

DEPARTMENT OF GENETICS AND PLANT BREEDING

Course Code	Course Title	Credit Hours
AG-102	Fundamentals of Genetics	3(2+1)
AG-201	Fundamentals of Crop Physiology	3(2+1)
AG-303	Fundamentals of Plant Breeding	3(2+1)
AG-403	Principles of Seed Technology	3(2+1)
AG-502	Crop Improvement - I (Kharif Crops)	2(1+1)
AG-602	Crop Improvement - II (Rabi Crops)	2(1+1)
AG-609	Fundamentals of Biotechnology	2(1+1)

Total - 18

Course wise Syllabus

Fundamentals of Genetics 3(2+1) AG-102

Theory

Pre and Post Mendelian concepts of heredity, Mendelian principles of heredity. Architecture of chromosome; special types of chromosomes. Chromosomal theory of inheritance; cell cycle and cell division - mitosis and meiosis. Chi-square test; Dominance relationships, epistatic interactions; Multiple alleles, pleiotropism and pseudo-alleles. Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics. Linkage and its estimation. crossing over mechanisms, chromosome mapping. Structural and numerical variations in chromosome and their implications, use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CLB technique.

mutagenic agents and induction of mutation. Qualitative & Quantitative traits. Polygenes and continuous variations, multiple factor hypothesis. Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material (DNA). Protein synthesis. Transcription and translational mechanism of genetic material. Gene concept: Gene structure, function and regulation.



Practical

Study of microscope. Study of cell structure. Mitosis and Meiosis cell division. Experiments on monohybrid, dihybrid, trihybrid. test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division. Experiments on probability and Chi-square test. Determination of linkage and crossover analysis (through two point test cross and three point test cross data). Study on sex linked inheritance in *Drosophila*. Study of models on DNA and RNA structures.

Fundamentals of Crop Physiology 3(2+1) AG-201**Theory**

Introduction to crop physiology and its importance in Agriculture; Plant cell: an Overview: Diffusion and osmosis; Absorption of water, transpiration and Stomatal Physiology; Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and Dark reactions, C3, C4 and CAM plants; Respiration: Glycolysis, TCA cycle and electron transport chain; Fat Metabolism: Fatty acid synthesis and Breakdown; Plant growth regulators: Physiological roles and agricultural uses. Physiological aspects of growth and development of major crops: Growth analysis, Role of Physiological growth parameters in crop productivity.

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, Separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content, Measurement of photosynthetic CO₂ assimilation by Infra Red Gas Analyser (IRGA).

Fundamentals of Plant Breeding 3(2+1) AG-303**Theory**

Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility-genetic consequences. Domestication, Acclimatization and Introduction: Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self-pollinated crops -mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-



Weinberg Law; Genetic basis and methods of breeding cross pollinated crops. modes of selection; Population improvement Schemes-Ear to row method, Modified Ear to Row. recurrent selection. Heterosis and inbreeding depression. development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops. clonal selection and hybridization: Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding. mutation breeding methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection.

Practical

Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross-pollinated crops. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids. Emasculation and hybridization techniques in self & cross-pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs and their analysis in plant breeding experiments.

Principles of Seed Technology 3(2+1) AG-403

Theory

Seed and seed production technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production. Seed quality; Definition and Characters of good quality seed, different classes of seed. Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification. phases of certification, procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983. Varietal identification through Grow Out Test. History and development of Seed Industry in India. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage. Seed marketing, Private and public sectors and their production and marketing strategies.

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum and Bajra. Seed



production in major pulses: Urd, Mung, Pigeonpea, Lentil, Gram, field bean, pea. Seed production in major oilseeds: Rapeseed and Mustard. Seed production in important vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test. Seed certification: Procedure. Field inspection, Preparation of field inspection report. Visit to seed production farms, seed testing laboratories and seed processing plant.

Crop Improvement - I (Kharif) 2(1+1) AG-502

Theory

Centers of origin, distribution of species, wild relatives in different cereals (Rice, Maize, Sorghum and Pearl millet); pulses (Pigeonpea, Urdbean and Mungbean); oilseeds (Groundnut); fibre (Cotton). Important concepts of breeding self-pollinated and cross-pollinated. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress and quality (physical, chemical, nutritional); Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea.

Practical

Floral biology, emasculation and hybridization techniques in different crop species; viz., Rice, Maize, Sorghum, Pearl millet, Pigeonpea, Urdbean, Mungbean, Groundnut, Cotton crops. Maintenance breeding of different kharif crops. Study of field techniques for seed production and hybrid seeds production in Kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Visit to seed production plots; Visit to AICRP plots of different field crops.

Crop Improvement - II (Rabi) 2(1+1) AG-602

Theory

Centers of origin, distribution of species, wild relatives in different crops: cereal (Wheat); pulses (Chickpea, Pea); oilseeds (Rapeseed and Mustard, Sunflower); cash crop (Sugarcane); vegetable crop (Potato, Tomato); Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional); Hybrid seed production technology of rabi crops. Ideotype concept and climate resilient crop varieties for future.



Practical

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Chickpea, pea, Rapeseed Mustard, Sunflower, Tomato: Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seeds production in Rabi crops: Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments: Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops.

Fundamentals of Biotechnology 2(1+1) AG 609**Theory**

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; somatic hybridization and hybrids; Soma-clonal variation and its use in crop improvement; cryo-preservation; Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations.

Practical

Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of electro-phoresis techniques and DNA finger printing.

