

**Credits: 4**

**Course Objective:**

The objective of this course is to provide knowledge of classical Mendelian and non-Mendelian genetics and basic cytogenetics. The students who successfully complete this course to are expected to have sufficient basic knowledge to study advanced topics in genetics and cytogenetics.

**Course Outcomes:**

Upon the successful completion of this course, students should be able to:

1. Describe Mendelian and non-Mendelian inheritance.
2. Perform monohybrid and dihybrid crosses in eukaryotes, solving problems of incomplete dominance, multiple alleles, sex-linkage and epistasis using Punnett Squares.
3. Map genes in eubacteria and eukaryotes by 2 - or 3 - point test crosses.
4. Recognize, describe and discuss the different aspects of chromosomal structure and function.
5. Identify and describe different types of chromosomal aberrations, and their role in evolution.
6. Understand that inheritance can also be extra-nuclear, and be able to elucidate the different modes.

## Theory

## Unit 1: Mendelian genetics and its extension

Pre-Mendelian genetic concepts. Concepts of phenotype and genotype, haploid and diploid, alleles, heredity and variation; Mendelian experiments on pea plants – concept of dominant and recessive traits, monohybrid cross in pea plant, Law of segregation, back cross and test cross, dihybrid cross in pea plant, Law of independent assortment, penetrance and expressivity (genetic problems related to above topics); Extensions of Mendelian principles - codominance, incomplete dominance, gene interactions - complementary gene interaction/ duplicate recessive epistasis (flower colour in *Lathyrus odoratus*), supplementary gene interaction/ recessive epistasis (grain colour in maize), dominant epistasis (fruit colour in *Cucurbita pepo*), duplicate dominant epistasis (shepherd's purse fruit shape), dominant recessive epistasis; multiple alleles - ABO blood groups and Rh factor in humans, pleiotropy.

## Unit 2: Chromosome structure, types and function

Chromosome - gross morphology, fine structure and molecular organization of chromatin, Structure and significance of centromere and telomeres; Structure and functions of specialized chromosomes - polytene, lampbrush and B-chromosome; Review of meiosis; Synapsis, synaptonemal complex, Chromosomal theory of inheritance; Linkage - complete linkage and incomplete linkage, significance of linkage; Crossing-over - definition, recombination and recombination frequency; mechanism of crossing over and chiasma formation, cytological

recombination map



- 2) Griffith, A. J. F., Wessler, S. R., Carroll, S. B., & Doebley, J. (2010). Introduction to Genetic Analysis (10th ed.). W. H Freeman & Co. ISBN-13: 978-0716768876
- 3) Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2006). Principles of Genetics (8th ed.). USA: Wiley. ISBN-13: 978-8126510436.
- 4) Elrod, S., & Stansfield, W. (2010). Schaum's Outline of Genetics (5th ed.). McGraw Hill. ISBN-13: 978-0071625036.

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