

**BACHELORS WITH BOTANY AS MAJOR (CT - II)**  
**6<sup>th</sup> SEMESTER**  
**BOT622J2: BOTANY \_ GENETICS & CYTOGENETICS**

**CREDITS: THEORY: 4; PRACTICALS: 2**

**COURSE OBJECTIVES:**

*This course is aimed at understanding the basic concepts of genetics, provide insight into structure and functions of chromosomes, polyploidy and cytogenetic aspects of crop evolution. This will help students to develop their analytical, quantitative and problem- solving skills in the field of genetics and cytogenetics.*

**LEARNING OUTCOME:**

- i. Understand the basic concepts of the chromosomes, their structural and functional aspects.
- ii. Acquaint with the fundamental principles of inheritance in plants and animals
- iii. Acquaint with the fundamentals of chromosomal and cytoplasmic inheritance,
- iv. Understand the key differences and similarities of sex determination in plants and animals
- v. Knowledge on structural and numerical chromosomal aberrations and their genetic consequences.
- vi. To learn chromosome aberrations in humans and its implications

**UNIT I**

- Physical basis of heredity - Chromosome theory of inheritance,
- Chromosome morphology (prokaryotic and eukaryotic), Ultra structure of Chromosome - nucleosome model, Special types of chromosomes (Polytene & Lampbrush chromosomes).
- History of Genetics: Pre- Mendelian genetic concepts, Mendel's experiments on pea plants- Symbols and terminology,
- Monohybrid and dihybrid crosses (suitable examples), Mendel's Laws of inheritance (suitable examples), back cross and test cross, problems related.

**UNIT II**

- Multiple Alleles (ABO blood groups);
- Gene Interaction - Incomplete dominance and Codominance; complementary gene interaction (9:7); Duplicate gene interaction (15:1); Epistasis (dominant and recessive epistasis).
- Sex Determination-Chromosome theory of Sex determination (non-disjunction of sex chromosomes in drosophila); Balance theory of sex determination (Drosophila), dosage compensation; sex determination in plants,
- Sex linked and sex influenced traits, Sex linked inheritance in drosophila (eye colour) and man (Colour-blindness, Haemophilia), Genetic imprinting (brief idea).

**UNIT III**

- Concept and importance of Crossing over, Molecular mechanism of crossing over - Holiday model;
- Concept of Linkage-Coupling and Repulsion hypothesis, complete and incomplete linkage, factors affecting linkage;
- Maternal effects (suitable example), cytoplasmic inheritance in plants (male sterility).
- Structural changes in chromosomes –deletions, duplications, inversions, translocations (origin and significance).

**UNIT IV**

- Euploidy-origin of monoploidy, autopolyploidy, allopolyploidy;
- role of autotriploids and autotetraploids in crop improvement; evolution of major crop plants (wheat, cotton, tobacco);
- Aneuploidy – origin of monosomy, nullisomy, trisomy, tetrasomy; chromosomal aberrations in humans (Down's syndrome, Turner syndrome, Klinefelter syndrome);
- role of chromosomal aberrations in evolution; brief account of chromosome banding techniques.

## **PRACTICAL (2 CREDITS)**

- Preparation of stains for mitotic and meiotic chromosomal studies.
- Examination of various stages of mitosis and meiosis using permanent slides.
- Meiosis - temporary squash preparations of flower buds of suitable plant material for identification of various stages of meiosis.
- Working out the laws of inheritance (3:1; 9:3:3:1) using seed mixtures and/or ppt demonstrations.
- Biometrical Computation of Mean, Median and Mode; Variance, Standard Deviation; Problems on Student's 't' test and Chi square test
- Genetic problems on multiple alleles, Complementary effect, Dominant and recessive Epistasis using suitable seed mixtures and/or ppt demonstrations.
- Permanent slides on polytene and lampbrush chromosomes- study of essential features.
- Study of various chromosomal aberrations using permanent slides (Inversions, translocations, monosomy, nullisomy, trisomy etc.).

## **SUGGESTED READINGS**

1. Cytology, Genetics and Evolution by Gupta, P. K. Rastogi Publications, Meerut.
2. Genetics by Gupta, P. K. Rastogi Publications, Meerut.
3. Cytogenetics by Gupta, P. K. Rastogi Publications, Meerut
4. Chromosomal Aberrations: Basic and Applied aspects by Obe. G. and A.T. Natarajan- Springer Verlag, Berlin.
5. Cytogenetics, Plant Breeding and evolution by U. Sinha and Sunita Sinha, Vikas Publishing House Private, Limited.
6. Cytology, Genetics and Molecular Biology by P. K. Gupta, Rastogi publications.
7. Elements of Genetics by Phundan Singh, Kalyani Publishers.
8. Genetics, by Weaver, Hendrick and Brown.
9. Instant notes in Genetics by P. C. Winter et al., Viva Books Pvt.Ltd.
10. Principles of Genetics by E. J. Gardener, M. J. Simmons and D. P. Snustad. J. Wiley and Sons pubs.
11. Principles of Genetics by Sinnott, E.W., L.C. Dunn & J. Dobshansky-McGraw Hill Publishing Co., N.Y. Toronto, London.
12. Genetics by Winchester, A.M., Oxford & IBH Publishing House, Calcutta, Bombay, New Delhi. 1963):
13. Genetics by Strickberger, M.W., MacMillan Publishing Co., Inc., N.Y., London.
14. Genetics: Principles and Analysis by Hartl, D.L. and Jones, E.W., Jones & Bartlett Publishers, Massachusetts, USA.