Course name: Introduction to Symplectic Geometry

Introduction to the course: Symplectic geometry, a branch of differential geometry, has emerged as a powerful tool in mathematical physics and various areas of pure mathematics. It deals with symplectic manifolds, which are geometric spaces equipped with a non-degenerate, closed two-form called the symplectic form. This form captures essential geometric properties related to volume preservation and preserves the structure of Hamiltonian dynamics. Symplectic geometry finds applications in classical mechanics, dynamical systems, mathematical physics, and algebraic geometry, among others. Its elegant mathematical framework provides deep insights into the geometry of phase spaces, generating profound connections with topology, algebra, and analysis.

In this course we will mainly study the mathematical parts of the symplectic geometry. The first part of the course will be devoted to the proof of Darboux theorem. Although the course has some prerequisite, but I will revise most of the thing. Some of the things include:

- Vector fields and flows on smooth manifolds
- Differential forms

Therefore, this course will be suitable for undergraduate and graduate students. A short overview of the course is as follows:

(1) Review of differential geometry
(2) Review of symplectic algebra
(3) Symplectic manifolds
(4) Darboux theorem
(5) Hamiltonian mechanics (maybe next semester).

The reference for this course will be:

(1) [MS17]. This is a big book and a good reference.
(2) [Wei77]. A concise reference.
(3) [CdS01]. This is similar to [Wei77]. It is easy to read and more concise.
(4) [Nak03]. Mainly for physics part of the symplectic geometry and for mathematical preliminaries.

Introduction to the Instructor: Sachchidanand Prasad completed his PhD in 2022 from the Indian Institute of Science Education and Research Kolkata, India. His thesis was on Riemannian geometry, titled *Cut Locus of Submanifolds: A Geometric and Topological Viewpoint.* After his PhD, he was a postdoctoral fellow at International Centre for Theoretical Sciences (ICTS-TIFR) Bengaluru, India. His main area of research is differential geometry and algebraic topology.

References

[CdS01] Ana Cannas da Silva. *Lectures on symplectic geometry*, volume 1764 of *Lecture Notes in Mathematics*. Springer-Verlag, Berlin, 2001.

[MS17] Dusa McDuff and Dietmar Salamon. *Introduction to symplectic topology*. Oxford Graduate Texts in Mathematics. Oxford University Press, Oxford, third edition, 2017.

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[Nak03]   Mikio Nakahara. *Geometry, topology and physics*. Graduate Student Series in Physics. Institute of Physics, Bristol, second edition, 2003.

[Wei77]   Alan Weinstein. *Lectures on symplectic manifolds*. Regional Conference Series in Mathematics, No. 29. American Mathematical Society, Providence, RI, 1977. Expository lectures from the CBMS Regional Conference held at the University of North Carolina, March 8–12, 1976.