

GENERIC ELECTIVE COURSE -22**Classical and Molecular Cytogenetics****Zoo-GE -22****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	Department offering the course
		Lectures	Tutorial	Practical/ Practice			
Classical and Molecular Cytogenetics Zoo-GE-22	4	2	0	2	As per the Program Eligibility	Nil	Zoology

Learning Objectives

The learning objectives of this course are to:

- Understand the structure of chromosomes and its classification along with the condensation of DNA into chromosomes.
- Explore the transmission of the chromosomes from a generation to the next.
- Explain the organization and complexity of the human genome at the cytogenetic level.
- Investigate the nature of chromosomal abnormalities and related cytogenetic disorders.
- Evaluate appropriately the family pedigree and population and ethnic aspects of inherited disorders.
- Estimate the risk of recurrence of various inherited disorders in affected families.
- Acquire knowledge of the molecular cytogenetic tools which aid in prenatal diagnosis..

Learning Outcomes

By studying this course, students will be able to:

- Describe the condensation process of chromosomes along with their structural details.
- Have an in-depth understanding of chromosome transmission.
- Comprehend and analyze the factors leading to cytological disorders.
- Appreciate the role of genetic counseling in the prenatal stage.

- Develop essential skills for handling of cytogenetic tools such as FISH, PCR, and NSG used in genetic diagnostics.

SYLLABUS

THEORY **30 Hrs**

UNIT 1: Introduction to Cytogenetics **3 hrs**

Overview of cytogenetics and its historical development. Relationship between genetics, cytogenetics, and cytogenomics.

UNIT 2: Genomes and chromosomes **8 hrs**

Cell division: Mitosis, Meiosis, and the Cell Cycle. Sex chromosomes and their determination. Chromosome morphology and structure. Chromosomal aberrations and associated genetic diseases. Epigenetic mechanisms. Genomic analysis techniques.

UNIT 3: Techniques and Molecular Markers Cytogenetics **14 hrs**

Principles and applications of cytogenetic tools: Karyotyping, FISH, CGH, DNA microarray, PCR, NGS, and CRISPR-Cas9. Basics of probe design and labelling. Emerging trends in the field. Molecular markers: Microsatellites, Single nucleotide polymorphisms (SNPs), DNA sequencing techniques

UNIT 4: Clinical Cytogenetics **5 hrs**

Genome instability and its role in cancers. Genetic counselling and Prenatal diagnosis.

PRACTICALS **60 hrs**

(Laboratory periods: 15 classes of 4 hours each)

1. Demonstration of cell culture techniques.
2. Study of Mitosis and Meiosis using permanent slides and squash techniques.
3. Chromosome staining methods: G-banding
3. Karyotype preparation and analysis of metaphase chromosomes for genetic disorders/abnormalities.
4. To study the methods, principles, and procedures of FISH
5. Demonstration of DNA microarray
6. To study applications of Next-generation sequencing (NGS) in cytogenetics
7. To perform Polymerase chain reaction (PCR) and Primer designing.

Essential/recommended readings

1. Textbook 1. Marilyn S. Arsham and Margaret J. Barch (2017) The AGT Cytogenetics Laboratory Manual, 4th Edition
2. J. McGowan-Jordan and A. Simons (2016) An International System for Human Cytogenomic Nomenclature Reprint of: Cytogenetic and Genome Research, Vol. 149, No. 1-2
3. Rooney D.E., Czepulkowski B.H. (2001) Human Cytogenetics: A Practical Approach. Volume I og II, Oxford University Press.
4. Wolpert, L. (2002). Principles of Development. II Edition, Oxford University Press.

Suggested readings

1. Susan Mahler Zneimer (2014) Cytogenetic Abnormalities: Chromosomal, FISH, and Microarray Based Clinical Reporting and Interpretation of Result
2. Steven L. Gersen and Martha B. Keagle (2004) The Principles of Clinical Cytogenetics

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