

## Syllabus template

<b>Semester: VI</b>	
<b>Course : Microbiology (Minor)</b>	
<b>Paper Title: Bioinstrumentation</b>	
<b>Paper code: B3MB230611T</b>	<b>Credits: 4</b>
<b>Hours/week : 4 hours/week</b>	
<b>Category: Core/MDC/SEC/VAC : Core (Minor)</b>	
<b>Theory / Practical / Composite : Theory (Non composite)</b>	
<b>No of Modules : No modules</b>	
<p><b>Course Overview:</b> This course provides a comprehensive study of different bioinstrumentation techniques widely used in biological as well in clinical studies. This course will provide an introduction to the physics and chemistry behind the basic working principle of the physico-chemical techniques like centrifugation, electrophoresis, chromatography and viscosity. The knowledge is a prerequisite for the separation and purification of macromolecules from a mixture.</p> <p>The course further aim at building the basic understanding of absorption and emission spectroscopic methods like UV-Vis, Infrared (IR) and Fluorescence which can be used to study the concentration of separated biomolecules, understand and examine the denaturation, renaturation and binding kinetics of macromolecules. IR spectroscopy can be used to analyse and formulate the primary chemical structure of macromolecules.</p> <p>The course also will introduce learners to the amazing world of advanced state of art microscopic techniques with wide array of biological and clinical applications. It will provide learners with a detailed knowledge of fluorescence microscopy to advanced electron microscopy with some idea of image processing. Further basic introduction to the principle and use of bio-medical techniques like Magnetic resonance imaging (MRI) and functional imaging like Positron Emission Tomography (PET) will be provided.</p>	
<b>Course Outcome:</b>	
1. Remember the basic concepts of sedimentation , viscosity, light propagation, interaction of light with a particle, change in dipole moment, radioactivity, magnetic effects	
2. Understand the basic concept of centrifugation, chromatography, electrophoresis, chromophores, fluor, quenching, photobleaching, electron microscopy	
3. Apply the physico-chemical techniques to separate biomolecules, use UV-Vis or fluorescence spectroscopy to study biomolecular concentration or demonstrate interaction which can also be validated using microscopic techniques.	
4. Analyse the primary macromolecular structures using IR spectroscopy as well as mass spectrometry	
5. Evaluate the patient's tissues abnormal condition using MRI and PET scans.	
6. Create 3D structure of macromolecules-from isolation steps to analysis of primary structure and cryo EM tomography to develop the higher order structure.	
<b>Prerequisites: Basic knowledge about any prior course: 10+2 level of physics and chemistry</b>	
<b>SYLLABUS</b>	

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
	<p><b>Unit 1: Physico-chemical techniques</b>  Basic principle, types of centrifugation, types of centrifuges and biological applications of centrifuge. Analytical problems. Basic principle, types of conventional chromatography- Paper chromatography, thin layer chromatography, Column chromatography, Gas Chromatography, GLC. HPLC; biological applications of chromatography.  <b>Electrophoresis:</b> Principle, types and different types of Blotting techniques.  <b>Viscosity:</b> basic principle and study of Ostwald viscometer.  <b>Unit 2: Spectroscopy</b>  Properties of light relevant to spectroscopic studies, principles of light absorption and emission. Concept of chromophores, fluorophores, quenching and photobleaching. Basics of UV-Vis spectroscopy, Instrumentation and application  Fluorescence spectroscopy  Instrumentation and application  Basics of IR spectroscopy and Mass Spectrometry.  <b>Unit 3: Advanced Microscopy</b>  Advanced fluorescent microscopy: wide-field, evanescent, confocal, super resolution. Principles and uses. Super resolution microscopy, Correlative Light and electron microscopy and advanced electron microscopy. Biological</p>	50 classes	CO1 CO2 CO3 CO4 CO5 CO6	K1,K2,K3,K4,K5, K6

	applications. <b>Unit 4: Non-Invasive Biomedical Imaging</b> Basics and use of MRI, PET scans			
<b>Text Books</b>				
1. Biophysical chemistry –principles and application by Upadhyay, Upadhyay and Nath.				
2. Biophysics and biophysical chemistry by Debajyoti Das, Academic Publishers				
3. Molecular techniques in Biochemistry and biotechnology by S Srivastava, NCB Agency Ltd				
4. Fundamentals of bioanalytical techniques and Instrumentation by Ghosal and Srivastava, PHI learning Pvt Ltd				
5. Biomedical imaging by Shukla and Qureshi, Discovery Publishing house Pvt Ltd				
6. Introductory biomedical imaging by Abney and Scalettar, CRC press				
<b>Suggested readings</b>				
1. Physical biochemistry by D Freifelder, WH Freeman Publisher				
2.				
<b>Web Resources</b>				
1.				
2.				
3.				
4.				
<b>Evaluation</b> Theory CIA:30 Semester Exam:70; No Practical component is included in the course				
<b>Paper Structure for Theory Semester Exam Module :</b> <b>Full marks 70</b> Short questions: 10 (each 2 marks) from 12 (10x2=20) Long questions: 5 (each 10 marks) from 7 (5x10=50)				

#### Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	Remember the basic concepts of sedimentation , viscosity, light propagation, interaction of light with a particle, change in dipole moment, radioactivity, magnetic effects	K1, K2
CO2	Understand the basic concept of centrifugation, chromatography, electrophoresis, chromophores, fluor, quenching, photobleaching, electron microscopy	K2
CO3	Apply the physico-chemical techniques to separate biomolecules, use UV-Vis or fluorescence spectroscopy to study biomolecular concentration or demonstrate	K3

	interaction which can also be validated using microscopic techniques.	
<b>CO4</b>	Analyse the primary macromolecular structures using IR spectroscopy as well as mass spectrometry	K4
<b>CO5</b>	Evaluate the patient's tissues abnormal condition using MRI and PET scans	K5
<b>CO6</b>	Create 3D structure of macromolecules-from isolation steps to analysis of primary structure and cryo EM tomography to develop the higher order structure.	K6