MANIPAL INSTITUTE OF TECHNOLOGY
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IV SEMESTER B. TECH. END SEMESTER EXAMINATIONS, APRIL/MAY 2019
ANALYTICAL METHODS AND INSTRUMENTATION (CHM 3281)

Date: 07-05-2019   Time: 3 Hours   Max. Marks: 50

Note: Answer all five full questions. Draw a neat diagram and equations wherever necessary.

1A. Write four differences between common and instrumental methods of analysis

1B. Which of the following compounds are expected to absorb ultraviolet radiation? Explain your reasoning.
i) Benzene   ii) Cyclohexane iii) Acetaldehyde   iv) 1,3-butadiene

1C. Give reasons for the following:
i) Symmetric stretching vibration of CO_2 is IR inactive.
ii) Beer's law not applicable to the colloidal solutions.
iii) ^{1}H-NMR spectrum of ethyl alcohol shows 3 peaks however ethane shows only one peak.
iv) Glass sample holders can't be used in the UV-spectrophotometers

[2+4+4]

2A. Calculate the frequency, wave number and energy for a typical IR radiation of wavelength 10 μm.

2B. Show that $I = \mu r^2$ for a simple diatomic rigid rotator. Describe how the spectrum of rigid and non-rigid diatomic rotators differs.

2C. i) Calculate the approximate wave number of the fundamental absorption peak due to the stretching vibrations of a carbonyl group. The force constant for a double bond has an approximate value of 1×10^6 dynes/cm. The masses of carbon and oxygen atoms are 1×10^{-23} and 2.6×10^{-23} g/atom.
ii) Explain the construction and working principle of the Golay detector.

[2+4+4]

3A. A sample was excited by the 435 nm line of mercury. A Raman line was observed at 444 nm. Calculate the Raman shift in cm^{-1}.

3B. Deduce Lambert's law and discuss the chemical deviations Beer's law.

3C. What is meant by chemical shift? Describe the spin-spin splitting of ethyl bromide and n-butanol in the NMR Spectra.

[2+4+4]

4A. Give reason: Helium is a suitable carrier gas in Gas Liquid Chromatography (GLC) when Differential Thermal Conductivity Detector (DTCD) is used.

4B. Explain the various factors influencing the band broadening of a chromatographic column using a van deemter equation.

4C. i) Discuss the various steps involved in the determination of retention factor (R_f) of a solute by thin layer chromatography (TLC)
ii) Explain the determination of concentration of an unknown acid by potentiometric titrations using a standard NaOH.

(4+4+2)

5A. Write any two similarities and two dissimilarities between GLC and HPLC.

5B. Discuss the various classes of chromatography based on the mobile phase and the equilibrium involved in each type of chromatographic technique.

5C. The following data apply to a column for partition chromatography.
Length of packing = 22.6 cm
Flow rate = 0.287 mL/min.
V_M = 1.26 mL
V_S = 0.148 mL

species	Retention time (min.)	Width of peak base (min.)
unretained	4.2	---
A	14.4	1.07
B	15.4	1.16
C	20.7	1.45

Calculate
(i) Average number of plates and plate height
(ii) Resolution for species A and B; B and C
(iii) Selectivity factor for A and B; for B and C
(iv) the length of the column necessary to give a resolution of 1.5 for A and B

(4+4+2)

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