GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

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 2023-2024

A (semester 1)	English	Gent	lecture
B (semester 1)	Dutch	Gent	

Lecturers in academic year 2023-2024

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

Offered in the following programmes in 2023-2024	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
Exchange Programme in Physics and Astronomy (Master's Level)	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.

Learning materials and price

Slides

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.