GENERIC ELECTIVES (GE-15): Inheritance in Biology

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Inheritance in Biology **GE-15**	**4**	**2**	**0**	2	Class XII pass	**Nil**

Learning Objectives:

- Mendelian and non-Mendelian inheritance: How is genetic information transferred across generations?
- Genetic defects in humans: Causes, inheritance and diagnostics
- Mutations: Types and agents
- DNA fingerprinting: DNA as a tool for establishing unique identity

Learning Outcomes:

Students will get familiarized with the concepts and principles of inheritance, sex determination, causal agents of genetic changes (mutations) and defects (congenital diseases) in humans. The course will also enable students to learn how genetic information is used to detect diseases and also to establish unique identity of an individual.

Section A: Information transfer across generations: Transmission Genetics

Unit 1: Chromosomal Inheritance **7 hours**

Principles of Mendelian inheritance; Chromosomal theory of inheritance, Incomplete dominance and co- dominance; Multiple allelism; lethal alleles; Epistasis; Pleiotropy; Penetrance and expressivity; Polygenic inheritance; Linkage and crossing over.

Unit2: Extra-chromosomal Inheritance: **4 hours**

Chloroplast Inheritance: Variegation in Four O` clock plant; Mitochondrial inheritance: petite mutants in yeast; Maternal effect- shell coiling in snails.

Section B: Male or Female? What determines the gender of the offspring?

Unit 3: Sex determination **3 hours**

Mechanism of sex determination in Insects (*Drosophila*), Plants (*Melandrium, Coccinia*)and humans (Sex determination regions/genes-TDF, SRY and Testicular feminisation), Dosage compensation in humans.

Section C: Human Genetics

Unit 4: Genetic defects-Structural **3 hours**

Autosomal and sex linked, congenital defects: Hemophilia, Thalassemia, Sickle cell anemia, Phenylketonuria, Cystic fibrosis, pedigree analysis

Unit 5: Genetic Defects-Variation in Chromosome number **3 hours**

Syndromes associated with chromosomal abnormalities: Down, Turner, Klinefelter, Edward and Patau.

Section D: Molecular Genetics

Unit 6: Heritable changes (mutations) and their causes **3 hours**

Physical and chemical mutagens, Transposable genetic elements and their role in mutations.

Unit 7: Diagnostics for human genetic disorders **3 hours**

Molecular, chromosomal and biochemical testing

Unit 8: DNA fingerprinting as molecular signatures- applications **4 hours**

Forensics (case studies), Paternity testing, unique identity establishment, conservation, finding adulterants in food/drugs.

Practicals **60 hours**

1. To understand the genetic interaction involved using the given seed mixture. Genetic ratios to be calculated using Chi square analysis.
2. Pedigree analysis (Sex linked dominant and recessive; autosomal dominant and recessive)
3. To study/list human dominant and recessive traits and to observe the listed physical traits among the students present in the class. Analyse the results.
4. To study the syndrome through photographs (Klinefelter, Turner, Downs /Patau/Edwards)
5. To demonstrate variation in the ability to taste PTC (Phenylthiocarbamide) in a given population.
6. Chromosomal and gene mutations: Complex translocation ring, quadrivalents, lagging chromosomes, dicentric/inversion bridge, sickle cell anaemia, xeroderma pigmentosum
7. To study sex chromosomes in *Drosophila, Melandrium, Coccinia* and human through photographs.

Suggested Readings:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2020). Introduction to Genetic Analysis, 12th edition. New York, NY: W.H. Freeman and Co.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics, 12th edition. San Francisco, California: Benjamin Cummings.
4. Campbell, N.A., Urry,L.A., Cain, M.L., Wasserman,S.A., Minorsky, P.V., Reece, J.B. (2020). Biology, 12th Edition. Harlow,England : Pearson

Additional Resources:

1. Hartl, D.L., Ruvolo, M. (2019). Genetics: Analysis of Genes and Genomes, 9th edition. New Delhi, Delhi: Jones and Bartlett Learning.
2. Snustad, D.P., Simmons, M.J. (2019). Principles of Genetics, 67th edition. New Delhi, Delhi: John Wiley & sons.
3. Singh, B. D. (2023). Fundamentals of Genetics, 6th edition. MedTech.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.