Government Degree College Baramulla

SEMESTER – 5th **MAJOR / MINOR COURSE**

Subject: BOTANY

Title: Genetics and Plant Breeding **Course code:**

CREDITS: Theory: 04; Practicals: 02 **Contact hours: (64T + 64 P)**

Course Objectives:

The course has been scrupulously designed to make students conversant with the key concepts of Genetics and Plant Breeding, including concepts of crop germplasm, its introduction and conservation, and methods of plant breeding. Special focus has been given on Mendelian and Post-Mendelian principles of inheritance, linkage and crossing over, Numerical and structural changes in chromosomes, heterosis and inbreeding depression.

Learning Outcomes:

After completion of the course, the students should have a thorough understanding of Mendelian and Post-Mendelian principles of inheritance, sex determination, linkage and crossing over, germplasm conservation, polyploidy, hybridization techniques and their role in crop improvement.

Part 1: Theory = (04 Credits)

Unit 1: Heredity

Mendelian principles of inheritance; Modified Mendelian ratios: 2:1- lethal Genes; 1:2:1- Co dominance, Incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1 and 15:1. Multiple Allelism and Pleiotropy with examples. Quantitative inheritance: Concept, monogenic versus polygenic inheritance.

Unit 2: Genes and Chromosomes

Chromosomal theory of inheritance, Chromosomal mechanisms of sex-determination and sex linked Inheritance. Linkage: concept; complete & incomplete linkage, Bridges's experiment. Crossing over: concept and significance. Numerical changes in chromosomes– euploidy, aneuploidy Structural changes - deletions, duplications, inversions and translocations.

Unit 3: Plant Breeding

Introduction to Plant Breeding. Origin and domestication of wild crop plants with reference to rice and wheat. Plant Genetic Resources. Plant introduction,

acclimatization. Selection methods for self-pollinated, cross-pollinated and vegetatively propagated plants.

Unit 4: Methods of Crop Improvement

Polyploidy and distant hybridization - their role in crop improvement. Heterosis and its applications, Inbreeding depression and its genetic basis, Hybridization techniques and their utility in crop plants; Concept of point mutations and their role in crop improvement.

Part I1: Practicals = (02 Credits)

1. Preparation of stains for mitotic and meiotic chromosomal studies.
2. Examination of various stages of mitosis and meiosis using permanent slides.
3. Meiosis - temporary squash preparations of flower buds of suitable plant material for identification of various stages of meiosis.
4. Working out the laws of inheritance (3:1; 9:3:3:1) using seed mixtures and/or ppt demonstrations.
5. Genetic problems on multiple alleles, Complementary effect, Dominant and recessive eepistasis using suitable seed mixtures and/or ppt demonstrations.
6. Permanent slides on polytene and lampbrush chromosomes- study of essential features.

Suggested Readings:

1. Gardner EJ, Simmons MJ, Snustad DP (2008). *Principles of Genetics*. 8th edition. Wiley India. Gupta, P. K. (2005). *Plant Breeding Plant Propagation and Biotechnology*. Deep and Deep Publications.
2. Gupta, P. K. (2005). *Cell and Molecular Biology*. Rastogi Publications.
3. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*, John Wiley & Sons Inc., 5th edition. India.
4. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). *Concepts of Genetics*, 10th edition, Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). *Introduction to Genetic Analysis*. 10th edition, W. H. Freeman and Co., U.S.A.
6. Pierce BA (2011) *Genetics: A Conceptual Approach*, 4th edition, Macmillan Higher Education Learning.
7. Singh, B.D. (2005). *Plant Breeding: Principles and Methods*. 7th edition, Kalyani Publishers.

8. Chaudhari, H.K. (1984). *Elementary Principles of Plant Breeding*. Oxford – IBH.

9. Acquaah, G. (2007). *Principles of Plant Genetics & Breeding*. 2nd edition, Blackwell Publishing.

10. Karp, G. (2010). *Cell Biology*, John Wiley & Sons, 6th edition, U.S.A.

11. Hardin, J., Becker, G., Skliensmith, L.J. (2012). *Becker's World of the Cell*, 8th edition, Pearson Education Inc. U.S.A.

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Semester: 5th **Course: Major**

Subject: Botany

Course Title: Cell and Molecular Biology **Course Code:**

Credit: Theory: 04; Practical: 02 **Contact Hours: (64 T + 64 P)**

Course Objectives:

The course has been prescribed to enable students to learn structure and functions of cell and cell organelles, with special reference to prokaryotic and eukaryotic cells. Special emphasis has been given on cell cycle, origin and evolution cells and various cellular organelles and central dogma of molecular biology.

Learning Outcome:

At the completion of the course, students should have the ability to explain the detailed structure and functions of cells and cellular organelles which constitutes the basis of cell and molecular biology

Part 1: Theory = (04 Credits)

Unit 1: Cell, Plasma Membrane and Cell Wall

Cell: History and origin; prokaryotic and eukaryotic cells; properties of cell; Bio-membranes; structure and function, fluid mosaic model, fluidity of bio-membranes; Cell wall- ultrastructure and functions.

Unit II: Cell Organelles and Their Functions

Non-membranous organelles: Ribosomes, centrioles, basal bodies and cytoskeleton.

Single membrane bound organelles: Endoplasmic reticulum, Golgi bodies, Lysosomes**,** Peroxisomes and Glyoxisomes**.**

Double membrane bound organelles: Chloroplast and Mitochondria, semi-autonomous nature; Endosymbiont hypothesis.

Unit III: Nucleus and Cell Cycle

Nucleus: History, structure, functions and importance.

Chromosomes: Types and functions of chromosomes. Giant chromosomes-Polytene chromosome and Lampbrush chromosome. Nucleosome Model

Cell Cycle: Phases of Prokaryotic and Eukaryotic Cell Cycle, Mitosis and Meiosis and their significance, Regulation of Cell Cycle.

Unit IV: DNA, RNA and Protein Synthesis

Structure and Types of DNA and RNA, Replication of DNA, Transcription and post transcriptional modification, Protein Synthesis, Regulation of Gene Expression (Operon Hypothesis), Genetic Code

Part 2: Practicals = (02 Credits)

1. To **s**tudy prokaryotic and eukaryotic cells with the help of photomicrographs.

2. To study of cell organelles using photomicrographs.

3. To study the structure of plant cell through temporary mounts.

4. To study mitosis and meiosis (temporary mounts and permanent slides).

5. To study the effect of temperature and organic solvent on semi permeable membrane.

6. To study plasmolysis and deplasmolysis in onion peelings.

7. To study the structure of nuclear pore complex by photomicrograph.

8. To study special chromosomes (polytene and lampbrush) either by slides or photographs.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). The Molecular Genetic Mechanisms That Create Specialized Cell Types. In Molecular Biology of the Cell. 4th edition. Garland Science.
6. Watson, J. D. (2008). Molecular Biology of the Gene, latest edition.
7. Lodish, H. F. (2008). Molecular Cell Biology. Macmillan, latest edition.
8. Sadava, D. E. (1993). Cell Biology: Organelle Structure and Function, latest edition.

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Semester 5th **Course: Major**

Subject: Botany

Course Title: Plant Biotechnology **Course Code:**
Credit: Theory: 04; Practical: 02 **Contact Hours: (64 T + 64 P)**

Course Objectives*:*

The students shall gain an understanding of plant biotechnology, its principles and applications in plant tissue culture, genetically modified plants and agricultural crops. They will get acquainted with various genomic and transcriptomic methods involved in plant biotechnology. Also, information about the ethical and environmental concerns related to plant biotechnology will be imparted to the students.

Learning Outcomes:

After the successful completion of the course, the students are able to understand the basics of plant biotechnology, a*cquire hands-on skills in plant biotechnological techniques and their application to real-world problems.*

Theory:

Unit 1: Introduction to Biotechnology

- Biotechnology and its applications in plant science.
- Historical development of biotechnology.
- Plant Tissue Culture and its applications in plant science.

Unit 2: Plant Biotechnology

- Plant tissue culture techniques- culture media preparations, callus culture, micro propagation, somatic embryogenesis.
- Genetic transformation methods in plants: *Agrobacterium*-mediated transformation.
- Transgenic plants: development, applications, and controversies.

Unit 3: Molecular Techniques in Plant Biology

- Techniques in biotechnology: PCR, DNA sequencing
- Basic concept of genomics
- Functional genomics: gene expression analysis, RNA interference (RNAi), gene editing techniques (elementary idea).
- Bioinformatics tools for analyzing plant genomics and transcriptomics (brief data).

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Unit 4: Applied Plant Biotechnology

- Plant Biotechnology in agriculture: genetically modified crops, herbicide resistance, insect resistance, stress tolerance.
- Bioremediation and phytoremediation: using plants for environmental cleanup.
- Plant-based neutraceuticals: production of therapeutic proteins and vaccines in plants.
- Ethical and environmental concerns in plant biotechnology.

Suggested readings:

1. Prasad, B. D., Sahni, S., Kumar, P., & Siddiqui, M. W. (Eds.). (2017). *Plant Biotechnology, Volume 1: Principles, Techniques, and Applications*. CRC Press.
2. Chawla, H. S. (2011). *Introduction to Plant Biotechnology*. CRC Press.
3. Slater, A., Scott, N., & Fowler, M. (2008). *Plant Biotechnology: The Genetic Manipulation of Plants*. OUP Oxford.
4. Stewart Jr., C.N. (2008). *Plant Biotechnology and Genetics: Principles, Techniques, and Applications*. Wiley–Blackwell.
5. Singh, B. D. (2022). *Plant Biotechnology*, 4TH edition, Medtech.
6. Altman, A., & Hasegawa, P. M. (Eds.). (2012). *Plant Biotechnology and Agriculture: Prospects for the 21st Century*. Academic press.
7. Srivastava, P. S. (2005). *Plant Biotechnology and Molecular Markers*. Anamaya Publishers.
8. Halford, N. (Ed.). (2006). *Plant Biotechnology: Current and Future Applications of Genetically Modified Crops*. John Wiley & Sons.