GHENT UNIVERSITY

# Course Specifications

Valid as from the academic year 2024-2025

## Theoretical Mechanics (C004210)

**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 2) | 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** | **crdts** | **offering** |
|---|---|---|
| Bachelor of Science in Mathematics | 6 | A |
| Bachelor of Science in Physics and Astronomy | 6 | A |

**Teaching languages**

Dutch

**Keywords**

Newtonian mechanics, formalisms of Lagrange and Hamilton.

**Position of the course**

This course unit belongs to the learning pathway "Theoretical physics" in the Bachelor program Physics and Astronomy.
Deepening of the basic principles of classical Newtonian mechanics that were acquired in the Mechanics course. Getting acquainted with theoretical physics as the modeling of natural phenomena using mathematical concepts and techniques. Application to physics problems of the course material on Linear algebra and Analysis.

**Contents**

Introduction and rehearsal of mathematical concepts; Kinematics: velocity and acceleration in various reference frames; Dynamics: Newton's laws. Inertial and non-inertial frames. Motion of a particle in a force field. Power, energy and conservative forces. Applications: central forces, Kepler's problem, motion constrained to a surface or curve; Systems of interacting particles; Kinematics and dynamics of rigid bodies. Euler's laws; Lagrange-Hamilton formalism: classification of constraints and forces. Concept of generalized coordinates. Lagrangian equation of motion with applications. Conservation laws. Legendre transformation. Hamilton's equations of motion. Small-amplitude excursions from equilibrium: vibrational analysis.

**Initial competences**

This is a second-semester course using material from the introductory physics (Mechanics) and mathematics (Algebra and Functions) courses. It is assumed the students have acquired the final competences of these courses.

**Final competences**

1 Understanding and being able to apply the mathematical description of classical Newtonion mechanics, both in terms of Newton's laws as in terms of the Lagrange-Hamilton formalism.
2 Understanding the idealizations unavoidably present in mathematical modeling, and of the associated computational techniques.
3 Exhibiting problem-solving capabilities when dealing with mechanical problems.

**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: lectures
- Exercises: guided sessions

**Study material**

Type: Slides

Name: slides
Indicative price: Free or paid by faculty
Optional: no
Language : Dutch
Number of Slides : 250
Available on Ufora : Yes
Online Available : Yes

**References**

- H. Goldstein, C. Poole, J. Safko, “Classical mechanics”, Addison Wesley

**Course content-related study coaching**

Additional consultations with teacher and assistants are possible. Presentation slides will be made available on Ufora.

**Assessment moments**

end-of-term assessment

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

Written assessment with open-ended questions

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

Written assessment with open-ended questions

**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 exam with closed book
- Exercises: written exam with open book

**Calculation of the examination mark**

Equal weights for theory and exercises.