Course code	Course name	L-T-P-Credits	Year of Introduction
AE402	ANALYTICAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the various graphical programming environment in virtual instrumentation.
- To study a few applications in virtual instrumentation.

Syllabus

Fundamentals of analytical instruments –Classification of instrumental techniques - Electromagnetic radiation- Electromagnetic spectrum- Absorption spectroscopy - Ultra violet and visible absorption spectroscopy - Colorimeters/ photometers - Spectro photometers - Infra red spectroscopy - Atomic absorption spectrophotometers - Fluorescence spectroscopy - Raman spectrometer - Mass spectrometer - Nuclear Magnetic Resonance spectroscopy - Electron spectroscopy - X- Ray spectrometers - Chromatographic process – Classification - Gas chromatography - Liquid Chromatography - High pressure Liquid Chromatography - Industrial Gas analysers - Gas analysers - Blood PH measurement – Thin film technology for gas sensors- Thermal Sensors.

Expected outcome

- At the end of the semester students will be able to obtain comprehensive knowledge in analytical instrumentation and some of its applications.

Text Books

1. Skoog, Holler, Nieman, "Principles of Instrumental Analysis", Thomson books-cole publications, 5th edition.
2. Willard, Merritt, Dean, Settle , "Instrumental Methods of Analysis", CBS Publishers & Distributors, New Delhi, Seventh edition.

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Reference Books

1. Galen W. Ewing, "Instrumental Methods of Chemical Analysis", , McGraw-Hill Book Company, Fifth edition.
2. R. S. Khandpur , "Handbook of Analytical Instruments", , Tata McGraw–Hill Publications, 3rd edition.
3. Robert D. Braun, "Introduction to Instrumental Analysis", , McGraw-Hill Book Company

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to Analytical Instrumentation: Fundamentals of analytical instruments: Elements of an analytical instrument – PC based analytical instruments –Classification of instrumental techniques. Electromagnetic radiation- Electromagnetic spectrum- Laws relating to absorption of radiation. Absorption spectroscopy: Absorption instruments – Radiation sources- Optical filters- Monochromators- Detectors. Ultra violet and visible absorption spectroscopy.	6	15%
II	Colorimeters/ photometers: Single beam and double beam filter photometer – Spectro photometers: Single beam and	7	15%

	double beam spectro photo meters- Infra red spectroscopy: Basic components- Radiation sources- Monochromators- Detectors. Flame Photometry: Principle and constructional details of flame photometer- Emission system – Optical system – Detectors. Atomic absorption spectrophotometers: Theoretical concepts, Instrumentation: Radiation sources - Burners and flames - Plasma excitation sources - Optical and electronic system.		
FIRST INTERNAL EXAMINATION			
III	Fluorescence spectroscopy: Principle of fluorescence – Measurement of fluorescence – Single beam and double beam filter fluorimeter- Ratio fluorimeter. Spectro fluorimeters. Raman spectrometer- Basic theory-Photo acoustic spectroscopy- Photo thermal spectroscopy. Mass spectrometer: Principle of operation- Magnetic deflection mass spectrometers- Components of a mass spectrometer – Inductively coupled plasma mass spectrometer.	7	15%
IV	Nuclear Magnetic Resonance spectroscopy: Basic principle – Constructional details of NMR spectrometer – Nuclear radiation detectors. Electron Spin Resonance spectrometer: Basic ESR spectrometer – Electron spectroscopy: Instrumentation for electron spectroscopy. X- Ray spectrometers: X – ray spectrum –Instrumentation for x –ray spectrometry. X-ray diffractometers- X-ray absorption meters- X- ray fluorescence spectrometry.	7	15%
SECOND INTERNAL EXAMINATION			
V	Chromatography: Chromatographic process – Classification- Terms in chromatography- Gas chromatography: Block diagram- Principle - Constructional details – Column details- GC detectors. Liquid Chromatography: Types of liquid chromatography- High pressure Liquid Chromatography (HPLC): Principle- Constructional details.	7	20%
VI	Industrial Gas analyzers- pH meters- Conductivity meters - Dissolved oxygen meters- Sodium analyser– Gas analysers- Paramagnetic oxygen analyser – CO analysers – Flue gas analysers- Blood PH measurement – Thin film technology for gas sensors- Basic concepts. Measurement techniques and application of gas sensors. Thermal Sensors:- Radiation Sensors, Mechanical Sensors and Bio-Chemical sensors.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)