Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science College
Semester-3 (M.Sc. MLT)

Subject: Cellular and Molecular Biology- MSCMT13513

Type of course: Major

Prerequisite: Basic understanding of biology, including cell structure, biomolecules (proteins, carbohydrates, lipids, nucleic acids), and fundamental concepts of genetics and chemistry.

Rationale: This subject provides a foundational understanding of cellular processes and molecular mechanisms that govern life. It is essential for advanced studies in biotechnology, microbiology, genetics, and medical sciences, enabling students to analyze and apply biological concepts in research and real-world applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Evaluation		Practical Marks			
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	00	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Genetic Cross Hackathon** In groups, students solve complex inheritance problems (linked genes, incomplete dominance, etc.) given by faculty and compete to present the fastest and most accurate solutions and upload them on GMIU web portal.	10
2	**Build-a-Pathway Activity** Students construct step-by-step pathways for DNA replication, transcription, and translation using cards/diagrams, then rearrange when errors are introduced, and upload on GMIU web portal.	10
3	**Mutation Impact Challenge** Faculty provide different gene mutation challenges to students and ask them to predict effects on protein structure/function and inheritance patterns, then justify their reasoning and upload on GMIU web portal.	10
4	**Molecular Process Debugging** Students are given an intentionally incorrect sequence of events for processes like DNA replication, transcription, or translation. They must identify errors, correct them, and justify the proper sequence, and have to upload on GMIU web portal.	10
5	**Organelle Dysfunction Case Simulation** Each group is assigned a malfunctioning organelle (e.g., mitochondria, lysosome, nucleus). Students predict cellular consequences, link them to diseases or defects, and present their reasoning and upload on GMIU web portal.	10
	Total	**50**

Course Content:

Unit No.	Course content	Hrs	% Weightage
1	**Cell Structure, Organization, and Functional Dynamics** • Cell Structure and Function. • Overview of Prokaryotic and Eukaryotic Cells. • Cellular Organelles and Their Functions, Nucleus, Mitochondria, Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, etc. • Cell Membrane: Structure, Function, and Transport Mechanisms. • Cytoskeleton and Cell Movement: Actin, Myosin, Microtubules.	15	25%

2	**Cell Division, Cell Cycle, and Growth Regulation** • Cell Division and Growth Regulation. • The Cell Cycle: Phases and Regulatory Checkpoints,. • Mitosis: Purpose, Stages, and Regulation. • Meiosis: Importance in Sexual Reproduction and Genetic Variation, Growth Regulation: Role of Growth Factors, Oncogenes, and Tumor Suppressors.	15	25%
3	**Molecular Mechanisms of Gene Expression** • DNA Replication, Transcription, and Translation • DNA Structure and Replication: Enzymes and Mechanism, Transcription: RNA Synthesis from a DNA Template, Role of RNA Polymerase, Promoters, and Terminators • Translation: Protein Synthesis at the Ribosome- tRNA, mRNA, rRNA Roles and Interaction, • Post-Translational Modifications and Protein Folding.	15	25%
4	**Genetic Inheritance and Molecular Basis of Heredity** • Basic Principles of Molecular Genetics and Inheritance. • Mendelian Genetics: Laws of Segregation and Independent Assortment. Linkage and Recombination: Genetic Maps and Crossing Over, • Modern Molecular Genetics: DNA Markers, QTL Mapping, and Genome-Wide Association Studies. • Patterns of Inheritance: Autosomal, Sex-linked, Co-dominance and Incomplete Dominance.	15	25%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	20%	20%	10%	10%	20%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Explain the structure, organization, and functional dynamics of cells including organelles, membrane transport, and cytoskeletal components.
CO2	Describe the cell cycle, mechanisms of cell division (mitosis and meiosis), and molecular regulation of cell growth.
CO3	Interpret and analyze the molecular processes of DNA replication, transcription, translation, and post-translational modifications in gene expression.
CO4	Evaluate patterns of genetic inheritance and molecular techniques used to study heredity and genetic variation.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

1. Alberts, B., Heald, R., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular biology of the cell (7th ed.). W. W. Norton & Company.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K. C., Yaffe, M., & Amon, A. (2021). Molecular cell biology (9th ed.). W. H. Freeman/Macmillan Learning.
3. Cooper, G. M., & Hausman, R. E. (2019). The cell: A molecular approach (8th ed.). Sinauer Associates.
4. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2013). Molecular biology of the gene (7th ed.). Pearson.
5. Karp, G. (2019). Cell and molecular biology: Concepts and experiments (9th ed.). Wiley.
6. Lewin, B. (2017). Genes XII. Jones & Bartlett Learning.
7. De Robertis, E. D. P., & De Robertis, E. M. F. (2018). Cell and molecular biology (8th ed.). Lippincott Williams & Wilkins.
8. Paul, A. (2015). Textbook of cell and molecular biology (4th ed.). Books and Allied Pvt. Ltd.