



**SECOND SEMESTER 2021-2022**  
Course Handout Part II

Date: 15-01-2022

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 F425  
Course Title : Advanced Mathematical Methods of Physics  
Instructor-in-Charge : Subhash Karbelkar

**Scope and Objective of the Course:** The course will cover topics in advanced mathematics which find extensive applications in Theoretical Physics. Upon successful completion, students will have the knowledge and skills to:

1. Explain the fundamental concepts of a few special topics in theoretical physics.
2. Demonstrate accurate and efficient use of specific mathematical physics techniques.
3. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from theoretical physics.

**Textbooks:**

1. Lectures on Advanced Mathematical Methods for Physicists<sup>a</sup> (Sunil Mukhi and N. Mukunda)
2. Gauge Fields, Knots and Gravity<sup>b</sup> (John Baez and Javier Muniaín)

**Reference books**

1. Geometrical Methods of Mathematical Physics (Bernard F. Schutz)
2. Introduction to Topology (Bert Mendelson)
3. Elementary Differential Geometry (Christian Bar)

**Course Plan:**

Number of lectures	Learning objectives	Topics to be covered	Chapter in the Text Book
10	Introduction to Topology	Topology, Metric Spaces, Manifolds, Connected and compact spaces, Homeomorphisms, Homotopy	a.1-a.2, b.1
10	Homology and Fibre Bundles	Simplicial Homology, de Rham Cohomology, Vector bundles and Principal Bundles	a.5-a.6, b-1
8	Differential Manifolds	Calculus on manifolds, Vector and Tensor fields, Differential Forms, Riemannian Geometry	a.3-a.4



6	Continuous Groups	Abelian, Non-abelian groups, Lie Groups, Representation, Dynkin Diagrams	a.7-a.9
6	Gauge Fields	De Rham Theory in Electromagnetism, Curvature and Yang Mills Equations	b.1-b.2

**Evaluation Scheme:**

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid Sem Exam	90 mins	35	11/03 3.30pm to 5.00pm	Open Book
Assignments (2)		15 each		
Comprehensive Exam	120 mins	35	10/05 AN	Open Book

**Chamber Consultation Hour:** Will be announced during the class.

**Notices:** CMS

**Make-up Policy:** Student must inform prior to the exam and provide convincing proof for absence.

**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**

