

**P. G. DIPLOMA IN ANALYTICAL
CHEMISTRY (PGDAC)**

Term-End Examination

December, 2025

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 Hours

Maximum Marks : 75

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

(ii) All questions carry equal marks.

1. Answer any *three* parts : 5×3=15
 - (a) Using an energy level diagram, explain the band spectrum of the molecules.
 - (b) Name the types of transitions involved in UV-Visible, Infrared, Microwave absorption, NMR and ESR spectroscopies.
 - (c) Enlist the types of detectors employed in UV-Visible spectrometry and explain any *one* type.

- (d) Draw a schematic diagram for a double beam UV-Visible spectrometer.
 - (e) Compute the number of normal modes of vibration for CO_2 and H_2O .
2. (a) What are the *two* important regions in infrared spectra of molecules ? Write their significance in structural elucidation of organic compounds. 5
- (b) Discuss the rule of mutual exclusion. 5
- (c) Describe briefly the applications of Raman spectroscopy. 5
3. (a) Explain Franck-Condon's principle and its implication in the Jablonski diagram. 5
- (b) Explain with the help of suitable examples the relationship between the structure and the fluorescence characteristic of molecules. 5
- (c) Discuss the analysis of aluminium using 8-hydroxy-quinoline by fluorescence method. 5
4. (a) Discuss the role of cyclodextrins in room temperature phosphorescence. 5

- (b) Explain atomic line width in flame photometry giving a schematic diagram. 5
- (c) Explain the quantitative applications of flame photometry. 5
5. (a) What are the types of interferences in quantitative determinations by flame photometry ? Describe briefly any *one* type. 5
- (b) List the types of atomic fluorescence transitions and briefly describe any *one* type. 5
- (c) What are the advantages and disadvantages of graphite furnace atomic absorption spectrophotometry ? 5
6. (a) Enlist *two* merits and *three* limitations of atomic absorption spectrophotometry. 5
- (b) What is the rationale behind the choice of argon as plasma gas ? 5
- (c) Give some important analytical applications of ICP-AES in industry. 5

7. (a) What is meant by FT-NMR ? How is it better than CW-NMR ? 5
- (b) Why is the analysis of geological sample done preferably by atomic emission spectrometry ? 5
- (c) Why is tetramethylsilane (TMS) a molecule of choice as a reference standard in NMR spectroscopy ? 5
8. (a) Draw the low and high resolution proton magnetic resonance spectra of ethanol. 5
- (b) Discuss the processing and output devices for mass spectrometry. 5
- (c) What is meant by IHD ? Compute the IHD parameter for the following : 5
- (i) $C_4H_{10}O$
- (ii) C_3H_6

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