MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

DEPARTMENT OF SCIENCES, I SEMESTER M.Sc (CHEMISTRY)
END SEMESTER EXAMINATIONS, Feb 2021

Subject: Spectroscopy I [CHM 5154]

(Choice-Based Credit System, 2020)

Time: 3 Hours Date: 15 Feb 2021 MAX. MARKS: 50

1A. Discuss the moment of inertia equations involved in spherical top and asymmetric top molecules in microwave spectroscopy. Comment on their microwave activity.

1B. Describe the basic principles of FTIR instrument. Write any four advantages of FTIR instrument over the dispersive instruments.

1C. State and deduce the expression for Beer's law. Discuss any two chemical and instrumental deviations from Beer's law.

2+4+4

2A. Give reason for the following;

i) Aniline shows blue shift in the acidic medium.

ii) Stokes lines are more intense than that of anti-stokes lines in Raman spectrum.

2B. i) Differentiate between the following;

a) Fermi resonance and coupled vibrations

b) Rigid and non-rigid microwave spectra of a diatomic molecule

ii) Pure rotational (microwave) spectrum of the gaseous molecule CO consist of a series of equally spaced lines separated by 3.7978 cm^{-1}. Calculate the internuclear distance of the molecule. The molar masses are $^{12}C = 12.011$ and $^{14}N = 15.9994$ $gmol^{-1}$.

2C. Describe the instrumentation involved in Raman Spectroscopy technique.

2+4+4

3A. Based on the symmetry aspects, explain why NH_3 is a dipole while CH_4 is a non-dipole.

3B. Describe the Woodward Fiesher rules for computing λ_{max} of homo/hetero annular dienes in UV-Visible spectroscopy

3C. Explain the procedure for the quantitative determination of cadmium present in a sample of water through Atomic Absorption Spectroscopy. Write the advantages of Atomic Absorption Spectroscopy over Flame Photometry.

2+4+4

4A. Identify the rotation-reflection operation, (Sn) which can be carried out on trans dichloroethylene and eclipsed ferrocene.

4B. Identify the point group of m-dichlorobenzene and prove that the set of symmetry operations of this molecule forms an Abelian group.

4C. What is Doppler effect? Explain the factors responsible for the width of spectral lines.

2+4+4

5A. Explain the following interferences observed in Atomic Absorption Spectroscopy with an example each.

i) Solvent Interference

ii) Ionization Interference

5B. Draw a schematic diagram of the instrumentation involved in Atomic Absorption Spectroscopy and explain the function of hollow cathode lamp, chopper and monochromator.

5C. Determine the point groups of the given molecules by following the systematic procedure.

a) Planar trans H_2O_2

b) $PtCl_4^{2-}$

c) Silicon tetrachloride

d) Cis-dichloroethylene

2+4+4

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