

MA2824 Differential Geometry

Professor: Julien Duval

Language of instruction: French – **Number of hours:** 36 – **ECTS:** 3

Prerequisites: Advanced course in analysis, infinitesimal and integral calculus

Period: S8 Elective 09 February to April IN281E2, SEP81E2

Course Objectives

This course is part of the Differential Geometry course of the MSc of Fundamental Mathematics of University Paris XI. The basic concepts of differential geometry and Riemannian geometry are fundamental tools for the study of Differential Equations and General Relativity (see course PH2500). This theoretical mathematics course introduces the fundamental notions of differential geometry, with many applications in geometry and topology.

On completion of the course, students should be able to

follow advanced courses based on manifolds, operations on vector fields, differential forms and Riemannian metrics

Course Contents

Topology and Differential Calculus in the n -dimensional space

- ◇ Local inversion Theorem ; Brouwer's Theorem, Domain invariance ; Borsuk-Ulam 's Theorem; Jordan's Theorem

Implicit function Theorem, submanifolds

- ◇ Vector fields, differential equations, Cauchy-Lipschitz' Theorem
- ◇ Matrix exponential, Closed subgroups of the linear group

Planar curves, curves in the 3-dimensional space

- ◇ Length, curvature

Surfaces in the 3-dimensional space

- ◇ Length of arcs, area
- ◇ Mean curvature, Gauss curvature, minimal surfaces
- ◇ Gauss-Bonnet's Theorem

Complements (possibly treated in the M1 course)

- ◇ Laplacian, spectrum of a surface
- ◇ Rudiments of Morse theory
- ◇ Toward manifolds and Riemannian manifolds

Course Organization

Lectures: 21 hr, Tutorials: 12 hr, Exam: 3 hr

All courses will take place at Orsay.

Teaching Material and Textbooks

- ◇ Course reader of similar courses (in French)
- ◇ J. Thorpe, Elementary Topics in Differential Geometry, Springer-Verlag
- ◇ J. Milnor, Topology from the differentiable viewpoint, Princeton Univ. Press
- ◇ S. Lang, Differential and Riemannian Manifolds, Springer-Verlag

Evaluation

3-hr written final exam, without documents