JEETENDER CHUGH  TYPE OF COURSE: New | Core | PG
Department of Chemistry & Biology
IISER Pune

COURSE DURATION: 12 Weeks (18 Jan’ 21 - 09 Apr’ 21)
EXAM DATE: 24 Apr 2021

PRE-REQUISITES: General Physical Chemistry, Fundamentals of Spectroscopy

INTENDED AUDIENCE: 3rd year BS-MS students, 1st year M.Sc. students with Chemistry major, 1st year Chemistry Ph.D. students

COURSE OUTLINE:
The objective of the course is to help recognize symmetry in molecules and understand its role in Chemistry. The course will explore the role of symmetry in (A) determining molecular properties (e.g. optical activity, dipole moment), (B) classifying and assigning nomenclature to molecules, molecular states and molecular motions and (C) bringing about simplifications in the application of quantum mechanics to molecules, and (D) determining spectroscopic selection rules based on molecular symmetry. Group theory applied to the study of molecular symmetry has far reaching consequences in chemistry and the course will provide an in-depth appreciation of this.

ABOUT INSTRUCTOR:
He has obtained his M.Sc. in Organic Chemistry from the University of Delhi in 2002; and his Ph.D. in Molecular Biophysics (under the supervision of Prof. R V Hosur) from the Tata Institute of Fundamental Research, Mumbai in 2008 while working in NMR Spectroscopy. He joined IISER Pune as an Assistant Professor in the Department of Chemistry and Biology in 2013 after finishing a postdoctoral fellowship at the University of Michigan, USA (mentor: Prof. Hashim M Al-Hashimi). During his tenure at the University of Michigan, He taught a course on Physical Chemistry Experiments. After joining IISER Pune, He has been teaching several theory and lab courses. He has also been teaching Introduction to NMR spectroscopy in Structural Biology at multiple departments of Savitribai Phule Pune University since 2014. He has been teaching the proposed course (Symmetry and Group Theory) at IISER Pune since Aug 2017.

In this course, he will be using whiteboard to teach, with his voice over and video insert to explain. This is specifically important in this course as students need to see how to draw various symmetry elements and carry out respective operations, which is not so clear in pre-drawn power-point based teaching. Also, all the derivations will be done on the whiteboard and not by showing pre-written equations in power-point. He believe this style of teaching will be really beneficial for the students.

COURSE PLAN:

Week 1: Introduction to the course; Symmetry Elements and Operations
Week 2: Product of symmetry operations, Symmetry Point Groups, Schonflies Notations of the Point Groups
Week 3: Point Group Determination; Applications of Symmetry - Prediction of Dipole Moment and Optical Activity
Week 4: Definition of Group, Sub-group, Class; Group Multiplication Tables
Week 5: Matrix Representation of the Symmetry Operations in Point Groups
Week 6: Reducible, Equivalent, and Irreducible Representations
Week 7: The Great Orthogonality Theorem and its Corollaries
Week 8: Construction of Character Tables and Meaning of all the terms in the Character Table; Mulliken Symbols for Irreducible Representations; Representations of Cyclic Groups
Week 9: Direct Product of Irreducible Representations
Week 10: Application to Spectroscopy
Week 11: Projection Operator and its application to Symmetry Adapted Linear Combinations (SALCs)
Week 12: Application to Quantum Mechanics; Construction of Molecular Orbital correlation diagram of simple and complex molecules