P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

December, 2011

00115

MCH–003 : SPECTROSCOPIC METHODS

Time : 3 hours   Maximum Marks : 75

Note : Answer five questions in all. Question number 1 is compulsory.

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

   (a)   What is meant by interference ? Differentiate between constructive and destructive interference.

   (b)   In what way is the standard addition method of calibration in UV-VIS spectro photometry better than standard solution method ?

   (c)   Water generally is not used as a solvent in IR spectrometry. Explain why.

   (d)   Fluorescence spectrometry has distinct advantage over UV-visible spectrophotometry. Justify.

   (e)   In what way is a double beam atomic absorption spectrophotometer better than a single beam spectrophotometer ?

   (f)   What is meant by the index of hydrogen deficiency ? What is its importance in the structure determination of organic molecules ?

2. (a) State Lambert's law and derive a relationship between the absorbance and the thickness of the absorbing medium.   3x5=15

    (b) The concentration of Fe^{3+} ions can be determined by forming a complex with *hexacyanoruthenate* (II) that has a λ_{max} of 550 nm. Calculate the absorbance of the complex obtained from a solution containing 0.2 mm of ferric ions. The moler absorptivity for the metal complex at this wavelength is found to be 9970 $M^{-1}cm^{-1}$ and the measurement is done in a *Curette* having a path length of 1 cm.

    (c) Explain the origin of stoke's and anti-stokes lines in a Raman spectrum in terms of the quantum model of radiation. What is the relationship between the stoke's and anti-stokes lines.

3. (a) The fluorescence of a molecule depends on its structure. Justify the statement with the help of suitable examples.   3x5=15

    (b) Phosphorimetry is an important analytical tool yet its applications are for lesser than fluorescence. Give reasons for the same.

    (c) What is meant by non-radiative deactivation ? Explain the mechanisms of non radiative deactivation of an encited molecule.

4. (a) The determination of environmental pollutants is an important activity undertaken by analytical chemists. Describe an analytical application of chemiluminescence in the area of environmental pollution measurement. 3x5=15

   (b) Explain the principles of atomic absorption spectrophotometry and atomic emission spectrometry.

   (c) Draw a schematic diagram showing the layout of various components of a flame photometer.

5. (a) Different types of instrumented set ups are used in ICP - AES. List these and describe the working of any one of these. 3x5=15

   (b) Enlist the limitations of flame photometre method.

   (c) Enumerate the applications of atomic fluorescence spectrometry in diverse areas.

6. (a) What is the principle of calibration plot method for AAS ? Why do we need to use 3-4 standards calibration line ? 3x5=15

   (b) Enumerate the advantages and disadvantages of the GFAAS method.

   (c) Enlist different components of an ICP torch and give their function in one line each.

7. (a) Explain the splitting of NMR signals due to spin-spin coupling by taking suitable examples.   5

   (b) Write short notes on *any two* of the following :   2x5=10

      (i) Chemical shift

      (ii) Chemical ionisation method

      (iii) Lermour precession

8. (a) Explain the principle of double focussing analyser used in mass spectrometer.   5

   (b) The important spectral details of an organic molecule having the molecular formula $C_3H_6O_2$ are as follows   10

   Mass : (Prominent peaks at $m/z = 28$ (base peak); 29, 45, 57 and 74 (molecular ion))

   IR : Broad band around 3000 cm^{-1}; 1700 cm^{-1} (strong),

   NMR : $\delta = 1.2$ ppm(3H, triplet); $\delta = 2.3$ ppm(2H, quartet); $\delta = 12.0$ppm (1H, singlet)

   Determine the structure of the molecule and assign the signals.