

Course-Plan

School: Science and Technology

Department: Environmental Science

Course Code: ES-529

Course Name: Principles of Instrumental Methods and Analysis

Instructor: Prof. K.P.Sarma

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1. Abstract:

It gives details an overview of nature of electromagnetic radiation and molecular spectroscopy. This course provides a foundational understanding of the basic principles of UV-Visible, IR, NMR, XRD, ion-selective electrode and a comprehensive knowledge of voltage, current, resistance. Theoretical principle and application of UV visible, IR, NMR, XRD , pH, and conductivity ion selective electrode becomes a kind of beneficial tool for analyzing environmental samples.

2. Objectives:

1. To develop an understanding of the range and theories of instrumental methods available in analytical chemistry
2. To provide practical experience in selected instrumental methods for analysis of environmental samples

3. Prerequisites of the course:

Knowledge of introductory analytical chemistry like pH redox potential, electronic spectroscopy etc.

4. Course outline+ suggested reading:

Introduction, nature of electromagnetic radiation and electromagnetic spectrum, Types of molecular energies , types of molecular spectroscopy, Beer-Lambert's law, theory of electronic spectroscopy, Types of electronic transition , auxochrome , absorption and intensity shifts, Types of absorption bands, factor affecting the UV-band, characteristic absorption of organic compounds , instrumentation, Double beam UV-Visible spectrophotometer, Principles of chromatography, Classifications, Column Chromatography, Ion exchange , gas chromatography,HPLC,electrophoresis IR region, theory – molecular vibrations, fundamental vibrations, Frequency of vibrations of a diatomic molecule, frequency of shifts, factors influencing vibrational frequency, Interpretation of IR , instrumentation double beam IR, different components and its function, Nuclear spin , phenomenon of resonance Chemical shifts, shielding and deshielding, Instrumentation of NMR, X-Ray , Bragg's law Instrumentation of X-Ray Diffractometer, Current , voltage , power , electrometric methods Redox potential , pH meter , principle of glass electrode , hydrogen electrode Principle of Flame photometer, AAS, ICP-OES, Types of Ion-selective membrane Conductivity Bridges, principle of construction, measurement of conductance

Textbooks:

1. Gary D. Christian, *Analytical Chemistry*, (John Wiley & Sons , Inc.,2004)
2. W. Kemp, *Organic Spectroscopy*, ELBS Macmillan,2000

3. S.Morris, *Measurement and Instrumental Principles*, Prentice Hall of India, New Delhi, 2000
4. D.A.Skoog, F.J.Holler and S.R.Crouch, *Principles of Instrumental Analysis*, 8th Edition, Thomson, 2008

Reference Books:

1. B.K.Sharma, *Industrial Methods of Chemical Analysis*, Krishna Prakashan, Meerut, 2001
2. F.W.Fifield (edtr), *Environmental Analytical Chemistry*, Blackwell, 1999
3. Vogel, *Textbook of Quantitative Chemical Analysis*, Wiley, 1999

5. (a) Time-Plan for the course

Lecture No.	Topics
1	Overview of the course
2	Nature of electromagnetic radiation and electromagnetic spectrum
3	Types of molecular energies , types of molecular spectroscopy
4	Beer-Lambert's law, theory of electronic spectroscopy
5-7	Types of electronic transition , auxochrome , absorption and intensity shifts, Types of absorption bands, factor affecting the UV-band, characteristic absorption of organic compounds , instrumentation, Double beam UV-Visible spectrophotometer
8	Principles of chromatography, Classifications, Column Chromatography
9-10	Ion exchange , gas chromatography, HPLC, electrophoresis
11	IR region, theory – molecular vibrations, fundamental vibrations
12-13	Frequency of vibrations of a diatomic molecule, frequency of shifts, factors influencing vibrational frequency
14	Unit test
15-16	Interpretation of IR , instrumentation double beam IR, different components and its function
17	Nuclear spin , phenomenon of resonance
18	Chemical shifts, shielding and deshielding
19	Instrumentation of NMR
20	X-Ray , Bragg's law
21	Instrumentation of X-Ray Diffractometer
	Mid-term test
22-23	Current , voltage , power , electrometric methods
24-25	Redox potential , pH meter , principle of glass electrode , hydrogen electrode
26-27	Principle of Flame photometer, AAS, ICP-OES
28-29	Types of Ion-selective membrane Conductivity Bridges , principle of construction , measurement of conductance
30	General discussion
31	Unit Test
	End-term test

(b) Evaluation plan

Performance of the student is evaluated on the basis of the following continuous assessment

Mid-term: 40 Marks

Practicals: 100 marks

End term: 60 marks

Term paper/ unit test: 25 marks

Total: 250 marks

6. Pedagogy:

Lecture method, Group discussion, Group presentation, assignment, etc.

7. Expected outcome: Towards the end of the course the student would be able to develop an understanding of the range and theories of instrumental methods and gain experience in selected instrumental methods for analysis of environmental samples