Semester: 4	
Course: Skill Enhancement Course 2	
Paper Title: Techniques in Molecular and Cell Biology	
Paper code: S2BT230411T	**Credits: 3**
Hours/week : 3 Hours	
Category: Core/MDC/SEC/VAC : SEC	
Theory / Practical / Composite : Theory	
No of Modules : 2	

Course Overview:

The course aims to:

1. To provide a comprehensive understanding of gene transfer mechanisms, molecular cloning, and the tools used in molecular biology.
2. To familiarize students with techniques for the analysis of nucleic acids and proteins, including electrophoresis, hybridization, and interaction assays.
3. To introduce advanced microscopy and centrifugation methods for studying cellular structures and subcellular components.
4. To develop skills in histochemical, immunological, and localization techniques for investigating biomolecules and cellular processes.
5. To equip learners with knowledge of electrophysiological and imaging methods for exploring cellular and neurophysiological functions..

Course Outcome:

1. Explain the mechanisms of gene transfer in bacteria (conjugation, transformation, transduction) and their role in horizontal gene transfer.
2. Apply molecular biology tools such as restriction enzymes, electrophoresis, PCR, and cloning strategies to analyze and manipulate genetic material.
3. Analyze DNA-protein and protein-protein interactions using hybridization and immunoprecipitation techniques to interpret molecular relationships.
4. Interpret cellular structures and functions through advanced microscopy (light, fluorescence, electron, AFM) and centrifugation-based fractionation methods.
5. Evaluate histochemical stains, immunoassays (ELISA, flow cytometry), and localization techniques (FISH, GISH) for studying biomolecules and cellular processes.
6. Design experimental strategies integrating electrophysiological methods and imaging techniques (PET, MRI, fMRI, CAT) to investigate cellular and neurophysiological functions.

Prerequisites: ***Basic knowledge about biological macromolecules and cell structure***

SYLLABUS

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I. MODULE A	**UNIT I:** Gene transfer: Gene transfer in bacteria - Conjugation, transformation and transduction	**4**	**CO 1**	**K1 to K6**
II.	**UNIT II:** Tools and techniques: Concepts of genomic DNA, cDNA, plasmids and episomes; Restriction enzymes; Gel electrophoresis; Northern and Southern hybridization; Protein purification methods; DNA-protein and protein-protein interaction techniques (South-western blots, EMSA, DNase I foot printing, Immunoprecipitations- Chromatin immunoprecipitation, Co-immunoprecipitation). Introduction to PCR. Cloning and sub-cloning strategies.	**14**	**CO 2, CO 3**	**K1 to K6**
III. Module B	**UNIT III:** Microscopy and centrifugation methods - Bright Field and Dark field microscopy, phase contrast microscopy, fluorescence microscopy, Scanning and transmission electron	**8**	**CO 4**	**K1 to K6**

	microscopy, AFM. Sedimentation and density gradient techniques, subcellular fractionation methods.			
IV.	**UNIT IV:** Histochemical assays and immunotechniques: Biochemical reporter assays; protein localization and interaction techniques; histochemical stains; in situ localization techniques - FISH and GISH; ELISA and Flow cytometry; chromosome banding.	**6**	**CO 5**	**K1 to K6**
V.	**UNIT V:** Electrophysiological methods – Neurophysiology techniques, pharmacological testing, Imaging techniques – PET, MRI, fMRI, CAT.	**4**	**CO 6**	**K1 to K6**

Text Books

1. **Principles of Genetics- Gardner et al.**
2. **An Introduction to genetic analysis- David Suzuki**
3. **Genetics- Strickberger**
4. **Molecular Cloning: A Laboratory Manual - Sambrook and Russell**
5. **Principles of Gene Manipulation & Genomics-Primrose & Twyman**
6. **Biophysical Chemistry - David Friefelder**
7. **Cell and Molecular Biology – P. Sheeler, D.E. Bianchi (3rd Edition)**
8. **Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology- Eighth Edition**
9. **Brock Biology of Microorganisms, Microbiology, Fourteenth Edition, By Pearson, 14th Edition**
10. **Molecular Biology of the Cell, 7th Ed, by Bruce Alberts**

11. Lippincott Illustrated Reviews: Cell and Molecular Biology (South Asian Edition) - by Dr Poonam Agrawal
Suggested readings: **Relevant research papers and review articles**
Evaluation: Theory: 50 marks CIA- 10 Assignment – 03 Attendance - 02 End-Semester Exam- 35
Paper Structure for Theory Semester Exam Module: **Module A (18 marks):** 3 questions, 2 marks each; i.e. 2x3=6 marks 2 questions, 6 marks each; i.e. 2x6=12 marks. **Module B (17 marks):** 5 questions, 1 mark each; i.e. 1x5=5 marks 2 questions, 6 marks each; i.e. 2x6=12 marks.

COURSE OUTCOMES (COS) AND COGNITIVE LEVEL MAPPING

COs	CO Description	Cognitive levels
CO1	Explain the mechanisms of gene transfer in bacteria (conjugation, transformation, transduction) and their role in horizontal gene transfer.	K1 to K6
CO2	Apply molecular biology tools such as restriction enzymes, electrophoresis, PCR, and cloning strategies to analyze and manipulate genetic material.	K1 to K6
CO3	Analyze DNA-protein and protein-protein interactions using hybridization and immunoprecipitation techniques to interpret molecular relationships.	K 1 to K6
CO4	Interpret cellular structures and functions through advanced microscopy (light, fluorescence, electron, AFM) and centrifugation-based fractionation methods.	K1 to K6
CO5	Evaluate histochemical stains, immunoassays (ELISA, flow cytometry), and localization techniques	K1 to K6

	(FISH, GISH) for studying biomolecules and cellular processes.	
CO6	Design experimental strategies integrating electrophysiological methods and imaging techniques (PET, MRI, fMRI, CAT) to investigate cellular and neurophysiological functions.	K1 to K6