GHENT UNIVERSITY

# Course Specifications

From the academic year 2024-2025 up to and including the academic year

## Plasma Technology and Fusion Technology (E006900)

**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) | English | Gent | lecture |
| B (semester 1) | Dutch | Gent | |

**Lecturers in academic year 2025-2026**

| | | |
|---|---|---|
| Morent, Rino | TW17 | lecturer-in-charge |
| Biel, Wolfgang | TW17 | co-lecturer |

| Offered in the following programmes in 2025-2026 | crdts | offering |
|---|---|---|
| Master of Science in Teaching in Science and Technology(main subject Physics and Astronomy) | 6 | A |
| European Master of Science in Nuclear Fusion and Engineering Physics | 6 | A |
| Master of Science in Engineering Physics | 6 | B |
| Master of Science in Engineering Physics | 6 | A |
| Master of Science in Physics and Astronomy | 6 | A |
| Master of Science in Physics and Astronomy | 6 | A |

**Teaching languages**

English, Dutch

**Keywords**

Low-temperature and high-temperature plasmas, plasma sources, plasma-chemical interactions, materials technology, environmental technology, lasers and light sources, biomedical applications, plasma medicine, fusion technology, magnet technology, plasma-wall interaction, plasma-facing components, radiation damage, materials modelling, tokamaks and stellarators, fusion reactors, diagnostics, plasma control, data analysis, plasma heating

**Position of the course**

The goal of the course is twofold:
- To acquire a thorough level of understanding of low-temperature plasma applications in materials technology, environmental technology, biomedical technology and plasma medicine.
- To acquire a thorough level of understanding of energy production via nuclear fusion, fusion physics, fusion reactor principles, fusion reactor diagnostics and material technology for fusion.

**Contents**

**Part A: Plasma Technology**
- Plasma sources
- Plasma-chemical reactions
- Applications in materials technology
- Applications in environmental technology
- Lasers and light sources
- Plasmas for biomedical applications
- Plasma medicine

**Part B: Fusion Technology**

- Introduction and overview on fusion physics and technology
- Magnet technology
- Blanket technology
- Basics of plasma-wall interactions
- Radiation damage in structural materials for fusion reactors
- Materials modelling
- Plasma-facing-components (PFCs): materials under high heat loads
- Different types of fusion reactors: tokamak, stellarator, Wendelstein W7-X, ...
- Alternative confinement concepts
- Diagnostics, control and data analysis for fusion plasmas
- Plasma heating

**Initial competences**

Vector calculus, classical mechanics, electromagnetism

**Final competences**

1 Understand the working principles and engineering challenges of industrial plasma sources
2 Insight in technological applications of plasmas in different fields
3 Being able to process scientific literature and to make a synthesis/review on a certain subject
4 Being able to report and present scientific findings as a team
5 Knowledge of the physical basis of nuclear fusion
6 Knowledge of technological and engineering aspects of nuclear fusion regarding material requirements, plasma diagnostics and reactor development

**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**

Group work, Seminar, Lecture, Independent work, Peer teaching

**Extra information on the teaching methods**

Part A: Plasma Technology
- Lecture
- Invited lectures by specialists in the field
- Lab visit
- Independent work and group work
- Student group work presentations and discussion

Part B: Fusion Technology
- Lectures
- Invited lectures by specialists in the field
- Problem solving

For the group work, each student team elaborates on a case study, prepares a joint report and presents it together with their team fellows to all students. Questions are asked to test the insight in the subject.

**Study material**

None

**References**

- F.F. Chen: I*ntroduction to Plasma Physics and Controlled Fusion*
- J. Freidberg: *Plasma Physics and Fusion Energy*
- Y.P. Raizer, *Gas Discharge Physics*
- M. Kikuchi, K. Lackner, M.Q. Tran, *Fusion Physics*
- W. Lochte-Holtgreven: *Plasma diagnostics*

**Course content-related study coaching**

The instructor can be contacted after the lectures, or by appointment. Interactive support via the electronic learning platform

**Assessment moments**

end-of-term and continuous assessment

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

Oral assessment

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

Oral assessment

**Examination methods in case of permanent assessment**

Oral assessment, Presentation, Assignment

**Possibilities of retake in case of permanent assessment**

examination during the second examination period is not possible

**Extra information on the examination methods**

- Part A: Plasma Technology:
  - Continuous assessment, presentation, oral examination, report
  - graded report of group work; graded oral presentation with questions. Frequency: 1 case study + 1 oral presentation
- Part B: Fusion Technology:
  - Oral examination
  - Oral closed-book exam

**Possibilities of retake permanent evaluation:** group worl report in adapted form – to be submitted before the start of the second examination period

**Calculation of the examination mark**

Special conditions: The weight of the non-permanent evaluation is in principle 50%. However, when a mark of less than 10/20 is obtained for the permanent or non-permanent evaluation, the weight of the lowest score is increased to 90%. The results of the first examination period for the permanent evaluation will be transferred to the second examination period.