JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095
DEPARTMENT OF GENETICS
B.Sc. II SEMESTER GENETICS PAPER II SYLLABUS (2024 SEP Batch Onwards)
CYTOGENETICS

Course title	**Cytogenetics**
Course code	**24IIGT2T**
Course credits	**03**
Total contact hours	**56 Hours**
Duration of ESA	**03 Hours**
Continuous Internal assessment (CIA)	**20 Marks**
End Semester Examination	**80 Marks**

Course Objectives:

The course enables the students to:

- Understand the Laws of Mendel and deviation from Mendelism.
- Gain knowledge on the principles of Linkage and crossing over.
- Comprehend the phenomenon of extra nuclear inheritance.
- Study the mechanism of sex linkage and sex determination.
- Gain knowledge on various structural and numerical chromosomal aberration.

Course Outcomes:

After the successful completion of the course, the student will be able to:

- Interpret Mendel's laws of inheritance and analyze different types of gene interactions, such as epistasis and pleiotropy.
- Employ the principles of linkage and crossing over, and construct genetic maps based on recombination frequencies.
- Analyse and identify the patterns of extra nuclear inheritance.
- Apply the mechanisms of sex linkage and sex determination to develop inheritance patterns.
- Explain different types of chromosomal aberrations, and their implications on genetic disorders and inheritance.

Contents	56 hrs.
Unit-I	**14 hrs.**
• **History of Genetics:** Concept of allele, gene and genome, Phenotype and Genotype; Heredity, Variation, Pure lines and Inbred Lines. Mendelian experiments on pea plants - Law of Segregation; Monohybrid cross, Back cross and Test cross, Law of Independent Assortment: Dihybrid cross in pea plant, Back cross and Test cross. • **Multiple Alleles**: Definition, ABO blood groups and Rh factor in Human, Related Genetic Problems. • **Gene Interactions:** Incomplete inheritance and co- dominance, Epistatic Interactions-Complementary gene interaction (9:7) (Flower colour in *Lathyrus odoratus*) Supplementary gene interaction (9:3:4) (Grain colour in *Zea mays*) Dominant epistasis (Fruit colour in *Cucurbita pepo*) Recessive Epistasis (Coat color in mouse), non-epistasis (Comb pattern in fowl).	
Unit-II	**14 hrs.**
• **Linkage:** Definition of Linkage, Coupling and Repulsion hypothesis, Linkage group- *Drosophila*, Types of linkage - complete linkage and incomplete linkage, Factors affecting linkage - distance between genes, age, temperature, radiation, sex, chemicals and nutrition. **Crossing over:** Definition and types of crossing over: Germinal and Somatic crossing over. Stern's experiments in *Drosophila*, Creighton and Mc Clintock experiment in maize. Molecular mechanism of crossing over - Holiday model. Absence of crossing over in male *Drosophila.* Significance of linkage and crossing over. • **Chromosome mapping:** Steps involved in chromosome mapping – determination of percent crossover values, two-point cross, three-point cross, determination of map distance between gene loci, Interference and coincidence, Construction of genetic map in *Drosophila*, Problems.	
Unit-III	**14 hrs.**
• **Sex Linkage:** Definition, non – disjunction, Chromosome theory of inheritance. Bridges theory of non-disjunction. Attached X-chromosome. Sex linkage in *Drosophila*, Sex linked inheritance in man (Colour-blindness, Haemophilia). • **Sex Determination** - Chromosome theory of Sex determination: XX- XY, XX-XO, ZZ-ZW, ZZ – ZO. Genic balance theory of Bridges, Intersexes and Super sexes in *Drosophila*, Y chromosome in sex determination of *Melandrium*. Environment and sex determination, Hormonal control of Sex determination (Freemartins). Gynandromorphs. • Dosage compensation - Lyon's hypothesis, Hyper activation of X in *Drosophila* and random inactivation in human. • **Extra nuclear inheritance:** Characteristic features of Cytoplasmic Inheritance, Mitochondrial DNA (petit character in yeast), Chloroplast DNA (plastid inheritance in *Mirabilis jalapa*), Sigma factor in *Drosophila*, Shell coiling in snail, Cytoplasmic Male Sterility (CMS) in maize.	

Unit-IV	14 hrs.
Chromosomal aberrations: • **Numerical aberrations**: Euploidy (Monoploidy, Haploidy and Polyploidy) Polyploidy - Autopolyploidy and Allopolyploidy. Aneuploidy- Monosomy, Nullisomy and Trisomy. • **Structural aberrations with examples:** Deletions- Terminal, Interstitial, Duplication - Tandem, Reverse tandem and Displaced, Translocation - Simple, Isochrome, Reciprocal, Displaced and Inversions - Pericentric and Paracentric, Inversion heterozygote and polymorphism, Iso-chromosome, Ring chromosome. Significance of chromosomal aberrations.	

GENETICS PAPER – II PRACTICALS

Course title	**Cytogenetics**
Course code	**24IIGT2P**
Course credits	**02**
Total contact hours	**3 Hours / week**
Duration of ESA	**03 Hours**
Continuous Internal assessment (CIA)	**10 Marks**
End Semester Examination	**40 Marks**

Practical Content	**15 units**
1. Culturing and maintenance of *Drosophila.*	**1 unit**
2. Study of lifecycle in *Drosophila.*	**1 unit**
3. Observation of sexual dimorphism in *Drosophila.*	**1 unit**
4. Mounting of sex comb in *Drosophila.*	**1 unit**
5. Study of *Drosophila* mutants- body colour mutant, wing mutant and eye mutants.	**1 unit**
6. Study of ABO blood group system in Human.	**1 unit**
7. Genetic problems on Monohybrid, Dihybrid cross, Multiple alleleism, epistasis and Non mendelian Inheritance	**2 units**
8. Genetic problems on Linkage and crossing over.	**2 units**
9. Induction of polyploidy in *Allium cepa*	**2 units**
10. Study of translocation in *Rheo.*	**2 units**
11. Study of Barr body in buccal epithelium cells.	

References

1 Snustad and Simmons, Principles of Genetics, 6th Edition, 2015 John Wiley Publications

2 William S. Klug (Author), Michael R. Cummings (Author), Charlotte A. Spencer, Concepts of Genetics, 11th Edition ,2019 Pearson Publcation

3 Genetics: A Molecular Approach, 3rd Edition by Peter j Russell, Pearson India, 2016.

4 Brown T A, Genetics: A Molecular Approach, 3rd Edition, Garland Science Publication

5 Gupta P K, Genetics, 5th Edition, Rastogi Publications. 2022.

6 Veer Bala Rastogi, Genetics 4th Edition 2019.

7 Verma P.S. and Agarwal V.K,Genetics, 9th Edition, S.Chand and co.