

Total Pages - 10

UG/5th Sem/CHEM(H)/T/19  
2019

B.Sc. (Honours)

5th Semester Examination

**CHEMISTRY**

**Paper - DSE-2T**

Full Marks : 40

Time : 2 Hours

*The figures in the margin indicate full marks.  
Candidates are required to give their answers  
in their own words as far as practicable.*

**Analytical Methods in Chemistry**

**Group - A**

1. Answer any *five* questions out of eight carrying 2 marks each :  $2 \times 5 = 10$

(a) Distinguish between accuracy and precision.

(b) What is determinate error ?

(c) What is 'stationary phase' in an ion-exchange chromatography ?

**[ Turn Over ]**



- (d) Define the term 'extraction coefficient'.
- (e) What criterion is used in selecting an indicator for a particular acid-base titration ?
- (f) How does solid-phase extraction differ from solvent extraction ?
- (g) Why is a sharp line source desirable for atomic absorption spectroscopy ?
- (h) What is the most common form of HPLC and why ?

### Group - B

Answer any *four* questions out of six  
carrying 5 marks each:

$$4 \times 5 = 20$$

2. (a) What is the retention time and the  $R_f$  value ?  
2
- (b) How does fast LC differ from conventional HPLC?  
2
- (c) What compounds can be determined by Gas chromatography (GC) ?  
1



3. Describe the principles of fluorescence. Why is fluorescence generally more sensitive than absorption measurements ? Under what conditions is fluorescence intensity proportional to concentration ?  
2+2+1
4. Describe the principles of flame emission spectrometry and atomic absorption spectrometry.  
 $2\frac{1}{2}+2\frac{1}{2}$
5. Describe two principal solvent extraction systems for metal ions. Give examples of each. 2+2+1
6. (a) Compare the operations of a single-beam spectrophotometer and a double-beam spectrophotometer. 3
- (b) What are F-test and t-test ? 2
7. (a) Distinguish between a primary standard and secondary standard. 2
- (b) Calculate the energy, in calories, of one einstein of radiation at  $3000\text{\AA}$ . 2
- (c) The results of an analysis are 36.97 g, compared with the accepted value of 37.06 g. What is the relative error in parts per thousand ? 1

[ Turn Over ]



### Group - C

Answer any *one* question out of two questions

carrying 10 marks each :

$$10 \times 1 = 10$$

8. (a) Explain the differences between cation-exchange resin and anion exchange resin. 2

(b) Describe the principle and method of determination of total cation concentration in a given sample of water by ion exchange method. 3

(c) In a paper chromatographic separation of  $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$  and  $\text{Ag}^+$ , the solvent front was 21 cm, while fronts due to these metals were 7, 14 and 18.5 cm, respectively. Calculate the  $R_f$  values of them. 3

(d) In solvent extraction process, the extracting solvent is used in a number of parts instead of using the whole liquid in one lot — Explain. 2

9. (a) What do you mean by coefficient of variation ? 2

(b) Using a proper relation, calculate the transmittance of a solution when its absorbance is 0.222. 2



( 5 )

(c) What do you mean by capacity and capacity factor in ion exchange ? 2

(d) Discuss the principle of liquid-liquid extraction and its important application. 4

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**Instrumental Methods of Chemical Analysis**

Full Marks : 40

Time : 2 Hours

**Group - A**1. Answer any *five* questions : $2 \times 5 = 10$ 

- (a) What happens when a substance is irradiated with infrared radiations ?
- (b) What do you mean by fundamental vibrations and overtones ?
- (c) What is spin-spin splitting ? Define coupling constant (J).
- (d) Write down the basic principles of Mass Spectrometry.
- (e) Which type of nuclei show magnetic properties for the purpose of NMR Spectroscopy ?
- (f) What do you mean by fluorescent radiation ?
- (g) The wave length associated with an ultra-violet radiation is 285 nm. Determine the energy associated with it in Kcal/mole.
- (h) What is Hooke's law ? Give its mathematical form.



## Group - B

Answer any *four* questions

5×4=20

2. (a) What do you mean by monochromatic light ?  
How it can be obtained ? 2
- (b) How thin layer chromatography is carried out ? 2
- (c) What is meant by molar absorptivity ? 1
3. (a) An organic compound with molecular formula  $C_8H_6$  decolourises bromine in carbon tetra chloride and gives a white precipitate with ammonical silver nitrate solution. Give the probable structure of the compound. Its IR spectrum gives a band at  $2150 - 2200\text{ cm}^{-1}$  and the region near  $3300\text{ cm}^{-1}$  is transparent. 3
- (b) Explain Emission and Absorption spectra. 2
4. (a) Give a brief discussion on instrumentation of NMR spectrophotometer with a diagram. 2+1=3
- (b) Discuss with an example how does UV technique help to distinguish equatorial and axial conformations ? 2

[ Turn Over ]



5. (a) What is the basic difference between supercritical Fluid Chromatography and Gas Chromatography? 2
- (b) How will you distinguish three isomeric butanols on the basis of mass spectrometry ? 2
- (c) Write down the most important source of IR light. 1
6. (a) What do you mean by chemical shift ? What are the factors that influence the chemical shift ? 1+2=3
- (b) Calculate the chemical shift in ppm ( $\delta$ ) for a proton that has resonance at 126 Hz downfield from TMS on spectrophotometer that operates at 60 MHz. 2
7. (a) Discuss with an example, how does IR spectroscopy help to make a quantitative estimation of an organic mixture ? 2½
- (b) How structural isomers can be distinguished by NMR spectroscopy ? Explain with an example. 2½



**Group - C**

Answer any *one* question :

10×1=10

8. (a) Describe the basic principles of Column Chromatography. 2
- (b) How do you explain that  $m/l$  94 ion is formed in the mass spectrum of phenitol ? 2
- (c) How will you distinguish between inter and intra molecular hydrogen bonding on the basis of proton NMR spectroscopy ? 2
- (d) Give a schematic diagram for an FT-IR Spectrometer. 2
- (e) Discuss the positions of absorption of a particular band in a substance in all the three states. 2
9. (a) Compared to the number of bonds in a molecule, there are generally more number of peaks in the infra-red spectrum — Explain. 2
- (b) Write down the advantages of FT-IR method. 1½



- (c) Predict the number of signals, their multiplicities and chemical shifts with respect to TMS as reference for the  $^1\text{H}$  NMR spectrum of cinnamaldehyde. 3
- (d) Do spin-spin coupling giving multiplets has any relation with coupling constant ? Explain.  $1\frac{1}{2}$
- (e) Describe the procedure for separation of pigments present in leaves by column chromatography. 2
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