

Core VII

Genetics

Course Objective

- To know general organization, possible function, and frequency of genes and non-gene DNA sequences in a typical eukaryotic genome.
- Practical methodology for applying Mendelian laws (heavily reliant on problem solving).
- Extensions of Mendelian genetics, including different forms of allelic relationships.
- To know different types of mutations, affect genes and the corresponding mRNAs and proteins.
- Inheritance of linked genes, including recombination mapping, and the physical basis of these rules (chromosomal behaviour during meiosis)

Course Outcomes:

- Learn the basic principles of inheritance at the molecular, cellular and organismal levels.
- Understand the mechanism of inheritance and its relationship with the expression of morphological traits.
- Understand the relationships between molecule/cell level phenomena (“modern” genetics) and organism-level patterns of heredity (“classical” genetics)
- Know about the variations by polyploidy, chromosomal aberration and gene mutations.
- Test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations

Unit-I:

Learning Outcomes: To acquire the basic principles of inheritance at the molecular, cellular and organismal levels

- Mendelian genetics and its extension Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Interaction of genes, Pleiotropy, Recessive and Dominant traits, Polygenic inheritance.
- Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; cytoplasmic male sterility; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.

Unit-II:

Learning Outcomes: Relationships between modern genetics and classical genetics

Linkage, crossing over and chromosome mapping: Linkage and crossing over- Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numerical based on gene mapping; Sex Linkage.

Unit-III:

Learning Outcomes: To develop mutants using different mutagens

- Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy
- Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens - physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.

Unit-IV:

Learning Outcomes: : Applying this knowledge in a variety of problem-solving situations of genetics

- The structure of gene: Classical vs. molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.
- Population and Evolutionary Genetics: Gene pool, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation

Practical:

1. Analysis of allelic and genotypic frequencies.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex-linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Blood Typing: ABO groups & Rh factor.
7. Chromosome anomaly: Translocation Ring, Laggards and Inversion Bridge, break etc. (through photographs).

Text Books:

- ✓ *Singh B. D. (2017). Fundamental of Genetics, Kalyani Publishers, New Delhi.*
- ✓ *Gupta P. K. (2017). Genetics, Rastogi Publication, Meerut.*
- ✓ *Verma P. S (2022) Genetics Revised Ed. Schand Publication. New Delhi*

Reference Books:

- ✓ *Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & Sons, India. 8th edition.*
- ✓ *Sinnot, E.W., Dunn, L.C. and Dobzhansky, T. (1985) Principles of Genetics, Tata Mc Grow Hill, New Delhi*
- ✓ *Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th edition.*
- ✓ *Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W.H. Freeman and Co., U.S.A. 10th edition.*
- ✓ *Strickberger, M.W. Genetics, Pearson Publishers, 3rd Edition*
- ✓ *Rastogi V. B. (2017). Genetics, Kedar Nath & Ram Nath, Meerut*