School of Science
M.Sc. (Zoology) Programme

Subject Code& Name: - MS01CZOO04 – Bioinstrumentation

Teaching and Evaluation Scheme:

Teaching Scheme				Examination Scheme			
Credits				Component Weightage			
				Internal		External	
L	T	P	Total	TH	PWE	TH	PWE
2	--	2	4	25%	25%	25%	25%

Programme Name	M.Sc. Zoology
Semester	I
Course Code	MS01CZOO04
Course Title	Bioinstrumentation
Course Content Type (Th./Pr.)	Theory + Practical
Course Credit	4
Sessions+ Lab. Per Week	2 + 4
Total Teaching/Lab. Hours	60 Hours
*** 2 Laboratory = 1 Session**	

Learning Objectives

1. Understand the principles, structure and applications of major bioinstrumentation techniques used in cell and molecular biology.
2. Develop familiarity with analytical and separation techniques for studying biomolecules and cellular components.
3. Interpret experimental data generated through microscopy, cytometry, electrophoresis, chromatography and spectroscopy.

Prerequisites (if any)

1. Basic knowledge of cell biology and molecular biology.
2. Understanding of fundamental concepts in biochemistry and genetics.
3. Familiarity with laboratory safety practices and basic laboratory equipment.

Learning Outcomes

After successful completion of the course students will be able to:

- Explain the working principles and applications of microscopy, flow cytometry, FISH and GFP-based visualization techniques.
- Perform and interpret basic experiments involving centrifugation, electrophoresis, chromatography and spectrophotometric analysis.
- Analyze biological samples and experimental data using modern bioinstrumentation tools for research and diagnostic applications.

13

School of Science
M.Sc. (Zoology) Programme

Detailed Contents		
UNIT	**TOPIC/SUB-TOPIC**	**TEACHING HOURS**
I	**Cell and Molecular Visualization Techniques:** **Microscopy** Principle, structure & applications of: Bright field & dark field microscopy, Phase contrast microscopy, Fluorescence microscopy, Confocal microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) **Immunofluorescence** Antibody-based detection of proteins **Cytophotometry & Flow Cytometry** Analysis of cell populations Fluorescent labeling and quantification Applications in immunology and cancer biology **Green Fluorescent Protein (GFP) Tagging** Visualization of gene expression and protein localization **Fluorescence in Situ Hybridization (FISH)** Detection of specific DNA/RNA sequences	15
II	**Separation Techniques & Spectroscopy** **Centrifugation** Basic principle, Analytical vs. preparative centrifugation, Types of rotors Sedimentation coefficient & RCF, Differential, density & ultracentrifugation **Electrophoresis** Principle & applications, Agarose gel electrophoresis, 2D gel electrophoresis, Capillary electrophoresis and Native-PAGE & SDS-PAGE **Chromatography** Gel-filtration, ion-exchange, affinity chromatography, TLC & HPTLC, Gas chromatography (GC) and HPLC & FPLC **Spectroscopy** Electromagnetic radiation basics: UV, Visible, IR (FTIR, ATR), AAS, NMR, Mass spectrometry and MALDI-TOF	15

14

School of Science
M.Sc. (Zoology) Programme

Practical

List of Practical (Practical are demonstrated using charts, models and multimedia videos)

1. Study of Bright and Dark Field Microscopy
2. Study of Phase Contrast Microscope
3. Study of Fluorescence Microscope
4. Comparative Study of SEM and TEM Micrographs
5. Observation of Animal Tissue Sections Under Bright Field Microscopy
6. Demonstration of Immunofluorescence Technique
7. Study of Flow Cytometer Components and Working by multimedia or chart
8. Study of FISH Technique and Applications
9. Study of Laboratory Centrifuges and Rotor Types
10. Separation of Cellular Components by Differential Centrifugation
11. Study of Agarose Gel Electrophoresis Apparatus
12. Study of SDS-PAGE Technique
13. Separation of DNA by Agarose Gel Electrophoresis
14. Separation of Amino Acids by Thin Layer Chromatography
15. Study of UV-Visible Spectrophotometer by multimedia or chart

Text Book(s)

1. An Introduction to Practical Biochemistry by Plummer
2. Environmental science and Biotechnology: Theory and techniques by Murugesan and Rajkumari
3. Instrumental methods of chemical analysis by B. K. Sharma
4. Microscopy for students by J. D. Casartelli, McGraw, Hill pub
5. Principles and techniques of biochemistry and molecular biology by Wilson and Walker
6. Research Methodology: For Biological Sciences by N. Gurumani

Reference Books

1. Instrumental method of chemical analysis: Sharma B K
2. Instrumental methods of analysis: D A Skoog
3. An introduction to practical Biochemistry: Plummer
4. Instrumentation: Chatwal and Anand
5. Modern experimental Biology: Boyer
6. Freifelder D. M. Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman, 1982.
7. Wilson & Walker. Principles and Techniques in Practical Biochemistry. 5th ed. Cambridge Univ. Press, 2000.

School of Science
M.Sc. (Zoology) Programme

Web Resources
1. Bio-Protocol – https://bio-protocol.org 2. Current Protocols – https://currentprotocols.onlinelibrary.wiley.com 3. Thermo Fisher Scientific Protocols – https://www.thermofisher.com/in/en/home/references/protocols.html 4. Merck/Sigma-Aldrich Protocols – https://www.sigmaaldrich.com 5. Bio-Rad Learning Center – https://www.bio-rad.com 6. Cell Signaling Technology Protocols – https://www.cellsignal.com/learn-and-support/protocols 7. New England Biolabs (NEB) Protocols – https://www.neb.com/protocols 8. Nature Protocol Exchange – https://protocolexchange.researchsquare.com 9. R&D Systems Flow Cytometry Protocols – https://www.rndsystems.com/resources/protocols/flow-cytometry-protocols 10. Olympus Life Science Learning Center – https://www.olympus-lifescience.com
Required Software(s) (if any)
--

L:: Lecture, **T::** Tutorial , **P::**Practical

PWE:: Practical Work Examination

(PWE includes Laboratory practical work, project work, viva simulation exercise work etc.)

16