ENVIRONMENTAL INSTRUMENTATION

Paper Code: ETEN-309	**L**	**T/P**	**C**
Paper: Environmental Instrumentation	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objective: In this course students will learn various types of instrumentation based techniques used in environmental sciences. The course will introduce students to the techniques of instrument calibration, deployment, and data acquisition. Students will also become familiar with Principles of continuous ambient air quality monitoring instruments.

UNIT – I

Environmental analysis: Accuracy, Precision, Types of errors, Minimization of error, Significant figures, Criteria for rejection of data. Signals and Data: Signal to Noise Ratio, Sensitivity and Detection limit, Evaluation of results.

Absorption and Emission Spectroscopy: Electromagnetic Spectrum, Atomic, Molecular and Vibrational energy Levels, Raman Effect, Lasers, Nuclear and Electron Spin behavior, X- ray energy levels.

[T1,T2][No. of Hours: 11]

UNIT – II

Ultraviolet and Visible Spectrometery:: Radiation sources, wavelength selection, sampling devices and detectors, Instruments for absorption photometry, Fundamental laws of photometry, photometric accuracy and precision.

Difference and derivative Spectroscopy, Photometric Titrations, Turbidimetry and Nephelometry.

Principle of Flame emission spectroscopy (FES) and Atomic Absorption Spectroscopy (AAS), Interferences associated with flames and furnaces, Comparison of FES and AAS.

Principles of Inductively Coupled Plasma (ICP) Atomic Fluorescence Spectroscopy, Comparison of ICP and AAS methods.

[T1,T2][No. of Hours: 11]

UNIT – III

Principles of NMR Spectroscopy, Elucidation of NMR Spectra.

Mass Spectroscopy (MS) : Ionization methods, Ion collection systems, Vacuum system, Isotope-ratio Spectrometry, Correlation of Mass spectra with molecular structure. Interfacing with ICP with MS.

Chromatographic Methods: Classification, Principle of Gas Chromatography, Gas chromatographic columns, liquid phases and column selection, detectors for GC, Gas-solid Chromatography, Interfacing GC with MS.

HPLC: Mobile phase Delivery System, Sample Introduction, Separation Columns, Detectors.

Ion Chromatography, Paper and Thin Layer Chromatography.

[T1,T2][No. of Hours: 11]

UNIT – IV

Automated analysis: Infrared Process Analyzers, Oxygen Analysers, Chemical Sensors, Continous online process control, Automatic Chemical Analyzers and Automatic Elemental Analysers

Continuous Monitoring Instruments and their principles: NDIR for CO, Chemiluminescent analyzer for NOx, Fluorescent analyzer for SO_2, Instruments for Hydrocarbons and ozone monitoring, Automated wet chemical analyzer for water quality.

[T1,T2][No. of Hours: 12]

Text Books :

[T1] Willard H.H., Meritt L.L., Dean J.A.,Settle F.A., “Instrumental Methods of Analysis”, CBS Publishers and Distributers (P) Ltd., New Delhi.

[T2] Sawyer C.N., McCarty P.L. and Parkin G.F., “Chemistry for Environmental Engineering and Science”, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Reference Books:

[R1] De A.K., “Environmental Chemistry ", New Age International (P) Ltd., New Delhi.

[R2] Sharma B.K.,”Analytical Chemistry”, Krishns Prakashan, Meerut.

[R3] Recsok R.L. and Shields L.D., “Modern Methods of Chemical Analysis”, Wiley India (P) Ltd.

[R4] Ewing G.W., “Instrumental Methods of Chemical Analysis”, Tata McGraw Hill