GROUP THEORY METHODS IN PHYSICS

PROF. P. RAMADEVI
Department of Physics
IIT Bombay

TYPE OF COURSE: Renew | Elective | UG
COURSE DURATION: 12 weeks (18 Jan' 21 - 09 Apr' 21)
EXAM DATE: 25 Apr 2021

PRE-REQUISITES: Linear Algebra, Quantum Mechanics, Special Theory of Relativity
INTENDED AUDIENCE: Students with background in Physics
INDUSTRIES APPLICABLE TO: This tool may be applicable at R&D department of industries

COURSE OUTLINE:
This course is a first course pitched at UG level so that the students can appreciate the wide applications of the group theory tools in other areas of Physics

ABOUT INSTRUCTOR:
Prof. Ramadevi's research is in Mathematical Physics. She has been working on knot invariants from Chern-Simons theory and topological strings.

COURSE PLAN:
Week 1: Introduction to discrete groups, subgroups and generators, conjugacy classes
Week 2: Symmetric groups, permutation group, cycle notation
Week 3: Direct product groups, semi-direct product groups
Week 4: Symmetries of molecules, point groups and Stereographic projection
Week 5: Matrix representation of groups, Reducible and irreducible representation
Week 6: Great Orthogonality Theorem and Character tables, Mulliken notation
Week 7: Tensor product, projection operator, observables, selection rules, Molecular vibrations
Week 8: Continuous groups, generators, Lorentz transformations
Week 9: Orthogonal groups and Lie algebra
Week 10: Unitary groups, SU(2), SU(3), weight vector diagrams and root vector diagrams
Week 11: Wigner Eckart Theorem, Examples
Week 12: Quark model, SU(3) baryons, mesons, Wigner-Eckart theorem, hydrogen atom, dynamical symmetry