

**JYOTI NIVAS COLLEGE AUTONOMOUS  
SYLLABUS FOR 2018 BATCH AND THEREAFTER**

**Programme: B.Sc.**

**Semester: III**

**GENETICS PAPER III**

**CYTOGENETICS**

**Course Code: 18IIIGT3**

**No. of Hours: 60**

**COURSE OBJECTIVES:**

- To learn chromosome structure and special types of chromosomes
- To understand the process of recombination of genes
- To learn and construct chromosome maps

**LEARNING OUTCOMES:**

- Students acquire the knowledge of prokaryotic and eukaryotic genome
- Students are able to construct chromosome maps and understand linkage of genes

<b>UNIT I</b>	<b>PHYSICAL BASIS OF INHERITANCE</b>	<b>17 HRS</b>
	Chromosome theory of inheritance	<b>1 HR</b>
	Prokaryotic chromosome	<b>1 HR</b>
	Eukaryotic chromosome – Macro-molecular organization of chromosome – primary and secondary constrictions, satellite bodies, centromere and telomere	<b>3 HRS</b>
	Types of chromosomes.	<b>1 HR</b>
	Heterochromatin and euchromatin and its significance.	<b>2 HRS</b>
	Ultra structure of chromosome – Du Praw's folded fibre model, nucleosome model and nucleosome structure	<b>2 HRS</b>
	Chemical composition of chromosome	<b>1 HR</b>
	<b>Banding techniques</b> – G, C, Q, R and Ag-NOR (Nucleolar organizing region)	<b>1 HR</b>
	<b>Karyotype and idiogram</b> (Human and Drosophila); Digital and Spectral	
	karyotyping	<b>2 HRS</b>
	<b>Special types of chromosomes:</b> Polytene chromosomes – Salivary gland chromosomes in Drosophila, Lampbrush chromosome in amphibian oocytes and B chromosomes	<b>2 HRS</b>
	A brief account of Paris nomenclature	<b>1 HR</b>
	<b>UNIT II LINKAGE AND CROSSING OVER</b>	<b>14 HRS</b>
	<b>Linkage:</b>	<b>2 HRS</b>

Concept of linkage - linkage groups, Bateson and Punnett's experiment, coupling and repulsion hypothesis; cis-trans arrangement

Theories of linkage – differential multiplication theory and chromosome theory **1 HR**

Types of linkage – complete and incomplete linkage with examples from Drosophila and Maize **2 HRS**

**Crossing over:**

Types of crossing over – Germinal (twin spot and yellow spot) and Somatic crossing over **2 HRS**

Cytological theories of crossing over **2 HRS**

Molecular mechanism of crossing over and recombination – Single break and Double strand break models **2 HRS**

Cytological evidence of crossing over – Stern's experiment in Drosophila, McClintock's experiment in Maize; crossing over in Drosophila; absence of crossing over in male Drosophila **2 HRS**

Frequency and percentage of crossing over. Factors affecting crossing over – age, distance, temperature and X-rays **1 HR**

**UNIT III CHROMOSOME MAPPING 9 HRS**

**Steps involved in chromosome mapping: 4 HR**

Determination of percent crossover values, two point cross, three point cross

Determination of map distance between gene loci, sequence of gene loci

Map construction in Maize and Drosophila

Interference and coincidence **1 HR**

Tetrad analysis in Neurospora **1 HR**

Genetic problems related to mapping **3HR**

**UNIT IV CHROMOSOMAL ABERRATIONS 14 HRS**

**Numerical:**

Euploidy (monoploidy, haploidy and polyploidy) **1 HR**

Polyploidy – autopolyploidy and allopolyploidy and their significance in polyploidy in plants **2 HR**

Aneuploidy – monosomy, nullisomy and trisomy **2 HR**

**Structural:**

Deletions, duplications, Robertsonian translocation, inversions, isochromosomes and ring chromosomes. **4 HR**

Evolutionary significance of chromosomal aberrations **1 HR**

**Transposons:**

IS elements and composite transposons in prokaryotes. Eg.:Ac and Ds elements in

Maize **1 HR**

Retrotransposons and P elements in *Drosophila* **2 HRS**

Genetic and evolutionary significance of transposons **1 HR**

**UNIT V EXTRACHROMOSOMAL INHERITANCE /CYTOPLASMIC INHERITANCE **6 HRS****

Mitochondrial DNA – petite character in yeast **1HR**

Chloroplast DNA – plastid inheritance in *Mirabilis jalapa*, **1HR**

Kappa particles in *Paramecium* **2 HR**

Sigma factor in *Drosophila* **1 HR**

Cytoplasmic male sterility (CMS) in Maize and its commercial exploitation **1 HR**

## II B.Sc. Genetics

### III Semester Practical III

**DURATION : 3 HRS/UNIT**

**NO. OF UNITS: 15**

**1. Culturing and handling of Drosophila: 2 UNIT**

- i) Media preparation
- ii) Cleaning and sterilization of bottles
- iii) Handling of Drosophila
- iv) Isolation of virgin flies

**2. Genetics of Drosophila:**

- a) Salivary gland chromosomes: Dissection of salivary glands and preparation of Polytene chromosomes **2 UNIT**
- b) Mounting of sex comb **1 UNITS**
- c) Types of mutants of Drosophila: eye colour, body colour, shape of wings **2 UNIT**

**3. Study of chromosomal aberrations: 3 UNITS**

Temporary squash preparation of flower buds of *Rhoeo discolor* to study translocations

Identification of permanent slides:

Inversion - salivary gland chromosomes of *Drosophila*;

Translocation - flower buds of *Rhoeo discolor*

Induction of polyploidy in onion root tip (demonstration)

**4. Genetic problems on linkage and crossing over 3 UNITS**

- i) *Drosophila*
- ii) Maize
- iii) Human (Sex linkage)

Practical tests/repetition **2 UNITS**

**Note:** 13 Practical + 2 units for practical tests/repetition

### REFERENCES:

1. Bruce Alberts et al (1989), MOLECULAR BIOLOGY OF THE CELL, 4<sup>th</sup> edition, Garland Publications, New York.
2. Daniel Hartl & Jones E.W. (1998), GENETICS, PRINCIPLES AND ANALYSIS, 4<sup>th</sup> edition, Jones & Bartlett Publication, Massachusetts.
3. Goodenough U. (1984), GENETICS, 3<sup>rd</sup> edition, CBS College Publishing.

4. Gupta P. K. (2003), CELL AND MOLECULAR BIOLOGY, 2<sup>nd</sup> edition, Rastogi Publications, Meerut.
5. O'Brien S. (1993), GENETIC MAPS, 6<sup>th</sup> edition, Book 3: Lower Eukaryotes. Book 4: Nonhuman Vertebrates. Book 6: Plants, Cold Spring Harbor Lab Press, New York.
6. Obe G. and Natarajan A.T. (1990), CHROMOSOMAL ABERRATIONS: BASIC AND APPLIED ASPECTS, Springer Verlag, Berlin.
7. Sambamurthy A.V.S. (1999), GENETICS, Narosa Publishing House, New Delhi.
8. Sinha U. and Sinha S., CYTOGENETICS, PLANT BREEDING AND EVOLUTION, Vikas Publishing House, New Delhi.
9. Snustad, D.P, Simmons M.J (2006), PRINCIPLES OF GENETICS, 4<sup>th</sup> edition, Wiley Asia Student Edition.
10. White M.J.D. (1973), ANIMAL CYTOLOGY AND EVOLUTION, Cambridge University Press.