

**SEMESTER-III**  
**COURSE 6: PRINCIPLES OF GENETICS**

Theory

Credits: 3

3 hrs/week

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**LEARNING OBJECTIVES**

- To provide the background knowledge on the history of genetics and the importance of Mendelian principles.
- To provide the required knowledge on the gene interactions
- To acquaint the students, distinguish between polygenic, sex-linked, and multiple allelic modes of inheritance and extrachromosomal inheritance.
- To understand the principles of sex determination in animals with a reference to human being, and sex-linked inheritance
- To understand the human karyotyping and the concept of pedigree analysis basics.

**LEARNING OUTCOMES:** By the completion of the course the graduate should be able to –

- To understand the history of genetics, gain knowledge basic terminology of genetics
- To acquire knowledge on interaction of genes, various types of inheritance patterns existing in animals with reference to non-Mendelian inheritance.
- To acquire knowledge on chromosomal inheritance
- Acquiring in-depth knowledge on various aspects of genetics involved in sex determination,
- Acquiring in-depth knowledge on human karyotyping, pedigree analysis and chromosomal disorders concepts of proteomics and genomics

**SYLLABUS:**

**UNIT-I:**

- 1.1 History of Genetics- Concepts of Phenotype, Genotype, Heredity, Variation, Pure lines and Inbred Lines
- 1.2 Mendelian Principles on Monohybrid cross, back cross and Test cross
- 1.3 Mendelian Principles on Dihybrid cross

**Activity:** *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Problem solving on Mendelian principles*

**Evaluation:** *Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity*

**UNIT-II:**

- 2.1 Linkage - Definition, Types of linkage-complete linkage and incomplete linkage, Significance of linkage.
- 2.2 Crossing over - definition; Mechanism of crossing over: Chiasma Interference and coincidence
- 2.4 Gene Interactions: Incomplete dominance, codominance, Pleiotropy
- 2.5 Gene Interactions: Lethal alleles, Epistasis, Non- Epistasis

**Activity:** *Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Model preparation of linkage/crossing over*

***Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity***

### **UNIT-III:**

- 3.1 Polygenes (General Characteristics & examples)
- 3.2 Multiple Alleles (General Characteristics and Blood group inheritance)
- 3.3 Rh inheritance erythroblastosis foetalis
- 3.4 Extra chromosomal inheritance- Kappa particles in Paramecium and Shell coiling in snails

***Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/Case study on Rh/Erythroblastosis foetalis***

***Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity***

### **UNIT-IV:**

- 4.1 Sex determination- Chromosomal theory and Genic Balance theory
- 4.2 Sex determination- Hormonal, Environmental and Haplo-diploidy types
- 4.3 Sex linked inheritance: X-linked inheritance
- 4.4 Sex linked inheritance: Y-linked & XY-linked inheritance

***Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Preparation of animated model /chart on sex determination methods***

***Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity***

### **UNIT-V:**

- 5.1 Human karyotyping, Pedigree Analysis(basics)
- 5.2 Autosomal Recessive disorder-Sickle cell anaemia – causes, treatment, inheritance pattern, modes of testing and prevention
- 5.3 Autosomal Dominant disorder- Huntington disease
- 5.4 Basics on Genomics and Proteomic

***Activity: Assignment /Students Seminar/Quiz/Project/Peer teaching/Report writing after watching any video on the above/ Case study of a family for pedigree analysis***

***Evaluation: Instructor supposed to prepare a detailed Rubrics for the evaluation of the above activity***

### **Co-curricular activities (Suggested)**

- Observation of Mendelian / Non-Mendelian inheritance in the plants of college botanical garden or local village as a student study project activity
- Observation of blood group inheritance in students, from their parents and grandparents
- Karyotyping and preparation of pedigree charts for identifying diseases in family history
- Charts on chromosomal disorders

### **REFERENCE BOOKS:**

- Harper, P. (2010). Practical genetic counselling. CRC Press.

- Kessler, S. (Ed.). (2013). Genetic counselling: psychological dimensions. Academic Press. 3.
- Stevenson, A. C., & Davison, B. C. (2016). Genetic counselling. Elsevier.
- Evans, C. (2006). Genetic counselling: a psychological approach. Cambridge University Press.
- References:
- Atlas of Inherited Metabolic Diseases.
- Mendelian Inheritance in Man: A Catalog of Human Genes and Genetic Disorders, Victor A. McKusick, 2 Vol I & II
- Stacy L Blachford (Editor) 2001. The Gale Encyclopedia of Genetic Disorders. Gale Group Publishers, Vol.1 (A-L), Vol.II (M-Z).
- Limoine, W.R. and Cooper, D.NB. 1996: Gene Trophy, Bios Scientific Pub.Oxford.
- REFERENCES:
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- James D. Watson, Nancy H. Hopkins 'Molecular Biology of the Gene'
- Gupta P.K., 'Genetics

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**SEMESTER-III**  
**COURSE 6: PRINCIPLES OF GENETICS**

Practical

Credits: 1

2 hrs/week

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**LEARNING OBJECTIVES**

- To acquire practical knowledge on the importance of Mendelian principles by solving the problems.
- To provide the required knowledge on the gene interactions
- To acquaint the students on Human karyotype & pedigree analysis basics
- To understand the various genetic concepts through Virtual labs

**SYLLABUS:**

1. Study of Mendelian inheritance using suitable examples/Problems
2. Study of linkage recombination, gene mapping using the data
3. Study of human karyotypes
4. Blood grouping and Rh in humans
5. Demonstration of prenatal diagnosis (Virtual lab).
6. Amniocentesis demo or virtual lab
7. Demonstration of Ultrasonography (Virtual lab).
8. Scoring dysmorphic features in syndromic patients
9. Genetic Counselling methods based on case history
10. Construction and analysis of Pedigree

**REFERENCE WEB LINKS:**

- <https://www.iitg.ac.in/cseweb/vlab/anthropology/Experiments/Mendels%20law/index.html>
- <https://learn.genetics.utah.edu/content/labs/>
- [https://virtuallabs.merlot.org/vl\\_biology.html](https://virtuallabs.merlot.org/vl_biology.html)
- <https://blog.praxilabs.com/2020/06/30/dna-extraction-virtual-lab/>
- <https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Genetics.pdf>
- [https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1008&context=ny\\_oers](https://academicworks.cuny.edu/cgi/viewcontent.cgi?article=1008&context=ny_oers)
- <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>
- <https://www.rlbcu.ac.in/pdf/Agriculture/AGP%20113%20%20Fundamentals%20of%20Genetics.pdf>
- [https://coabnau.in/uploads/1610707528\\_GPB3.2PracticalManual-Final.pdf](https://coabnau.in/uploads/1610707528_GPB3.2PracticalManual-Final.pdf)

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