Course syllabus

Variationskalkyl
Calculus of Variations

FMAN25, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED F/Pi
Date of Decision: 2023-04-18

General Information

Elective for: D4, E4, F4, F4-bg, Pi4-bs, Pi4-fm, Pi4-bem
Language of instruction: The course will be given in English on demand

Aim

The aim of the course is to present the basic theory for, and applications of, the calculus of variations, i.e., optimization problems for "functions of functions". A classical example is the *isoperimetric problem*, to find which closed curve of a given length encloses maximal area. Many physical laws can be formulated as *variational principles*, i.e. the law of refraction. The calculus of variations is also a corner stone in classical mechanics, and has many other technological applications e.g. in systems theory and optimal control.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

be able to explain the basic parts of the theory in the context of an oral examination.

Competences and skills
For a passing grade the student must

- be able to demonstrate an ability to identify problems which can be modelled with the concepts introduced.
- be able to integrate methods and approaches from the different parts of the course in order to solve problems and answer questions within the framework of the course.

- in writing and orally, with clear logic and proper terminology be able to explain the solution to a mathematical problem within the course.

Contents

- Variational problems without and with constraints. Euler's equations with and without constraints. Legendre's, Jacobi's and Weierstrass necessary conditions for a local minimum.
- Hilbert's integral and Weierstrass sufficient conditions for a strong local minimum.
- Hamilton's principle and Hamilton's equations. Lagrange's och Mayer's problems.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written assignments and oral exam.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: FMAB30 Calculus in Several Variables.
The number of participants is limited to: No
The course overlaps following course/s: FMA200, MATC25

Reading list

- Kot, M: A First Course in the Calculus of Variations. American Mathematical Society, 2014, ISBN: 978-1-4704-1495-5.

Contact and other information

Course coordinator: Anders Holst, studierektor@math.lth.se
Course administrator: Studerandeexpeditionen, expedition@math.lth.se
Teacher: Andrey Ghulchak, Andrey.Ghulchak@math.lth.se
Course homepage: https://canvas.education.lu.se/courses/20370