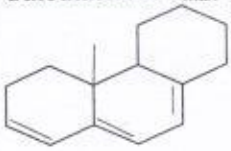
MANIPAL
ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

Reg. No.									

DEPARTMENT OF SCIENCES
I SEMESTER M.Sc. (CHEMISTRY)
END SEMESTER REGULAR EXAMINATIONS, NOVEMBER & DECEMBER 2023
SPECTROSCOPY-I [CHM 5104]
(CHOICE BASED CREDIT SYSTEM - 2021)

Time: 3 Hours Date: MAX. MARKS: 50

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

Q. No.		Marks	CO	BL
1A	Describe the Intensities of rotational spectral lines based on Boltzmann distribution law. Calculate J_{max} for a diatomic molecule at 300 K, having the rotational constant 1.566 cm^{-1}.	3	2	2
1B	How do you distinguish the following using IR spectroscopy? i) Intra molecular and inter molecular hydrogen bonding ii) Primary and secondary amines iii) Geometrical isomers	3	4	2
1C	Define Raman shift. Calculate the Raman shift in cm^{-1} and anti-stoke's line in nm when a sample was excited by 435 nm line of mercury and a Raman stoke's line was observed at 477 nm.	4	4	3
2A	Predict the different types of electronic transitions involved in acetaldehyde and cyclohexane. Write ascending order of energies involved in those transitions.	3	5	2
2B	Distinguish between the following. i) Bathochromic and Hypsochromic shifts in UV-spectroscopy ii) Stoke's and Anti-stoke's lines in Raman spectroscopy iii) Coupled vibrations and Fermi resonance in IR spectroscopy	3	4	3
2C	Describe the working principles of FTIR instrument and write any two advantages of it over the dispersive IR. Why is symmetric stretching vibration of CO_2 IR inactive.	4	4	1
3A	Calculate the λ_{max} for the following molecule using Woodward-Fieser rule. 	3	4	3
3B	Explain the working principle of Flame Emission Spectroscopy. Mention it's drawback.	3	3	2
3C	What is Doppler effect? Explain the factors responsible for the width of spectral lines.	4	1	1
4A	Explain the procedure for the quantitative determination of sodium present in a sample of water using Atomic Absorption Spectroscopy technique. How is the background correction carried out in this technique?	3	3	2

4B	Prove that the set of symmetry operations of a molecule belonging to C_{2v} point group forms an Abelian group.	3	2	3
4C	Define Sn symmetry operation that can be carried on organic molecules. Identify the point groups for the following molecules. i) NO_3^- ii) m-dichlorobenzene iii) Staggered ferrocene	4	5	3
5A	Explain the function of hollow cathode lamp, atomizer, and monochromator in Atomic Absorption Spectroscopy.	3	3	2
5B	Explain the following interferences observed in Atomic Absorption Spectroscopy i) Spectral ii) Chemical iii) Bulk	3	3	2
5C	Based on the symmetry aspects, explain why NH_3 is a dipole while CH_4 is a non-dipole. Describe the interaction of organic molecules with the following electromagnetic radiation. (i) Infrared (ii) UV-visible	4	5	3