

**MAJOR
COMPULSORY
PRINCIPLES OF GENETICS
Code: ZOO-2011
Credit: 3 (T) + 1 (P)**

Course Objectives:

Human beings had been applying the principles of genetics by engaging in selective breeding of domesticated animals for many centuries. However, it was only with the work of Mendel and advent of 20th century, that basic principles of the science of genetics were formulated. In about a century of its existence, this field has generated tremendous amount of knowledge through observational and experimental research. The information amassed in the last century has laid the foundation for more discoveries in this important field of life science. This course aims to provide an overview of genetics starting from the work of Mendel to the current understanding of various phenomena like gene mapping, sex determination and mutations. The course will help in building sound fundamental knowledge of the principles of genetics, to be used as a stepping stone for higher studies and research in this field.

Learning Outcomes:

Upon completion of the course, students will be able to:

1. Understand the basic principles of inheritance.
2. Analyze Mendelian Law and gene interactions leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner.
3. Know the mechanisms of mutations, the causative agents and the harmful impact of various chemicals and drugs being used in day-to-day life.
4. Gain knowledge on genetic and environmental basis of sex determination.

**MAJOR 1
PRINCIPLES OF GENETICS
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THEORY	Hours
Unit 1: Principles of inheritance, Incomplete dominance and co-dominance; Multiple alleles; Lethal alleles, penetrance and expressivity; Epistasis; Pleiotropy; Sex-linked, sex-influenced and sex-limited characters inheritance and concept of gene. Linkage and crossing over, Cytological basis of crossing over, Recombination frequency as a measure of linkage intensity; Two factor and three factor crosses; Linkage map; coefficient of coincidence and Interference; Gene mapping by Somatic cell hybridization.	15
Unit 2: Gene mutations; Chromosomal aberrations – Deletion, duplication, inversion, translocation, aneuploidy and polyploidy; Induced versus spontaneous	20

mutations; Backward and forward mutations; Suppressor mutations; Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations in *Drosophila*: CLB method, attached *X* method.

Unit 3:

10

Basis of sex determination: Genetic and environmental; Sex determination in *Drosophila* and human; Mechanism of dosage compensation.

Comparison of nuclear and extra nuclear inheritance; Organelle inheritance: Antibiotic resistance in *Chlamydomonas*, Mitochondrial mutations in *Saccharomyces* and human disorders, Infective heredity in *Paramecium*. Maternal effects: Shell coiling in *Limnaea*, pigmentations in *Ephesia*.

Polygenic inheritance and Transgressive variation

PRINCIPLES OF GENETICS

Practical

Hours

1. To study Mendelian laws and gene interactions and their verification by Chi-square analyses using seeds/beads/*Drosophila*.
2. Study of linkage maps based on data from *Drosophila* crosses.
3. Identification of various mutant types of *Drosophila*(through culture/photomicrograph)
4. Study of human karyotype (normal and abnormal) using photomicrograph.
5. Preparation of polytene chromosomes from *Chironomus/Drosophila* larvae.
6. Preparation of metaphase chromosome from fish/mammal.

Suggested Readings:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. 8thEdition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. 5thEdition. John Wiley and Sons Inc
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics. 10thEdition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. 3rdEdition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. 9thEdition. W. H. Freeman and Co.
6. Tamarin R. H. (2017). Principles of Genetics. Tata McGraw Hill Edition.
7. Brown, T. A. (2023). Genomes 5. 5th edition, CRC Press