Reg. No. | | | | | | | | | |

ICH 501

III Semester M.Sc. Degree Examination, April/May 2022
INDUSTRIAL CHEMISTRY
Spectroscopic Techniques

Time : 3 Hours Max. Marks : 70

Note : *a) Answer **any five** subdivisions from Part-**A** and **any five full** questions from Part-**B**.*

*b) Figures to the **right** indicate marks.*

PART – A

1. Answer **any five** sub-divisions. **(5×2=10)**

   a) Mention any two applications of Raman Spectroscopy.

   b) What is Stark effect ?

   c) State Beer Lambart law.

   d) Give any two differences between proton and carbon NMR.

   e) Mass spectrometry is the correct terminology but not Mass spectroscopy. Justify the same.

   f) In NMR spectroscopy, what is meant by spin-spin coupling ?

   g) With any one suitable example. Write McLafferty rearrangement.

   h) In vibrational spectroscopy. What is meant by zero point energy ?

PART – B

Answer **any five** of the following.

2. a) The fundamental vibrational frequency of HCl is 86.63 x 1012 Hz. Calculate zero point energy and force constant for HCl.

   b) Explain the factors influencing width and intensity of spectral lines.

   c) Obtain the expression for moment of inertia for rigid diatomic molecule. **(4+4+4=12)**

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ICH 501

3. a) What are Nuclear and Electron spin interaction ? Explain.
   b) How does IR spectroscopy differ from Raman spectroscopy ?
   c) Explain the activity of the following molecules with respect to IR and microwave spectrum H_2, HCl, CO_2 and CH_4. **(4+4+4=12)**

4. a) Write a short note on factors affecting the positions of UV bands.
   b) How do you distinguish following pair of compounds by IR spectroscopy ?
      i) Acetanilide ii) Acetic acid
      iii) Phenol iv) Ethyl benzoate
   c) Discuss the applications of UV spectroscopy in the structural study of organic molecules. **(4+4+4=12)**

5. a) With a neat labelled diagram, explain the working principle of IR spectroscopy.
   b) Describe the factors affecting band positions and intensities hydrogen bonding phase and solvent. **(6+6=12)**

6. a) Why is it necessary to use deuterated solvents for NMR experiments ?
   b) Briefly explain spin-spin coupling and spin decoupling.
   c) Write a short note on double resonance techniques used in NMR spectroscopy. **(4+4+4=12)**

7. a) With neat labelled diagram, explain the working principle of Nuclear Magnetic Resonance spectroscopy.
   b) Briefly explain the terms
      i) Coupling constant
      ii) Shielding and deshielding.
   c) A compound (molecular formula $C_9H_{10}O_2$) gives the following spectral data.

      IR : 1720 cm^{-1}
      'HNMR : δ1.29(3H,t)
      4.35 (2H, g)
      7.40 (3H, m)
      8.81 (2H, m)

      Determine the structure of compound. **(4+4+4)**

8. a) Predict the fragmentation in the following compounds from their molecular ion

   i) Benzyl acetate

   ii) I-Phenyl ethanol

   b) How do you distinguish aromatic ester and alcohol by using mass spectroscopy technique ?

   c) An organic compound A (Molecular Formula $C_5H_{10}O$) exhibits the following spectral data

   UV (λ_{max}) : 280 nm

   $IRV_{max}^{(cm-1)}$: 17.5

   ^{1}HNMR(δppm) : 0.9 (3H, t)

   1.60 (2H, m)

   2.20 (3H, s)

   2.40 (2H, t)

   Mass (m/z) : 86, 71, 43 (100%)

   Deduce the structure of compound. **(4+4+4)**

9. a) Write a short note on double McLafferty rearrangement and Nitrogen rule.

   b) Discuss fragmentation pattern for following compounds

   i) Accetanilide

   ii) P-Nitrobenzene.

   c) How does a mass spectrometer detect isotopes ? Explain with example.

(4+4+4=12)