

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

Term-End Examination

June, 2026

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 Hours

Maximum Marks : 75

Note : (i) Attempt any **five** questions.

(ii) All the questions carry equal marks.

1. (a) Draw a generalized labelled molecular orbital energy level diagram and show possible transitions for organic compounds in the UV-VIS region. 5
- (b) State Lambert's law and derive its expression. 5

- (c) Describe double beam spectrometers (UV-Visible) with the help of a labelled diagram. 5
2. (a) Write any *five* advantages of FT – IR spectrometers. 5
- (b) List the qualitative applications of infra-red spectrometry and describe any *one*. 5
- (c) Write the necessary condition for observing an IR spectrum. Draw the different modes of vibration for CO₂ molecule. Which one of these will be IR active. 5
3. (a) State the rule of mutual exclusion. Explain with the help of a suitable example. 5
- (b) Draw a labelled schematic diagram for experimental set up of a dispersion Raman spectrometer. 5

- (c) Describe the coherent Anti-stokes Raman spectroscopy with the help of a suitable energy level diagram. 5
4. (a) Explain the Phenomena of fluorescence and phosphorescence using the Jablonski diagram. 5
- (b) Explain the principle of revolving can shutter system used for simultaneous measurement of fluorescence and phosphorescence. 5
- (c) List the factors which affect fluorescence and phosphorescence. Explain any *one* of these. 5
5. (a) Describe the processes which occur when a sample is sprayed into a flame. 5
- (b) Discuss the spectral interferences that affect the spectral intensity or resolution in flame photometry. 5
- (c) Write the limitations of flame photometry. 5

6. (a) Give a schematic diagram of an atomic absorption spectrophotometer. What are the functions of the monochromator in it ? 5
- (b) What is the principle of atomic absorption spectrophotometry. Explain the importance of calibration plot in it. 5
- (c) Write any *five* characteristics of an ideal atomization-excitation source to be used in atomic spectroscopy. 5
7. (a) Define nebulisation and list the different types of nebulisers used in ICP-AES. 5
- (b) Define chemical shift and explain the factors affecting it. 5
- (c) What makes TMS a molecule of choice as reference in NMR spectrometry ? 5
8. (a) Explain the McLafferty rearrangement with the help of a suitable example. 5

- (b) What is Plasma ? What makes argon a good choice for the plasma gas ? 5
- (c) The important spectral details of an organic molecule having molecular formula $C_5H_{10}O$ are as follows :

Mass : (prominent peaks at m/z 41, 43 (base peak) and 86(Mt)

IR : 2937 cm^{-1} (medium); 1718 cm^{-1} (strong); 1428 cm^{-1} (medium) and 1254 cm^{-1} (medium)

NMR : $\delta = 1.11$ (6H, *d*), $\delta = 2.14$ (3H, S) and $\delta = 2.58$ (1H, *m*)

Determine the structure of the organic molecule. 5

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