

## IV Semester / Botany Core Course –5

### Cell Biology, Genetics and Plant Breeding

(Total hours of teaching – 60 @ 04 Hrs./Week) **Theory:**

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#### **Learning outcomes:**

On successful completion of this course, the students will be able to:

- Distinguish prokaryotic and eukaryotic cells and design the model of a cell.
  - Explain the organization of a eukaryotic chromosome and the structure of genetic material.
  - Demonstrate techniques to observe the cell and its components under a microscope.
  - Discuss the basics of Mendelian genetics, its variations and interpret inheritance of traits in living beings.
  - Elucidate the role of extra-chromosomal genetic material for inheritance of characters.
  - Evaluate the structure, function and regulation of genetic material.
  - Understand the application of principles and modern techniques in plant breeding.
  - Explain the procedures of selection and hybridization for improvement of crops.
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#### **Unit – 1: The Cell**

**12 Hrs.**

1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.
2. Ultra-structure of cell wall.
3. Ultra-structure of plasma membrane and various theories on its organization.
4. Polymorphic cell organelles (Plastids); ultrastructure of chloroplast. Plastid DNA.

#### **Unit – 2: Chromosomes**

**12 Hrs.**

1. Prokaryotic vs eukaryotic chromosome. Morphology of a eukaryotic chromosome.
2. Euchromatin and Heterochromatin; Karyotype and ideogram.
3. Brief account of chromosomal aberrations - structural and numerical changes
4. Organization of DNA in a chromosome (solenoid and nucleosome models).

#### **Unit – 3: Mendelian and Non-Mendelian genetics**

**14 Hrs.**

1. Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.
2. Complementary, supplementary and duplicate gene interactions (plant based examples are to be dealt).
3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3 point test cross.
4. Concept of maternal inheritance (Corren's experiment on *Mirabilis jalapa*); Mitochondrial DNA.

#### **Unit – 4: Structure and functions of DNA**

**12 Hrs.**

1. Watson and Crick model of DNA. Brief account on DNA Replication (Semiconservative method).
2. Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.
3. Regulation of gene expression in prokaryotes - Lac Operon.

#### **Unit – 5: Plant Breeding**

**12 Hrs.**

1. Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.
2. Definition, procedure; applications and uses; advantages and limitations of : (a) Mass selection, (b) Pure line selection and (c) Clonal selection.
3. Hybridization – schemes, and technique; Heterosis (hybrid vigour).
4. A brief account on Molecular breeding – DNA markers in plant breeding. RAPD, RFLP.

#### **Text books :**

- Botany – III (Vrukshasastram-I) : Telugu Akademi, Hyderabad
  - Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
  - Ghosh, A.K., K.Bhattacharya & G. Hait (2011) *A Text Book of Botany, Volume-III*, New Central Book Agency Pvt. Ltd., Kolkata
  - Chaudhary, R. C. (1996) *Introduction to Plant Breeding*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
- Books for Reference:**

- S. C. Rastogi (2008)*Cell Biology*, New Age International (P) Ltd. Publishers, New Delhi
- P. K. Gupta (2002)*Cell and Molecular biology*, Rastogi Publications, New Delhi
- B. D. Singh (2008) *Genetics*, Kalyani Publishers, Ludhiana
- A.V.S.S. Sambamurty (2007) *Molecular Genetics*, Narosa Publishing House, New Delhi
- Cooper, G.M. & R.E. Hausman (2009)*The Cell – A Molecular Approach*, A.S.M. Press, Washington
- Becker, W.M., L.J. Kleinsmith & J. Hardin (2007)*The World of Cell*, Pearson Education, Inc., New York
- De Robertis, E.D.P. & E.M.F. De Robertis Jr. (2002)*Cell and Molecular Biology*, Lippincott Williams & Wilkins Publ., Philadelphia
- Robert H. Tamarin (2002)*Principles of Genetics*, Tata McGraw –Hill Publishing Company Limited, New Delhi.
- Gardner, E.J., M. J. Simmons & D.P. Snustad (2004)*Principles of Genetics*, John Wiley & Sons Inc., New York
- Micklos, D.A., G.A. Freyer & D.A. Cotty (2005) *DNA Science: A First Course*, I.K. International Pvt. Ltd., New Delhi
- Chaudhari, H.K.(1983)*Elementary Principles of Plant Breeding*, TMHpublishers Co., New Delhi
- Sharma, J.R. (1994)*Principles and Practice of Plant Breeding*, Tata McGraw- Hill Publishers, New Delhi
- Singh, B.D. (2001)*Plant Breeding : Principles and Methods* , Kalyani Publishers, Ludhiana
- Pundhan Singh (2015) *Plant Breeding for Undergraduate Students*, Kalyani Publishers, Ludhiana
- Gupta, S.K. (2010)*Plant Breeding : Theory and Techniques*, Agrobios (India), Jodhpur
- Hayes, H.K., F.R. Immer & D.C. Smith (2009) *Methods of Plant Breeding*, Biotech Books, Delhi

## **Practical Syllabus of Botany Core Course – 5/IVSemester**

### **Cell Biology, Genetics and Plant Breeding**

(Total hours of laboratory exercises 30 Hrs. @ 02 Hrs. /Week)

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**Course Outcomes:** After successful completion of this practical course the student shall be able to:

1. Show the understanding of techniques of demonstrating Mitosis and Meiosis in the laboratory and identify different stages of cell division.
2. Identify and explain with diagram the cellular parts of a cell from a model or picture and prepare models
3. Solve the problems related to crosses and gene interactions.
4. Demonstrate plant breeding techniques such as emasculation and bagging

#### **Practical Syllabus:**

1. Study of ultra structure of plant cell and its organelles using Electron microscopic Photographs/models.
2. Demonstration of Mitosis in *Allium cepa*/*Aloe vera* roots using squash technique; observation of various stages of mitosis in permanent slides.
4. Demonstration of Meiosis in P.M.C.s of *Allium cepa* flower buds using squash technique; observation of various stages of meiosis in permanent slides.
4. Study of structure of DNA and RNA molecules using models.
5. Solving problems monohybrid, dihybrid, back and test crosses.
6. Solving problems on gene interactions (at least one problem for each of the gene interactions in the syllabus).
7. Chromosome mapping using 3- point test cross data.
8. Demonstration of emasculation, bagging, artificial pollination techniques for hybridization.

#### **Model paper for Practical Examination**

Semester-IV / Botany Core Course – 5

#### **Cell Biology, Genetics and Plant Breeding**

Max. Time: 3 Hrs.

Max. Marks: 50

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1. Make a cytological preparation of given material 'A' (mitosis or meiosis in Onion) by squash technique, report any two stages, draw labeled diagrams and write the reasons.

15 M

2. Solve the given Genetic problem (Dihybrid cross/ Interaction of genes/ 3-point test cross) 'B' and write the conclusions.

15 M

3. Identify the following and justify with apt reasons.

3 x 4 = 12 M

C. Cell Biology (Cell organelle)

D. Genetics (DNA/RNA)

E. Plant Breeding

4. Record + Viva-voce

5 + 3 = 8 M

### **Suggested co-curricular activities for Botany Core Course- 5 in Semester-IV:**

#### **A. Measurable :**

##### **a. Student seminars :**

1. Light microscopy : bright field and dark field microscopy.
2. Scanning Electron Microscopy (SEM).
3. Transmission Electron Microscopy (TEM).
4. Mitosis and Meiosis
5. Cell cycle and its regulation.
6. Cell organelles bounded by single membrane.
7. Prokaryotic chromosomes
8. Special types of chromosomes :Polytene, Lampbrush and B-chromosomes.
9. Different forms of DNA.
10. Gene mutations.
11. DNA damage and repair mechanisms.
12. Reverse transcription.
13. Protein structure.
14. Modes of reproduction in plants.
15. Modes of pollination in plants

##### **b. Student Study Projects :**

1. Study of mitotic cell cycle in roots of *Allium cepa*
2. Study of mitotic cell cycle in roots of *Aloe vera*
3. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to industrial effluent(s).
4. Observation of chromosomal aberrations in *Allium cepa* root cells exposed to heavy metal(s).
5. Observation of polyembryony in *Citrus* spp. and *Mangifera indica*.

**c. Assignments:** Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus. **B. General :**

1. Field visit to Agriculture/Horticulture University/ Research station to observe Plant breeding methods.
2. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in syllabus of the course.

RECOMMENDED ASSESSMENT OF STUDENTS:

**Recommended continuous assessment methods for all courses:**

Some of the following suggested assessment methodologies could be adopted. Formal assessment for awarding marks for Internal Assessment in theory.

**(b) Formal:**

1. The oral and written examinations (Scheduled and surprise tests),
2. Simple, medium and Critical Assignments and Problem-solving exercises,
3. Practical assignments and laboratory reports,
4. Assessment of practical skills,
5. Individual and group project reports,
6. Seminar presentations,
7. Viva voce interviews.

**(c) Informal:**

1. Computerized adaptive testing, literature surveys and evaluations,
2. Peers and self-assessment, outputs form individual and collaborative work 3. Closed-book and open-book tests,

**Common pattern for Question Paper for Theory Examination(s) at Semester end**

Max. Time: 3 Hrs.

Max. Marks: 75 M

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**Section – A**

**Answer all the following questions.**

**5 x 2 = 10 M**

- ✓ One question should be given from each Unit in the syllabus.

**Section – B**

**Answer any three of the following questions. Draw a labeled diagram wherever necessary**

**3 x 5 = 15 M**

- ✓ One question should be given from each Unit in the syllabus.

**Section – C**

**Answer any five of the following questions. Draw a labeled diagram wherever necessary**

**5 x 10 = 50 M**

- ✓ Two questions (a & b) are to be given from each Unit in the syllabus (internal choice in each unit). Student has to answer 5 questions by choosing one from a set of questions given from a Unit.

**Note:** Questions should be framed in such a way to test the understanding, analytical and creative skills of the students. All the questions should be given within the framework of the syllabus prescribed.

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### *Annexure*

#### **Objectives and General Outcomes of Programme and Domain Subject**

**Programme(B.Sc.) Objectives:** The objectives of bachelor's degree programme with Botany are:

1. To provide a comprehensive knowledge on various aspects related to microbes and plants.
2. To deliver knowledge on latest developments in the field of Plant sciences with a practical approach.
3. To produce a student who thinks independently, critically and discuss various aspects of plant life.
4. To enable the graduate to prepare and pass through national and international examinations related to Botany.
5. To empower the student to become an employee or an entrepreneur in the field of Botany /Biology and to serve the nation.

#### **Programme Outcomes:**

1. Understand the basic concepts of Botany in relation to its allied core courses.
2. Perceive the significance of microbes and plants for human welfare, and structural and functional aspects of plants.
3. Demonstrate simple experiments related to plant sciences, analyze data, and interpret them with the theoretical knowledge.
4. Work in teams with enhanced inter-personal skills.
5. Develop the critical thinking with scientific temper.
6. Effectively communicate scientific ideas both orally and in writing.

#### **Domain Subject(Botany) Objectives :**



1. To impart knowledge on origin, evolution, structure, reproduction and interrelationships of microbes and early plant groups.
2. To provide knowledge on biology and taxonomy of true land plants within a phylogenetic framework.
3. To teach aspects related to anatomy, embryology and ecology of plants, and importance of Biodiversity.
4. To explain the structural and functional aspects of plants with respect to the cell organelles, chromosomes and genes, and methods of plant breeding.
5. To develop a critical understanding on SPAC, metabolism and growth and development in plants.
6. To enable the students proficient in experimental techniques and methods of analysis appropriate for various sub-courses in Botany.

**Domain Subject(Botany) Outcomes:**

1. Students will be able to identify, compare and distinguish various groups of microbes and primitive plants based on their characteristics.
2. Students will be able to explain the evolution of trachaeophytes and also distribution of plants on globe.
3. Students will be able to discuss on internal structure, embryology and ecological adaptations of plants, and want of conserving Biodiversity.
4. Students will be able to interpret life processes in plants in relation to physiology and metabolism.
5. Students will be able to describe ultrastructure of plant cells, inheritance and crop improvement methods.
6. Students will independently design and conduct simple experiments based on the knowledge acquired in theory and practicals of the different sub-courses in Botany.

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**SUBJECT EXPERTS**

*Prof. C.Sudhakar*  
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**SYLLABUS VETTED BY**

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