

<b>Course title:</b> Bioanalytical Techniques				
<b>Course code:</b> BBP111		<b>No. of credits:</b> 3	<b>L-T-P:</b> 32-10-0	<b>Learning hours:</b> 42
<b>Pre-requisite course code and title (if any):</b> Science graduate				
<b>Department:</b> Department of Biotechnology				
<b>Course coordinator:</b> Dr Udit Soni			<b>Course instructor:</b> Dr. Udit Soni	
<b>Contact details:</b> udit.soni@teriuniversity.ac.in				
<b>Course type:</b> core			<b>Course offered in:</b> Semester 1	
<b>Course description:</b> This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic bio analytical technique and an introduction to general terminologies. This course contains bio analytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.				
<b>Course objectives:</b> 1. The primary objectives of this course are to develop the skills to understand the theory and practice of bio analytical techniques. 2. To provide scientific understanding of analytical techniques and detail interpretation of results.				
<b>Course contents</b>				
<b>S. No</b>	<b>Topic</b>	<b>L</b>	<b>T</b>	<b>P</b>
1.	<b>Spectroscopy study of chemical compounds and bio-molecules</b> <b>Electromagnetic radiations and interactions with matters:</b> Electromagnetic spectrum. Quantisation of energy, Electronic, vibrational and rotational spectroscopy. Franck–Condon principle, Jablonski diagram, radiative, nonradiative pathways, fluorescence and phosphorescence. Absorption of radiation, Beer-Lambert’s law, deviation of Beer-Lambert’s equation and its limitations.  <b>Principals, instrumentation, sampling and application of few spectroscopic techniques:</b> UV-Visible spectroscopy, Fluorescence spectroscopy, IR/Raman spectroscopy, NMR Spectroscopy and Mass spectroscopy.	7	4	0
2.	<b>Microscopy:</b> Principals, instrumentation and applications of imaging techniques: Dark-field, Phase contrast, Fluorescence, Confocal microscopy, Atomic force microscopy, and Transmission and Scanning electron microscopy.	7	2	0
3.	<b>Diffraction Technique:</b> <b>Crystal geometry and structure:</b> Introduction to lattice and lattice systems, Bragg’s plane, miller indices, point groups and space groups <b>Principle of diffraction and X-ray diffraction:</b> X-rays production, X- ray spectra, Bragg’s law and intensity of X- rays, Mosley’s law, powdered XRD, percentage crystallinity, single crystal XRD, macromolecular XRD (protein crystallization, data collection and structure solution).	5	3	0
4.	<b>Chromatography:</b> Classification of chromatographic techniques and their principles, Theory of chromatography, band broadening, rate and plate theory factors responsible for separation. Column chromatography, TLC, Paper chromatography. <b>Liquid Chromatography and HPLC:</b> Instrumentation, pumps, solvent delivery system, isocratic and gradient programming modes, sample introduction system, columns, detectors, reversed phase and normal phase chromatography. <b>Gas Chromatography:</b> Instrumentation, carrier gas supply, injectors, columns,	6	1	0

	packed and capillary columns, column oven and temperature programming, different detectors. Introduction to hyphenated techniques in chromatography, GC-MS and LC-MS.			
5.	<b>Electrophoretic Techniques:</b> Principle, equipment and process, Agarose gel electrophoresis, horizontal and vertical gel electrophoresis, electrophoresis techniques, Isoelectric focusing, capillary electrophoresis and application of electrophoresis in analysing macromolecules.	7	0	0
	<b>Total</b>	<b>32</b>	<b>10</b>	<b>0</b>
<b>Evaluation criteria:</b>				
1. 2 minor tests : 30% each 2. 1 major test (end semester) : 40%				
<b>Learning outcomes:</b>				
1. To be able to use selected analytical techniques. 2. Familiarity with working principals, tools and techniques of analytical techniques. 3. To understand the strengths, limitations and creative use of techniques for problem-solving.				
<b>Pedagogical Approach:</b>				
Classroom lectures, tutorials, and demonstration of analytical techniques. Case studies based on peer reviewed research articles.				
<b>Skill Set:</b>				
1. Able to select analytical technique for case study. 2. Able to design experiments and understand the instrumentation.				
<b>Employability:</b>				
1. Academic and industrial research organization. 2. Industries based on biotechnology, pharmacy, agriculture, and chemical.				
<b>Materials:</b>				
<b>Suggested readings:</b>				
1. I. D. Campbell, <i>Biological spectroscopy</i> (Benjamin/Cummings Pub. Co, Menlo Park, Calif, 1984), <i>Biophysical techniques series</i> . 2. K. Wilson, J. M. Walker, Eds., <i>Principles and techniques of biochemistry and molecular biology</i> (Cambridge University Press, Cambridge, UK : New York, 7th ed., 2009). 3. R. F. Boyer, <i>Biochemistry laboratory: modern theory and techniques</i> (Prentice Hall, Boston, 2nd ed., 2012). 4. R. Katoch, <i>Analytical techniques in biochemistry and molecular biology</i> (Springer, New York, 2011). 5. D. L. Spector, R. D. Goldman, Eds., <i>Basic methods in microscopy: protocols and concepts from cells: a laboratory manual</i> (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y, 2006). 6. R. L. Switzer, <i>Experimental biochemistry</i> (W. H. Freeman and Co, New York, 3rd ed., 1999). 7. R. F. Boyer, <i>Modern experimental biochemistry</i> (Benjamin Cummings, San Francisco, 3rd ed., 2000). 8. J. R. Lakowicz, <i>Principles of fluorescence spectroscopy</i> (Springer, New York, 2006; <a href="http://site.ebrary.com/id/10229235">http://site.ebrary.com/id/10229235</a> ). 9. B. Fultz, <i>Transmission electron microscopy and diffractometry of materials</i> (Springer, Berlin ; New York, 2nd ed., 2002). 10. D. B. Williams, C. B. Carter, <i>Transmission electron microscopy a textbook for materials science</i> (Springer, New York, 2009; <a href="http://dx.doi.org/10.1007/978-0-387-76501-3">http://dx.doi.org/10.1007/978-0-387-76501-3</a> ). 11. R. M. Silverstein, <i>Spectrometric identification of organic compounds</i> (John Wiley & Sons, Hoboken, NJ, 7th ed., 2005). 12. D. Harvey, <i>Modern analytical chemistry</i> (McGraw-Hill, Boston, 2000).				
<b>Additional information (if any):</b>				
Please keep in mind that this course, require hands on experience to strengthen the concepts; however, this course				

provides supplemental material in order to communicate this information.

**Student responsibilities:**

1. Class attendance.
2. Study of course materials as specified by the instructor.
3. Regular submission of given class assignments.

**Course reviewer:**

**1. Vishal Trivedi, Ph.D**

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**2. Dr. Bishwajit Kundu,**

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