



जे. बोस विज्ञान एवं प्रौद्योगिकी विश्वविद्यालय, वाए.एम.सी.ए, फरीदाबाद

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA

SECTOR -6, MATHURA ROAD, FARIDABAD, HARYANA-121006

(Established vide Haryana State Legislative Act No. 21 of 2009)

'A+' GRADE NAAC Accredited

DEPARTMENT OF ENVIRONMENTAL SCIENCES

LESSON PLAN

Name of the Faculty: Dr. Somvir Bajaj
Discipline & Semester: M.Sc. (Environmental Sciences)
Subject: Instrumentation Techniques for Environmental Analysis
Lesson plan duration: 15 weeks

Department: Environmental Sciences
Semester/Year: I / I
Subject Code: ESP-105-V
Academic Year: 2025-26

Topic No.	Topic to be covered	Teaching Aids	No. of Lect/ Hrs Required	Text/ Ref. Books	CO Mapping
UNIT-1: BASICS OF ANALYTICAL APPROACH					
1	Defining of Problem	BB & PPT	1	R2	C01
2	Designing of Analytical Method	BB & PPT	1	R2	C01
3	Sampling: Types and Methods for Solid, Liquid and Gaseous Matrix	BB, PPT	3	R2, R3	C02
4	Sample Storage	PPT, Case Study	2	R2	C02
5	Sample Preparation	PPT, Case Study	1	R2	C02
6	Measurement and Assessing of Data	PPT, Case Study	1	R2	C02
7	Method Validation and Documentation	BB& PPT	2	R3	C01
8	Titrimetry	BB& PPT	2	R2	C02
9	Gravimetry	BB & PPT	1	R3	C01
UNIT-2: SPECTROMETRIC TECHNIQUES					
10	UV- Visible spectrophotometer	PPT, Demo	3	R4, R5	C03
11	Flame photometry	BB& PPT	2	R4, R6	C03
12	Atomic absorption spectrophotometry	BB& PPT	2	R4, R6	C03
13	Plasma Emission Spectroscopy	BB& PPT	2	R4	C03
14	X-Ray Diffraction (XRD)	BB& PPT	3	R4, R5	C03
15	X-Ray Fluorescence (XRF)	BB& PPT	3	R4, R5	C03
16	Fourier-transform Infrared Spectroscopy (FTIR)	BB& PPT	2	R5	C03
17	Nephelometry and Turbidimetry	BB& PPT	2	R5	C03
UNIT-3: CHROMATOGRAPHIC TECHNIQUES					
18	Paper Chromatography	BB& PPT	2	R2	C03
19	Thin Layer Chromatography	BB& PPT	2	R2	C03
20	Gas Liquid Chromatography	BB& PPT	4	R4	C03
21	High Performance Liquid Chromatography (HPLC)	BB& PPT	3	R4, R5	C03
22	Ion-exchange Chromatography (IEC)	BB& PPT	2	R4, R5	C03
23	Electrophoresis	BB& PPT	2	R4	C04
UNIT-4: MICROSCOPY TECHNIQUES					
24	Microscopic Techniques: Brightfield Microscopy	BB& PPT	1	R4	C03
25	Darkfield Microscopy	BB& PPT	1	R4	C03
26	Phase Contrast Microscopy	BB& PPT	2	R4	C03
27	Fluorescence Microscopy	BB& PPT	2	R4	C04
28	Confocal Microscopy	BB& PPT	2	R4	C04
29	Scanning Electron Microscopy (SEM)	BB& PPT	2	R4	C03
30	Transmission Electron Microscopy (TEM)	BB& PPT	2	R4	C03

Total Hours / Lectures

60

Mode of Teaching:

Blackboard (BB), PowerPoint Presentations (PPT), Discussion, Case Studies, E-tutoring, Online Resources, Demonstrations, and Field-based Illustrations.

LMS/ICT Tools:

Digital Classrooms, DLMS, ZOOM, G-Suite, MS PowerPoint, SWAYAM, YouTube Academic Channels, and Online Resources (IUCN, MoEFCC, CBD, ENVIS).

Prepared by:

Dr. Somvir Bajar
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Department of Environmental Sciences

Approved by:

Chairperson
Department of Environmental Sciences

M.Sc. ENVIRONMENTAL SCIENCES - SEMESTER I

Course Name: - Instrumental Techniques for
Environmental Analysis

Course Code: - ESP-105-V

Type of Course: - Theory

Maximum Credits: - 4

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SESSIONAL	:	25
FINAL EXAM	:	75
TOTAL	:	100

NOTE: Question paper will have two parts. Part-1 will be compulsory and have 10 questions of equal marks covering the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVE:

The objective of this course is to develop an understanding of fundamental principles of analytical techniques used in environmental sciences. It aims to familiarize students with sample collection, storage, and preparation methods, while training them in spectrometric, chromatographic, and microscopic techniques for environmental analysis. Additionally, the course enables students to interpret results obtained from different instrumental methods for accurate environmental assessment.

UNIT I: BASICS OF ANALYTICAL APPROACH

Analytical Approach: Defining of Problem and Designing of Analytical Method; Sampling: Types and Methods for Solid, Liquid and Gaseous Matrix; Sample Storage; Sample Preparation; Measurement and Assessing of Data; Method Validation and Documentation.

Wet Chemical Methods: Titrimetry; Gravimetry

UNIT-II: SPECTROMETRIC ANALYTICAL TECHNIQUES

UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier-transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry

UNIT-III: CHROMATOGRAPHIC TECHNIQUES

Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography); Electrophoresis

UNIT IV: MICROSCOPY TECHNIQUES

Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy (Scanning and Transmission Electron Microscopy)

COURSE OUTCOMES:

At the completion of this course, the learner will be able to:

- CO1: Understand the selection of suitable techniques for analyzing environmental samples.
- CO2: Demonstrate proficiency in sampling methods and characterization of pollutants.
- CO3: Explain the principles, working, and applications of various instrumental techniques.
- CO4: Differentiate between analytical methods and design appropriate techniques for environmental analysis.

REFERENCE BOOKS:

1. Hussain, C. M., & Kecili, R. (2019). *Modern Environmental Analysis Techniques for Pollutants*. Elsevier.
2. Khopkar, S.M. (2015). *Basic Concepts of Analytical Chemistry*. Wiley Eastern Ltd., New Delhi.
3. Mitra, S., & Kebbekus, B. B. (2018). *Environmental Chemical Analysis*. CRC Press.
4. Robinson, J. W., Frame, E. M. S., & Frame, G. M. (2014). *Undergraduate Instrumental Analysis*. CRC Press, New York
5. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of Instrumental Analysis*. Cengage learning.
6. Willard, H.H., Merritt, L.L, Deen, J.A. and Settle, F.A. (2015). *Instrumental Methods of Analysis*. CBS Publishers and Distributors, New Dehi.
7. Patnaik, P. (2017). *Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes*. CRC Press.

SUGGESTED WEB SOURCES:

1. http://envis.nic.in/ENVIS_html/ENVISSubject/subject.html
2. <https://nptel.ac.in/courses/103/106/103106162/>
3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>
4. <https://swayam.gov.in/>

MODE OF TRANSACTION:

Lecture, Demonstration, PowerPoint presentation, E-tutoring, Discussion, Assignments, Case study

LMS/ICT TOOLS: Digital Classrooms, DLMS, ZOOM, G-Suite, MS Power-Point, Online Resources