

## Theoretical Mechanics I (E040050)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2025-2026**

A (semester 1)

Dutch

Gent

seminar

lecture

**Lecturers in academic year 2025-2026**

Van Neck, Dimitri

WE05

lecturer-in-charge

**Offered in the following programmes in 2025-2026**

[Bachelor of Science in Engineering\(main subject Engineering Physics\)](#)

6

A

[Bridging Programme Master of Science in Engineering Physics](#)

6

A

[Preparatory Course Master of Science in Engineering Physics](#)

6

A

**Teaching languages**

Dutch

**Keywords**

Theoretical mechanics, systems of particles, Newtonian formalism, Lagrangian formalism, Hamiltonian formalism

**Position of the course**

Theoretical Mechanics aims at providing a mathematical formulation of mechanics. It gives the students insight into the construction of a mathematical model for a physical theory. In the course 'Theoretical Mechanics I' attention is paid to the mechanics of point particles. The first part which is devoted to Newtonian mechanics, is partly complementary to the mechanics which students have seen in the first bachelor's course "Physics I", at least in the sense that it covers the same concepts and techniques, but is presented now in a more mathematical and less descriptive way. The second part, Lagrange and Hamilton dynamics, offers an acquaintance with a more general formulation of mechanics which plays an important role in many domains of theoretical physics (quantum mechanics, field theories, ...).

**Contents**

- Introduction: goal of the course.
- Elements of vector calculus and kinematics: complements to vector calculus, motions, special coordinate systems, relative motion.
- Basic principles of dynamics.
- General theorems: linear momentum and angular momentum; kinetic and potential energy; conservation laws; qualitative study of 1-dimensional conservative systems; general phase diagram in the plane.
- Applications: oscillators, central forces and Kepler's problem, charged particle motion, motions with constraints (along a curve or on a surface).
- Dynamics of systems of particles: general theorems, centre of mass, application to the two-body problem.
- Introduction to the Lagrangian and Hamiltonian formalism.

**Initial competences**

Having followed successfully the following courses from the first year of bachelor and from the first semester of the second year of bachelor in the engineering sciences, or having acquired equivalent objectives: Mathematical Analysis I:

functions of one variable; Mathematical Analysis II: functions of several variables; Geometry and linear algebra.

### Final competences

- 1 To have insight in the Newtonian formulation of classical mechanics of point masses.
- 2 To be able to analyse and solve simple problems in mechanics and to be able to interpret their solution.
- 3 To have insight in the Lagrangian and the Hamiltonian formalism for point masses.
- 4 To be able to set up the Lagrange and the Hamilton equations in concrete applications.
- 5 To have a general insight in the construction and the meaning of a mathematical model for a physical theory.

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Seminar, Lecture

### Extra information on the teaching methods

Theory: plenary lectures.

Exercises: a combination of plenary exercises (some problems are worked out explicitly on the blackboard by way of example) and guided self-study (the students can work individually or in group on some problems).

### Study material

Type: Slides

Name: Slides Theoretical Mechanics I

Indicative price: Free or paid by faculty

Optional: no

Language : Dutch

Number of Slides : 235

Available on Ufora : Yes

Online Available : Yes

Available in the Library : No

Available through Student Association : No

### References

### Course content-related study coaching

The lecturer and the assistant are always available for explanations immediately after the lectures or during and after the practical classes, or after making an appointment. Smaller problems can also be dealt with by e-mail. General information concerning the lectures, the exercises and the exams is distributed via the electronic learning platform

### Assessment moments

end-of-term assessment

### Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions, Written assessment open-book

### Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions, Written assessment open-book

### Examination methods in case of permanent assessment

### Possibilities of retake in case of permanent assessment

not applicable

### Extra information on the examination methods

Theory: written closed-book exam; Exercises: written open-book exam.

**Calculation of the examination mark**

Special conditions: theory and exercises each have equal weight.