P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

00448

Term-End Examination

June, 2010

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 hours *Maximum Marks : 75*

Note : *Answer **any five** questions. All questions carry **equal** marks.*

1. Answer ***any five*** of the following : **5x3=15**

(a) Molecular spectra are band spectra whereas atomic spectra are line spectra. Explain.

(b) What is meant by charge transfer complexes ? Explain the origin of colour in a charge transfer complex with the help of an energy level diagram.

(c) Explain the chemical ionisation method of generating gas phase ions in mass spectrometry with the help of an example.

(d) LASERs are ideal sources in Raman spectroscopy. Comment.

(e) The fluorescence emission occurs at longer wavelength than the absorption. Explain.

(f) What are the limitations of phosphorimetry over fluorimetry as an analytical method ?

(g) It is advantageous to use line radiation sources in atomic absorption spectrometry. Justify.

(h) Explain the origin of Stokes and anti-Stokes lines in a Raman spectrum.

2. (a) Define electromagnetic radiation. List and explain the meaning of any three characteristics of electromagnetic radiation.

(b) List different types of transitions that occur in the organic molecule as a consequence of the absorption of radiation in the UV-VIS region. Arrange these transitions in the increasing order of the energy required.

(c) State and explain the 'Rule of mutual exclusion'. In what way is it useful in providing the structural information about the molecule ? **3x5=15**

3. (a) Under what conditions the fluorescence intensity is directly proportional to absorbance ? Derive the expression and give any two limitations of atomic fluorescence spectrometry. **3x5=15**

(b) What is chemiluminescence ? Describe its application in the determination of $NO-NO_2$ in a sample of polluted air.

(c) Describe the procedure to determine calcium and cadmium in serum by atomic absorption method.

4. (a) Calculate the number of, and draw the normal modes of vibration for a symmetric linear triatomic molecule, AB_2. Which of these modes will be IR active ? **3x5=15**

(b) What are the necessary and specific conditions to observe the infrared spectrum ? How would you differentiate between vibrational modes and normal vibrational modes ?

(c) What is meant by fluorescence quenching ? Describe different mechanisms of fluorescence quenching.

5. (a) Describe the standard addition method of calibration in atomic absorption spectrometry. How is it better than the standard solution method ? **3x5=15**

(b) Enlist different characteristics of atomic spectrum. What are different factors that contribute to the width of an atomic spectral line.

(c) What is meant by Fourier transformation ? In what way is FT-NMR better than continuous wave NMR ?

6. (a) What is the function of a nebuliser in atomic spectrometry ? Describe the functioning of ultrasonic nebuliser. **3x5=15**

(b) Explain the principle of mass spectrometry. In what way is mass spectrometry different from other spectral techniques ?

(c) Enlist different types of atomic fluorescence transitions and explain any two of them.

7. (a) Explain, in brief, the processes occuring when an analyte is put into the flame. **3x5=15**

(b) What is Room temperature phosphorescence ? How is it expected to revolutionise the applications of phosphorimetry ?

(c) Explain **any two** of the following with suitable examples :

(i) Chemical shift.

(ii) Anisotropy of chemical bonds.

(iii) Spin-spin coupling.

8. (a) Briefly describe the working of inductively coupled plasma (ICP) source used in atomic emission spectrometry. **2x7½=15**

(b) An organic compound having molecular formula $C_3H_6O_2$ shows the following spectral data :

IR : 1700 cm^{-1} (strong), ~3000 cm^{-1} (broad)

NMR : 81.2 ppm (3H), 82.3 ppm (2H)

Mass : m/z 74 (M^+), 57, 45, 29

Deduce the structure of the compound.