

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

Term-End Examination

00714 December, 2015

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 hours

Maximum Marks : 75

Note : Answer *five* questions in all. Question no. 1 is *compulsory*.

1. Answer any *five* of the following : 5×3=15

- (a) Discuss the causes of deviations from Lambert-Beer's law.
- (b) Distinguish between radiative and non-radiative relaxations.
- (c) What is the prerequisite for a molecule to show IR spectrum ? Will the asymmetric stretching mode of H₂O be IR active ? Give reason for your answer.
- (d) Enlist the advantages of ICP-AES method.
- (e) In what way is FT-NMR better than CW-NMR ?
- (f) Discuss the applications of flame photometry.

2. (a) State the principle of atomic emission spectrometry based on induced couple plasma. What property of helium makes it a potential gas to be used in a plasma source ? 5
- (b) Discuss the role of fluorescence spectroscopy in medicine, using a specific example. 5
- (c) Calculate the concentration in $\mu\text{g/mL}$ of a solution of tryptophan (mol.wt. 204.2) in 0.1 M HCl giving an absorption at its $\lambda_{\text{max}} = 277 \text{ nm}$ of 0.613 in a 4 cm cell. The molar absorptivity at 277 nm is 5432. 5
3. (a) In what way is a double beam atomic absorption spectrometer better than a single beam spectrometer ? 5
- (b) Why is a sharp line source required in atomic absorption spectrophotometry ? 5
- (c) Describe the analysis of $\text{NO} - \text{NO}_2$ by chemiluminescence method. 5
4. Justify the validity of any **three** of the following statements : $3 \times 5 = 15$
- (a) The acetylene molecule shows a pronounced diamagnetic as well as paramagnetic anisotropic effect, however the diamagnetic anisotropic effect predominates causing shielding of acetylenic protons.

- (b) Monochromators of high resolution are found in ICP-AE spectrometers but not in flame AA spectrometers.
 - (c) The intensities of Raman lines depend on the frequency of the incident radiation.
 - (d) Atomic emission is more sensitive to flame instability than atomic absorption.
5. (a) Discuss the principle of graphite furnace atomic absorption spectrometry. What do you understand by heating cycle in GFAAS ? 5
- (b) Briefly discuss the interferences in atomic absorption spectrophotometry. 5
- (c) Discuss the principle of ultrasonic nebuliser. 5
6. (a) Why is atomic absorption spectrometry not an ideal method for the determination of alkali metals ? Which method would you recommend for the determination of these elements ? 5
- (b) In what way is direct-current plasma different from microwave induced plasma ? 5
- (c) What precautions should be observed while preparing samples for ICP-AES using acid digestion method ? 5

7. (a) Explain how spectral lines due to chemical shift may be differentiated from those due to spin-spin splitting. 5
- (b) Using a specific example, explain how the rate of chemical exchange affects the appearance of NMR spectrum. 5
- (c) Briefly discuss the principle of mass spectrometry. What are the characteristics of a mass spectrum? 5
8. (a) Calculate the IHD for any *two* of the following compounds : 4
- (i) C_6H_6
- (ii) $C_4H_8O_2$
- (iii) C_4H_4
- (b) Enlist the various factors affecting chemical shift in proton NMR. 3
- (c) A compound having the molecular formula $C_3H_6O_2$ shows the following spectral data :
- IR : Intense band at about 1700 cm^{-1}
 Broad band around 3000 cm^{-1}
- NMR : δ 10.5, Singlet, 1H
 δ 1.2, Quartet, 2H
 δ 2.3, Triplet, 3H
- Mass (m/z) = M^+ 74, 57, 29, 45.
- Find the structure of the compound and assign spectral data to the structural units present in the compound. 8