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MCH-003

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

Term-End Examination

June, 2020

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 *five* of the following : 3 each

- (a) Electronic absorption spectrum for molecules are usually broad and called band spectrum ? Explain.

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- (b) State any *three* sources of infrared (IR) radiation.
- (c) Discuss the role of monochromators in spectrometers.
- (d) Explain the role of organic solvents in AAS.
- (e) What is the origin of isotopic peaks in mass spectrometry ?
- (f) Define quantum yield. Give the mathematical expression explaining all the terms.
2. (a) Draw a generalised molecular orbital energy level diagram and explain all the possible transitions for organic compounds with a suitable example.

- (b) Molar absorptivity of a substance is $3 \times 10^4 \text{ cm}^{-1} \text{ mol}^{-1} \text{ dm}^{-3}$. Calculate the absorbance of a solution containing $5 \times 10^{-6} \text{ mol dm}^{-3}$ of substance through a cuvette of path length 2.0 cm. 5
- (c) State the selection rules for vibrational spectroscopy. Draw an energy level diagram showing the transitions for fundamental vibration and overtones. 5
3. (a) Draw the vibrational modes of CO_2 molecule and comment on their IR and Raman activities. 5
- (b) Draw a suitably labelled schematic diagram of a double beam spectrophotometer. What are the detectors used in UV-Vis spectrophotometers. 5
- (c) Discuss the processes occurring when an analyte is put into a flame. 5

4. (a) Define and differentiate between atomic absorption (AAS) and atomic emission (AES) spectrometric methods. 5
- (b) What is meant by nebulisation ? Explain the principles of cross flow type nebuliser used in ICP-AES. 5
- (c) Explain the methodology of quantitative analysis in flame photometry using calibration plot. 5
5. (a) Describe various types of interferences in atomic fluorescence spectrometry with the help of suitable examples. 5
- (b) What is the requirement for a nucleus to show NMR spectrum ? Which of the following nuclei will show NMR ? 5

^{16}O , ^{13}C , ^{24}Mg , ^{19}F , ^{31}P , ^{32}S

- (c) What do you understand by relaxation mechanisms ? Explain its two types—spin-lattice and spin-spin relaxation. What happens to the line width by these processes ? 5
6. (a) Draw the structures of Morin or 8-hydroxy-quinoline. Explain, how these are used for the analysis of Al as water pollutant. 5
- (b) What is bioluminescence ? Explain with the help of a suitable example. 5
- (c) Discuss the theory of mass spectrum in terms of formation of molecular ion. Describe the characteristics of mass spectrum considering the example of CH_3OH . 5

7. (a) Describe the functioning of graphite furnace. Give any *two* advantages of GFAAS over flame AAS. 5
- (b) What are the two types of atomic absorption spectrometers ? Which one of these is better and why ? Draw a schematic sketch of any *one* of these. 5
- (c) Explain the basic principle of atomic emission spectrometry (AES) and discuss the choice of argon as a plasma gas. 5
8. (a) Define Index of Hydrogen Deficiency (IHD) and discuss its importance. Predict IHD of the following : 5
- (i) C_8H_6
- (ii) C_7H_8
- (iii) C_4H_4

- (b) Write short notes on the following : 5
- (i) Larmor precession
 - (ii) Pascal triangle
- (c) Explain the nature of NMR spectrum of ethanol in low resolution and high resolution. Why does it differ ? 5