

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech (LT)/SEM-2/MLT-202/2013**

**2013**

**INSTRUMENTAL METHOD OF ANALYSES**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

- i) The various transitions may be arranged in their decreasing order of energy

a)  $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

b)  $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

c)  $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^* > n \rightarrow \sigma^*$

d)  $\sigma \rightarrow \sigma^* > n \rightarrow \pi^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^*$

- ii) Which one is *not* correct ?
- a) More symmetric the molecule lesser would be the dipole moment changes
  - b) Transition from  $-\text{NH}_2$  to  $-\text{N}(\text{CH}_3)_2$  gives a bathochromic shift
  - c) Auxochromes can be hyperchromic / hypochromic
  - d) As the number of charged canonical structures increases, the colour of the compound deepens.
- iii) In the incandescent filament lamp based on tungsten and iodine, the envelope is made of
- a) Glass
  - b) Quartz
  - c) Fused silica
  - d) None of these.
- iv) Full form of FWHM is
- a) Frequency Width at Half Maxima
  - b) Full Width at Half Maxima
  - c) Full Width at Half Minima
  - d) Frequency Width at Half Minima.
- v) A dielectric layer ( thickness =  $1.85 \text{ nm}$  ), provides a third-order filter at a central wavelength of  $167 \text{ nm}$ . The refractive index of the dielectric layer would be
- a)  $1.35$
  - b)  $1.53$
  - c)  $1.39$
  - d) None of these.

- vi) Which one is *not* correct ?
- a)  $^{14}\text{N}$  can take up four different orientations under external magnetic field
  - b) Protons in  $\text{CH}_3\text{I}$  show lower  $\delta$  values than that of  $\text{CH}_3\text{Cl}$
  - c) TMS is insoluble in  $\text{D}_2\text{O}$
  - d) HPLC can be used for dye partitioning.
- vii) Laser beam should have the which of the following qualities ?
- a) Coherent and polarized
  - b) Monochromatic and parallel
  - c) Monochromatic, coherent and polarized
  - d) None of these.
- viii) Full form of SAXS is
- a) Small angle X-ray spectroscopy
  - b) Small angle X-ray scattering
  - c) Small angular X-ray spectroscopy
  - d) None of these.
- ix) Which is *not* a thermal detector ?
- a) Golay detector
  - b) MCT detector
  - c) Glober
  - d) Pyroelectric detector.
- x) A TGA instrument cannot detect
- a) Glass transition temperature
  - b) Blend composition
  - c) Filler percentage in a composite
  - d) None of these.

- xi) Exclusion chromatography is referred to as
- a) Ion-exchange chromatography
  - b) Gel permeation chromatography
  - c) Gel filtration
  - d) Both (b) & (c).

**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. What is glass transition temperature ? How can DSC be used to detect glass transition temperature of a polymer ? Write down the basic principle of DSC and its uses.  $1 + 2 + 2$
3. What is Beer-Lambert principle ? How can you measure the extent of dye exhaustion of a particular dye by UV-VIS spectroscopy ?  $2 + 3$
4. Explain the following with proper reasons :
  - a) Bandwidth is smaller than band pass.
  - b) Benzene is colourless but graphite is black.
  - c) Butadiene is colourless but  $\beta$ -carotene is orange red in colour.
  - d) NMR solvents should be of low viscosity.
  - e) Glass surface of the mirrors and lenses is modified by application of either dielectric or metallic thin film coating.
5. What is distribution co-efficient ? Explain basic principle of chromatographic technique.  $2 + 3$

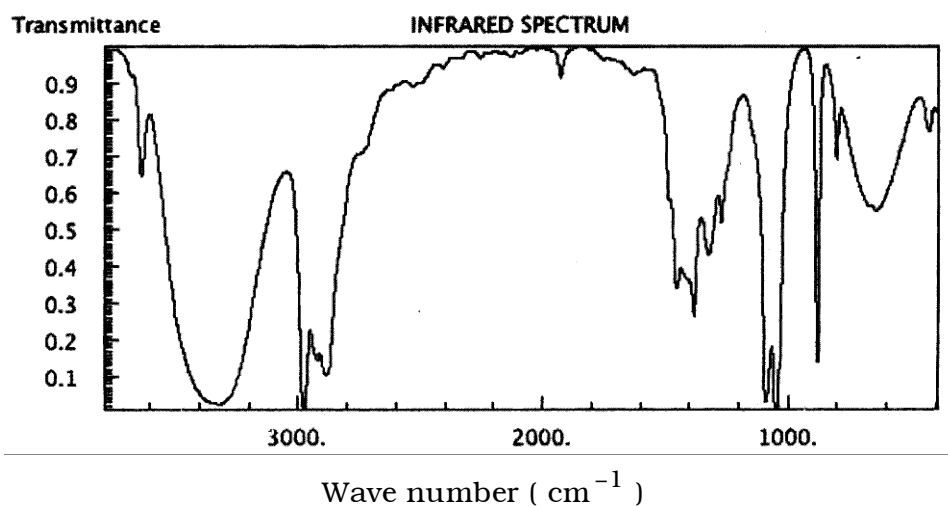
**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

6. What is the likely structure for a hydrocarbon of formula  $C_6H_{12}$  that shows strong absorption at  $2920$  and  $2840\text{ cm}^{-1}$  and at  $1450\text{ cm}^{-1}$ ; none above  $2920\text{ cm}^{-1}$ ; & below  $1450\text{ cm}^{-1}$  none until about  $1250\text{ cm}^{-1}$  ? With the help of FTIR spectrum ( shown below ), detect the structure of the compound of formula  $C_2H_5O$ .

Draw the diagram of FTIR instrumentation showing Michelson interferometer. What is the function of laser beam used in the instrument ?  $5 + 2 + 6 + 2$



7. What are the spin-lattice and spin-spin relaxation of nucleus ?

Explain the following :

- a) The chemical shifts are observed in the following order :  
 $\text{CH}_3\text{I} < \text{CH}_3\text{Br} < \text{CH}_3\text{F}$
- b) Chemical shift value for proton attached to  $\text{C} = \text{C}$  in alkenes is higher as compared to the proton attached to  $\text{C} \equiv \text{C}$  in alkynes.

The signal for the  $\text{CH}_2$  protons in the proton NMR spectrum of benzyl alcohol appears at  $\delta$  4.6. Calculate the difference in frequency, expressed in Hz, between this and the TMS signal in a (i) 300 Hz & (ii) 600 Hz NMR spectrum.

What would be change in chemical shift values under the influence of (i) intermolecular and (ii) intramolecular H-bonding ? Explain considering the concentration of the sample.

What is coupling constant ? In the NMR spectrum of ethyl bromide, triplet and quartet are observed at  $\delta \sim 1.6$  and  $\delta \sim 3.5$ , respectively. Draw the spectrum showing peaks indicating possible intensities. What is the possible reason behind such intensity variation ?

$$(1 + 1) + (1 + 1) + (2 + 2) + (1 + 1) + 1 + 2 + 2$$

8. What does make High Performance Liquid Chromatography ( HPLC ) different from Gas Chromatography ( GC ) ? Which type of GC detector is most commonly used ? Explain its working principle. What are its limitations ? What do you understand by specificity of a detector ? What should be the desirable characteristics of HPLC and GC detectors ?

5 + 1 + 4 + 2 + 3

9. Write short notes on any *three* of the following : 3 × 5

- a) Photomultiplier tubes
- b) Golay detector
- c) Electrode less discharge lamp
- d) Hollow cathode lamp.

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