Course title: Bioanalytical Techniques			
Course code: BBP 111	**No. of credits:** 3	**L-T-P:** 39-6-0	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Biotechnology			
Course coordinator: Dr. Shashi Bhushan Tripathi		**Course instructor :** Dr. Manish Rawat	
Contact details: shashi.tripathi@terisas.ac.in			
Course type: core		**Course offered in:** Semester 1	

Course description:

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.

Course objectives:

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.

Course contents

S.No	Topic	L	T	P
1.	**Spectroscopy study of chemical compounds and bio-molecules** **Electromagnetic radiations and interactions with matters:** Electromagnetic spectrum. Quantization 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. **Principals, instrumentation, sampling and application of few spectroscopic techniques:** UV-Visible spectroscopy, Fluorescence spectroscopy, IR/Raman spectroscopy, NMR Spectroscopy and Mass spectroscopy.	8	3	0
2.	**Microscopy:** 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.	**Diffraction Technique:** **Crystal geometry and structure**: Introduction to lattice and lattice systems, Bragg's plane, miller indices **Principle of diffraction and X-ray diffraction:** 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).	7	0	0

4.	**Chromatography:** 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. **Liquid Chromatography and HPLC**: Instrumentation, pumps, solvent delivery system, isocratic and gradient programming modes, sample introduction system, columns, detectors, reversed phase and normal phase chromatography. **Gas Chromatography**: Instrumentation, carrier gas supply, injectors, columns, packed and capillary columns, column oven and temperature programming, different detectors. Introduction to hyphenated techniques in chromatography, GC-MS and LC-MS.	7	1	0
5.	**Electrophoretic Techniques:** Principle, equipment and process, Agarose gel electrophoresis, horizontal and vertical gel electrophoresis, electrophoresis techniques, Isoelectric focusing, capillary electrophoresis and application of electrophoresis in analyzing macromolecules.	7	0	0
6.	**Automation**: Interdisciplinary association, Automation in analysis, sample collection, sample process, High Throughput Process, High throughput screening	3	0	0
	Total	**39**	**6**	**0**

Evaluation criteria:

1. Minor test 1 : 30%
2. Minor test 2 : 30%
3. Major test (end semester) : 30%
4. Assignment/Presentation : 10%

Learning outcomes:

1. Students will be able to use selected analytical techniques. (Minor test 1, Minor test 2 and Major test)
2. Students become familiar with working principals, tools and techniques of analytical techniques. (Minor test 1, Minor test 2 and Major test)
3. Students will understand the strengths, limitations and creative use of techniques for problem-solving. (Minor test 1, Minor test 2, Major test and Assignment/Presentation)

Pedagogical Approach:

Classroom lectures, tutorials, and demonstration of analytical techniques.
Case studies based on peer reviewed research articles.

Skill Set:

1. Able to select analytical technique for case study.
2. Able to design experiments and understand the instrumentation.

Employability:

1. Academic and industrial research organization.
2. Industries based on biotechnology, pharmacy, agriculture, and chemical.

Materials:

Suggested readings:

1. D. Campbell, *Biological spectroscopy* (Benjamin/Cummings Pub. Co, Menlo Park, Calif, 1984), *Biophysical techniques series*.
2. K. Wilson, J. M. Walker, Eds., *Principles and techniques of biochemistry and molecular biology* (Cambridge University Press, Cambridge, UK : New York, 7th ed., 2009).
3. R. F. Boyer, *Biochemistry laboratory: modern theory and techniques* (Prentice Hall, Boston, 2nd ed., 2012).
4. R. Katoch, *Analytical techniques in biochemistry and molecular biology* (Springer, New York, 2011).
5. D. L. Spector, R. D. Goldman, Eds., *Basic methods in microscopy: protocols and concepts from cells: a laboratory manual* (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y, 2006).
6. R. L. Switzer, *Experimental biochemistry* (W. H. Freeman and Co, New York, 3rd ed., 1999).
7. R. F. Boyer, *Modern experimental biochemistry* (Benjamin Cummings, San Francisco, 3rd ed., 2000).
8. J. R. Lakowicz, *Principles of fluorescence spectroscopy* (Springer, New York, 2006; http://site.ebrary.com/id/10229235).
9. B. Fultz, *Transmission electron microscopy and diffractometry of materials* (Springer, Berlin ; New York, 2nd ed., 2002).
10. D. B. Williams, C. B. Carter, *Transmission electron microscopy a textbook for materials science* (Springer, New York, 2009; http://dx.doi.org/10.1007/978-0-387-76501-3).
11. R. M. Silverstein, *Spectrometric identification of organic compounds* (John Wiley & Sons, Hoboken, NJ, 7th ed., 2005).
12. D. Harvey, *Modern analytical chemistry* (McGraw-Hill, Boston, 2000).

Additional information (if any):

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 reviewers:

1. Dr Narendra Tuteja, Visiting Scientist and Former Group Leader/Senior Scientist, PMB Group, International Centre for Genetic Engineering & Biotechnology, Aruna Asaf Ali Marg, New Delhi.
2. Dr. Anil K. Malik, Professor, Department of Physics, Ch. Charan Singh University, Meerut, India, Teachers' Fellow UGC, Govt. of India.