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**FIRST SEMESTER 2021-2022**

# Course Handout Part II

Date: 20-08-21

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* :  *PHY F422*

## Course Title : Group Theory and Applications

## Instructor-in-Charge : Rahul Nigam

**Scope and Objective of the Course: Group theory is an important tool which allows a better understanding of concepts across many areas of Physics including particle physics, string theory, atomic, molecular and nuclear physics. The objective of the course is to introduce students to the two essential branches of group theory – Discrete groups and Lie groups and their applications.**

**Textbooks:**

1. Elements of Group Theory for Physicists by A W Joshi (AWJ)
2. Lie Groups, Physics and Geometry by Robert Gilmore (RG)

**Reference books**

1. A course on Group Theory by John S. Rose

**Course Plan:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1-6 | Introduction to Symmetries and Abstract Group Theory | Definition of Groups, Connection between Symmetries and groups, Subgroups, Cosets, Isomorphism and Homomorphism, Classes | AWJ 1 |
| 7-12 | Hilbert spaces and operators | Vector spaces and Hilbert spaces, operators, Group action on vector spaces | AWJ 2 |
| 13-19 | Discrete groups | Permutation groups, Multiplication table, Schur’s lemma, Reducible and Irreducible Representations | AWJ 3 |
| 20-29 | Continuous groups and their representations | Topological and Lie groups, SO(2), SO(3), Lorentz group, Lie algebra and representation, Unitary representation | AWJ 4 |
| 30-34 | To understand Root spaces and Dynkin diagrams | Properties of roots, Root space diagrams, Dynkin diagrams | RG 10 |
| 35 – 43 | Learning the applications of Group Theory in Physics | Application in Molecular and crystal structure, Quantum Mechanics, Symmetry of Hamiltonian, Selection rules, Isospin symmetry, SU(3) quark model | AWJ 5,6 |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| MidSem | 90 mins | 30 | 19/10/2021 1.30 - 3.00PM | Open book |
| Assignments (2) |  | 15 each |  |  |
| Comprehensive Exam | 120 mins | 40 | 15/12 AN | Open book |

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** Notices concerning the course will be put up on the CMS

**Make-up Policy:** Make-up for the tests will be granted only for genuine cases of health.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**