

## **30. SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF TEACHING ASSOCIATE IN GENETICS AND PLANT BREEDING**

### **Unit 1: Basic Genetics and Plant Breeding**

Cell structure and division. Mendel's laws, modifications of Mendelian ratios. Gene concept, allelism and fine structure of gene. Extra chromosomal inheritance. DNA structure, function, replication and repair. Genetic code. Gene-enzyme relationship. Replication, Transcription and Translation. Gene regulation in prokaryotes and eukaryotes. Spontaneous and induced mutations and their molecular mechanisms. Multiple alleles, sex determination, sex linkage, sex-influenced and sex limited traits. Crop domestication, evolution of crops and centres of diversity. Gametogenesis and fertilization. Modes of reproduction, apomixis, self incompatibility and male sterility systems and their use in plant breeding.

Breeding methods for self-pollinated, cross-pollinated and clonally propagated crops. Mutagenesis and mutation breeding. Population improvement, hybrid breeding, heterosis and genetic basis of heterosis.

Origin, distribution, classification, botanical description and floral biology of cereals (wheat, rice, maize, sorghum, pearl millet, minor millets); pulses (pigeon-pea, chickpea, black gram, green gram, cowpea, soyabean, pea, lentil, horse gram, lab-lab, rice bean, winged bean, lathyrus, Lima bean); oilseeds (groundnut, sesamum, castor, rapeseed mustard, sunflower, Niger, linseed); fibers and sugar crops, fodder and green manures.

### **Unit 2: Genome organization and Cytogenetics of Crop Plants**

Chromosome structure, functions and replication. Linkage and crossing over. Karyotype analysis, banding techniques and In situ hybridization. Special types of chromosomes. Chromosomal aberrations and their utility. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre- and post-fertilization barriers in wide hybridization. Genome organization and cytogenetics of important crop species- wheat, maize, rice, brassica, cotton, bajra, sorghum, vigna, potato and sugarcane. Cytogenetic techniques for gene location and gene transfer.

### **Unit 3: Quantitative Genetics**

Quantitative characters, Additive-Dominance Model, Genetic advance and types of selection and correlated response. Hardy Weinberg law, Linkage disequilibrium, Genetic load, Polymorphism, Breeding value, heritability. Response to selection, correlated response, genetic divergence analysis. Estimates of variance components and covariance among relatives. Multiple factor inheritance. Genetic control of polygenic characters. Mating designs with random and inbred parents. Estimation of gene effects and combining ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects. Mating designs- classification, diallel, partial diallel, line x tester, North Carolina Designs and triple test cross analysis, approaches to estimate and exploit component of self and cross-pollinated crops. Genotype x environment interaction and stability analysis.

### **Unit 4: Biotechnology and Bio-informatics in Plant Breeding**

Somatic hybridization, micropropagation, somaclonal variation, invitro mutagenesis. Artificial synthesis of gene. Genetic and molecular markers, generations of molecular markers and their application in genetic analysis and breeding. Molecular markers in genetic diversity analysis and breeding for complex characters. Multiple factor inheritance. Genetic control of polygenic characters. Tissue culture and its application in crop improvement. Gene tagging, QTL mapping and marker aided selection. Genome projects and utilization of sequence formation. Vectors, DNA libraries, DNA fingerprinting, DNA sequencing. Nucleic acid hybridization and immunochemical detection. Chromosome walking, Recombinant DNA technology, Gene cloning strategies. Genetic transformation and transgenic. Antisense RNA, RNAi and micro-RNA techniques in crop improvement. Bio-informatics tools, biological data bases (primary and secondary) and their implications in crop improvement.

#### **Unit 5: Plant Breeding for Stress Resistance, Nutritional Quality and Climate Change**

Genetic basis and breeding for resistance to diseases and insect-pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for resistance to heat, frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for desirable traits. Role of molecular markers in stress resistance breeding: MAS, MARS and MABB.

#### **Unit 6: Plant Genetic Resources, IPR, Seed Science and Technology**

Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights (IPR). Biodiversity Act. Plant Variety Protection and Farmers' Rights Act. Varietal development, release, notification and maintenance breeding. Seed, its types and seed chain. Seed production, processing, storage, certification and marketing. Seed quality control.

#### **Unit 7: Statistical Methods and Field Plot Techniques**

Frequency distribution. Measures of central tendency, probability theory and its application in genetics. Probability distribution and tests of significance. Correlation, linear, partial and multiple regression. Genetic divergence. Multivariate analysis. Design of experiments- basic principles, completely randomized design, randomized block design and split plot design. Complete and incomplete block designs. Augmented design, Grid and honeycomb design. Hill plots, un-replicated evaluation. Data collection and interpretation.