

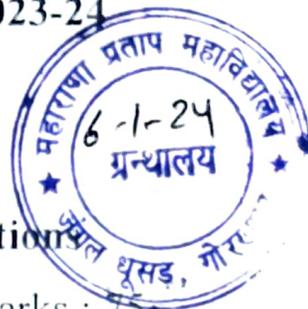
CHE 501

M.Sc. (Ist SEMESTER) EXAMINATION, 2023-24

(CBCS MODE)

CHEMISTRY

1354



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 : $5 \times 4 = 20$

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 :

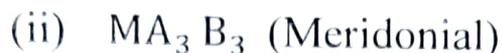
(i) $A_2 \times T_1 \times T_1$

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

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

Character table of T_d point group.

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



Or

(b) Explain the following with suitable examples.

(i) Dihedral Plane of Symmetry

(ii) Fourfold Axis of Rotation

Section-C

Note: Answer any two questions of the following : $20 \times 2 = 40$

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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