



Gyanmanjari
Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-2 (B.Sc.)

Subject: Cell biology - BSC1EM12305

Type of course: Major

Prerequisite: Basic knowledge of biochemistry and genetics of cell biology

Rationale: Cell Biology provides the foundation for understanding embryonic development. It explains cellular structure, division, communication, and differentiation, which are essential for studying fertilization, stem cells, genetic regulation, and developmental processes in clinical embryology.

Teaching and Examination Scheme

| Teaching Scheme | | | Credits | Examination Marks | | Total Marks |
|-----------------|---|---|---------|-------------------|-----|-------------|
| CI | T | P | C | SEE | CCE | |
| 2 | 0 | 4 | 4 | 100 | 100 | 200 |

Legends: CI-Class Room Instructions; T- Tutorial; P - Practical; C - Credit; SEE - Semester End Evaluation; LWA - Lab Work Assessment; V - Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.



Course Content:

| Sr. No | Course Content | Hrs. | % Weig htag e | | | | | | | | | | | | | | | | | | | | |
|--------|--|--|--------------------|-----|-----|---|--|--|---|---|--|----|--|---|---------|--|---|---|--|--|----|-------------|----|
| 1 | <p>Basics of Cell Biology and Microscopy</p> <ul style="list-style-type: none"> Cell history and cell theory, overview of plant vs. animal cells, and basics of microscopy: light, phase contrast, and electron microscopy <p>Practical</p> <ol style="list-style-type: none"> Study of Cell organs. Discovering the Barr Body in Cheek Cells Osmostic pressure Dialysis Tubing Observation of Different Types of Microscopes <ol style="list-style-type: none"> Light microscope Electron microscope Fluorescence microscope Phase contrast microscope <p>Evaluation method</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td> <p>Topic Preparation and Digital Submission: Faculty will assign a subtopic. Students will prepare a short report or digital presentation (PDF format) and upload it on the GMIU web portal..</p> </td> <td></td> <td>5</td> </tr> <tr> <td>2</td> <td> <p>Microscopy Observation and Analysis: Students will observe specimens under light microscopes review. They will record observations, label diagrams, and interpret results.</p> </td> <td>20</td> <td></td> </tr> <tr> <td>3</td> <td>Journal</td> <td></td> <td>5</td> </tr> <tr> <td>4</td> <td> <p>Chart/Model Preparation: Students will design a comparative chart showing:</p> <ul style="list-style-type: none"> Differences between plant and animal cells Comparison among light, phase contrast, and electron microscopy (principle, resolution, magnification, image type, advantages & </td> <td></td> <td>10</td> </tr> </tbody> </table> | Sr. No | Evaluation Methods | SEE | CCE | 1 | <p>Topic Preparation and Digital Submission: Faculty will assign a subtopic. Students will prepare a short report or digital presentation (PDF format) and upload it on the GMIU web portal..</p> | | 5 | 2 | <p>Microscopy Observation and Analysis: Students will observe specimens under light microscopes review. They will record observations, label diagrams, and interpret results.</p> | 20 | | 3 | Journal | | 5 | 4 | <p>Chart/Model Preparation: Students will design a comparative chart showing:</p> <ul style="list-style-type: none"> Differences between plant and animal cells Comparison among light, phase contrast, and electron microscopy (principle, resolution, magnification, image type, advantages & | | 10 | T:P 6:12 | 20 |
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| | limitations). Charts to be submitted and uploaded digitally on the GMIU portal. | | | | | | | | | | | | | | | | | | |
|---|---|---|-----|-------------|--------|--------------------|-----|-----|---|---|--|---|---|--|----|--|--|--|--|
| | Total | 20 | 20 | | | | | | | | | | | | | | | | |
| 2 | <p>Plasma Membrane and Cell Communication</p> <ul style="list-style-type: none"> • Structure and models of plasma membrane • Transport across membranes: passive, active, facilitated diffusion, endocytosis, exocytosis • Cell adhesion molecules and signaling in embryology <p>Practical:</p> <p>5. Perform Onion Plasmolysis 6. Dialysis Tubing Osmosis. 7. Osmotic Fragility of Red Blood Cells . 8. Effects of temperature and solvents on plasma membrane permeability-beet root experiment.</p> <p>Evaluation method</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Report Preparation: Students will prepare a detailed report describing the structure and models of the plasma membrane (Davson–Danielli, Singer–Nicolson), transport mechanisms (passive, active, facilitated diffusion, endocytosis, exocytosis), and cell adhesion molecules with their embryological roles. The report must include labeled diagrams and should be uploaded to the GMIU web portal in PDF format.</td> <td></td> <td>5</td> </tr> <tr> <td>2</td> <td>Practical Examination: Students will perform any one of the practicals such as osmosis experiment or model demonstration. They must record observations, interpret results, and explain the underlying mechanism of</td> <td>10</td> <td></td> </tr> </tbody> </table> | | | | Sr. No | Evaluation Methods | SEE | CCE | 1 | Report Preparation: Students will prepare a detailed report describing the structure and models of the plasma membrane (Davson–Danielli, Singer–Nicolson), transport mechanisms (passive, active, facilitated diffusion, endocytosis, exocytosis), and cell adhesion molecules with their embryological roles. The report must include labeled diagrams and should be uploaded to the GMIU web portal in PDF format. | | 5 | 2 | Practical Examination: Students will perform any one of the practicals such as osmosis experiment or model demonstration. They must record observations, interpret results, and explain the underlying mechanism of | 10 | | | | |
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| | | | | T:P 6:12 | 20 | | | | | | | | | | | | | | |



| | membrane transport or communication.. | | | | | | | | | | | | |
|--------|---|--------|--------------------|-----|-----|--|--|--|--|--|--|-------------|----|
| 3 | Spotting: Students will identify membrane-related structures and models (e.g., phospholipid bilayer, carrier proteins, ion channels, endocytic vesicles) from charts, micrographs, or slides and write a brief description of their structure and function. | 10 | | | | | | | | | | | |
| 4 | Journal | | 5 | | | | | | | | | | |
| 5 | Cell Communication Challenge: Faculty will provide a list of cell adhesion molecules and signaling pathways. Students must prepare a short presentation/report identifying their functions during embryonic development and upload it on the GMIU portal | | 10 | | | | | | | | | | |
| | Total | 2 | 20 | | | | | | | | | | |
| 3 | <p>Cell Organelles and Structures</p> <ul style="list-style-type: none"> • Nucleus and nucleolus: role in gene regulation • Mitochondria: biogenesis and maternal inheritance • Lysosomes and ER–Golgi system: protein trafficking in embryonic cells • Study of Blood Composition <p>Practical:</p> <p>9. Rooted in Science: Tissue Architecture of a Monocot Root</p> <p>10. Study of tissue organization on the dicot root stem</p> <p>11. Demonstration of endocytosis/exocytosis by model simulation or case study</p> <p>12. Study of total count of WBC</p> <p>13. Study of total count of RBC</p> <p>14. Differentiate count of blood cells</p> <p>Evaluation method</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | Sr. No | Evaluation Methods | SEE | CCE | | | | | | | T:P 6:12 | 20 |
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|---|---|--|----|----|--|-------------|----|
| | 1 | From Nucleus to Mitochondria: Mapping the Eukaryotic Interior: Students will prepare a chain notes on the structure and function of major cell organelles (nucleus, nucleolus, mitochondria, lysosomes, ER-Golgi). The chain notes must be uploaded to the GMIU portal. | | 5 | | | |
| | 2 | Organelle Observation and Identification: Students will perform staining techniques (e.g., endospore staining or metachromatic granule staining) and observe cellular inclusions. They will record microscopic observations, identify key or inclusion bodies, and interpret their biological significance. | 10 | | | | |
| | 3 | Oral-Examination | 10 | | | | |
| | 4 | Journal | | 5 | | | |
| | 5 | Chart Preparation: Cellular Coordination and Function Mapping: Students will prepare a detailed chart showing the structure, function, and interrelationship of major cell organelles — nucleus, nucleolus, mitochondria, endoplasmic reticulum, Golgi apparatus, and lysosomes. | | 10 | | | |
| | | Total | 20 | 20 | | | |
| 4 | Cell Cycle, Growth and Division <ul style="list-style-type: none"> • Cell cycle regulation • Mitosis, meiosis, and cell differentiation • Apoptosis vs. necrosis in embryology Practical: 15. To observe the cell cycle stages each phase 16. Study of different stages of mitosis | | | | | T:P 6:12 | 20 |



| 17. Study of different phases of meiosis I | | | |
|---|---|-----|-----|
| 18. Study of different phases of meiosis II | | | |
| Evaluation method: | | | |
| Sr. No | Evaluation Methods | SEE | CCE |
| 1 | Cell Cycle Phases Flowchart: Students will prepare a flow diagram or infographic showing all stages of the cell cycle (G ₁ , S, G ₂ , M) and key regulatory checkpoints. The diagram should include major control proteins (cyclins, CDKs) and uploaded on the GMIU portal. | | 5 |
| 2 | Case Study Analysis: Faculty will provide a case scenario involving abnormal cell division (e.g., uncontrolled growth, apoptosis failure, or meiotic errors). Students will analyze and interpret how regulatory disruption affects cell differentiation and embryonic development | 10 | |
| 3 | Spot Identification: Mitosis and Meiosis Stages: Students will observe prepared slides or digital micrographs of mitosis and meiosis stages. They will identify and label each phase, describe the key events, and distinguish between the two processes. | 10 | |
| 4 | Journal | | 5 |
| 5 | Apoptosis vs. Necrosis Poster: Students will prepare a poster comparing apoptosis and necrosis. It should include morphological and biochemical differences, examples from embryonic development, and mechanisms of regulation. Upload to GMIU portal. | | 10 |



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|----|--|--|-----|--------|--------------------|-----|-----|----|--|--|---|----|---|----|--|--|-------------|----|
| 5 | Cell-Tissue Organization and Development <ul style="list-style-type: none"> • Cell Communication in Tissue Organization • Organogenesis, Tissue Engineering & Artificial Organs • Cancer as a Tissue Disease <p>Practical:</p> <p>19. Demonstration of apoptosis & necrosis + Observation of Barr body in cheek cells.</p> <p>20. Visualization of cytoskeleton – prepared slides of microtubules & microfilaments</p> <p>21. Chloroplast pigments separation by paper chromatography</p> <p>22. Observe oogenesis and spermatogenesis using permanent slides.</p> <p>Evaluation method</p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Evaluation Methods</th> <th>SEE</th> <th>CCE</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td> Tissue Communication Mapping: Students will prepare a labeled diagram or flowchart showing various cell-cell communication types (tight junctions, desmosomes, gap junctions) and their roles in maintaining tissue integrity. The completed diagram must be uploaded to the GMIU web portal. </td> <td></td> <td>5</td> </tr> <tr> <td>2.</td> <td> Seminar: Each student will prepare and deliver a PowerPoint presentation on an assigned topic such as Organogenesis, Tissue Engineering Techniques, or Cancer as a Disease of Disordered Tissue Growth. The presentation should include recent developments, key mechanisms, and applications. </td> <td>10</td> <td></td> </tr> </tbody> </table> | | | Sr. No | Evaluation Methods | SEE | CCE | 1. | Tissue Communication Mapping: Students will prepare a labeled diagram or flowchart showing various cell-cell communication types (tight junctions, desmosomes, gap junctions) and their roles in maintaining tissue integrity. The completed diagram must be uploaded to the GMIU web portal. | | 5 | 2. | Seminar: Each student will prepare and deliver a PowerPoint presentation on an assigned topic such as Organogenesis, Tissue Engineering Techniques, or Cancer as a Disease of Disordered Tissue Growth. The presentation should include recent developments, key mechanisms, and applications. | 10 | | | T:P 6:12 | 20 |
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| | | | | | | |
|--------------|---|----|----|--|-----------|-------------|
| 3. | Histopathology Observation: Normal vs. Cancerous Tissue: Faculty will provide microscopic slides or high-resolution digital images of normal and cancerous tissues. Students must identify differences in cell organization, nuclear morphology, and tissue boundaries, then interpret findings in a short report. | 10 | | | | |
| 4. | Journal | | 5 | | | |
| 5. | Tissue Engineering Model Preparation: Students will prepare a model showing the process of tissue regeneration or artificial organ design. The illustration should include scaffold design, cell seeding, growth factors, and clinical applications. The chart/model must be uploaded to the GMIU portal. | | 10 | | | |
| Total | | 20 | 20 | | | |
| | | | | | 90 | 100% |

| Distribution of Marks (Revised Bloom's Taxonomy) | | | | | | |
|---|--------------------|----------------------|--------------------|----------------|-----------------|---------------|
| Level | Remembrance (R) | Understanding (U) | Application (A) | Analyze (N) | Evaluate (E) | Create (C) |
| Weightage % | 20% | 20% | 20% | 20% | 20% | 00 |



RUBRICS:**UNIT 1:**

Basics of cell microbiology and microscopy: Evaluation based on

Proper use of Microscope: 5 marks

Observation & Diagram: 5 marks

Comparative Understanding: 5 marks

Result Interpretation: 5 marks

UNIT 2:

Practical Examination: Evaluation based on

Practical Handling: 3 marks

Observation and Accuracy: 2 marks

Use of Microscope / Model Presentation: 2 marks

Cleanliness and Organization : 1 marks

Result Interpretation: 2 marks

UNIT 3:

Observation of Spore-Forming Bacteria from Home Samples: Evaluation based on

Identification of cell organelles and their structures: 4 marks

Understanding of organelle functions and interrelations: 3 marks

Interpretation of organelle roles in embryonic development: 3 marks

UNIT 4:

Spot Identification – Mitosis and Meiosis Stages Evaluation based on:

Accurate identification of mitotic and meiotic stages – 3 marks

Understanding of chromosomal behavior and cell division events – 4 marks

Interpretation of significance in growth and differentiation – 3 marks

UNIT 5:

Histopathology Observation – Normal vs. Cancerous Tissue Evaluation based on:

Observation and Identification of Tissue Changes – 3 marks

Analytical Interpretation of Pathological Features – 5 marks

Report Presentation and Clarity – 2 marks

Seminar: Evaluation based on

Quality and Design of PPT – 3 marks

Depth of Content Knowledge and Accuracy – 4 marks

Presentation Skills and Audience Interaction – 3 marks



Course Outcome

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.

Instructional Method:

The course delivery method will depend upon the requirement of content and 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 the 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.] Cooper, G. M., & Hausman, R. E. . **The cell: A molecular approach (4th ed.)**. ASM Press.
- [2.] Giese, A. C. **Cell physiology**.
- [3.] Bhatnagar, D., Murthy, M., Chinoy, N. J., & Shah, V. C. **Essential techniques in cell biology**.
- [4.] Swanson, C. P., & Webster, J. **The cell**
- [5.] Alberts, B., Johnson, A., Lewis, J., & Raff, M. (2015). **Molecular biology of the cell (6th ed.)**. Garland Science.

