

Your Roll No.-----

**B.Sc. M.Sc. Integrated Program (Chemistry)**

**Semester-V Examination-2020**

**Paper Code- BCH-DSE1TH**

**Paper Title: ANALYTICAL METHODS IN CHEMISTRY**

**Time: Three Hours**

**Max Marks: 75**

(Write your Roll No. on the top immediately on receipt of question paper)

*Attempt all questions. Use of Scientific Calculator is permitted.*

**Q1. Explain briefly of the following:**

**[7x2+1x1=15]**

- A Monochromator and detector
- B Atomization techniques and Atomic absorption Spectroscopy
- C Job's Method of composition determination
- D pH-metric titrations
- E Qualitative and quantitative aspects of separation
- F Chiral solvents and Chiral shift reagents
- G Chiral chromatographic techniques (chiral-GC and chiral-HPLC).
- H Development of chromatograms (frontal, elution and displacement methods).

**Q2. Attempt ANY THREE of the following:**

**[3x5=15]**

- A Define Beer-Lambert Law and state its limiting conditions? In an absorption cell, the transmittance of 0.1 M solution of a substance X is 80% and that of 0.1 M solution of another substance Y is 60% at a given wavelength. What is the transmittance of a solution that is simultaneously 0.1 M in X and 0.1 M in Y?
- B State the significance of FTIR Spectroscopy? The force constant of CO is  $1840 \text{ N m}^{-1}$ . Calculate the vibrational frequency in  $\text{cm}^{-1}$  and the spacing between the vibrational energy levels in eV. Compare this spacing with thermal energy at room temperature and comment on your result. (Given the atomic masses  $^{12}\text{C} = 19.9 \times 10^{-27} \text{ Kg}$ ;  $^{16}\text{O} = 26.6 \times 10^{-27} \text{ Kg}$  and  $1 \text{ eV} = 8066 \text{ cm}^{-1}$ )
- C Explain the meaning of Spectroscopy? Discuss the factors affecting width and intensity of a spectral line?
- D Explain Franck- Condon principal? Differentiate between Fluorescence and phosphorescence?
- E Discuss the different types of spectra given by a molecule? Explain Bathochromic, Hypsochromic, Hypochromic and Hyperchromic Shift? Which of the following molecule will show a spectrum and why?

| Type of spectrum     | Molecules                                                                                                                                                                                         |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pure rotational (MW) | $\text{H}_2$ , HCl, CO, $\text{CHCl}_3$ , $\text{H}_2\text{O}$ , $\text{NH}_3$ , and $\text{NH}_4\text{Cl}$                                                                                       |
| Vibrational (IR)     | $\text{H}_2$ , HCl, CO, $\text{CHCl}_3$ , $\text{H}_2\text{O}$ , $\text{NH}_3$ , $\text{NH}_4\text{Cl}$ , $\text{CH}_3\text{-CH}_3$ , $\text{C}_6\text{H}_6$ , $\text{CCl}_4$ , and $\text{CO}_2$ |
| Rotational Raman     | $\text{H}_2$ , HCl, CO, $\text{CH}_4$ , $\text{CHCl}_3$ , $\text{H}_2\text{O}$ , $\text{NH}_3$ , $\text{CH}_3\text{-CH}_3$ , and $\text{SF}_6$                                                    |
| Vibrational Raman    | $\text{H}_2$ , HCl, CO, $\text{CH}_4$ , $\text{CHCl}_3$ , $\text{H}_2\text{O}$ , $\text{NH}_3$ , $\text{CH}_3\text{-CH}_3$ , and $\text{SF}_6$                                                    |

**Q3. Attempt ANY THREE of the following:**

**[3x5=15]**

- A Discuss the normal law of distribution of undetermined error?
- B Illustrate and explain the various types of errors?
- C Explain the meaning of F-, Q- and t-Test?
- D Explain (a) Confidence Interval and (b) Sampling and (c) Error?
- E Explain (a) Accuracy and (b) Precision?

**Q4. Attempt ANY THREE of the following:**

**[3x5=15]**

- A Explain the basic principle of following
  - (i) Potentiometric titrations? and (ii) Conductometric titrations?
- B Define the following terms and explain how we determine them
  - (i) Equivalence point and (ii) pKa value
- C Discuss the theory of thermogravimetry and its Instrumentation part?
- D Discuss the different electroanalytical methods of analysis?
- E Explain the quantitative estimation of Ca and Mg from mixture?

**Q5. Attempt ANY THREE of the following:**

**[3x5=15]**

- A Discuss the various aspects of solvent extraction [Classification, principle and efficiency]?
- B Explain the Classification, principle and efficiency of the Chromatographic technique?
- C Discuss the mechanism of separation (adsorption, partition & ion exchange)?
- D Discuss the stereoisomeric separation and analysis (optical rotation measurement, calculation of Enantiomeric excess (ee).
- E Explain the role of computers in instrumental methods of analysis?

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***Terms have their usual meaning***

Avogadro number:  $N_A = 6 \times 10^{23}/\text{mol}$ ;

Universal gas constant:  $R = 8.31 \times 10^7 \text{ erg/mol/K}$ ;

Boltzmann Constant:  $k_B = 1.38 \times 10^{-16} \text{ erg/K}$