

SHRI GNANAMBICA DEGREE COLLEGE: MADANAPALLE



(AUTONOMOUS)

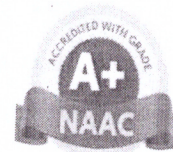
BIOTECHNOLOGY

COURSE-1: INTRODUCTION TO CELL BIOLOGY AND GENETICS

SEMESTER I

(W.E.F. 2025-2026)

Program: B.Sc. Biotechnology Honors



Hours per week: 4

Credits: 3

Course Outcomes:

Unit I:

To understand the structural and functional organization of cells, including differences among viral, bacterial, fungal, plant, and animal cells, and explain the roles of the cell wall, glycocalyx, and plasma membrane.

Unit II:

To describe the sub-cellular organization of eukaryotic cells, including organelle structure and function, mechanisms of cellular transport, cytoskeletal components, and the morphology and types of chromosomes.

Unit III:

To apply Mendelian principles of inheritance, analyse deviations such as incomplete dominance and co-dominance, and understand chromosome structure and organization in prokaryotes and eukaryotes.

Unit IV:

To explain the types and causes of genetic mutations, the cellular mechanisms for DNA repair, and assess the impact of mutagenesis on genetic integrity.

Unit V:

To analyse the phases and regulation of the eukaryotic cell cycle, mechanisms of cancer development, and the roles of apoptosis, cancer stem cells, and cell signalling in disease and development.

Learning Outcomes:

After completing this course, students will be able to:

- Identify and describe the structure of different types of cells and their components.
- Explain the functions of cell organelles and mechanisms of cell transport.
- Apply Mendelian principles and recognize deviations in inheritance patterns.
- Analyze causes of mutations and describe DNA repair mechanisms.
- Compare normal and cancer cells, and explain the regulation of cell cycle and apoptosis.



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Syllabus

Unit I

Cell as a basic unit of living organism; Cell wall Structure, chemical composition and function. Glycocalyx. Structure and Function of Cell membranes; Brief description of viral, bacterial, fungal, plant and animal cells.

Unit II

Sub-cellular organization of eukaryotic cell: Nucleus, nuclear envelope, transport across nuclear membrane; Nucleolus; cytosol, endoplasmic reticulum, chloroplast, mitochondria, vacuoles, ribosomes, peroxisomes, lysosome and golgi complex; Cell Transport: Active and Passive transport, phagocytosis, pinocytosis, exocytosis. Chromosomes: Morphology, Structural Organization; Specialized chromosomes- Salivary gland & lamp brush chromosomes, **Cytoskeletal System (Microtubules, Microfilaments and Intermembrane filaments).**

Unit III

Mendel Experiments, Mendel Laws and Deviations: Incomplete Dominance and Co- dominance; Concept of multiple alleles; Structure of prokaryotic and Eukaryotic chromosomes. Eukaryotic chromosome organization, histone proteins.

Unit IV

Mutagenesis - Spontaneous and induced (Chemical and physical) mutations; Mutations- point mutations, frameshift mutations; Factors affecting DNA damage; Repair Mechanisms - Light induced repair, Excision repair and mismatch repair and SOS repair.

Unit V

Phases of the eukaryotic cell cycle - Mitosis and Meiosis; Regulation of cell cycle- checkpoints. **Cyclins and CDKs**, Basics of Cancer Development (Concept of Angiogenesis and Metastasis) and Cancer causative agents. Proto- oncogenes, oncogenes. Differences between cancer cell and normal cell. Programmed Cell Death (**Apoptosis**), **Cancer Stem Cells**. Introduction to cell signaling.



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Reference books:

- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter – *Molecular Biology of the Cell* – Garland Science.
- Geoffrey M. Cooper and Robert E. Hausman – *The Cell: A Molecular Approach* – ASM Press & Sinauer Associates.
- Gerald Karp – *Cell and Molecular Biology: Concepts and Experiments* – John Wiley & Sons.
- De Robertis, E.D.P. and De Robertis, E.M.F. – *Cell and Molecular Biology* – Saunders College Publishing.
- Snustad, D.P. and Simmons, M.J. – *Principles of Genetics* – John Wiley & Sons.
- Gardner, E.J., Simmons, M.J. and Snustad, D.P. – *Principles of Genetics* – John Wiley & Sons.
- Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. – *Molecular Cell Biology* – W.H. Freeman and Company.

Extracurricular / Practical Activities

- 1. Observation of microorganisms from house dust and pond water under a microscope**
Objective: Identify and differentiate cell types (viral, bacterial, fungal, protozoan), reinforcing concepts of prokaryotic and eukaryotic cell structure.
- 2. Identification of given organisms as harmful or beneficial**
Objective: Enhance understanding of microbial diversity and their ecological or medical significance.
- 3. Demonstration and hands-on session with basic biotechnology lab equipment (e.g., centrifuge, micropipette, electrophoresis unit)**
Objective: Familiarize students with tools used in molecular and cellular biology for DNA/RNA/protein handling.
- 4. 3D model preparation of a eukaryotic cell and its organelles**
Objective: Reinforce the structural and functional roles of organelles like mitochondria, ER, Golgi, lysosomes, and the nucleus.
- 5. Problem-solving activity on Mendelian genetics and chromosome mapping**
Objective: Apply Mendel's laws, study deviations (incomplete dominance, codominance), and practice genetic cross analysis.
- 6. Poster presentation or awareness drive on cancer, its causes, and prevention**
Objective: Reinforce understanding of oncogenes, tumor suppressors, metastasis, and cell signaling through communication and outreach.



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SEMESTER - I

COURSE 1: INTRODUCTION TO CELL BIOLOGY AND GENETICS

Practical

Credits: 1

2 hrs/week

Practical Component:

1. Principle and utilization of microscope
2. Preparation of blood smear and observation of cells
3. Study of divisional stages in mitosis
4. Study of divisional stages in meiosis
5. Observation of differences between stained bacterial cells and cells in onion peels
6. Observation of permanent slides of bacterial, fungal, plant and animal cells
7. Problem solving in genetics
8. Human Karyotype analysis
9. Simple Mendelian traits in humans and pedigree analysis



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COURSE-1: INTRODUCTION TO CELL BIOLOGY AND GENETICS

SEMESTER I

(W.E.F. 2025-2026)

Program: B.Sc. Biotechnology Honors

Question Paper Blue Print

Time : 3 Hrs

Max Marks: 70

(Draw diagrams wherever necessary)

I. Answer any Four Questions 4 X 5 = 20

1.
2.
3.
4.
5.
6.
7.
8.

II. Answer all the questions 5 X 10 = 50

1. (A).....

Or

(B).....

2. (A).....

Or

(B).....

3. (A).....

Or

(B).....

4. (A).....

Or

(B).....

5. (A).....

Or

(B).....




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COURSE-1: INTRODUCTION TO CELL BIOLOGY AND GENETICS
SEMESTER I

(W.E.F. 2025-2026)

Program: B.Sc. Biotechnology Honors
Model Question Paper

Time : 3 Hrs

Max Marks: 70

(Draw diagrams wherever necessary)

I. Answer any Four of the following questions $4 \times 5 = 20$ Marks

1. Describe the structure and function of the glycocalyx.
2. Differentiate between plant and animal cells (any five points).
3. Write a short note on lampbrush chromosomes.
4. What is incomplete dominance? Give an example.
5. Describe the role of histone proteins in chromosome organization.
6. Define point mutation and frameshift mutation with examples.
7. Write a note on cyclins and CDKs.
8. Differentiate between normal cells and cancer cells.

II. Answer all questions. $5 \times 10 = 50$ Marks

9. a) Explain the structure and function of cell membranes.

OR

- b) Describe the chemical composition and function of the cell wall.

10. a) Write a detailed note on the structure and functions of the endoplasmic reticulum and Golgi complex.

OR

- b) Explain active and passive transport mechanisms across cell membranes.

11. a) Discuss Mendel's laws of inheritance and their exceptions (incomplete dominance and codominance).

OR

- b) Describe the structural differences between prokaryotic and eukaryotic chromosomes.

12. a) Explain various DNA repair mechanisms in cells.

OR

- b) Describe the types and causes of mutations in DNA.

13. a) Describe the phases of the eukaryotic cell cycle and its regulation.

OR

- b) Explain apoptosis and its significance in preventing cancer.



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