

No. of Printed Pages : 6

MCH-003

**POST GRADUATE DIPLOMA IN
ANALYTICAL CHEMISTRY (PGDAC)**

Term-End Examination

June, 2024

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 Hours

Maximum Marks : 75

Note : Answer any **five** questions out of **8** given. All questions carry equal marks.

Answer any **Five** of the following :

1. (a) Define non-radiative relaxation and radiative relaxation. 3
- (b) What are monochromators ? Name the two types of monochromators. 3
- (c) Write the structure of phenolphthalein. Is it fluorescent ? Explain 3
- (d) Name any **three** factors affecting applications of fluorimetry. 3

P.T.O.

[2]

MCH-003

- (e) Name the most preferred gas used as plasma gas. Write any **two** reasons for its preference. 3
- (f) Which compound is used as standard for chemical shifts in ¹H NMR spectroscopy ?
2. (a) Explain the terms reflection, refraction and diffraction with diagrammatic representation. 5
- (b) How charge transfer complex is formed ? Draw a schematic diagram showing MO of donor, acceptor and charge transfer complex species. 5
- (c) State Lambert Beer's law. 5(1+4)
Molar absorptivity of a compound is $5.0 \times 10^4 \text{ cm}^{-1} \text{ mol}^{-1} \text{ dm}^{-3}$. Calculate the transmittance in or cuvette of path length 1.0 cm containing $4.0 \times 10^{-6} \text{ mol dm}^{-3}$ solution of the compound.
3. (a) Name three regions of infrared radiations. What are the two types of infrared spectrometers. Write the advantages of one over the other. 5

[3]

MCH-003

- (b) Explain the theory of Raman spectroscopy with the help of schematic representation of energy changes. Calculate the wave number (in cm^{-1}) of wavelength 500 nm. 5
- (c) Draw a neat labelled Jablonski diagram showing the origin of phosphorescence and fluorescence. 5
4. (a) How is fluorescence in a molecule related with its structure ? Explain with suitable examples. Which one of pyridine and biphenyl be fluorescent ? 5
- (b) Name the essential components of an instrument used to measure fluorescence. Draw a schematic layout of a fluorimeter. 5
- (c) Briefly describe all the factors adversely affecting quantitative application of fluorimetry. 5
5. (a) Discuss fluorimetric determination of blood glucose with all the chemical equations. Can it be used for the determination of fructose or sucrose ? 5

[4]

- (b) In what respect molecular spectrum differs from that of atomic spectrum ? Explain three characteristics of molecular spectrum with suitable illustration. Which one of these characteristics is related with the concentration ? 5
- (c) Name any **one** fuel-oxidant mixture used in flame photometry. Write the approximate temperature obtained. Draw the structure of flame. 5
6. (a) Discuss the merits and the limitations of flame photometry methods. 5
- (b) Draw a schematic diagram of hollow cathode lamp (HCL) illustrating different components. In what respects electrodeless discharge lamp (EDL) is an improvement over HCL ?
- (c) Draw a typical calibration plot used in flame photometry. What happens at higher concentrations ? How these could be avoided by using low concentration range ?

[5]

MCH-003

7. (a) Name all the components of atomic absorption spectrophotometer (AAS). Draw a schematic diagram of AAS. Write any one fuel-oxidant combination commonly used in AAS. 5
- (b) Describe the three types of interferences in AAS explaining how these could be avoided. 5
- (c) Write the principle of atomic emission spectrometry (AES). Draw a schematic diagram of ICP torch showing all inlets. 5
8. (a) Define chemical shift. Why is it called so ? How are its units in δ and τ scales related ? 5
- (b) Define Index of Hydrogen Deficiency (IHD) calculate IHD of $C_4H_{10}O$ and predict if it contains unsaturation or ring structure. 3
- (c) An organic molecule having molecular formula C_3H_6O shows the following spectral characteristics : 7

P.T.O.

[6]

MCH-003

IR : Strong absorption band at 1700 cm^{-1}

NMR : Single peak at $\delta = 2.2$

Mass spectrum : At m/z 15, 43, 58.

Interpret the spectra and identify the compound.
