

Unit 1: Overview of Genetics

History and development of genetics. Classic researches and pioneer scientists in genetics. Mendelism and its deviations. Chromosomes and heredity. Sex in relation to chromosomes and genes. Linkage and crossing over. Artificial transmutation of genes. Pleiotropy. Penetrance and expressivity. Multiple factor inheritance. Gene modifiers. Nonchromosomal genes and their inheritance, sex-linked, sex limited and sex influenced inheritance. Sex determination, Chromosomal aberrations. Mosaicism and chimerism.

Unit 2 : Advanced Genetics

Fine structure of chromosomes and chromosomal banding. Gene and mechanism of gene action. DNA replication. Central dogma. Protein synthesis. Genetic code and DNA cloning. Recombinant DNA technology. PCR. Gene banks. Split gene. Use of biotechnological tools in improving animal productivity. Application of immunogenetics. Biochemical polymorphism. Genetic polymorphism. Chromosomal studies in livestock improvement programmes. Development of clones in relation to animal productivity and maintaining biodiversity. Production of transgenic animals. Gene mixing for useful functions.

Unit 3 : Overview of Breeding

Brief history of domestication of livestock. Important breeds of livestock & poultry with special reference to economic characters. Evolution of genetic systems. Isolating mechanisms and origin of species / sub-species, their adaptation. Mating systems for different livestock and poultry. Genetic and phenotypic consequences and applications of inbreeding and out-breeding. Genetic basis of heterosis and its use. Diallele and polyallele crossing. Reciprocal and reciprocal-recurrent-selection. Combining ability. Developments in population and production of livestock and poultry in India. Status of Animal Genetic Resources in India.

Unit 4 : Genetic Properties of Population

Population Vs individual. Inheritance and continuity of population. Effective population size. Biodiversity. Description of animal population. Value and means; Average effect of gene and gene substitution. Components of total phenotypic variance of a population. Resemblances between relatives. Concept of heritability, repeatability; & phenotypic, genetic and environmental correlations. Methods of estimation, uses, possible biases and precision of estimates.

Unit 5 : Population Genetics

Gene and genotypic frequencies and factors affecting them. Hardy Weinberg Law and consequences of it. Prediction of selection response by different methods. Selection for threshold characters. Indirect selection and correlated response. Theoretical basis of change of population mean and variance on inbreeding and cross breeding. Genotype – environment interaction.

Metric characters under natural selection. Quantitative trait loci and their applications. Marker-assisted selection.

Unit 6 : Genetic Strategies

Purpose-wise breeding strategies for livestock and poultry under different agro-climatic zones of India. Evaluation of past genetic improvement programmes for livestock and poultry in India. Bottlenecks in implementation of livestock breeding programmes in India. Evaluation and characterization of various indigenous breeds of livestock and poultry. Ex-situ and In-situ conservation of animal and poultry genetic resources. Development of new breeds / strains for better productivity in animals. Open nucleus breeding system in livestock improvement in India. Biotechnology and its role in improving animals and poultry production. Role of artificial insemination / frozen semen / embryo transfer / ONBS / MOET technology in animal breeding. Formulation of breeding programmes : Purpose-wise, breed-wise, region-wise for different species of livestock and poultry. Programmes for genetic improvement of non-descript livestock population of different species. Evaluation and current recommendations of cross breeding programmes of cattle, sheep and goat in India.

Unit 7 : Selection & Selection Experiments

Basis and methods of selection. Construction of selection indices. Different methods of sire evaluation. Selection differential and intensity of selection. Prediction of response. Improvement of response. Effect of selection on variance. Realised heritability. Long-term and short-term objectives of selections. Selection experiments in livestock and poultry. Role of control population in selection experiments. Selection for disease resistance and development of general and specific disease resistant strains / breeds. Purpose based selection and breeding of domestic animals and poultry. Genetic-slippage. Estimation of genetic divergence and its implications in livestock improvement programmes. Selection for better feed conversion efficiency in meat animals and poultry.

Unit 8 : Genetic Laboratory Techniques

Culturing Drosophila stock. Study of Drosophila with markers. Gene sequencing. Blood group typing. Karyotyping and chromosomal mapping. Gene mapping. Nucleic acid hybridization. Development of breed descriptors at molecular level for different livestock and poultry breeds. Biochemical polymorphism analyses – blood groups, transferrins, milk proteins. Collection and storage of samples for DNA fingerprinting; isolation and quantification of DNA from blood and semen; Restricted enzyme digestion of genome DNA, Analysis and transfer of DNA from agarose electrophoresis; Nucleic acid hybridization; Analysis of DNA fingerprinting, PCR-RFLP assay. Cryogenic preservation of animal germplasm.

Unit 9 : Research Techniques for Quantitative Animal Genetics

Use of computers in handling animal breeding data. Estimation of variances and covariances. Development of statistical models for analyses of breed data and to quantify environmental variance. Estimation of inbreeding and relationship. Estimation of inbreeding rate in a closed

herd / flock. Estimation and interpretation of genetic and phenotypic parameters. Development of efficient selection programmes and procedures. Estimation of genetic gains. Designing and evaluation of breeding strategies like reciprocal recurrent selection, diallele and polyallele crossing. Designing field based progeny testing programmes. Development of efficient methods and traits for genetic evaluation of males under indigenous conditions. Data bank concept.

Unit 10 : Laboratory Animal Breeding

Laboratory animal species viz mice, rat, guinea pig, rabbit, dog and monkey – Their chromosome numbers – genome size – major genes. Physiological, nutritional, reproduction parameters, maintenance protocol – pedigree recording, planned mating. Selection and Mating methods /systems- monogamous, polygamous and others. Genetic control and monitoring- Record keeping-Ethics and legislation for management and use of laboratory animals. Nomenclature for different strains, inbred lines (SPF line, Knockout mice, etc.) – Animal model for human disease. Specific utility of different laboratory species for different requirements.