SEMESTER S5
ANALYTICAL INSTRUMENTATION

Course Code	**PEICT521**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To understand the theory and operational principles of various instrumental methods for qualitative and quantitative evaluation by different types of spectroscopy
2. To review of important methods in the analysis of industrial gases and also to impart fundamental knowledge on chromatography

SYLLABUS

KTU SPECIAL

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals and Spectroscopy** Fundamentals of analytical instruments: Elements of an analytical instrument: PC based analytical instruments. Fundamental laws of spectroscopy: electromagnetic spectrum, interaction of radiation with matter, laws of radiation: beer lambert law, deviation from beer lambert law. Absorption spectroscopy: Absorption instruments – Radiation sources-Optical filters-Monochromators- Detectors. Examples of Absorption spectroscopy.	7
2	**UV-Vis, IR and fluorescence spectroscopy** UV and Visible Spectroscopy: Colorimeters/ photometers: Single beam and double beam filter photometer – Spectro photometers: Single beam and double beam spectrophotometers. Infrared Spectrophotometers (NIR-Near IR): wave number, basic principle using diatomic harmonic structure, radiation sources, detectors. Fourier Transform Infrared Spectroscopy (FTIR). Raman spectroscopy: Raman Effect, basic principle, Raman	**8**

	spectrometer. Fluorescence spectroscopy: Principle of fluorescence – Measurement of fluorescence –Single beam and double beam filter fluorimeter- Ratio fluorimeter. Spectro fluorimeters.	
3	**Photometry, Atomic Absorption spectrometer, and ESR Spectrometer** Flame Photometry: Principle and constructional details of flame photometer- Emission system –Optical system – Detectors. **Atomic Absorption spectrometer**: basic block diagram, atomizers, nebulizers, plasma excitation sources, radiation sources **Electron Spin Resonance Spectrometers (ESR)**: Electron spin resonance, basic ESR spectrometer, microwave bridge, Klystrone, modulation, sample cavities. **Mass, NMR spectroscopy and Gas Analysers** Molecular Mass spectrometry: Principle of operation, Magnetic deflection mass spectrometers, Components of a mass spectrometer. **Proton Nuclear Magnetic Resonance spectroscopy (NMR)**: Nuclear spin, resonance condition, relaxation condition Industrial Gas analysers- pH meters- Conductivity meters - Dissolved oxygen meters-Sodium analyser	**12**
4	**Chromatography** Chromatography: Chroma to graphic process–Classification- Terms in chromatography Gas chromatography: Block diagram, Principle, Constructional details, Column details, GC detector, katharometer, flame ionization detector, flame photometric detector, photo ionization detector, electro capture detector, argon ionization detector. Liquid Chromatography: Types of liquid chromatography (adsorption chromatography, partition chromatography, gel permeation chromatography, ion-exchange chromatography High pressure Liquid Chromatography (HPLC): Principle, Constructional details.	**8**

KTU SPECIAL

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

KTU SPECIAL

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Discuss the basic knowledge about analytical instruments, its concepts, and its technique.	**K1**
CO2	Explain the principle and operation of UV-Visible, IR and fluorescence spectroscopic analysis	**K2**
CO3	Explain the basic principle and working of Photometry, Atomic Absorption, and ESR Spectrometer. Discuss on the Mass, NMR spectroscopy and different types of Gas Analysers.	**K2**
CO4	Explain the concept of different Chromatography techniques.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2	3											3
CO3	3											3
CO4	3											3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of Analytical Instruments	R.S. Khandpur	Tata McGraw-Hill	3rd edition, 2015
2	Principles of Instrumental Analysis	Skoog.D.A, Holler.F.J and Niemann.T.A.	Saunders	7th edition, 2017

KTU SPECIAL

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	X-ray Method	Wiston.C	John Wiley	1ST 1991
2	Instrumental Methods of Analysis	Ewing.G.W	McGraw-Hill	5th edition, 1985.
3	Instrumental Analysis	Mann.CK., Vickers.T.J, and Gullick.W.H	Harper and Row Publications	
4	Introduction to Instrumental Analysis	Robert.D. Braun	McGraw-Hill	1ST EDITION 1987
5	Handbook of Instrumental Techniques for Analytical Chemistry	Frank.A.Settle	Prentice Hall	1997
6	Instrument Methods of Analysis	Willard, Merritt Dean and Settle	East-west Press	7th edition, 1988
7	Analytical Instruments	S. Abirami& D. Vijayanandh	Anuradha Publications	

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/104/106/104106122/
2	https://archive.nptel.ac.in/courses/104/104/104104084/
3	https://archive.nptel.ac.in/courses/103/108/103108124/
4	https://www.youtube.com/watch?v=gaBXQW9rCDA

KTU SPECIAL

KTU SPECIAL

Downloaded from ktuspecial.in