

MATH-515

**Topics in calculus of variations**

Cursus	Sem.	Type
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Oral
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Remark**

pas donné en 2023-24

**Summary**

Introduction to classical Calculus of Variations and a selection of modern techniques.

**Content**

- Classic functionals in the Calculus of Variations
- Semi-direct methods
- Direct method in Calculus of Variations
- Functionals in Sobolev spaces, convexity, lower semicontinuity, existence and regularity
- If time allows: Plateau's problem, Gamma-convergence, isoperimetric problem

**Keywords**

calculus of variations, optimization, minimization, Euler-Lagrange equations, first variation, direct method, Lagrangian, convexity, lower semicontinuity.

**Learning Prerequisites****Required courses**

- MATH-200: Analysis III
- MATH-205: Analysis IV
- MATH-303: Measure and integration

**Recommended courses**

- MATH-301: Ordinary differential equations
- MATH-302: Functional analysis I

- MATH-305: Sobolev spaces and elliptic equations
- MATH-437: Calculus of Variations

### Learning Outcomes

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

- Demonstrate proficiency in statements
- Identify use and role of the assumptions
- Recognize which concepts and results could be used in a given context
- Describe concepts and proofs
- Apply theory for specific examples

### Teaching methods

Lectures + Exercises

### Assessment methods

Oral

Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

### Supervision

Assistants                      Yes

### Resources

#### Bibliography

"Introduction to the Calculus of Variations", B. Dacorogna

"Direct Methods in Calculus of Variations", B. Dacorogna

"Calculus of Variations", J. Jost & X. Li-Jost

"One-dimensional Variational Problems", G. Buttazzo & M. Giaquinta & S. Hildebrandt

"Introduction to the Modern Calculus of Variations", F. Rindler

"Sets of Finite Perimeter and Geometric Variational Problems: An Introduction to Geometric Measure Theory", F. Maggi

"Measure Theory and Fine Properties of Functions", L.C. Evans & R.F. Gariepy

#### Ressources en bibliothèque

- [One-dimensional Variational Problems / Buttazzo](#)
- [Introduction to the Calculus of Variations / Dacorogna](#)
- [Calculus of Variations / Jost](#)
- [Direct Methods in Calculus of Variations / Dacorogna](#)
- [Introduction to the Modern Calculus of Variations / Rindler](#)
- [Sets of Finite Perimeter and Geometric Variational Problems: An Introduction to Geometric Measure Theory / Maggi](#)
- [Measure Theory and Fine Properties of Functions / Evans](#)