

M.Tech. Instrumentation and Electronics Engineering, Examination 2025
(1st Year, 2nd Semester)

Instrumental Analysis

Time: Three Hours

Full Marks: 100

[CO1]: Attempt any two questions from Q1, Q2 and Q3.

- Q1. Describe the working principle of a spectrophotometer. Explain the construction and operation of a typical double-beam UV-Visible spectrophotometer. 4+16
- Q2. Explain the fundamental principles of Raman spectroscopy. Illustrate a block diagram of a Raman spectrometer and describe the function of each component. Outline the major applications of Raman spectroscopy in scientific and industrial fields. 5+10+5
- Q3. Write brief notes on the following topics: 2 × 10
- a) X-ray diffraction (XRD)
 - b) Near-infrared (NIR) spectroscopy

[CO2]: Attempt any one question from Q4 and Q5.

- Q4. a) Define the following terms as related to gas chromatography:
i) Stationary phase
ii) Retention time
b) Illustrate and describe the main components of a gas chromatograph. 4+16
- Q5. a) Define high-performance liquid chromatography (HPLC) and list two of its major advantages over classical liquid chromatography.
b) Explain the steps involved in quantitative analysis using HPLC, including calibration and standard preparation. 5+15

[CO3]: Attempt any two questions from Q6, Q7 and Q8.

- Q6. a) What are the main components of a typical voltammetry instrument?
b) Differentiate between cyclic voltammetry and linear sweep voltammetry.
c) What is the role of the reference electrode in a voltammetric setup? Draw and explain the block diagram of a typical voltammetry instrument. 3+3+14
- Q7. a) Define potentiometry and state its basic principle.
b) Explain the principle, construction, and applications of glass electrodes. 6+14
- Q8. Give short descriptions of the following concepts: 2 × 10
- a) Field emission scanning electron microscopy (FESEM)
 - b) Energy-dispersive x-ray analysis (EDAX)