Exam. Code : 210402
Subject Code : 4250

M.Sc. (Chemistry) 2nd Semester

SPECTROSCOPY B : TECHNIQUES FOR STRUCTURE ELUCIDATION OF INORGANIC COMPOUNDS

Course—XII

Time Allowed—3 Hours] [Maximum Marks—75

Note :— (1) The students are allowed to use Non-Programmable Calculator. Ask for Character tables from the Supervisor.

(2) Attempt a total of **five** questions. Each question carries equal marks. Attempt **one** question from each section. The **fifth** question can be attempted from any section.

SECTION—A

1. (a) Identify various symmetry elements belonging to the following molecules :

(i) $PtCl_4^{2-}$

(ii) Allene $CH_2 = C = CH_2$

(iii) $Ni(CO)_4$

(iv) CO_3^{2-}

(v) PCl_3. 7½

(b) Determine the Point Groups in each of the following cases :

(i) H_2S

(ii) PCl_3

(iii) B_2H_6

(iv) C_6H_6

(v) $[CoCl(NH_3)_5]^+$. 7½

2. Determine the hybridization of CH_4 molecule using the following reducing representation of the molecule :

Operation	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$
Character	4	1	0	0	2

The character table for T_d group is :

T_d	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma_d$	
A_1	1	1	1	1	1	$x^2+y^2+z^2$
A_2	1	1	1	–1	–1	–
E	2	–1	2	0	0	$2x^2-y^2-z^2$, x^2-y^2
T_1	3	0	–1	1	–1	R_x, R_y, R_z
T_2	3	0	–1	–1	1	(x,y,z), (xy,yz,zx)

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SECTION—B

3. (a) Differentiate between harmonic and an-harmonic oscillations.

   (b) Describe applications of vibrational spectroscopy.

   (c) Derive an equation for the energies of rotational transitions of rigid diatomic rotor. 5×3=15

4. (a) Discuss non-rigid rotator and compare selection rules of rigid and non-rigid rotators critically.

   (b) Explain polarizability and selection rules in Raman Spectroscopy.

   (c) How symmetry elements are used to determine number of active IR and Raman lines ? 5×3=15

SECTION—C

5. (a) Explain Zeeman Effect and support your answer with diagram. 8

   (b) What is effect of electronic spin on electronic spectra of atoms ? 7

6. (a) Explain Larmor precession in electronic paramagnetic resonance (epr). 8

   (b) How does spin and magnetic field interact in epr to generate signals. 7

SECTION—D

7. (a) How structure elucidation of $I_2Br_2Cl_4$ molecule is done by Mossbauer Spectroscopy ? 8

   (b) Explain isomer shift in Mossbauer spectra. 7

8. (a) What information are obtained from Nuclear Quadruple Resonance spectra of PCl_5, PCl_4Ph, and $TeCl_4$ molecules. 7

   (b) Discuss hyperfine coupling in isotropic systems in NQR spectra. 8