MATH-213

Differential geometry I - curves and surfaces

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Cursus	Sem.	Type
Mathematics	BA3	Obl.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**6 weekly**
Courses	3 weekly
Exercises	3 weekly
Number of positions	

Summary

This course serves as an introduction to classical differential geometry, which studies the geometric properties of curves and surfaces in the Euclidean space.

Content

- Curves in the Euclidean plane and the Euclidean space.
- The notion of submanifolds of Euclidean space, charts, local parametrizations, the tangent space.
- The metric tensor (first fundamental form) of a parametrized surface.
- Curvature of regular surfaces (second fundamental form, Gaussian curvature, mean curvature, principal curvatures).
- Isometric surfaces. Gauss's Theorema Egregium.
- Notions of hyperbolic geometry.
- A short introduction to notions of abstract manifolds.

Keywords

Curves, surfces, submanifolds, curvature, torsion, geodesics, first/second fundamental form, differential geometry, hyperbolic geometry.

Learning Prerequisites

Required courses

All first year courses in the mathematics (or physics) programme.

Learning Outcomes

By the end of the course, the student must be able to:

- Give an example of a regular curve and a regular surface and know how to parametrize them.
- State the definitions given in class.
- Prove the theorems presented in class.
- Develop a geometric intuition around the concepts presented in class.
- Develop the ability to perform geometric calculations.
- Solve the problems in the exercise sheets.

Transversal skills

- Use a work methodology appropriate to the task.
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking

Teaching methods

Weekly lectures and exercise sessions.

Expected student activities

Study and understand the concepts presented in class, solve the exercises.

Assessment methods

Written exam.

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

The course will be based on the following books, which can be accessed via the EPFL library:
- S. Kobayashi, "Differential geometry of curves and surfaces",
- M. do Carmo, "Differential geometry of curves and surfaces".

The following books can be used as alternative resources:
- T. Needham, "Visual differential geometry and forms",
- V. Toponogov, "Differential geometry of curves and surfaces",
- M. Umehara, "Differential geometry of curves and surfaces".

Ressources en bibliothèque

- Find the references at the Library

Moodle Link

- https://go.epfl.ch/MATH-213

Prerequisite for

The rest of the courses on the differential geometry series (manifolds, Riemannian geometry, general relativity), algebraic geometry.