

**6 SEM TDC CHM M 7 (N/O)**

**2019**

**( May )**

**CHEMISTRY**

**( Major )**

**Course : 607**

**( Spectroscopy )**

*The figures in the margin indicate full marks  
for the questions*

**( New Course )**

Full Marks : 48

Pass Marks : 14

**Time : 2 hours**

1. Choose the correct answer :

1×5=5

(a) Symmetric top molecules have

- (i) two equal moments of inertia and one different
- (ii) all the three moments of inertia equal
- (iii) all the three moments of inertia different
- (iv) all the moments of inertia zero

**( Turn Over )**

(b) The shift of an absorption maximum towards longer wavelength is known as

- (i) hypsochromic effect
- (ii) bathochromic effect
- (iii) hyperchromic effect
- (iv) hypochromic effect

(c) The absence of absorption bands near  $1600\text{ cm}^{-1}$ ,  $1580\text{ cm}^{-1}$  and  $1500\text{ cm}^{-1}$  is a sure proof for the absence of

- (i) aromatic ring
- (ii) carbonyl group
- (iii)  $\text{—OH}$  group
- (iv) secondary amino group

(d) The multiplicity of the signals in  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$  in NMR spectrum is

- (i) two triplets
- (ii) a triplet and a quartet
- (iii) two singlets
- (iv) two doublets

(e) Using  $4358\text{ \AA}$  lines of mercury as the source of radiation, a Raman line was observed at  $4447\text{ \AA}$ . The Raman shift was

- (i)  $460\text{ cm}^{-1}$
- (ii)  $89\text{ cm}^{-1}$
- (iii)  $89 \times 10^{-8}\text{ cm}^{-1}$
- (iv)  $460 \times 10^{-8}\text{ cm}^{-1}$

2. Answer any five of the following : 2×5=10

- (a) What do you mean by fundamental vibrations and overtones?
- (b) What is mutual exclusion principle? Explain with examples.
- (c) The nuclei like  $^{12}\text{C}$  and  $^{16}\text{C}$  do not exhibit NMR spectra. Explain why.
- (d) What do you mean by a good solvent in UV spectroscopy and what is its effect on absorption maximum?
- (e) Explain the effects of change of solvents on  $n \rightarrow \pi^*$  and  $\pi \rightarrow \pi^*$  transitions.
- (f)  $\text{HCl}$  molecule is microwave active. Explain properly.



## UNIT—I

3. (a) Discuss the effect of isotopic substitution on the rotational spectra of a diatomic molecule.  $2\frac{1}{2}$
- (b) In the absorption rotational spectrum of CO, the first line has a wave number of  $3.8424 \text{ cm}^{-1}$ . Calculate the bond length between C and O atoms.  $2\frac{1}{2}$

## UNIT—II

4. (a) Show that the frequency of the absorbed radiation in pure vibrational spectra is equal to the fundamental frequency of vibration  $\nu_0$  of the molecule. 3
- (b) Sketch the normal modes of vibration of a linear triatomic molecule  $AB_2$  and predict the IR active bands. 2

Or

Write a short note on fingerprint region. 2

- (c) The force constant of HF is listed at  $880 \text{ cm}^{-1}$ . At what wave number is the fundamental  $\nu = 0 \rightarrow \nu = 1$  vibrational absorption expected? 3

## UNIT—III

5. (a) What are Stokes and anti-Stokes lines? Explain why the anti-Stokes lines are weaker than that of Stokes lines.  $2+2=4$
- (b) Discuss about the rotational Raman spectra in linear molecule. 3

Or

Write any three differences between Raman spectra and infrared spectra. 3

## UNIT—IV

6. (a) Describe the terms chromophores, auxochromes, bathochromic shift and hypsochromic shift giving examples. 4
- (b) Write the selection rules for electronic transitions. 2

Or

Explain why ethanol is a good solvent for UV measurement but not for IR. 2

## UNIT—V

7. (a) Discuss briefly the principle of NMR spectroscopy. 4

Or

What is chemical shift in NMR spectroscopy? Mention the factors that affect chemical shift. 2+2=4

- (b) Explain why TMS is used as internal standard in NMR spectroscopy. 2

Or

Describe the ESR spectrum of a single electron in contact with a single proton. 2

- (c) Describe briefly spin-spin relaxation process. 1