1354

CHE 501

M.Sc. (I[st] SEMESTER) EXAMINATION, 2023-24

(CBCS MODE)

CHEMISTRY

Molecular Symmetry and Molecular Vibrations

Time : Three Hours] [Maximum Marks : 75

Note: There are **three** sections (**A**, **B** and **C**) and Candidate has to attempt all questions. Marks are indicated against each section.

Section-A

1. Answer all questions : 3×5=15

(a) Define inversion operation with suitable example.

(b) Discuss the selection rules for IR. and Raman spectroscopy.

(c) Give all the symmetry operation generated by the following axes of symmetry.

(i) C_5

(ii) S_4

(d) What is Subgroup ? Explain with an example.

(e) Discuss symmetry operation in PCL_5 molecule.

Section-B

Note: Answer all questions of the following : 5×4=20

2. (a) Derive the matrices for rotation operation.

Or

(b) Explain "The Great Orthogonality Theorem" and its consequences.

3. (a) What is Isomorphic Groups ? Explain with suitable example.

Or

(b) What is similarity transform ? Explain its rules. And discuss that three planes of C_{3v} point group fall in same class.

4. (a) What is irreducible representations ? Explain its properties.

Or

(b) Find out the values of the following :

(i) $A_2 \times T_1 \times T_1$

(ii) $E \times T_1 \times T_2$

(iii) $A_1 \times E \times E$

Character table of T_a point group.

5. (a) Define the term point group and assign the following molecules to the correct point group.

(i) CH_4

(ii) MA_3B_3 (Meridonial)

Or

(b) Explain the following with suitable examples.

(i) Dihedral Plane of Symmetry

(ii) Fourfold Axis of Rotation

Section-C

Note: Answer any <u>two</u> questions of the following : 20×2=40

6. What is Normal Modes of Vibration ? Discuss the Cartesian and internal coordinate method to derive the normal mode of vibration for NH_3 molecule. Explain its IR and Raman activity.

7. Discuss the character table for C_{2v} point group in detail.

8. What is Group Multiplication Table ? Discuss group multiplication table of order 1 to 4 with suitable example.

9. Discuss the classification of molecules based on their symmetry operations.

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