NIRMA UNIVERSITY
School of Engineering, Institute of Technology
Chemical Engineering Department
Open Elective Course

Course Policy

B.Tech. Semester - V &VI **Academic Year: 2022-23**

Course Code & Name	:	2CHOE01, Chemical Analytical Techniques
Credit Details	:	Lectures-3, Tutorial-0, Practicals-0 **Credits-3**
Course Coordinator	:	Dr. Amita Chaudhary
Contact No. & Email	:	079-716529134 Email ID: amita.chaudhary@nirmauni.ac.in
Office	:	A 108
Course Faculty	:	1. **Dr. Amita Chaudhary** Visiting Hours: Monday – 1.30 p.m. to 02.00 p.m. Odd Saturdays: 02:00 p.m. to 04:00 p.m. 2. **Dr. Neha Patni** Visiting Hours: Monday – 1.30 p.m. to 02.00 p.m. Odd Saturdays: 02:00 p.m. to 04:00 p.m. NOTE: Queries by Emails are encouraged
Course Site	:	Course: Chemical Analytical Techniques (nirmauni.ac.in)

1. Introduction to the Course

Analysis of materials is essential to the systematic development of new materials and understanding how they behave in practical applications. This course focuses on the principal methods required to analyze a broad range of engineering materials such as metal, alloys, semiconductors, insulators, polymers, ceramics, nanostructures etc. for their applications based on mechanical, electrical, optical, magnetic, thermal properties of materials. This course provides the basic fundamental of analytical techniques to all engineering branch students.

1.1 Objective of the Course

The aim of this course is to provide introductory understanding of important techniques in terms of the instrumentation, working principles, and information obtained and possible analysis of the engineering materials.

1.2 Prerequisite

Basic knowledge in chemistry, physics and mathematics are required. Students are expected to review their fundamentals before coming to class.

2. Course Outcomes (CO)

COs are clear statements of the expectations for student achievements in the course.

At the end of the course, student will be able to-

1. relate the essential theory and principle of analytical techniques in various streams of engineering
2. identify the importance of specific analytical technique for any application
3. select and apply the appropriate analytical method to evaluate a sample
4. interpret the qualitative and quantitative results of analysis

3. Syllabus

Syllabus:		Teaching Hours
Unit I	**Overview of Analytical Techniques** Introduction to various analytical methods, precision and accuracy, standard solutions, types of errors involved in analysis of engineering materials	**04**
Unit II	**Ultraviolet spectroscopy** Origin and theory of ultraviolet spectra, types of transition of organic and inorganic molecules, Chromophore, bathochromic shift, hypochromic shift, Woodward-Fisher rules for calculating λmax	**12**
Unit III	**Infrared spectroscopy** Electromagnetic spectrum, modes of molecular vibration, theory and interpretation of IR spectra	**12**
Unit IV	**Physico-Chemical Analysis** Thermo gravimetric analysis, differential scanning colorimetry, X-ray diffraction, energy dispersive X-Ray	**14**
Unit V	**Applications of Analytical Techniques** Applications of various advance techniques in various domains	**03**

3.1. Self-Study

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

3.2. References

1. Chatwal, Anand, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House.
2. Hobart H. Willard, Lynne L. Merritt Jr., John A. Dean, *Instrumental Methods of Analysis*, CBS Publishers.
3. Douglas A. Skoog, Donald M. West, *Fundamentals of Analytical Chemistry*, Cengage Learning.
4. William Kemp, *Qualitative Organic Analysis: Spectrochemical Techniques,* European chemistry series, McGraw-Hill.
5. M. Khopker, *Basic Concepts of Analytical Chemistry*, New Academic Science
6. Seamus P.J. Higson (2006). *Analytical Chemistry*.

4. Assignment

Assignment at the end of the course will be in the form of quiz/assignment. Details will be covered by the concerned faculty. Submission and Assessment duration shall be discussed by the faculty in lecture sessions.

5. Assessment Policy

5.1 Component wise Continuous Evaluation (CE) and Semester End Examination (SEE) weightage

Assessment scheme	**CE**			**SEE**
Component weightage	0.6			0.4
	Class test 35% (35 marks)	Sessional 35% (35 marks)	Term Assignment 30% (30 marks)	100 marks

5.2 Assessment Policy for Continuous Evaluation (CE)

Assessment of Continuous Evaluation comprises three components.

1. Two quizzes will be conducted as per academic calendar. It will be conducted online/ offline.
2. There will be an Term Assignment of 30 marks at the end of the course in the form of quiz/assignment. Details will be shared by the faculty during the lectures.

5.3 Assessment Policy for Laboratory and Project Work (LPW)

NA

5.4 Assessment Policy for Semester End Examination (SEE)

A written examination of 3 hour duration will be conducted for the course as per academic calendar. It will carry 100 marks and marks obtained out of 100 will be converted as per weightage assigned. However, it is subjected to the current conditions and guidelines provided by the University.

6. Lesson Plan

Session No.	Topics	Mapped CO
1.	Overview of the course, Discussion on Course Policy, Course Website .	
	Overview of Analytical Techniques	
2.	Introduction to Analytical Chemistry Applications of Analytical Chemistry used in different fields	1
3.	Steps in a Chemical Analysis, Classifying Analytical Techniques: Classical and Instrumental, Basic tools and operations in Analytical Techniques	1,2
4.	Preparing solutions- Stock solutions, dilutions, and standard solutions: primary and secondary	1,2,4
	Ultraviolet spectroscopy	
5.	Electromagnetic radiation, Units, Electromagnetic Spectrum	1
6.	Introduction to Ultraviolet Spectroscopy.	1,2,
7.	Absorption Laws; Lambert Beer's law	3,4
8.	Instrumentation	1,2
9.	Types of electronic transitions	2,3
10.	Chromophore and auxochrome concept	2,3,4
11.	Absorption and Intensity shifts	1
12.	Solvent effects	1,3,4
13.	Conjugated dienes	1,3
14.	Woodward Fieser rules for calculating absorption maximum	1,3
15.	Numericals for calculating absorption maximum	3,4
16.	Applications of UV spectroscopy	1,2
	Infra-red spectroscopy	
17.	Introduction and Principle of IR Spectroscopy	1

18.	Molecular VIbrations and vibrational frequency	1,2
19.	Number of Fundamental vibrations	2,4
20.	Selection Rules (Active and Forbidden Vibrations)	4
21.	Instrumentation and Sampling Techniques	2,3
22.	Fingerprint Region	1,2
23.	Spectral features of some classes of Organic Compounds	1,2
24.	Alkanes, Alkenes, and Alkynes	1,2,4
25.	Halogens and Amines	1,2,4
26.	Aromatic Hydrocarbons and Carbonyl Compounds	1,2,4
27.	Important Features in Infra-red Spectroscopy	3
28.	Applications of Infra-red Spectroscopy	3
	Physico-Chemical Analysis	
29.	Introduction to Thermal Analysis techniques: Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo-gravimetric analysis (TGA)	1
30-36.	Working principle, applications and importance of thermal characterization techniques-DTA, DSC and TG analysis	1,2,4
36-40.	Structure analysis tools: X-ray diffraction, Bragg's law, basic powder diffraction, generation of X-rays, characteristic X-ray spectrum, Moseley's law.	1,3,4
41-42.	EDX: Principles and applications	1,4
	Applications of Analytical Techniques	
43.	Brief overview of different types of analytical techniques	1,2
44.	Applications of spectroscopy, Application of physico-chemical analysis	2,3
45.	Summarize the course and relate the linkages with other course/s and applications in different fields of engineering	2,3,4

7. Mapping of Session Learning Outcomes (SLO) with Course Outcomes (CO)

Session No.	Session Learning Outcomes: After successful completion of the session, student will be able to	CO
1.	understand the importance, scope and policy of the course	
2.	Understand the Applications of Analytical Chemistry used in different fields	1
3.	explore different Analytical Techniques in the characterization of different sample	1,3
4.	prepare solutions- Stock solutions, dilutions, and standard solutions: primary and secondary	3,4
5.	know the electromagnetic radiation, its Units and electromagnetic Spectrum	1
6.	understand the basic introduction of Ultraviolet Spectroscopy.	1,2,
7.	find out the principle of absorption Laws specifically Lambert Beer law	3,4
8.	draw the instrument used for UV spectroscopy	1,2
9.	learn the types of electronic transitions	2,3
10.	outline the concept of Chromophore and Auxochrome	2,3,4
11.	make a list of absorption and types of intensity shifts	1,2
12.	understand the effect of solvent on intensity	1,3,4
13.	know about the conjugated dienes	1,3
14.	outline the Woodward Fisher rule for calculating absorption maximum	1,3
15.	calculate and analyze the absorption maximum for a compound	3,4
16.	summarize the applications of UV spectroscopy	1,2
	Infra-red Spectroscopy	
17.	Understand the purpose of Infra-red Spectroscopy and its Principle	1
18.	Identify the Molecular Vibrations and calculate the vibrational frequency of a molecule	1,2
19.	calculate the number of Fundamental vibrations	2,4
20.	Apply the selection rules (Active and Forbidden Vibrations) to the different compounds	4
21.	understand the Instrumentation and Sampling Techniques	2,3
22.	identify the Fingerprint Region of certain molecules	1,2
23.	analyse the Spectral features of some classes of Organic Compounds	1,2
24.	identify Alkanes, Alkenes, and Alkynes	1,2,4
25.	evaluate the structure containing Halogens and Amines	1,2,4

26.	identify Aromatic Hydrocarbons and Carbonyl Compounds	1,2,4
27.	explain the important features in Infra-red Spectroscopy	3
28.	relate the different applications of Infra-red Spectroscopy	3
	Physico-Chemical Analysis	
29.	introduce thermal analysis techniques	1
30-36.	identify the working principle, applications and importance of thermal characterization techniques-DTA, DSC and TG analysis	1,2,4
36-40.	apply the structure analysis tools in various applications	1,3,4
41-42.	outline and interpret the principles and applications of EDX	1,4
	Applications of Analytical Techniques	
43.	provide a brief overview of different types of analytical techniques	1,2
44.	make a list of important applications of spectroscopy and physico-chemical analysis	2,3
45.	summarize the course and relate the linkages with other course/s and applications in different fields of engineering	2,3,4

8. Teaching-learning methodology

Lectures: Till the conditions are not controlled, the lectures would be delivered online using Cisco Webex Meeting. Later on, we will switch to chalk and black board. However, where required, PowerPoint Presentations (PPTs), Video lectures, Simulations/Animations, Flipped classroom will be used to enhance the teaching-learning process.

9. Active learning techniques

Active learning is a method of learning in which students are actively participating in the learning process. Following active learning techniques will be adopted for the course.

Flipped classroom - Students will be given a topic to study on their own and discuss in the classroom.

One Sentence Summary- Students have to summarize the entire session in one sentence.

10. Course Material

Course Site URL: https://lms.nirmauni.ac.in/course/view.php?id=410

The following course material would be uploaded on the course site as per the requirement:

- Course Policy

- Lecture Notes
- Books / Reference Books / NPTEL video lectures
- Assignments, Tutorials, Lab Manuals
- Question bank
- Web-links, Blogs, Video Lectures, Journals
- Animations /Simulations, Softwares
- Advanced topics

11. Course Outcome Attainment

Following means will be used to assess attainment of course outcomes.

- Use of formal evaluation components of continuous evaluation, tutorials, laboratory work, semester end examination
- Informal feedback during course conduction

12. Academic Integrity Statement

Students are expected to carry out assigned work under Continuous Evaluation (CE) component. Copying in any form is not acceptable and will invite strict disciplinary action. Evaluation of corresponding components will be affected proportionately in such cases. Turnitin software will be used to check plagiarism wherever applicable. Academic integrity is expected from students in all components of course assessment.