First Course Handout for 'A Physicist's Introduction to Topology and Differential Geometry': PHY 690XX

1. **About the Course**: In general some conceptions in topology and differential geometry are essential for modern physics students. The conceptions are heavily used in modern theories of condensed matter, high energy physics, theories of gravity and cosmology. Concepts of topology and differential geometry are highly used in the modern formulation of classically dynamics and dynamical systems studies. In such a situation a course on the basic concepts of topology and differential geometry for physicist's becomes an essential duty.

   In this course we will start with the basic conception of a topological space and show how it is naturally connected with some topics used in physics as the Lie groups SO(3) or functional spaces as Hilbert spaces. Then we will elaborate on various topological properties of spaces as homotopy and homology. After introducing the basic concepts of topology we will like to set up the basic concepts of differential geometry. The theory of manifolds will be discussed and then we will elaborate the theory of tensors on manifolds. A elaborate introduction to p-forms will be discussed. We will see how these topics are intimately related to our physical description of various systems. We will end with a discussion on fiber bundles.

2. **Mode of Examinations**: If the number of students in the course is more than twenty-five, we will have two standard open notes examinations in the course. If the number of students enrolled in the course is less than twenty five then we will have only the end-sem examination and project work. The exact plan can only be specified after the course starts.

3. **Prerequisites**: Mathematical Method I. Anyone who has taken a similar course in the mathematics department is recommended not to credit this course.

4. **Attendance Policy**: Ten percent of the total evaluation, for each student, will depend upon his/her class attendance.

5. **Recommended books**:

   - 'Topology' by James R. Munkres
   - 'Introduction to Topology and Modern Analysis' by George F. Simmons
   - 'Elements of Algebraic Topology' by James R. Munkres
   - 'Topology and Geometry for Physicists' by Charles Nash, Siddhartha Sen

Kaushik Bhattacharya,
Department of Physics,
IIT Kanpur