# INTERNATIONAL CENTRE FOR APPLIED SCIENCES
# MAHE, MANIPAL

**B.Sc. (Applied Sciences) in Engg.**

**End – Semester Theory Examinations – Nov./ Dec. 2020**

**IV SEMESTER - INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS (ICH 241)**

**(Branch: Chemical)**

**Time: 3 Hours** **Date: 07 December 2020** **Max. Marks: 100**

- ✓ **Answer any FIVE full questions.**
- ✓ **Missing data, if any, may be suitably assumed**

**1A**. Discuss the classification of molecules in the Microwave spectroscopy based on the momentum of inertia equations. The pure rotational spectrum of gaseous HCl consists of a series of equally spaced lines separated by 10.80 $cm^{-1}$. Calculate the inter nuclear distance and second excited rotational energy of the molecule. The atomic masses are $^{1}H$ = 1.673 x$10^{-27}$ kg, $^{35}Cl$ = 35.06 x $10^{-27}$ kg.

**1B.** Describe any two major applications of Raman Spectroscopy. Write any four characteristic features of Raman lines.

**1C.** Differentiate the following:

i) Stretching and bending Vibrations in IR spectroscopy.

ii) Single beam and double beam spectrophotometers

**(8 + 8+4)**

**2A.** Deduce Lambert's law. Describe the energy level diagram of electronic transitions involved in the organic molecules.

**2B.** Derive mathematical expression, $\nu = 1/2\pi\sqrt{k/\mu}$ Hz for a diatomic molecule performing simple harmonic vibration using Hooke's law. Write significance of zero point energy.

**2C.** Account for the following:

i) IR spectroscopy is a good tool to distinguish the aliphatic and aromatic amines

ii) Photocell is more sensitive than that of Photovoltaic cell.

**(8 + 8+4)**

**3A.** Write any four advantages and limitations of instrumental methods of analysis over the common methods of analysis. Calculate the energy in joule and wave number in $cm^{-1}$ for an infrared radiation of 25 μm.

**3B.** Describe the working principles of any two detectors and sources used in the IR instrument.

**3C.** Write basic principles of potentiometric titrations. Write any four factors affecting conductance.

**(8+ 8+4)**

**4A.** Describe the various types of energy involved in the spectroscopy? Differentiate between atomic and molecular spectroscopy.

**4B.** Describe the Raman Instrumentation. Mention any four advantages of laser source over the other sources.

**4C.** Sketch the modes of vibrations in $CO_2$ and $H_2O$ molecules. **(8 + 8+4)**

**5A.** Describe electrode potential of the glass electrode. Write any four merits and demerits of it over the hydrogen electrode.

**5B.** Describe the procedure involved in the determination of strength of aqueous solutions of strong acid versus strong base using conductometric titrations graphically.

**5C.** Explain the use of Microwave spectroscopy in the detection of isotopic abundance in the simple molecules.

**(8+8+4)**

**6A.** Give the classification of column chromatographic methods. Explain the terms distribution constant and retention time in chromatography.

**6B.** Discuss the following: i) Conductometric titration of ($HCl$+ $CH_3COOH$) Vs. NaOH ii) Advantages of conductometric titrations

**6C.** Applications of DTA in glass and polymer industry

**(8+8+4)**

**7A.** Draw a schematic diagram of DTA apparatus and give the function of its different components.

**7B.** Briefly explain i) the preparation of thin layers in plates and ii) Direct methods of evaluation of chromatogram in TLC.

**7C.** Give an account of applications of Gas-liquid chromatography

**(8+8+4)**

**8A.** With a Schematic diagram explain the working of HPLC. Discuss the effect of temperature in HPLC.

**8B.** Discuss the Instrumental factors affecting TGA curve.

**8C.** Write notes on the following: i) Bathochromic shift ii) Hypsochromic shift

**(8+8+4)**

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