



**PARVATHANENI BRAHMAYYA  
SIDDHARTHA COLLEGE OF ARTS & SCIENCE**

*Autonomous*

Siddhartha Nagar, Vijayawada-520010

*Re-accredited at 'A+' by the NAAC*

**22BOTT41: Cell Biology, Genetics and Plant Breeding**

**Offered to:** BSc.BZC

**Course Type:** Theory (TH)

**Year of Introduction:** 2022-23

**Semester:** IV

**Credits:** 3

**60Hrs**

**Max.Marks: 100(30+70)**

**Course Prerequisites:** Knowledge of Cell Biology, Genetics and Plant Breeding studied in intermediate.

**Course Description:** This course will provide one with a basic and comprehensive understanding of cell biology. Enable the student with depth of topics and helps them to gain an appreciation in the genetics. On the other hand, importance of understanding plant breeding provides an extensive knowledge to the student.

**Course Objectives:**

1. Knowledge of Cell Biology.
2. The study of Chromosomes.
3. The study of Mendelian and Non-Mendelian genetics.
4. Study of Structure and functions of DNA.
5. Knowledge of Plant breeding.

**Course Outcomes:** At the end of this course, students should be able to:

CO1: Distinguish prokaryotic and eukaryotic cells and design the model of a cell.

CO2: Explain the organization of a eukaryotic chromosome and the structure of genetic material.

CO3: Demonstrate techniques to observe the cell and its components under a microscope.

CO4: Discuss the basics of Mendelian genetics, its variations and interpret inheritance of traits in living beings.

CO5: Elucidate the role of extra-chromosomal genetic material for inheritance of characters.

Evaluate the structure, function and regulation of genetic material.

CO6: Understand the application of principles and modern techniques in plant breeding.

Explain the procedures of selection and hybridization for improvement of crops.

CO-PO MATRIX							
CO-PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1						L	
CO2				M			
CO3				M			
CO4					H		
CO5						H	

**Syllabus**

**Course Details**

Unit	Learning Units	Lecture Hours
I	<b>The Cell</b> 1. Cell theory; prokaryotic vs eukaryotic cell; animal vs plant cell; a brief account on ultra-structure of a plant cell.	12

	<p>2. Ultra-structure of cell wall.</p> <p>3. Ultra-structure of plasma membrane and various theories on its organization.</p> <p>4. Polymorphic cell organelles (Plastids); ultrastructure of chloroplast. Plastid DNA.</p>	
II	<p><b>Chromosomes</b></p> <p>1. Prokaryotic vs eukaryotic chromosome. Morphology of a eukaryotic chromosome.</p> <p>2. Euchromatin and Heterochromatin; Karyotype and ideogram.</p> <p>3. Brief account of chromosomal aberrations - structural and numerical changes</p> <p>4. Organization of DNA in a chromosome (solenoid and nucleosome models).</p>	12
III	<p><b>Mendelian and Non-Mendelian genetics</b></p> <p>1. Mendel's laws of inheritance. Incomplete dominance and co-dominance; Multiple allelism.</p> <p>2. Complementary, supplementary and duplicate gene interactions (plant-based examples are to be dealt).</p> <p>3. A brief account of linkage and crossing over; Chromosomal mapping - 2 point and 3-point test cross.</p> <p>4. Concept of maternal inheritance (Corren's experiment on <i>Mirabilis jalapa</i>);</p>	12
IV	<p><b>Structure and functions of DNA</b></p> <p>1. Watson and Crick model of DNA. Brief account on DNA Replication (Semi-conservative method).</p> <p>2. Brief account on Transcription, types and functions of RNA. Gene concept and genetic code and Translation.</p> <p>3. Regulation of gene expression in prokaryotes - Lac Operon.</p>	12
V	<p><b>Plant Breeding</b></p> <p>1. Plant Breeding and its scope; Genetic basis for plant breeding. Plant Introduction and acclimatization.</p> <p>2. Definition, procedure; applications and uses; advantages and limitations of : (a) Mass selection, (b) Pure line selection and (c) Clonal selection.</p> <p>3. Hybridization – schemes, and technique; Heterosis (hybrid vigour).</p> <p>4. A brief account on Molecular breeding – DNA markers in plant breeding. RAPD, RFLP.</p>	12

**Textbook:**

1. Botany – III (Vrukshasastram-I): Telugu Akademi, Hyderabad
2. Pandey, B.P. (2013) *College Botany, Volume-III*, S. Chand Publishing, New Delhi
3. Ghosh, A.K., K. Bhattacharya & G. Hait (2011) *A Text Book of Botany, Volume-III*, New Central Book Agency Pvt. Ltd., Kolkata

4. Chaudhary, R. C. (1996) *Introduction to Plant Breeding*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

**Recommended Reference book:**

1. S. C. Rastogi (2008) *Cell Biology*, New Age International (P) Ltd. Publishers, New Delhi

2. P. K. Gupta (2002) *Cell and Molecular biology*, Rastogi Publications, New Delhi

3. B. D. Singh (2008) *Genetics*, Kalyani Publishers, Ludhiana

4. A. V. S. S. Sambamurty (2007) *Molecular Genetics*, Narosa Publishing House, New Delhi

5. Cooper, G.M. & R.E. Hausman (2009) *The Cell – A Molecular Approach*, A.S.M. Press, Washington

6. Becker, W.M., L.J. Kleinsmith & J. Hardin (2007) *The World of Cell*, Pearson Education, Inc., New York

7. De Robertis, E.D.P. & E.M.F. De Robertis Jr. (2002) *Cell and Molecular Biology*, Lippincott Williams & Wilkins Publ., Philadelphia

8. Robert H. Tamarin (2002) *Principles of Genetics*, Tata McGraw –Hill Publishing Company Limited, New Delhi.

9. Gardner, E.J., M. J. Simmons & D.P. Snustad (2004) *Principles of Genetics*, John Wiley & Sons Inc., New York

10. Micklos, D.A., G.A. Freyer & D.A. Cotty (2005) *DNA Science: A First Course*, I.K. International Pvt. Ltd., New Delhi

11. Chaudhari, H.K. (1983) *Elementary Principles of Plant Breeding*, TMH publishers Co., New Delhi

12. Sharma, J.R. (1994) *Principles and Practice of Plant Breeding*, Tata McGraw- Hill Publishers, New Delhi

13. Singh, B.D. (2001) *Plant Breeding : Principles and Methods*, Kalyani Publishers, Ludhiana

Pundhan Singh (2015) *Plant Breeding for Undergraduate Students*, Kalyani Publishers, Ludhiana

14. 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

**Course Delivery method:** Face-to-face / Blended.

**Course has focus on:** Foundation

**Websites of Interest:**

<https://youtu.be/LFvjJBiltFI>

<https://youtu.be/hUJZ4X3Hkbw>

<https://youtu.be/rBkE5SAL7IA>

**Co-curricular Activities:**

**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, Lamp brush 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.

**Formal:**

1. Assessment of practical skills
2. Individual and group project reports
3. Seminar presentations

**Model Question Paper Structure for SEE**

**Semester End Examination Model Paper**

**Max Marks:70**

**Max Time:3Hrs**

**SECTION-A**

**Answer all Questions (5x4=20)**

1. (a) Distinguish the difference between eukaryotic cell and prokaryotic cell. **CO1, L4.**  
OR  
(b) Explain the ultra-structure of Chloroplast. **CO1, L2.**

2. (a) State the difference between euchromatin and heterochromatin. **CO2, L1.**  
OR  
(b) Explain 2-point test cross. **CO2, L2.**
3. (a) Describe incomplete dominance. **CO3, L2.**  
OR  
(b) Describe the concept of maternal inheritance in *Mirabilis jalapa*. **CO3,L2.**
4. (a) Discuss about the semiconservative method of DNA replication. **CO4, L6.**  
OR  
(b) Discuss about the genetic code. **CO4,L6.**
5. (a) What is pure line selection? Explain. **CO5, L1.**  
OR  
(b) Elucidate the role of RAPD in molecular breeding. **CO5, L2.**

**SECTION-B**

**Answer all Questions (5x10=50)**

6. (a) Explain ultrastructure of plasma membrane. **CO1, L2.**  
OR  
(b) Explain the ultrastructure of cell wall. **CO1, L2.**
7. (a) Write a detailed account of chromosomal aberrations. **CO2, L6.**  
OR  
(b) Describe the organization of DNA in a chromosome (solenoid and nucleosome models). **CO2, L2.**
8. (a) Design a detailed account on Linkage. **CO3, L5.**  
OR  
(b) Compose a detailed account on Crossing Over. **CO3, L5.**
9. (a) Discuss about the Watson and Crick model of DNA. **CO4, L6.**  
OR  
(b) Elucidate the regulation of gene expression in prokaryotes - Lac Operon. **CO4, L2.**
10. (a) Develop a note on advantages and limitations of : (a) Mass selection, (b) Pure line selection. **CO5, L3.**  
OR  
(b) Explain the process of Hybridization, with respect to the schemes and techniques.

**CO5, L2.**