Semester	JAN 2022
Open to semester	8,12,14
Course code	**MTH422**
Course title	**Differential Geometry**
Credits	4 /
Course Coordinator & participating faculty (if any)	Mainak Poddar
Nature of Course	Lectures
Pre-requisites	Calculus on Manifolds (MTH 322)
Objectives (goals, type of students for whom useful, outcome etc)	This capstone class in geometry completes the treatment of manifolds from MTH 327, and continues into the deeper terrain of Riemannian Geometry and Lie Theory. A Riemannian metric on a manifold M is used to define the notions of lengths and area on submanifolds of M, and moreover notions of geodesics, curvature and parallel transport. This course leads up to Gauss' celebrated Theorem Egregium of the intrinsic nature of curvature. A group may be given a manifold structure so that it becomes a “Lie Group”; naturally a manifold with many symmetries. Lie groups and their quotients, called homogeneous spaces, furnish a wealth of interesting examples in geometry. Their infinitesimal generators form interesting algebraic objects called “Lie algebras”. The beautiful correspondence between Lie groups and Lie algebras is described in this course. This is an important course for both future topologists and theoretical physicists.
Course contents (details of topics /sections with no. of lectures for each)	Smooth manifolds, tangent spaces, Lie groups and Lie algebras, Homogeneous spaces, examples, Derivatives of functions on manifolds, Immersions and submersions, vector fields, Frobenius theorem, Flows and exponential map, matrix exponential function on a linear Lie group, Lie subgroups and subalgebras, Adjoint representation, Tensor fields, differential

	forms, Exterior derivatives, Orientation, Integration on manifolds, Connections, Parallel transport, Covariant derivatives, Riemannian metrics, Levi-Civita connection, Geodesics, First and second fundamental form for surfaces, Gaussian curvature, Theorema Egregium, Examples of negatively/positively curved/flat manifolds, Isometry groups of Riemannian manifolds.
Evaluation /assessment	End-Sem Examination-40% Mid-Sem Examination-40% Others-Continuous assessment: 20%%
Suggested readings (with full list of authors, publisher, year, edn etc.)	1. Riemannian manifolds. An introduction to curvature: John M. Lee (1997) GTM Springer 2. Foundations of Differentiable Manifolds and Lie Groups: F. Warner (1983) GTM Springer 3. An Introduction to Manifolds: L. Tu (2011) Springer 4. Introduction to Differentiable Manifolds and Riemannian Geometry: W. M. Boothby (2003) Academic Press 5. Differential Geometry of Curves and Surfaces: Manfredo P. do. Carmo (1976) Prentice Hall 6. A Course in Differential Geometry and Lie Groups: S. Kumaresan (2002) Hindustan Book Agency