Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

IV SEMESTER B.TECH. (PROGRAMME ELECTIVE)

END SEMESTER EXAMINATIONS, JAN 2021

SUBJECT: ANALYTICAL METHODS AND INSTRUMENTATION [CHM 4301]

REVISED CREDIT SYSTEM

Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Draw diagrams and write equations wherever necessary.

Data Given: h = 6.624 x 10^{-34} Js, c = 3 x 10^{8} m/s, Atomic mass of Hydrogen = 1 amu. Atomic mass of Iodine = 127 amu., Avogadro number = 6.024 x 10^{23}.

1A. Explain the effect of dilution on the equivalent and molar conductance. Why Conductometric titrations provide unsatisfactory results for precipitation titrations?

1B. Derive an expression for the equivalence potential using redox potentiometric titration. Discuss the variation of potential in precipitation titrations by potentiometry.

1C. **(i)**The following data were obtained by gas liquid chromatography on a 30 cm packed column. Calculate the average number of plates, plate height, selectivity factor and resolution for the species A and B.

Compound	t_R (min)	$W_{½}$ (min)
Unretained species	1.8	
A	10.2	0.86
B	11.5	0.92

ii) Define the term column resolution. Discuss the effect of length of column and band broadening on the resolution of peak in chromatographic technique.

[2+3+5]

2A. Explain the direct methods of evaluation of chromatogram in TLC.

2B. Give an account of applications of Gas-liquid chromatography. Discuss the following components of a gas chromatograph: i) Carrier gas ii) Sample introduction system

2C. With a Schematic diagram explain the working of HPLC. Briefly explain i) Column packing in HPLC and ii) Any two Detectors used in HPLC.

[2+3+5]

3A. i) Write the expression for the rotational energy of a simple linear molecule and explain the terms. ii) What is the basis for IR absorption spectroscopy?

3B. Calculate the frequency in Hz and energy in kJ for a UV radiation of wavelength 250 nm. Compare its energy with a radio wave of wavelength of 1m with appropriate calculations.

3C. i) Prove that the separation between the lines of microwave spectrum of a diatomic rigid rotator is a constant. ii) The microwave spectrum of HI molecule consists of a series of equidistant lines with a spacing of 12.8 cm^{-1}. Calculate the bond length of the molecule.

[2+3+5]

4A. Why is microwave spectroscopy also known as rotational spectroscopy? What is the necessary condition for a molecule to be microwave active?

4B. i) Explain the quantum theory of Raman effect. ii) The rotational Raman spectra of H_2 gas is found to consist of a series of lines of which the first line appears at 3459 cm^{-1} relative to the source of excitation. Calculate the bond length of H_2.

4C. i) Deduce the mathematical expression for the frequency (in terms of wave number) of harmonically oscillating diatomic rigid molecule. ii) With appropriate expressions prove that frequency of radiated light is equal to frequency of the harmonically oscillating diatomic molecule.

[2+3+5]

5A. What are allowed and forbidden transitions in UV-VIS spectroscopy? Explain with examples.

5B. What is the significance of i) Number of signals, ii) Position of signals, iii) Intensities of the signals in the ^1H NMR spectrum of a compound?

5C. What are the disadvantages of single beam IR spectrophotometer? With a neat labelled diagram explain the double beam IR spectrophotometer.

[2+3+5]