B.E. (Inst. & Electronics Engg.) 3rd Year 1st Semester Supple Examination 2024

Subject: Analytical Instrumentation

Time: Three Hours | Full Marks: 100

Group A
Answer any five questions

1. Explain briefly the different components of a Gas Chromatograph? 5
2. a) Describe the chromatographic inlet for coupling a gas chromatograph with a mass spectrometer. 2
   b) Calculate the resolution of a mass spectrometer required to resolve peaks for CH_2N (Mol. Wt. 28.0187) and N_2^+ (mol. Wt. 28.0061). 3
3. Explain the principle of operation of a quadrupole type mass analyzer? 5
4. Name one detector used in a gas chromatograph and explain the principle. 5
5. How is the efficiency of a chromatographic column expressed? Explain with plate theory. 5
6. What are the roles of stationery phase, mobile phase and support materials in a chromatographic column? 5

Group B
Answer any five questions

7. State the Beer Lambert's law and derive the relation between absorbance, cell width, concentration of the analyte and molar absorptivity in the context of absorption spectroscopy. 5

8. Why heat detectors are used instead of the photon detectors in the IR region. Name two detectors used in the IR region and discuss their principle of operation. 1+4

9. What are the differences between atomic absorption spectroscopy and atomic emission spectroscopy? Explain the function of a diode array detector. 3+2

10. Discuss the principle of operation of a flame atomizer used in atomic spectroscopy. 5
11. Discuss briefly the principle of operation of FTIR spectrometer. 5

12. For a dispersive type grating, how many lines per millimeter would be required in order for the first-order diffraction line at $\lambda = 625$ nm to be observed at a reflection angle of -45° when the angle of incidence is 45°?

Group C
Answer any five questions

13. Explain with a diagram the working principle of an electrochemical cell. 5

14. What is liquid junction potential and what is the function of a salt bridge? Mention the difference between activity and concentration. 1+2+2

15. Describe the commonly used reference electrodes used in electrochemical analysis. 4

16. Write down the Nernst equation and explain the different terms. Mention the features and differences between potentiometry, voltametry and amperometry. 2+3

17. Briefly explain the construction and working principle of a combination type pH meter. What is the composition of the glass in the glass electrode? 4+1

18. Mention one application where oxygen analysers are used. Briefly describe the zirconia oxygen analyser. 1+4

Group D
Answer any five questions

19. With a diagram, explain the principle of operation of capillary tube viscosity meter. 5

20. What is cell constant in a conductivity meter? Explain the working principle of an electrodeless conductivity meter. 1+4

21. Explain with a diagram the arrangement of a dual beam type turbidity meter. 5

22. How chemical shift data from NMR spectrometer is useful to the chemists for obtaining chemical structure of compounds? 5

23. What is relative humidity? Discuss a scheme of measurement of dew point. 1+4

24. Explain the principle of operation of a paramagnetic oxygen analyzer. 5