to a voluntary organization to study the developmental activities. Visit to villages.

AEX311 Extension Methodologies for Transfer of Agricultural Technology 2(1+1)

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

Innovations – Meaning, Definition, Models of adoption Process, Innovation – Decision Process – Elements, Adopter categories and their characteristics, Factors influencing adoption process. Capacity building of Extension Personnel and Farmers – Meaning, Definition, Types of training, Training to farmers, farm women and Rural youth – FTC and KVK. TOT- Concept, Types of agricultural technology, Models of TOT and Determinants of TOT.

Practical: Organization of Group discussion and Method demonstration. Visit to KVK / FTC. Planning and Writing of scripts for Radio and Television. Audio Visual aids – Meaning, Importance and Classification. Selection, Planning, Preparation, Evaluation and Presentation of visual aids. Planning & Preparation of visual aids – Charts, Posters, Over Head Projector, (OHP) Transparencies, Power Point Slides. Planning and 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.

AEX 321 Entrepreneurship Development and Communication Skills 2 (1+1)

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

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations.

ACB AGRICULTURAL BIOCHEMISTRY

ACB111 Biochemistry 3(2+1)

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, Immobilization 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 application 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.

AST Agricultural Statistics

AST 311 Statistics 3(2+1)

Unit I: 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; 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. Probability: Definition and concept of probability; Expectation and Variance of a random variable, A brief introduction of Binomial, Poisson, Normal distribution and their properties.

Unit II: 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; ANOVA: one way and two way analysis, Experimental Designs: Basic Designs, Completely Randomized Design(CRD), Layout and analysis with equal and

unequal number of observations, Randomized Block Design (RBD).

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 Standard Deviation, Variance and Coefficient of Variation for Un-Grouped and Grouped data; Computation of Correlation Coefficient 'r' and its testing; Fitting of regression equations- Y on X and X on Y; 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.

CMA COMPUTER APPLICATION

CMA111 Introduction to Computer Applications 2(0+2)

Introduction to computers, components of computers and their use, input and output devices. Binary system. Booting and shut down. Units of Memory, Hardware, Software and Classification of Computers. Types of Processors. Computer Viruses, Worms and Vaccines. Operating System – DOS and WINDOWS. File management system - 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. Features of selected packages: Word Processing, Spread Sheet, Power Point. MSWORD: Creating, editing, formatting and saving a document. MSEXCEL: Creating, editing and saving a document, use of in-built statistical and other functions and writing expressions, use of data analysis tools, correlation and regression, creating graphs. MS Power Point: Creating, editing, formatting and saving a document. MSACCESS: Concept and creating database. Principles of Programming: Flow charts and algorithms, illustration through examples. Internet: World Wide Web (WWW), Web Browsing and Electronic Mail

ANS ANIMAL SCIENCE

ANS 121 Livestock Production and Management 3(2+1)

Place of livestock in the national economy, different livestock development programmes of Govt. of India. Important exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting fertility in livestock, housing principles, space requirements for different species of livestock. Reproductive behaviour like oestrus, parturition, fertility, sterility etc. Dairy science: Milk secretion, milking of animals and factors affecting milk yield and composition. Selection and breeding of livestock for higher milk and meat production. Pasteurisation, homogenization, sterilization and toned milk. Clean milk production. Dairy microbiology.
Animal nutrition: Feeding and management of calves, growing heifers and milch animals and other classes and types of animals. Digestive system of cattle and fowl. Classification of feeds, feeding standards. Composition of ration. Green fodders. Functions of carbohydrate, fat, protein, water, minerals & vitamins. Veterinary science: Important livestock diseases; Bacterial, viral, metabolic

etc.with prevention and control. Common idea of A.I. Zoonotic diseases. Livestock farm and environment. Breeding, feeding and production records. Poultry science: Breed characteristics of poultry, their methods of rearing, breeding, feeding and management, incubation, hatching and brooding, vaccination and prevention of diseases, preservation and marketing of eggs, its economics and keeping quality. Cost of production of milk, economical units of cattle, buffalo, sheep, goat and swine.

Practical: External body parts of cattle & fowl. Identification, handling and restraining of animals; Judging and culling; Feeding and ration formulation; Identification of feeds & fodder. Hatching, housing and management of poultry; Estimation of specific gravity and fat percentage of milk. Familiarity with A.I. system. Visit to livestock farms. Economics of livestock production.

Part-II: Experiential Learning

MODULE: CROP PRODUCTION

ELCP 01 Seed Production Technology 4 (2+2)

Importance of seeds, Seed quality, Different classes of seed, Nucleus, Breeder, Foundation, Certified and Truthfully labeled seeds, Seed dormancy–types, methods to break seed dormancy, Maintenance and multiplication of released varieties in self and cross- pollinated crops, Seed certification, Seed Legislations in India and Quarantine; Genetic and agronomic principles of seed production, hybrid seed production, Seed Sampling and Testing, Central and State Seed Testing Laboratories; Importance of seed treatment, Seed treatment, types of seed treatment, equipments used for seed treatment, Seed storage and packaging, Seed processing, Measures for pest and disease control, Seed marketing.

Practical: Study of floral biology of monocots and dicots, external and internal structures of monocot and dicot seeds; Preparation of seed album and identification. Seed testing – taking seed samples –germination test, moisture test and conventional purity tests of different crops, Seed treatment–methods of breaking seed dormancy, treatment against systemic disease, seed priming, coating, treatment with beneficial microorganisms. Hand emasculation and pollination in pulses, detasseling in maize, identification of rogues and pollen shedders; Pollen collection, storage, viability and stigma receptivity; gametocide application; Seed production in different crops – Cereals, pulses, oilseeds and vegetable crops (crops suitable to the season only). Maintaining isolation distance–roguing practices–harvesting, cleaning and packing; Visits to seed production plots and Seed Testing Laboratory; Specifications of tags and labels for different types of seeds; Identification of equipments for seed processing and seed testing.

ELCP 02 Integrated Farming Systems 3(1+2)

Farming system– Concept, definition, characteristics, classification and objectives; 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; Role of farming systems in sustainable agriculture – Integrated farming systems, different enterprises in a farming system, factors governing choice and size of enterprises, resource allocation in IFS; Merits of IFS; Models of IFS for irrigated and rainfed ecosystems. Importance and role of IFS in organic farming.

Practicals: Studies on farming systems prevailing in different agroecological situations in West Bengal. Package of practices and management of various components in IFS. Studies on ancillary activities. Computation of economics of IFS. Record keeping for IFS models. Visit to different units of IFS. Recycling of farm residues. Cropping system analysis.

ELCP 03 Water Management (Watershed, Micro Irrigation, Problematic Water) 4(1+3)

Watershed management- concept, component, objectives, delineation, problems and deterioration; Watershed development planning, watershed based cropping system; Soil and water conservation, water harvesting and recycling, ground water recharge, roof water harvesting; Concept of conservation agriculture. Importance of irrigation; Methods of irrigation – surface, subsurface and overhead irrigation; Micro irrigation methods – sprinkler and drip irrigation, localized irrigation; Irrigation management in different soil types. Water conveyance structures; Irrigation of principal crops; Water logging and drainage; Quality of irrigation water and management of problematic water for crop production.

Practicals: Delineation of watersheds- soil survey for land capability classification; Water harvesting structures; Preparation of watershed development plan; Different methods of ground water recharge and monitoring of ground water level; Analysis of rainfall data and determination of length of crop growing period; Field demonstration of surface and subsurface irrigation systems; Installation, operation and maintenance of sprinkler and drip irrigation systems; Demonstration of aqua fertilizer application, localized irrigation and micro sprinkler, mist, foggers, bubblers, etc; Water conveyance structures; Measurement of irrigation water; Quality testing of irrigation water; Crop management under limited irrigation and deficit rain; Crop raising under conservation agriculture; Visit to watersheds under National Watershed Development Project; Field study of ongoing schemes on watershed and irrigation management.

ELCP 04 Integrated Nutrient Management 3 (2+1)

Concept and objective of INM. Components of INM- soil nutrients, crop residues, green manure, organic manures, chemical fertilizers and biofertilizers; Soil properties and INM, INM under Indian context, FAO models, strength, weakness, opportunities and threats of INM, Fertilizer use efficiency, Biofertilizer, Site specific nutrient management, soil quality , soil degradation and its management. Concept of IPNS, importance on nutrient availability, Water- nutrient interactions and Diagnosis and Recommendation Integrated System (DRIS). Evaluation of soil fertility under INM, Soil testing and fertilizer recommendation.

Practical: Determination of soil pH, EC, organic carbon, available N,P,K, Calcium and Magnesium, micronutrients, Identification and quality analysis of common fertilizers and manures, case study on INM under Indian context, Soil testing and fertilizer recommendation.

ELCP 05 Soil Management (Conservation, Problematic Soil, and Soil Quality) 3(2+1)

Introduction; Need for soil conservation; Forms of soil erosion; Factors affecting soil erosion; Estimation of soil erosion; Methods of soil conservation: Agronomical and engineering measures; Land capability classification; Understanding the need of soil conservation in arid, semi-arid, humid, hilly and waterlogged areas. Concepts of problem soils; Types and distribution of problem soil; development and characteristics of problem soils; Effect on soil condition and plant growth; Management of problem soils; Quality and management of irrigation water; Concept of soil quality and soil health; Soil resilience; Elements of soil quality: indicators and their quantification; Approaches for interpreting soil quality and health indicator data; pedotransfer function; Fuzzy logic; Soil quality and health assessment and management.

Practicals: Determination of different soil erosivity indices: Suspension percentage, dispersion ratio, clay ratio, erosion ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index. Characterization of problem soils; Determination of cations (Na+, K+, Ca+, Mg+) and anions (Cl-, SO4--, CO3-, HCO3-) in ground waters and soil samples; Lime and gypsum requirements of acid and sodic soils, Rainfall erodibility, Estimation of soil loss. Physical and chemical test for monitoring soil quality; Preparation of a soil health score card.

ELCP 06 Remote Sensing and Geographical Information System for Natural Resource Management and Land Use Planning 3(1+2)

Remote Sensing: Introduction to remote sensing and aerial photography; Definition and principles of remote sensing; Energy sources and radiation principles; Nature of electromagnetic and thermal radiations; Active and passive remote sensing systems; Propagation of radiations through the atmosphere; Atmospheric window; Types of remote sensors and scanners; Satellite data products; Spatial, temporal, spectral, and radiometric resolutions; Spectral signature of different earth features; Remote sensing in optical infrared region for study of vegetation, soil, and water; Crop stress detection and crop yield modeling; Vegetation indices. Background and history of Indian space programme; Satellite imageries; Digital image processing: Image pre-processing, image processing, and image transformation; Image interpretation: True colour. Pseudo colour, and False colour compositions; Image classification: Supervised and unsupervised classifications. Global Positioning System (GPS): Introduction and applications of GPS navigation techniques; GPS satellites; Segments of GPS systems; Principles of GPS navigation; GPS broadcast signals; Accuracy of GPS systems; Sources of error in GPS; Error corrections; Pseudo range and differential GPS systems. Geographic Information System (GIS): Definition and objectives; Components of GIS; Types of data: Geographic and attribute data; Data structures in GIS: vector and raster based data models; Analysis tools in GIS: Buffer analysis, overlay analysis, and network analysis. Natural Resource Management and Land Use Planning: Objectives, methods, and interpretation of land use planning; Applications of geoinformatics for natural resource management and land use planning.

Practical: Familiarization with remote sensing and GIS equipments, softwares (ERDAS Imagine/Geomatica/ENVI; IDRISI/Arc Info/Arc View/Arc GIS), and data products; Topographic sheets; Creation of data files in a geographic database system; Onscreen digitization technique; Map projections; Image interpretation and enhancement techniques; Supervised and unsupervised classifications; Distance and area measurement; Soil survey and interpretation of satellite imageries, topographic sheets, and reports towards natural resource management and land use planning.

ELCP 07 Farm Mechanization 3 (1+2)

Farm mechanization - importance, objective, scope, benefits and impact of farm mechanization; Evolution and present status of farm mechanization in India; Prospects and constraints of farm mechanization in West Bengal; Mechanization policies and strategies of Government or concerned agencies; Prospects of different machines, tools and implements useful for agricultural mechanization; Equipment for tillage, sowing and planting operations; Intercultural tools and equipment; Spraying and dusting machinery; Irrigation equipment; Harvesting machinery-reaper, mower, potato digger and harvester, combine harvester; Threshing machinery- pedal and power threshers, multicrop thresher, groundnut decorticator, maize sheller; Cost economics of farm machines & equipment.

Practicals: Study of different tillage equipment including subsoiler and chisel plow; Adjustments, care and maintenance of different tillage equipment; Calculation of draft & hp requirement for operating implements; Testing of Rotavator; Testing of seed cum fertilizer drill to different crops; Study of zero till drill; Calibration of seed drill; Problems on seed drill & planters; Testing of paddy transplanter and potato planter; Study of commonly used sprayers and dusters- knapsack sprayers, compression sprayers, boom sprayers and centrifugal duster; Study of vertical conveyor reaper, combine harvester, potato digger and harvester, and flail mower; Study of different threshing equipments- pedal thresher, power thresher, multicrop thresher, maize sheller, and groundnut decorticator. Identification of different parts of tractor; Care and maintenance of tractor; Tractor driving; Hitching of implements, control of implements during operation; Operation of tractor with MB plough, disc plough, disc harrows, cultivators, chisel plough, leveler, puddler and intercultural equipment; Operation of bund formers, levelers ridgers and trenchers; Operation of mower; Operation of power tiller with rotavator and its care and maintenance.

MODULE: CROP PROTECTION

ELCPT 01: Integrated pests and disease management 4 (2+2)

GROUP -A

History and development of pest and disease management. Concepts of pest and disease management; Strategies for development of pest and disease management programmes. Plant protection organizations in India. IPM - Pest sampling and sampling programmes; survey and surveillance; Methodology of development .Problems and constraints in implementation of IPM. Biotechnological and other innovative approaches in IPM and IDM. Common and safe fungicides and their field application relevant to IPM. Phytotoxicity and compatibility among pesticides

GROUP -B

Crop loss and economic decision levels for pest populations. Concepts of economic levels – dynamics of economic injury levels. 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. Resistance of population to pest management tactics, pest population resurgence and replacement. Components of IPM and basic strategies – Physical, mechanical, biological, chemical and legislative methods. Chemical modifiers of development. Bio-rational insecticides. Integration of different components. Insecticides and Environment- Effect on soil, water, air and biota. Safe handling and use of pesticides, symptoms of poisoning and First aid.

Practicals

1. Study of physical and mechanical methods of control
2. Study of biological control of insects
3. Sampling techniques of different pests
4. Estimation of crop loss, yield loss, population of different pests
5. Study of pheromone and light traps
6. Study of IPM practices of rice, cotton, cabbage and chilli

ELCPT 02 Stored Grain Pests and Their Management 2 (1+1)

Importance of stored grain pests. Source and kinds of infestation and types of damage caused by pests of stored product. Distribution, commodities attacked, systematic position, marks of identification, nature of damage, biology and management practices of pests associated with stored grains of cereals, pulses, vegetables, condiments, spices and dried fruits *viz*., Angoumois grain moth, rice moth, potato tuber moth, Indian meal moth, lesser grain borer, Khaira beetle, pulse beetle, groundnut brunched, cigarette beetle, drug store beetle, rice weevil and flour grain mite. Important species of rodents, marks of identification, nature and extent of damage. Methods of rodent management - mechanical, physical, biological, chemical. Bait shyness, bait preferences, placement of baits, evaluation of efficacy of bait. Poisons – acute & anticoagulant rodenticides, fumigants etc. Methods of storage of food grains. Storage structures – methods of disinfestation –preventive and curative measures.

Practicals

1. Estimation of pest damage
2. Methods of monitoring of storage pests
3. Estimation of moisture content of grains
4. Identification of damage to stored grain by Lepidopteran & Coleopteran pests
5. Visit to NSC/ FCI/ WHCG
7. Storage structures for household and bulk storage of food grains
8. Calculation of concentration/dosages of insecticide for treatment in godowns.
9. Identification of important rodent species.
10. Burrow patterns and feeding habits of important rodent species.
11. Pre baiting and baiting with poisons.

ELCPT 03 Industrial Entomology (Apiculture, Sericulture & Lac Culture) 3 (2+1)

Apiculture: Study of important species of honey bees. Apiary box for scientific cultivation of honeybees. Study of equipments for handling of bees. Method of honey extraction by using honey extractor. Study of nectar and pollen yielding flora. Starting of a new Apiary. Management of bee colonies in honey flow & dearth period. Seasonal management of bee colonies. Division and uniting of colonies., Methods of Queen introduction into a new colony and Queen replacement. Transport of bee colonies and migratory bee keeping. Study of effect of honey bees as pollinators on the yield of crops, Study of effect of pesticides on honey bees. Bee products and their uses. Study of parasites, predators and diseases of honey bees and their management. Study of wax moths and their management. Economics of bee keeping.

Sericulture: Silkworm species of commercial values, morphological character, systemic position, and distribution. Wild and semidomesticated and domesticated species- their host plants and types of silk produced by them. Mulberry silk production- Moricuture including different species, variety, their propagation, cultivation methods and picking of leaves. Silk worm rearing- Requisites for local and scientific rearing, Grainage- Procedure for production of Dfls and commercial cocoon production. Protection from hazards.

Lac culture: Lac insect, economic importance of lac and its products, life history of lac insect, host plants, lac culture (local and improved methods), diseases and pests of lac and their management.

Practical

1. Management of apiary- general management (e.g. division, uniting, swarm management, control of robbing, queen introduction, transportation of apiary box, honey extraction, pests & disease control), seasonal management. Preparation of bee calendar.
2. Rearing of mulberry silkworm & examination of Dfls. Numerical related to sericulture.
3. Calendar for scientific lac cultivation.
4. Visit to institute devoted to Apiculture/ Sericulture/ Lac culture.

ELCPT04 Bio-control of Insect Pests 2(1+1)

Definition, history, concepts and strategies of bio- control of insect pests. Different bio-control agents and their characteristics. 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, mode of action and factors that influences the effective of microorganisms, their practical application. Characteristics of bacterial pathogens of insects, transgenic Bt plants and current status. Fungi for microbial control of insects and current status. Viruses for microbial control of insects and current status. Safety testing and registration of biological control agents. Advantages and limitations of biological control in pest management. Role of biological control in IPM – future needs. Mass multiplication of bio-control agents (Parasites, Predators and Entomopathogens).

Practicals

1. Mass rearing of important parasitoids and predators of insect pests.
2. Preservation, shipment of bio-control agents.
3. Methods of releasing parasitoids and predators in crop fields.
4. Field trip for collection of natural enemies
5. Isolation, identification and mass production of entomopathogens.
6. Measuring various quality parameters of biopesticides.
7. Visit to biological control laboratory
8. Visits to mass production and biological control programme centers.

ELCPT 05 Insecticides and Plant Protection Appliances 3(2+1)

Insecticides- History of development, production and consumption in India and world. Registered/banned/ restricted insecticides. Insecticides and their mode of action- cyclodienes, organo-phosphates, carbamates, synthetic pyrethroids, botanicals and other novel insecticides. Insecticide formulations, mixtures and adjuvants. Factors affecting toxicity of insecticides. Methods of application of insecticides- Seed treatment, stem application, seedling root dip, root zone placement, whorl application, fumigation. Insecticide application technology- Spraying and dusting of insecticides – Types of sprayers and dusters – Operational techniques – Distribution systems. Types of Nozzles – droplet size and volume of spray fluid. Spray control –calibration and field efficiency. Care and maintenance of sprayers & duster – Hand operated and power operated. Other pesticides- Acaricides, Rodenticides, Mollusicides, Nematicides etc

Practicals

1. Demonstration of methods of application of insecticides
2. Calculation of concentration/doses of different formulations of insecticides.
3. Visit to insecticide manufacturing units.

4. Operation and testing of hand operated knapsack sprayer, foot pump sprayer, rocker sprayer, hand compression sprayer and their maintenance.
5. Determination of droplet size & Calculation of lethal concentration
6. Calibration of sprayers-Measurement of distribution and coverage of spraying.
7. Testing of nozzles for discharge rates, volume measurements & pressure influence
8. Operation, testing and maintenance of hand operated duster
9. Visit to National Plant Protection Training Institute (NPPTI)

ELCPT 06 Postharvest Diseases and their Management 3(2+ 1)

1. Postharvest- Concept, History, Classification of durables and perishables. Significance of post harvest pathology,
2. Loss in durables and perishables – assessment and methodology
3.Postharvest diseases of durables – type of diseases and their control .
4. Postharvest diseases of perishables -Important pathogens, their role, factors affecting postharvest of perishable diseases
5. Host - pathogen relationships - role of pathogens, mechanisms of damages caused by pathogens in durables and perishables.
6.Ecology and epidemiology – environmental and micro-ecological factors affecting the spoilage of durables and perishables.
7. Selected postharvest diseases of fruit crops - Citrus, banana, mango, papaya, apple, grapes, litchi; Other important diseases of India.
8. Selected postharvest diseases of important vegetable and condiments crops – Curcubits, brinjal, tomato, beans, bhindi, potato, onion, garlic, ginger,
9. Spoilage in spices – health problems
10. Management of post harvest diseases of fruits and vegetables

Practical:

1. Isolation of grain and seed deterioration fungi by different techniques
2. Survey for occurrence and loss of perishables
3. Study of symptoms of postharvest diseases and their isolation
4. Koch's postulates.
5. Selected exercises on ecology and host parasite relationship
6. Management of storage diseases –role of sanitation , botanicals and volatile oils;
7. Visit of cold storage and storage structures
8. Submission of catalogued disease specimens

ELCPT 07 Mushroom cultivation 3 (1+2)

1.Mushroom- Definition, history and importance of mushroom cultivation; present scenario of mushroom cultivation in India.
2.Types of mushrooms- edible, poisonous , medicinal mushroom; puff balls , truffles and false truffles. food value of mushroom.
2 General morphological features, life cycle pattern of cultivated mushroom.
4.Pure culture of mushroom fungi and their nutritional requirements.
5.Mushroom terminologies - spawn, spawn run period , substrate, supplements, casing , composting, cropping, weed mushroom
6. Spawn - types, characteristic of a good quality spawn, methods of spawn production

storage of spawn.
5.Cultivation of button mushroom - different *Agaricus* species, composting and its formulation, casing, preparation of casing mixture, sterilization.
6.Cultivation of Oyster mushroom - different *Pleurotus* species , substrate selection and cultivation technique
7. Cultivation of paddy straw mushroom – different *Volvariella* species *and* their cultivation
8. Other cultivated mushroom - *Lentinus*, *Calocybe,* Auricularia and *Ganoderma*
9.Identification and management of different pests and diseases of mushrooms.
10.Postharvest treatments and preservation of mushrooms. canning and dehydration. and preparation of different recipes.
11. Packing and processing – Different methods of processing, fortification in other food items
12. Economics of mushroom cultivation

Practical
1. Identification of common edible and poisonous mushrooms
2. Equipments used in mushroom laboratory and farms
3. Physical and chemical sterilization techniques
4. Preparation of spore print and spore culture
5. Preparation of culture media from tissues and spore
6. Preparation of spawn - mother spawn and bed spawn
7. Visit to a commercial spawn production unit
8. Cultivation of different mushrooms depending upon facilities
9. Casing soil preparation for milky mushrooms
10. Commonly used compost formulae, long and short method of composting
11. Familiarization with other edible mushroom varieties
12. Identification and management of different pests and diseases of mushroom.
13. Post harvest treatment and preservation of mushrooms

ELCPT 08: Biological control of plant diseases and mass multiplication of microbial biocontrol agents 3(1+2)

1.Definition, history, importance and concepts of biocontrol of plant diseases .
2.Understanding of ecological equilibrium in relation to biocontrol
3.Biological balance – attributes of ideal and successful pathogen and parasites; Different biocontrol agents and their characteristics.
4.Isolation, specific identification, purification and pure culturing of recognized biocontrol organisms. Growth promotion – *Pseudomonas* spp., *Bacillus* spp., *Trichoderma* spp. and Actinomycetes. Assessment of commercial potential of bioagent for crop disease management
5. Mechanisms of biological control. Interactions of harmful and beneficial rhizospheric microbes, VAM and PGPR for biocontrol.
6.Pilot scale mass production in laboratory. Nutritional requirement and designing of media for commercial production of biocontrol agents.
7. Carrier materials and their importance in maintaining the shelf life of wettable powder formulations.
8.Different types of biocontrol formulation and their efficacy under field level. 9.Legislature Acts in the production and marketing of biocontrol agents and biopesticides.
10.Organic amendments, culture filtrates and botanicals etc.for plant disease management.
11.Enterprenureship development in biocontrol unit

Practicals:

1.Visit to biological control laboratory and private industry
2.Isolation of antagonistic microorganisms from phyllosphere, rhizosphere.
3.Pure culturing and evaluation of biocontrol potential of isolates
Pseudomonas spp., *Bacillus* spp., *Trichoderma* spp., Actinomycetes.
4.Testing antibiotic production in culture; Antibiotics in culture filtrate.
5.In-vitro screening of fungal and bacterial antagonists
6.Mechanisms of biological control- antibiosis, lysis, parasitism, competition
7.Mass multiplication of biocontrol agents a) For soil treatment b) For seed treatment
8.Mass. multiplication by liquid, solid and semisolid fermentation technologies.
9. Measuring various quality parameters of biopesticides.
10. Use of various organic amendments in the management of plant diseases

ELCPT 09 Phytosanitation and Quarantine 3 (2+1)

1. Plant quarantine - History; Principles and concepts of plant quarantine PQ organization chart and its functioning in India.
2.Definitions of plant quarantine terms .
3. Avenues of pest/pathogen introduction.
4. Phytosanitation inspection and issue of phytosanitory certification.
5 General conditions required for import of germplasms and transgenics, insects, microbial cultures; Plant quarantine treatments for salvaging germplasm infected with insects and mites
5. Methods for detection of insects and plant pathogens in imported germplasm.
6. Phytosanitory measures – General conditions for import. Plants and plant products subjected to phytosanitory inspection at growing site.
8. Plant quarantine surveillance and list of intercepted plant pests into India.
9. Current plant quarantine regulations in India and FAO. Problem of their implementation in India.
10. Role of domestic plant quarantine in relation to germplasm movement in India. Future requirements of plant quarantine.

Practical:

1. Visit to plant quarantine unit
2. Detection of plant pathogens from seed, food grains and other imported fruits and vegetables.
3. Sample and sampling techniques
4. Preparation of check list for phytosanitory measures adopted by the farmers.
5. Different treatment methods for quarantine.

ELCPT 10 Fungicides in Plant Disease Management 3 (2+1)

1. Fungicides - Concept and Classification ; History of fungicidal development
2. Non-systemic fungicides- Copper , Mercury and other heavy metals , Sulphur, Heterocyclic compounds oils
3. Systemic fungicides – all groups including development
4. Antibiotics in plant disease management - different groups and mode of action.
5. Host resistance modifiers – Chemical approach and others; advantages and problems
6. Brief studies of nematicides and other chemicals in vector control
7. Resistance of plant pathogens against chemicals and their management

8. Brief study of bio-fungicides and essentials oils.
9. Structure activity relations in Sulphur, Triazole and Benzimidazole fungicides.

Practicals:
1. Application of different fungicides and assessment of efficacy
2. In vitro and In vivo testing of candidate fungicides and antibiotics
3. Use of host modifies at the field level and assessment of efficacy
4. Adaptation for resistance
5. Calculation of doses etc. for field application
6. Study of new product catalogues
7. Visit to farmers field and suggestion on spot management

MODULE: HORTICULTURE

ELHOR 01 Commercial vegetable production 4(1+3)

Vegetable growing tracts in India with special reference to West Bengal. Types of vegetable growing and vegetable forcing structures. Techniques of vegetable seed production. Familiarization of characters of different vegetable crops. Seed and soil treatments. Seed bio priming techniques. Preparation of nursery bed, sowing and aftercare of transplanted vegetables. Preparation of calendar of operations. Main field preparation and planting of different vegetables - formation of beds, application of manures and basal dressing of fertilizers, gap filling etc. Irrigation scheduling. Top dressing of fertilizers and earthing up operation. Preparation of growth regulator solutions and application. Preparation and application of pesticides/ fungicides/ botanicals. Mechanical control, setting up of traps. Intercultural operations- training and pruning, staking. Maturity indices and harvesting of vegetables for vegetable and seed purpose. Seed extraction methods, processing and storage. Marketing of vegetables- marketing channels- wholesale markets and retail markets. Economics of vegetable cultivation. Organic cultivation of vegetables.

Practical: Hands on training related to above topics

ELHOR 02 Commercial flower production and landscaping 4(1+3)

Status and prospects of commercial cultivation of flowers. Protected cultivation of commercially important flower crops. Selection of varieties, planting, cultural practices, propagation and post harvest handling techniques of important flower crops. Seed production in annual flower crops. Value addition in cut flowers and loose flowers. Flower arrangements. Production techniques of dry flowers. Production of pot plants. Hi-tech cultivation of commercial flowers and export oriented units (EOU). Organic cultivation of flowers. Integrated pest and disease management practices in cut flowers and foliage. Layout and preparation of different types of garden. Identification of different plants. Preparation of herbaceous border and colour scheme. Different garden operations like pruning of shrubs, hedges etc. Visit to various gardens, commercial production units, flower markets etc. Preparation of projects for starting a commercial unit of cut flowers and foliage.

Practical: Hands on training related to above topics

ELHOR 03 Commercial fruit production 4 (1+3)

Global scenario of fruit production and export. - Present status of fruit production for domestic market and export in the state and in the country - problems and prospects. Different planting systems and layout. Selection of site, pit making and filling. Commercial methods of propagation and advanced techniques of growing, harvesting and post-harvest handling of important fruit crops. Different methods of training and pruning techniques in major fruit crops. Studies on crop regulation / induction of flowering. Study of high density planting Vs normal planting, advantages of HDP, and tree vigour control (including pruning and paclobutrazol application). Preparation and application of important bioregulators, plant protection chemicals and herbicides - conventional and eco-friendly products. Maturity indices, harvesting, grading, packing, storage and different ripening techniques of fruit crops for local and distant markets and for export. Organic farming and other cultural practices for quality improvement. Visit to commercial orchards.

Practical: Hands on training related to above topics

ELHOR 04 Nursery management of horticultural crops 4(1+3)

Importance of plant propagation. Practice in propagation of plants through seeds. Familiarization with media, implements and containers for plant propagation. Practice in rootstock production, vegetative propagation methods-cutting, budding, grafting, layering etc., and separation of propagules. Other plant parts used for propagation-bulbs, tubers, runners, stolons etc-polyembryonic and apomitic seedlings Plant growing structures for propagation. Use of growth regulators for plant propagation. Tissue culture technique. Progeny orchards. Selection of site-factors for nurseries to be commercial in establishment. Familiarization with components of nurseries. Handling-display and sales of plants. Practice of potting/bagging, repotting etc. - packing and transport of nursery materials. Pest and disease management in nursery. Preparation of lay out in establishing of commercial nurseries. Estimation of production costs for different kinds of planting materials. Visit to different types of nurseries.

Practical: Hands on training related to above topics

ELHOR 05 Post harvest technology of horticultural crops 4(1+3)

Postharvest loss assessment of fruits and vegetables. Processing and dehydration of pepper, ginger, turmeric, preparation of white pepper, green pepper, preparation of spice oil and oleoresins. Familiarization of postharvest indices in various fruits and vegetables. Familiarization on the various harvesting devices employed in fruits and vegetables. Exposure to various packaging materials in fruits and vegetables. Packaging – storage studies in selected fruits and vegetables. Preparation of field level storage structure and its functions Exposure to various storage structures for the storage of horticultural crops. Postharvest handling and value addition of fruits, flowers, vegetables, spices, medicinal and aromatic plants etc. Drying techniques and various driers. Processing of spices – viz pepper, ginger, turmeric etc. Visit to various processing factories and exposure to commercial processing.

Practical: Hands on training related to above topics

MODULE: AGRI-BUSINESS MANAGEMENT

ELABM01 Introduction to Agri-Business Management 3 (1+2)

Agri-Business Management – Meaning, definition, importance and functions. Difference between administration and management. Functions of agri-business management-Planning, coordinating, leading, supervising, directing, staffing and controlling. Concepts of Firm & Industry-Firm, industry, plant, technical unit. Rural Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) /SSIs. Export and Import Policies relevant to agriculture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of agri inputs industry. Characteristics of Indian agricultural processing and export industry.

Practicals: Hands on training on rural entrepreneurship development in vermicomposting, handicrafts, seed production, fruit and vegetable processing, etc. Development of projects for agriculture and allied activities. Market survey.

ELABM 02 Information Communication Management 3(2+1)

Information - definition and meaning, information as a strategic resource, changing conceptions of information and Information systems. Need for information and communication systems. Approaches to management of information – technical approach, behavioral approach, socio-technical approach. The New role of information systems in organisations, the changing nature of information and communication on technology, the need to plan the information architecture of an organisation. Affect of Information systems on organisations, organizational resistance to change – implications for the design and understanding of information systems. Information management and decision, making – information management for structured and unstructured decisions, ethical and social impact of information systems. Ethics in an information society – responsibility, accountability and liability – moral dimensions of the information age – information rights, privacy and freedom in an information society. Technical foundations of information systems, computers and information process, information systems software, managing data resources – Organising data in traditional file environment, A modern data base environment (DBMS), Logical and Physical views of data, advantages of data base management systems. Telecommunications- the telecommunications revolution, components and functions of a telecommunications system. Telecommunications system components, types of signals – Analog and digital, types of communication channels, characteristics of communication channels, communication processors, telecommunications software. Enterprise wide computing and Networking.

Practicals

1. Visit to an organization to study information and communication system
2. Visit to an institute to study and analyse different approaches to management of information
3. Study of information storage and information retrivel both in traditional and modern information and communication system
4. Hands on practice with computers in information storage, retrieval and use

5. Study of relevant Websites for information
6. Information networking through computers

ELABM 03 Organizational Behaviour and Human Resource Management 3(2+1)

Organisation, meaning, definition, functions of organization, features of classical organizations and modern organizations. Need for and importance of organizations. Formal organizations, informal organizations, classification of organizations according to their objectives – profit organizations, government organizations, protective, service, political, religious and social organizations. Organisational goal, Individual versus organizational goal-need for integrating. Properties of formal organization. Organisation behaviour, definition and meaning, focus and purpose of study of organization behaviour. Nature and scope of organization behaviour. Different levels of study of organization behaviour – Individual, group and the organization. Learning-importance of learning in the organizations, learning curve, attitudes, factors affecting development of attitudes, perception, definitions for organizations. Motivation, definition, meaning, need to motivate people in the organizations Maslows need hierarchy theory of motivation Group, formal and informal groups, group dynamics, Role & relationships in Group behaviour. Organisational Conflict, conflict –meaning and features reasons for conflict in the organization. Measures to decrease conflict in the organizations. Human Resources Management, importance of Human resource in an organization, importance of human resource management, personnel manager, functions of human resource management, nature of human resources in the organized and unorganized sectors, of agribusiness. Human resource planning need for human resource planning, procedure for selection – recruitment, selection, placement, employee training, need for training employees, meaning and definition of training, methods of training, wage and salary, types of wages, components of salary, rewards and incentives, features of rewards. Industrial relations, participants in industrial relations, industrial disputes, reasons for industrial disputes, trade unions, functions of trade unions. Need for maintaining good industrial relations.

Practical

1. Exercise on Organisational Communication
2. Analysis of organisational process- attitudes, values, motivation, achievement motivation and leadership
3. Visit to three different organisations- government, public and private
4. Study of organisational structure of different development departments
5. Exercise on delegation of authority
6. Exercise on team building process
7. Training need assessment of employees of different development departments

ELABM 04 Management of Agro-based Industry 3(1+2)

Agribusiness - concept, meaning, function. Agro-industry in India and West Bengal- types and classifications trends, quality standards, agencies involved, public-private sector role, distribution network, demand supply condition, etc. Agro-processing industry- importance, status, constraints, policies, present role and future prospects. Rural entrepreneurship development. Financing agribusiness-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. Important laws relevant for agro-industries. Company Law – Nature of company, definition of company, kinds of companies – private company, public company, promotion and incorporation of a company.

Practicals: Study of functioning of rice mills, seed firms, food processing industry, dairy processing industry, livestock and poultry industry, sugar industry, horticulture based industries. Study of functioning of various institutional agencies financing agro based industries. The students are expected to attach themselves to one of the selected agri-business units.

ELABM05 Marketing Management 3(1+2)

Marketing Management-Concept, importance, scope, history and evolution and philosophies. Marketing mix- 5P's of marketing mix, environmental variables of marketing, market segmentation and targeting, marketing planning process, marketing research and information system, consumer market and consumer behaviour, market measurement and forecasting, product management, new product development, product life cycle. Pricing of the product- various pricing strategies, physical distribution, various channel members and their role, personal selling, publicity, direct and on-line marketing. New export import policy- special provision for agricultural exports, export promotion, WTO & AoA.

Practicals : Study of consumer behaviour and their attitudes in taking purchase decisions. Market survey- impact of brand image, demand forecasting. Study of steps involved in new product development. Creating and exhibiting an advertising campaign. Various packaging materials used for agro based products. Working out the economics of promotion activity. Case studies

ELABM06 Financial Management of Agri-Business 3(1+2)

Financial Management: Concepts and objectives. Importance and need for financial resources, 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, accounts classification, 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. Financial efficiency measures, financial planning, objectives of profit planning (or budgeting), essential of profit planning, types of budgets, preparation of profit plan or budgets.

Practicals: Preparing an income statement and balance sheet, profit and loss statement. Estimating financial efficiencies. Estimation of financial requirements for different projects. Preparation of farm plants and budgets. Case studies

ELABM07 Natural Resource Economics and Management 3(1+2)

Concept, subject matter and importance of Natural Resource Economics. Classification of natural resources. Natural resources and economic growth. Issues in natural resource use and management: depletion of natural resources and its conservation, preservation, externality problem, market failure, free riding of open access resources, common property resources, property rights. Time element in decision making for temporal resource allocation. Social welfare function and criteria of economic policy.

Practicals: Collection and analysis of relevant data on various natural resources. Visits to prominent reserves of natural resources. Classification and analysis of environmental problems in developing countries. Working out different approaches to measure agricultural sustainability. Methods of valuation of environmental costs and benefits. Analyzing the benefit cost ratio of environmental and resource improvement projects. Taxes, subsidies and markets – inter relations. Study of legislative issues, treaties, conventions on natural resource and environmental management.

ELABM08 Project Formulation, Evaluation and Monitoring 3(1+2)

Project – concept and meaning, characteristics of a project. Project classification – Quantifiable and non-quantifiable projects, sectoral projects, techno-economic projects, service projects. Importance of a project, dimensions of a project, project cycle, project location and its criteria, project formulation, project implementation. Project identification and selection – technical feasibility, financial feasibility, marketing feasibility, legal feasibility, social acceptability; different selection criteria – Efficiency criterion: Net Present Value, Benefit-Cost Ratio, IRR, Payback Period; Equity criterion, Employment criterion, Physical environmental criterion. Evaluation and monitoring: objectives, methodological issues, approaches, uses and monitoring.

Practicals: Idea generation for projects. Estimation of financial project appraisal indicators-NPV, IRR, PBP, BCR, etc. Technical feasibility analysis of project. Social-cost benefit analysis. Implementation of project-network diagrams PERT and CPM. Preparing a project report. Case studies.

ELABM09 International Trade and Indian Agri-Business 4 (2+2)

Globalization of Markets- global challengers, policy reforms, current challenges and opportunities. World trade- concept and dimensions, theories of international trade, the changing composition of world trade. WTO- History and components, TRIPS, TRIMS, SPS, AoA, GATS, MFN and regional co-operation like EEC, SAARC, ASEAN. International Economic organizations and forums – IMF, International Development Association, GATT, UNIDO. Foreign Trade of India, export promotion, major problems of India's export sector. Major initiatives taken by the Government of promote foreign trade. Balance of payments- concept, nature of balance of payments accounting. Trade Barriers and Protection- Tariffs and Non Tariff Barriers. Foreign exchange market. Foreign Direct Investment (FDI)- importance, trends, threats and opportunities in Indian agri-business. Multinational Enterprises- meaning the changing nature of the multinational enterprises, Indian multinational enterprises.

Practical: Visit to Agri-Export houses and AEZs/SEZs. Visit to a Food Processing Enterprise. Measurement of export competitiveness of major agricultural commodities in India. Collection and analysis of data on export, import, tariffs and FDI. Estimation of BOP, BOT and TOT over time. Group Discussion on EXIM Policy.

MODULE: SOCIAL SCIENCES

ELSS01 Agricultural Journalism 3(2+1)

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. E- Journalism / Journalism on line – Concept, scope and importance.

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.

ELSS02 Visual and Graphic Communication 3(2+1)

1. Meaning, Definitions and the Role of Visuals in communication
2. Characteristics of Visual aids
3. Classification of visual aids
4. Principles and Production of visuals
5. Contribution of visual perception in learning process
6. Planning, Preparation, Presentation and evaluation of visual aids
7. Designing of messages and titles for visuals

8 Layout of visual aids

9. Selection and use of graphic formats
10. Preparation and use of low cost visuals based on the local situation
11. Preparation and use of photographs and pictures
12. Reprographic visuals

13. Computer based visuals and digitized video materials
14. Use of drawing techniques for different visuals
15. Selection and use of animation tools in transfer of technology
16. Preparation and use of resource maps for extension work
17. Designing of visuals for print and electronic media

Practicals
1. Preparation of low-cost visuals
2. Designing and layout of visual aids
3. Generating computer aided presentation of graphics
4. Scanning of visuals
5. Image editing and script writing for telecasts
6. Development of agricultural video films
7. Editing of video visuals
8. Visit to animation production center
9. Visit to print and electronic media centers
10. Presentation and evaluation of low cost visuals

ELSS03 Project Development, Appraisal and Monitoring 3 (2+1)

Define Project – Project Development – Need and Scope for Project Development in Agriculture and Rural Development –Role of NABARD in Project Development, Management and Implementation – Agricultural finance Project Cycle – Various steps involved in Project Management and Project Management Cycle – Development of Projects Related to Agriculture and Rural Development Project Appraisal Techniques Discounting technique, computation of Internal Rate of Return (IRR) Monitoring the projects – various techniques like Programme Evaluation Review Technique (PERT), Critical Path Method (CPM) etc – Difference between Monitoring and Evaluation Project Evaluation – Approaches Pre- Post, Ex-Ante and Ex- Post, With and Without – Situations and Justification – Preparation and Writing the Report

Practicals
1. Identification of Agro Based Projects
2. Visit to NABARD
3. Preparation of Statement of Balance Sheet, Profit Loss Statements
4. Financial ratios
5. Visit to Micro Finance Institute (MFI)
6. Preparation of Agricultural and Rural Development Projects
7. Application of Project Evaluation Techniques
8. Presentation of projects Prepared
9. Report Writing

ELSS04 Emerging Trends in Agricultural Extension 2(1+1)

Agricultural Extension in the new millennium – Issues and strategies. Investments in Agricultural Extension in India and Other Countries. Women and Youth in Agricultural Extension – Role, Importance and Empowerment. Human Resource Development in Extension Organisations – Meaning, Issues and strategies Changing Roles of Agricultural Extension Professionals in the context of WTO- Issues and Strategies Participatory Extension Approaches – RRA, PRA & PLA – Meaning, Features, Principles, Techniques. Demand Driven Extension – Meaning, Features, Model. Reorganized Extension System – Broad Based Extension- Meaning, Concept Farmer Led

Extension – Meaning, Features, Scope and Importance. Farming Systems Approach & Farming Situation Based Extension – Concept, Characters, Activities, Scope. Strategic Research and Extension Plan – Meaning, Importance. Group Led Extension – Meaning, Concepts, Procedures, Advantages and Limitations. Market Led Extension – Meaning, Problems in Agricultural Marketing, Characteristics, Approaches and Strategies. Privatization of Agriculture Extension Services and Public Private Partnership – Meaning, Problems in Public Extension, Reasons for Privatization, Approaches, Possibilities. Cyber Extension – Meaning, Tools, Advantages and Limitations. Voluntary organizations in Agricultural Extension – Scope and Importance, Limitations. Latest Rural Development and Agricultural Extension Projects and Programmes in India.

Practicals

1. Analyzing the roles of Change Agents in State Department of Agriculture
2. Visit to a village to observe the extension activities at the field level
3. Visit to an ATMA district
4. Identification of technological needs of farmers through participatory approach
5. Identification of Suitable Alternative Extension approaches for solving extension problems in a specific farming situation
6. Preparation of Research and Extension plan using PRA, FSR/E and FSBE (03)
7. Analyzing the functions of a selected VO
8. Studying Role of Farm Women and Rural Youth in Agriculture in a selected Village
9. Studying RMGs & SHGs in a Selected Village

ELSS05 International Trade 3 (1+2)

Theory of International Trade, Process of Liberalization, Privatization and Globalization (LPG) – Balance of Payments – Nature and Components of Disequilibrium – Advantages of International Trade – Principal of Comparative Advantage – Trade Barriers – Tariff Rate quotas (TRQ) – Tariffication – Impact of International Trade Policy of International Trade in India – An Over View of Agricultural Exports and Imports In India – Major Constraints – Agro – Export Zones (AEZs) and Special Economic Zone (SEZ) – Export Promotion Council (EIC) – Agricultural Processed Food Export Development Agency (APEDA) – Marine Product Export Development Agency (MPEDA). Emerging Problems in the New Economic Regime – WTO Agreement and Implications to Indian Agriculture – Sanitary and Phyto Sanitary Measures (SPS) – Technical Barriers to Trade (TBT) – Pre-Shipment Inspection – Hazard Analysis Critical Control Point (HACCP). International Marketing Channels – International prices (fob and cif) – Export Risk Insurance – Market Intelligence in International trade

Practicals: Visit to Export units, Regional Export Promotion council, AEZs and SEZs. Collection and analysis of data on Exports, Imports and Prices. Exim Policy of the Govt – Group Discussion. Estimation of BOP, BOT and TOT over time.

ELSS06 Government Policies and Programmes related to Agriculture 3(1+2)

Importance of Agriculture in India- Status and contribution in economic development. Agricultural Policies of the State and Central government- Agriculture policy, water policy, price policy, land policy, seed policy, fertilizer policy, credit policy, EXIM policy, industrial policy, etc. Major schemes in agriculture- Central schemes, state schemes, others. Need for restructuring Agriculture policy in the globalized era.

Practicals: Group discussion on National Agricultural Policy, Seed Policy, Fertilizer Policy, Credit Policy, EXIM Policy, Industrialization Policy, Fiscal and Monetary Policy. Visit to PRIs, DRDA and Financial Institutions.

ELSS07 Livestock, Fish and Poultry Trade and Marketing 4 (2+2)

Sources of poultry, fishery and livestock products in India - its importance in national economy, various systems of production and systems of farming, poultry, fish and dairy production and supply – its marketing and distribution, export and import of poultry, fishery and dairy products, Structure of allied agricultural industries – public and private sector, demand for allied agricultural products, pricing of allied agricultural products, allied agricultural product policies, WTO and allied agricultural products industries, promotion of grading and standardization of allied agricultural products, state trading of allied agricultural products – objectives, types of state trading, livestock investment opportunities in India. Marketing Environment of allied agricultural products, Exchange and Transactions, Needs, Wants and Demands, Product or Offering, Brand, Brand Image, Brand Strength and Brand Equity, Competition, Relationships and Networks, Marketing Channels, Supply Chain of allied agricultural products, Value and Satisfaction, Target Markets and Segmentation, Marketing Mix; Company Orientations towards the Market Place - Production Concept, Product Concept, Selling Concept, Marketing Concept, Societal, Marketing Concept, Difference between Selling and Marketing.

Practical: Visit to livestock, fish and poultry production units. Economic analysis of poultry, fishery and dairy enterprises. Collection and interpretation of data on allied agricultural products export. Study on international organizations for quality standards. Study on marketing channels of allied agricultural products. Market survey for livestock, fish and poultry products.

ELSS08 Farm Planning and Budgeting 3 (1+2)

Theory
Farm Planning and Budgeting– Concepts and importance, types of farm budgeting, characteristics of good farm plan, tools and techniques of farm planning. Linear Programming- Concept, definition, assumptions, limitations and formulation of problems. Farm Budgeting – Types, partial budgeting, complete budgeting, enterprise budgeting. Record keeping. Cost of cultivations. Financial analysis of farm plans.

Practicals : Development of farm plans. Preparation of alternative plans and budgeting. Formulation of Linear Programming problems and deriving optimal solutions. Calculation of Cost of cultivations.

ELSS09 Multimedia Technology 3 (2+1)

Multimedia – Definition, scope and importance in agricultural development: Important concepts in multimedia technologies Computers in agriculture: Cyber extension – Definition, successful models of cyber extension Introduction to basics in computers: MS PowerPoint Internet applications for multimedia: Multimedia file formats – HTML, audio, photo, video and image file formats and file posting Computer Assisted Information Basics: Story boarding and application Multimedia databases, Relational Database model, distributed and networks model Audio-production editing, photo editing, production and editing Animation tools and graphic tools Development of multimedia project – Resource development, integration and presentation Web based presentation Vs CD presentation

Practicals

1. Basics in computer: MS Office
2. MS PowerPoint and internet applications
3. CAI application and story board writing
4. CAI presentations, Multimedia file formats
5. Audio, photo and video production, editing and using the software
6. Animation and graphic tools software
7. Developing multimedia project using authoring tools
8. Development of multimedia project and presentation
9. Visit to multimedia technology centre

ELSS10 Behavioral Skills 3 (2+1)

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

MODULE: BASIC SCIENCES

ELBS 01 Techniques in Genetics and Plant Breeding 4(3+1)

Genetics:

(1) Architechture of the chromosome and organization of genetic material in eukaryotes and prokaryotes.
(2) Euchromatin and heterochromatin, supernumerary chromosome and plasmids, position effect.
(3) Nucleic acids - DNA its chemistry and types (A, B and Z forms), structure, replication and role as genetic material, RNA its chemistry and structure. RNA maturation/splicing
(4) Gene expression- Protein synthesis: Transcription and translation, Genetic code,
(5) Genetic regulation-inducible and repressible systems in prokaryotes. Differences in gene expression between prokaryotes and eukaryotes `
(6) Biochemical mutations and gene-enzyme relationship, Molecular interpretation of the mutation processes.
(7) Recombination in bacteria; Transformation, transduction (F-duction) and conjugation
(8) Fine structure of gene-genetic units of recombination, mutation and function.

Plant Breeding:

(1) Polyploidy – Types, causes, induction and their uses in plant breeding and distant hybridization.
(2) Heritable and nonheritable components of continuous variation- additive, nonadditive and interaction components.
(3) Concept of heritability and genetic advance under selection.
(4) Gene frequencies and Hardy-Weinberg equilibrium. Changes in the gene frequencies
(5) Theory of selection in the population of cross pollinated crops. Responses to selection.
(6) Systems of mating- Assortative, disassortative and random mating and their genetic consequences.
(7) IPR-definition, concept and components- plant breeders' rights & farmers' rights, UPOV, PPV & FR Act.

Practicals

(1) Pollen sterility, germination of pollen grain in artificial media and study of pollen tube growth.
(2) Linkage analysis; pedigree analysis; problems on probability theory
(3) Problems on Hardy-Weinberg law
(4) Study and analysis of quantitative characters through suitable statistical techniques. – Estimation of components of genetic variance, heritability (broad sense and narrow sense), genetic advance; t- test,
(5) Estimation of gene frequencies and changes in gene frequencies
(6) Preparation of different fixatives and stains for chromosome study.
(7) Critical study of various stages of mitosis and meiosis and determination of chromosome number with the help of smearing and squash methods.
(8) Preparation of permanent slide;
(9) Visit to AICRP trials and programme, visit to grow out test plots; visit to various research station and Institutions.

ELBS 02 Plant Tissue Culture 3(1+2)

History of plant tissue culture – scope and importance in crop improvement –Totipotency – morphogenesis, *in-vitro* culture methods, micro propagation, meristem culture, another culture, pollen culture, ovary culture, ovule culture, embryo culture, test tube fertilization – endosperm culture – factors effecting above *in-vitro* culture techniques – applications and achievements – somaclonal variation – types – reasons; protoplast isolation – culture manipulation – fusion – products of somatic hybrids and cybrids –applications in crop improvement –

Practicals: Requirement for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture Media components and preparation; Aseptic manipulations of various explants; Inoculation of various explants; Callus induction; Micropropagation, anther culture, pollen culture etc.

ELBS03 Breeding for Biotic and Abiotic Stresses 3(2+1)

Resistance breeding – its importance- general principles and methods of breeding for resistance. Breeding for resistance. Mechanism of resistance. Genetic basis of disease/pest resistance – gene for gene relationship, biochemical basis of disease resistance. Problems in breeding for biotic stresses Methods of breeding for resistance –recent approaches. Vertical resistance breeding. Horizontal resistance breeding Innovative techniques in breeding for biotic stresses. Breeding for abiotic stress –drought, salinity, heat cold flood. Achievements in breeding for biotic and abiotic stress

Practical: Screening techniques for insect resistance. Screening techniques for disease resistance. Screening techniques for abiotic stress drought, salinity, nutrient stress. Screening for through biochemical methods – proline. Invitro screening techniques Transfer of resistance through conventional and innovative techniques

ELBS 04 Molecular Diagnostics 3(2 + 1)

Introduction and importance of molecular diagnostics. Molecular make-up of cell structure-Ultra structure of cell wall membranes. Molecular organelle- Chloroplast and mitochondrial genomes, microsatillites, micro assays. Plant cell interaction with environmental stresses – biotic and abiotic stresses like drought, cold, salinity, heavy metal- their physiology and molecular bases. Studies on biochemical and molecular markers in crop plants under various stresses – cold stress, heat shock, herbicide stress, and defense against plant pathogens and pests. Signal transduction in plants and transduction molecules in plants. Molecular identification tools for plant diseases, bio-sensors and their application. DNA fingerprinting and DNA chips.

Practicals: Assessment of drought tolerance in crop plants through biochemical and molecular markers. Identification of high protein quality cultivars. Estimation of physiological and biochemical markers under water deficient and moisture stress in crop plants. Plant diseases verification through physiological, biochemical and molecular markers.

ELBS 05 Bioinformatics 3(2+1)

Bioinformatics as a science and overview. Applications. Data application and management. Use of data bases in biology; genome database, sequence data base. Sequence analysis- genome sequencing, Structural comparisons, Alignment of pairs of sequences, Multiple sequence

alignment. Similarity searches software and their applications. DNA marker data analysis. Primer designing and primer designing tools. Gene prediction and annotation. Phylogenetic analysis and software applications.

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, FASTA format primer designing , Genome sequence analysis, Identification of consensus sequences and domain identification, ORF finding, Microarray data analysis.

ELBS 06 Diagnostic Physiology 3(1+2)

Role of plant physiology in plant diagnosis-systematic approach to diagnosing plant damage; Factors causing plant damage – living (biotic) and non living (abiotic); Response of plants to adverse abiotic factors- deficiency and toxicity of nutrients, light, water, temperature, carbondioxide, pollutants, heavy metals, salinity, acidity and radiation; Mechanism of tolerance of plants to different abiotic stresses; Plant identification and characterization- growth and appearance of identified plants- normal and abnormal. Deficiency and toxicity symptoms of mineral nutrients in plants. Physiological disorders in major crops. Symptoms- identification, testing, correction and indicator plants; Foliar application of plant nutrients; Hydroponics; Storage disorders- identification, management.

Practical: Identifying the cause of the field problems, Hydroponics under controlled conditions (polyhouse)- preparation and development of symptoms due to nutrient, light and temperature stress, Nutrient diagnostic techniques- deficiency and toxicity symptoms, Identification of physiological disorders in major crops, field identification, Symptoms due to acidity alkalinity and radiation, Rapid tissue testing for nutrient deficiencies, Quantifying the stress damage using instruments- chlorophyll fluorescence meter, infrared thermometer- SPAD meter, Biochemical methods to assess stress damage, Storage disorders- pre-harvest and post harvest techniques for post harvest management, Application techniques/ mitigation techniques to manage the stress, On-farm diagnosis of plant damage patterns

ELBS 07 Plant Growth Regulators 3(2+1)

Definition and classification of plant growth regulators- Hormones, endogenous growth substances and synthetic chemicals; Endogenous growth regulating substances other than hormones; Tricontanol, Phenols – polyamines, jasmonates, concept of death hormone. Site of synthesis, biosynthetic pathways and metabolism and the influence on plant growth and development of individual group of hormones- Auxins, Gibberlins, cytokinins, Abscisic acid, Ethylene and Brassinosteroids; Signal perception, transduction and effect at functional gene level of different hormones- Auxins- cell elongation, Gibberellins- germination of dormant seeds, Cytokinins- cell division and retardation of senescence of plant parts, Abscisic acid-Stomatal closure and induction of drought resistance, Ethylene- fruit ripening. Synthetic growth regulators-Classification, their effect on plant growth and development. Practical utility in agriculture and horticulture.

Practical: Survey of plant growth regulators available in the market. Study of the nature of compounds in commercially available formulations. Methods of application of growth regulators. Extraction of hormones from plant tissue. Auxins- effect on rooting of cuttings, abscission, apical dominance, Gibberellins- effect on germination of dormant seeds, Cytokinins effect on apical

dormancy and senescence, ABA effect on stomatal movement, Ethylene-effect on breaking dormancy in sunflower and groundnut. Study of the effect of novel plant growth regulators (Brassinosteroids, Triacontanol, Polyamines etc.) on crop plants.

ELBS 08 Biochemical Techniques 3(1+2)

1. Biochemical techniques: Microscopy, Centrifugation, Spectroscopy, Chromatography, Electrophoresis.
2. Proteins: isolation methods, amino acid analysis, sequencing, peptide synthesis.
3. Enzyme technology: function and mechanism of action, immobilization techniques.
4. Nucleic acids: isolation methods, DNA sequencing, oligonucleotide synthesis, PCR, cDNA, molecular probes.
5. Secondary metabolites: methods of isolation and characterization.

Practical:

1. Space filling and ball & stick modeling of different bio-molecules viz. amino acids, proteins, lipids and nucleic acids.
2. Preparation of various buffers of different pH, standard solutions and reagents.
3. Separation of sugars by Paper chromatography.
4. Separation of amino acids by and HPTLC.
5. Separation of plant pigments by column chromatography.
6. Poly-acrylamide gel electrophoresis.
7. Agarose gel electrophoresis.
8. Isolation & quantitative determination of albumin from chicken egg.
9. Determination of amylase activity.
10. Determination of phosphatase activity from potato.
11. Isolation & quantitative determination of nucleic acids (RNA & DNA).

ELBS 09 Pesticides and Techniques of Residue Analysis in Agriculture 3(1+2)

1. Brief basic chemistry of pesticides.
2. Fundamentals of Toxicology. Physicochemical and biochemical decomposition of pesticides.
3. Principles of pesticide residue analysis, significant aspects of pesticide residues related to human health, Effects on soil fertility, Statistical implication of pesticides residues, Problems and management. Decontamination and detoxification of pesticides
4. Basic principle of different instruments viz., TLC, Column chromatography, GC,HPLC,HPTLC and Spectrophotometer etc and techniques used for isolation and characterization of pesticides and their metabolites.
5. Biopesticides in plant origin -Introduction, brief chemistry of flavonoids, pyrethrum, nicotininoids and terpinoids

Practical:

1. Methods of pesticide residue analysis: Basic steps involved Familiarization of apparatus and equipments; Extraction of soil, plant and water; Concentration of extract; Preparation of Glass column for chromatographic clean up, clean up by liquid-liquid partitioning.

2. Qualitative and quantitative estimation of Cu, S, Zn and Mn present in agro-chemicals.
3. Identification of agro-chemicals using TLC: Preparation of TLC plates, Spotting and development, Visualization and calculation of R_f.
4. Estimation of pesticide residues using spectrophotometer, GLC, HPLC.
5. Identification of metabolites of pesticides using GC-MS, Mass spectrophotometer, NMR etc

MODULE: ANIMAL SCIENCE

ELANS 01 Commercial Poultry Production and Management 3(1+2)

Poultry population and production statistics in India ; Commercial poultry farming to alleviate rural poverty ; Poultry birds and hybrids developed for commercial uses ; Improvement of indigenous stocks ; Nutrient requirements and feeding of poultry at various stages ; feed restriction ; Antibiotics and growth promoters ; preparation of economic rations ; Incubation and hatchery management. Care and management of poultry. Layer and broiler farming. Protection of poultry against epidemic & parasitic diseases; Processing, preservation and marketing of eggs and meat. Factors affecting profitability. Economics of poultry farming. Commercial poultry enterprises of India. Vaccination schedule. Farming and Environment.

Practical: Hatching of eggs-selection and handling of eggs, testing of eggs, management of incubator, handling of chicks at hatching level, maintenance of hatchery hygiene. Preparation of poultry houses and rearing of chicks, growers, layers/broilers. Culling and selection of birds. Preparation of ration. Feeding of poultry. Maintenance and sanitation of the farm. Vaccination and deworming. Preliminary Post-Mortem examinations. Grading and preservation of table eggs, Marketing of poultry products. Economics of poultry farming, preparation of schemes for large and small unit broiler and layer farming, record keeping, analysis of profitability of poultry farms. Visit to different commercial poultry farms.

ELANS 02 Animal Production and Management 3(1+2)

General: Livestock population and production strategies in India; Livestock farming areas of India; Livestock in mixed farming. Animal Breeding: Traits of economic importance in livestock production; Systems of breeding and breeding plans for increased production; Highlights on some new breeds formation. Different breeding projects running in the country-K.V.S, ICDP, AICRP, etc. Animal Nutrition: Livestock feeding standards; Formulation of rations for different categories of livestock. Feeding during scarcity period. Improvement of low quality roughages - Urea-molasses block. Preparation of economic feed. Digestibility and balanced feeding trials. Animal Management: Animal Housing systems: Housing types; Space requirements; different types of animal sheds. Breeding management: Package of practices for improving breeding efficiency, heat & detection; optimal stages of breeding. Artificial insemination and Embryo transfer technology; gestation and parturition in farm animals. Management of different categories of animals: Calf, heifer, lactating, dry and pregnant cows, working bullocks. Salient features of sheep, goat, pig and rabbit managements. Important infectious diseases of animals: their prevention and control; Routine vaccination and deworming programmes. Economic considerations of livestock farming. Record keeping, analysis of profitability of livestock enterprises. Farming & Environment.

Practical: Collection and study of different feeds and fodders. Formulation of rations by Thumb rule methods. Demonstration of urea-molasses treatment of paddy straw. Preparation of silage by polypack techniques. Collection, evaluation, dilution, preservation and A.I. (demonstration). Study of free body cells along with chromosome built up, Judging and selection of cattle. Preparation of farm lay out. Maintenance of farm records. Evaluation of animal fibre (hair, wool and synthetic fibre). Demonstration of vaccinations. Visit of to livestock farm. Visit of Dairy Plant.

ELANS 03 Disease Diagnosis and Management 3(1+2)

Livestock disease: Bacterial, viral, parasitic and other important diseases of cattle & their preventive measures Remedial measures: Application of Principle & supportive medicines. Vaccine Schedule, sanitary & other control measures.

Practical: Method of diagnosis, application of medicines & supportive therapy. Regular visit to veterinary hospital for case study. Application of vaccines to the cattle.

ELANS 04 Small Ruminants, Pig Production and Management 3(1+2)

Breeds of Goat, Sheep & Pig; housing, feeding. Preventive & controlling measures of different diseases. Preparation of small project/scheme, marketing etc.

Practical: Visit to farmer's house Regular study in regards to Breeding & feeding housing etc. with appropriate management. Vaccine schedule, treatment and culling procedure.

ELANS 05 Duck Keeping and Pisiculture 3(1 + 2)

Duck breeds, their habitat, feeds and diseases. Important bacterial, viral & other diseases. Special housing system to nearby ponds. System of farming with fish production. Breeds of sweet water fish, rearing, diseases, control & marketing. Fish product technology. Pond ecosystem and fish husbandry.

Practical: Learning hand to hand management at farmer's house in neighboring villages.

ELANS 06 Livestock Production with Mixed Farming Concept 3(1+2)

Study for suitable components of mixed farming. Different breeds, feeding, housing and utilization by products for lowering the cost of production. Study for rearing fishes, bee keeping, Piggery & duckery with pisiculture.

Practical : Study at farmer's house where crop-husbandry & Animal husbandry practices are available. Utilization of ponds, by product of crop & Animal husbandry.