UTTARANCHAL UNIVERSITY

(Established vide Uttaranchal University Act, 2012)
(Uttarakhand Act No. 11 of 2013)
Arcadia Grant, P.O. Chandanwari, Premnagar, Dehradun, Uttarakhand

Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	DSE704 (i)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Bio- Analytical Techniques		

Objectives of the Course:

1. Identify the principle, instrumentation of different bioanalytical techniques.
2. Acquire skills to analyze and interpret data obtained in analytical studies of biomolecules.
3. Appraise widespread applications of analytical techniques in lifesciences.

UNIT ICHROMATOGRAPHIC TECHNIQUES (Total Topics- 12 and Hrs- 10)

Chromatography - Principle and application. Types of chromatography - Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper & Thin layer chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC (High Performance/Pressure Liquid chromatography).

UNIT IIELECTROPHORETIC TECHNIQUES (Total Topics- 8 and Hrs- 10)

Electrophoresis - General principle and application electrophoresis, Gel electrophoresis (Native, Denaturing & Reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, Isoelectrofocussing (IEF), Isotachophoresis

UNIT- III CENTRIFUGATION TECHNIQUES (Total Topics- 12 and Hrs- 10)

Centrifugation: Basic principles. Common centrifuges used in laboratory (clinical, high speed & ultra-centrifuges). Sedimentation rate, Sedimentation coefficient. Types of rotors. Types of centrifugation: Preparative, differential & density gradient.

UNIT-IV MICROSCPIC AND SPECTROSCOPIC METHODS (Total Topics-15 and Hrs-10)

Principle of Microscopy. Types of microscopy- Light, phase contrast, Fluorescence and Confocal microscopy, Scanning and Transmission Electron microscopy. Spectroscopic methods : principle and applications of UV-visible, IR, NMR, ESR. X-ray crystallography. Mass Spectrophotometry, MALDI-TOF, ESI (Electron spray ionization).

UNIT-VMOLECULAR TECHNIQUES (Total Topics- 10 and Hrs- 10)

Blotting techniques- Southern, Western and Northern; CRISPER Technology, RAPD, RFLP, AFLP, SSR markers. Gene sequencing methods.

Course Outcomes (COs)

1. Exhibit profound understanding of concept and principle of various bioanalytical techniques.
2. Demonstrate conceptual knowledge and technical skills pertaining to types and process of electrophoresis, chromatography, centrifugation, microscopic and spectroscopic techniques.
3. Acquire ability to identify, analyze and apply bioanalytical techniques to address problem related to environment, health & medicine and scientific research.
4. Inculcate scientific temperament to appraise recent technological development and their respective application.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	DSE704	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Research & Instrumentation Techniques		

Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

UNIT I (Total Topics-12 and Hrs-12)

UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromospheres and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR).Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

UNIT- II(Total Topics- 12 and Hrs-12)

NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange,Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimatric analysis; TGA, DTA & DSG , DSC : Principle instrumentation and applications.

UNIT-III (Total Topics- 12 and Hrs- 12)

Microscopic Techniques: Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques

UNIT-IV (Total Topics- 12 and Hrs-12)

Physical instrumentation techniques: Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.
CO-2: Apprcise UV visible&Spectroscopic techniques.
CO-3: Learn interpretation of data used in spectroscopy analysis.
CO-4: Learn principle and method of microscopic & thermogravimatric techniques for characterisation of material for research.

Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpeach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS