

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NCYC512	Group Theory	3	1	0	4

### Course Objective

- This course will impart
- The fundamental understanding of symmetry elements and operations
- Basic principles of group theory
- Applications of group theory in spectroscopy.

### Learning Outcomes

- After studying this course, students should be able to:
- Symmetry of the molecules and the symmetry operations therein.
- Interpret whether a given group is Cyclic, Abelian and/or given a finite Cyclic group.
- Understand the construction and use of character tables in electronic and vibrational spectroscopy.
- Understand the techniques in group theory to interpret electronic spectra in transition metal complexes.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Symmetry elements and symmetry operations, Algebraic Operators, Point groups and its determination in various molecules. Matrix mathematics & Matrix representation symmetry operations, Eigenvalues and eigenvectors, Similarity transformation of matrices, Diagonalization of matrices.	13L + 5T	After studying this unit, the students should be able to: Symmetry of the molecules and the symmetry operations therein.
2	Definition of a Group, Subgroup, Abelian group, Cyclic group. Rearrangement Theorem, Group multiplication Tables, Lagrange's Theorem. Classes, Direct Products, Reducible & Irreducible representations. The Great Orthogonality Theorem and its consequences. Character table & its construction, Standard reduction formula, Symmetry of Translations and rotations. Symmetry of p and d orbitals.	14L + 4T	In this unit the students can interpret whether a given group is Cyclic, Abelian and/or given a finite Cyclic group. They will also learn the construction and use of character tables.
3	Classification & Determination of normal vibrational modes, Transition moment integral and selection rules. Projection operator, Application to atomic orbitals, molecular orbitals, hybridization, LCAO Approximation, $\pi$ -electron	15L + 5T	The students will use character tables in electronic and vibrational spectroscopy. They will learn the techniques in group theory to interpret electronic spectra in transition metal complexes.

	approximation, Hückel $\pi$ -orbital method and applications. Construction of SALCs for different geometry of molecules. SALCs for $\sigma$ and $\pi$ bonding. Molecular orbitals of sandwich compounds.		
<b>Total</b>		<b>42L+14T</b>	

**Text Books:**

1. Chemical Applications of Group Theory, F. A. Cotton, 3<sup>rd</sup> Edition, John Wiley & Sons, 2008.

**Reference Books:**

1. Symmetry and Group Theory in Chemistry, S. K. Dogra and H. S. Randhawa, 1st Edition, New Age International Publishers, 2014.
2. Symmetry in Bonding and Spectra (An Introduction), B. E. Douglas, C. A. Hollingsworth · Academic Press, 2012