MANIPAL ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

Reg. No.									

DEPARTMENT OF SCIENCES
I SEMESTER M.Sc. (CHEMISTRY)
END SEMESTER MAKEUP EXAMINATIONS, JANUARY 2024
SPECTROSCOPY-I [CHM 5104]
(CHOICE BASED CREDIT SYSTEM - 2021)

Time: 3 Hours Date:03-01-2024 MAX. MARKS: 50

Note (i) Answer ALL questions
(ii) Draw diagrams, and write equations wherever necessary

Q. No.		Marks	CO	BL
1A	Give reasons for the following: i) Symmetric stretching vibration of CO_2 is IR inactive. ii) Beer's law is not applicable to the colloidal solutions. iii) Glass sample holders can't be used in the UV-spectrophotometers.	3	4	3
1B	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 x 10^6 dynes/cm. The masses of carbon and oxygen atoms are 1 x10^{-23} and 2.6 x 10^{-23} g per atom. ii) Distinguish between rotational spectra of rigid and non-rigid rotator diatomic molecule.	3	4	3
1C	Which of the following organic molecules are expected to absorb ultraviolet radiation? Explain your reasoning. i) Benzene ii) Cyclohexane iii) Ethyl amine iv) 1,3 – Butadiene v) Methanol vi) Benzyl alcohol Write any one characteristic feature of Raman lines.	4	5	2
2A	Explain the construction and working principles of bolometer and photoconductivity cell as detectors in the IR spectrometer.	3	4	1
2B	Why mismatched cells cannot be used in spectrophotometry? Calculate the absorbance and molar absorptivity of 7.25 x 10^{-5} M solution of potassium permanganate, which has a transmittance of 44.1% when measured in a 2.10 cm cell at a wavelength of 525 nm.	3	5	3
2C	Derive mathematical expressions for fundamental, first overtone and second overtone frequencies using an anharmonic oscillator model of diatomic molecules. How do distinguish intra molecular and inter molecular hydrogen bonding using IR spectroscopy?	4	4	2
3A	Calculate the first and second excited rotational energies of CO molecule in the microwave spectroscopy. Given: The internuclear distance of the carbon monoxide molecule is 113 pm. The atomic masses are ^{12}C=1.99x10^{-26} kg; ^{16}O = 2.66x10^{-26} kg.	3	5	3
3B	Prove that the set of symmetry operations of a molecule belonging to C_{2v} point group forms an Abelian group.	3	2	2
3C	Explain the factors responsible for the width of spectral lines. Explain the interaction of organic molecules with the UV region of the electromagnetic spectrum.	4	1	1

4A	Explain the procedure for the quantitative determination of cadmium present in a sample of water through Atomic Absorption Spectroscopy.	3	3	1
4B	Identify the point group of (i) HCl (ii) para-dichlorobenzene (iii) planar cis-H_2O_2	3	5	3
4C	Explain the working of total consumption burner and carbon atomizers in Atomic Absorption Spectroscopy. Explain the function of hollow cathode lamp.	4	3	2
5A	Explain the following interferences observed in Atomic Absorption Spectroscopy. (i) Chemical (ii) Ionization (iii) Bulk	3	3	2
5B	Explain the working principle of Flame Emission Spectroscopy. Mention its drawback. How can it be minimized?	3	3	1
5C	Explain with an example the identification of molecules possessing a permanent dipole moment based on their symmetry. Mention all the symmetry operations which can be carried out on ammonia and phosphorous trichloride.	4	5	2