Programme Name	Ph.D.	Programme Code	
Course Code	DSE704	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Bio-Analytical & Microbial Techniques		

Objectives of the Course:

1. To provide scientific and computational knowledge related to various techniques associated with biotechnology.
2. To impart laboratory skills for handling analytical tools in industry and research institution.
3. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
4. To demonstrate the operating procedures associated with upstream and downstream process like chromatography, electrophoresis, centrifugation, etc.

UNIT I CHROMATOGRAPHY & CENTRIFUGATION ((Total Topics -10 and Hrs-10)

General principle and application chromatography, Gas chromatography, Paper chromatography, Thin layer chromatography, HPLC (High Performance/Pressure Liquid chromatography). Centrifugation: Principle and application. Common centrifuges used in laboratory Types of rotors (fixed angle, swing bucket), Types of Centrifugation: Preparative, differential & density gradient.

UNIT-II SPECTROSCOPY & MICROSCOPY (Total Topics -9 and Hrs-10)

Spectroscopic methods: principle and applications of UV-visible, FTIR. Principle & application of X-ray crystallography. Basic knowledge of the principles and applications of Microscopy: Light, phase contrast, Fluorescence and Transmission Electron microscopy

UNIT- III MICROBIOLOGICAL TECHNIQUES (Total Topics -8 and Hrs-10)

Media preparation (Selective and differential), Sterilization techniques, isolation and maintenance of bacterial and fungi cultures, staining techniques, biochemical characterization, antimicrobial assay along with determination of MIC.

UNIT-IV MOLECULAR TECHNIQUES (Total Topics -8 and Hrs-10)

Electrophoresis- General principle and application electrophoresis, Agarose gel electrophoresis, SDS- PAGE, Blotting techniques. Working & application of RT-PCR, Gel DOC.

Course Outcomes (COs):

CO1. Development of scientific, computational and analytical knowledge regarding principle and application of advanced analytical techniques in the field of biotechnology and microbiology.

CO2. Comprehension of microbial techniques and processes for isolation and screening of microbes isolated from different environment and sources.

CO3. Exhibit skills to pertaining to analytical characterization of biological samples.

CO4. Apply modern techniques and their statistical knowledge for solving various scientific problems in industry and research institution.

References Books :

1. *Sharma, V.K., Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991.*
2. *Alberts, B., Molecular Biology of the cell, Garland, 1989, 2nd edition.*
3. *Robyt, J.F. and White B.J., Biochemical Technique: Theory & Practical, Waveland Press, Inc.*
4. *Wilson, K. and Walker, J., Practical Biochemistry, University of Hertfordshire Cambridge University Press, 4th edition.*

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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

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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	Fundamentals of Environmental Chemistry		

Objectives of the Course:

1. To provide detailed understating of various aspects of air chemistry.
2. To acquire knowledge of various aspects of water Chemistry.
3. To appraise various aspects of soil chemistry.
4. To explain chemical constituent s present in the environment, interactions between them and manner in which changes are brought about due to pollution.

UNIT I (Total Topics-13 and Hrs-8)

Chemistry for Environment

Fundamental of environmental chemistry: Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change, thermodynamics, Electrochemistry and redox reactions, Gibbs' free energy; Chemical potential; chemical kinetics and chemical equilibrium. Sources of natural and artificial radiations. Applications and handling of isotopes and other radionuclides in environment.

UNIT II (Total Topics-09 and Hrs-8)

Air Chemistry

Atmospheric Chemistry: Chemical composition of atmosphere- atmospheric water and CO2; particles, ions and radicals in atmosphere, formation of particulate matter, Photo-chemical and chemical reactions in the atmosphere, thermal inversion, photochemical smog, acid rain, chemistry of ozone layer depletion; greenhouse gases and global warming.

UNIT- III (Total Topics-07 and Hrs-6)

Water Chemistry

Aquatic chemistry: Structure and properties of water, Water quality parameters, Physico- chemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonate system in water, redox reactions.

UNIT-IV (Total Topics-15 and Hrs-10)

Soil and Geochemistry

Soil Chemistry: Physio-chemical composition of soil, humus, Inorganic and organic components of soil, nutrients (NPK) in soil, And significance of C: N ratio, Cation exchange capacity (CEC), Reactions in soil solution. Environmental geochemistry: Concept of major, trace and REE. Classification of trace elements, Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, O3, PAN, MIC and other carcinogens

UNIT-V (Total Topics- 12 and Hrs-8)

Biologically Important Molecule

Chemistry of Biologically Important Molecules, Chemistry of Water, Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute.

CO-1: Develop concepts of basic chemistry associated with the occurrence of environmental pollutants.

CO-2: Understand various aspects of air and water chemistry so as to acquaint students with chemical constituents present in air and water, interactions among them and manner in which changes are brought about due to pollution.
CO-3: Describe the basic aspects of soil chemistry and environmental toxicants.
CO-4: Understand the latest technologies including green chemistry to reduce the impacts of pollutants in the environment.

Reference Books:

1. Baird, C. and Cann, M.).Environmental Chemistry, W.H. Freeman, USA.
2. Manahan, S. E. Fundamentals of Environmental Chemistry, CRC Press, USA.
3. Connell D.W.Basic concepts of Environmental Chemistry, CRC Press, USA.
4. Girard J. Principles of Environmental Chemistry, James &Barlett Publishers, USA.
5. Harrison RM. Principles of Environmental Chemistry, RSC Publishing, UK.
6. Lancaster M. GreenChemistry:An Introductory Text, RSC Publishing, UK.
7. Manahan, S.E.Green chemistry and the ten commandments of sustainability, Chem Char Inc. Publishers, USA.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	DSE704 (ii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Biofuels		

Objectives of the Course:

To assess the methods of Biofuel with basic concept for application in research.

UNIT I(Total Topics-7 and Hrs- 10)

Production of bioethanol

Raw materials and pretreatment processes. Enzymatic hydrolysis of cellulose and hemicelluloses. Fermentation of monosaccharides. Types of Reactor. Use of Bioethanol.

UNIT II(Total Topics-6and Hrs-10)

Production of biodiesel

The transesterification reaction Raw materials and pretreatment processes. Separation and purification stages Qualities of biodiesel.

UNIT- III (Total Topics- 7 and Hrs-10)

Biogas and Biohydrogen

Anaerobic digestion, Anaerobic digestion, Bioreactors for the production of biogas and scope. Production of biohydrogen by dark fermentation and photo-fermentation.

UNIT-IV (Total Topics- 8 and Hrs-10)

UV-VIS. Spectroscopy

UV-VIS. Spectroscopy - Electromagnetic spectrum, Basic Principle of Spectroscopy, Lambert Beer Law, Absorption and transmission, Energy Level Transitions In Spectroscopy, UV and Visible Spectroscopy and its Instrumentation.

UNIT-V (Total Topics- 5 and Hrs-10)

Unit- Infra-red Spectroscopy

Principles of Infra-red and Near Infra-red (NIR) Spectroscopy. Fundamental modes of vibration, Instrumentation and simple Applications**.**

CO-1: Learn production of biogas, biohydrogen, biodiesel and bioethanol.
CO-2: Knowledge of pre-treatment,transesterification, anaerobic digestion and other processes will be given.
CO-3: Inculcate knowledge about UV-Vis and Infrared Spectroscopy.

Reference Books:-

1. Bioenergy and Biofuel from Biowastes and Biomass, ACEBooks,Edited by Samir K. Khanal; ISBN

(print): 978-0-7844-1089-9ISBN (PDF): 978-0-7844-7330-6,2010.

2. Handbook of Biofuels Production, Elsevier,2010.
3. Green Nanotechnology for Biofuel Production,Book, Editor-Pramod W. Ramteke, Himanshu Pandey, Neha Srivastava, Manish Srivastava, P. K. Mishra 2018.