BIO-IMAGING

MODULE – I (Fundamentals of Bio - imaging and Microscopy)
Introduction to bio -imaging; Electromagnetic spectrum and interaction of light with biological samples; Principles of image formation; Resolution, magnification, contrast and numerical aperture; Bright field microscopy, dark field microscopy, phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample preparation techniques for microscopy.

MODULE – II (Advanced Microscopy and Spectroscopic Techniques)
Electron microscopy: TEM and SEM; Atomic force microscopy (AFM); Scanning probe microscopy; Raman spectroscopy; Infrared spectroscopy; Flow cytometry and cell sorting; Imaging probes and biosensors; Applications of advanced microscopy in biological sciences.

MODULE – III (Cellular and Applied Bioimaging Techniques)
Introduction to cellular imaging ; Staining and labeling techniques in biological samples; Fluorescent dyes and fluorescent proteins ; Imaging of microorganisms, plant cells, and animal cells; Imaging applications in cancer biology, microbiology, and immunology; Basics of medical imaging techniques: X-ray, ultrasound, and CT scan; Applications of bio imaging in clinical diagnosis and biomedical research.

MODULE – IV (Applications of Bioimaging in Biotechnology and Healthcare)
Applications of bioimaging in genomics, proteomics, stem cell biology, tissue engineering and drug discovery; Imaging in agriculture and environmental biotechnology; Personalized medicine and precision diagnostics; Ethical issues and biosafety in imaging; Recent trends in bioimaging and future prospects.

Course Outcomes (COs)
After completion of the course, students will be able to:
CO1: Explain the principles and instrumentation of various bioimaging techniques.
CO2: Apply microscopy and spectroscopy methods for biological sample analysis.
CO3: Analyze cellular and applied imaging data for research and diagnostic purposes.
CO4: Evaluate modern bioimaging applications in biotechnology, healthcare, and biomedical research.

Program Outcomes (POs)
PO1: Engineering knowledge – Apply knowledge of mathematics, science, engineering fundamentals, and biotechnology specialization.
PO2: Problem analysis – Identify and analyze complex biotechnology problems using logical and analytical approaches.
PO3: Design/development of solutions – Design systems and solutions for biotechnology-related applications.
PO4: Modern tool usage – Apply modern bioimaging, computational, and biotechnology tools effectively.

Program Specific Outcomes (PSOs)
PSO1: Apply principles of molecular biology, biochemistry, and biotechnology for imaging-based biological investigations.
PSO2: Utilize microscopy, spectroscopy, and computational tools for biological image analysis and interpretation.
PSO3: Apply bioimaging techniques in healthcare, diagnostics, biomedical research, and pharmaceutical industries.
PSO4: Develop innovative solutions using modern imaging technologies in biotechnology and life science applications.

Suggested Text Books

1. James Pawley – Handbook of Biological Confocal Microscopy.
2. Rafael Yuste – Imaging: A Laboratory Manual.
3. Murphy & Davidson – Fundamentals of Light Microscopy and Electronic Imaging.
4. Walter & Israelachvili – Introduction to Bioimaging.
5. Diane Lidke & R. Heintzmann – Advanced Fluorescence Microscopy.