GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2023-2024

Environmentally Assisted Degradation of Materials (E066662)

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

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2023-2024

A (semester 2)	English	Gent
B (semester 2)	Dutch	Gent

Lecturers in academic year 2023-2024

Verbeken, Kim	TW11	lecturer-in-charge
Depover, Tom	TW11	co-lecturer

Offered in the following programmes in 2023-2024	crdts	offering
Bridging Programme Master of Science in Sustainable Materials Engineering	6	A
Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)	6	A
Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research (main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Electromechanical Engineering (main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research (main subject Transport and Mobility Engineering)	6	A
International Master of Science in Sustainable and Innovative Natural Resource Management	6	A
Master of Science in Chemical Engineering Technology	6	A
Master of Science in Materials Engineering	6	A, B
Master of Science in Sustainable Materials Engineering	6	A

Teaching languages

Dutch, English

Keywords

Material degradation, corrosion, Thermal oxidation, Surface technology

Position of the course

One part of the course deals with corrosion.

Corrosion is an undesired material degradation because of an interaction between the material and its environment. Both high temperature corrosion and corrosion in aqueous solutions,i.e. at

room temperature, are discussed.

Effect of metal properties and of the environment are treated. The effect of mechanical stresses on the corrosion process are treated as well. Via an integrated study of the corrosion phenomenon, one comes to corrosion control. Strong emphasis is given onto examples and solutions from real practice. Finally an adequate choice of material becomes possible taking into account the specific conditions in which the material is used. An overview of typical design errors is given. Guest lectures about practical issues are planned as well.

One part of the course is dedicated to surface treatments of metals for the creation of various surface mechanical and functional properties, including corrosion protection. The concept of a metal surface is discussed and the importance of surface properties is emphasized. Examples of corrosion are given to illustrate the importance of surface processing for metal protection. Various types of surface treatments are explained and illustrated by research related case studies:

- Electrochemical conversion,
- Chemical deposition / passivation,
- Electrolytic conversion,
- Metal deposition.

The mechanisms and technological issues of these surface processes are detailed and the properties of the metal surfaces are explained. The importance of the full processing procedure including cleaning, etching, surface conversion and final metal finishing is illustrated for industrial examples.

Contents

- Corrosion: Basic theory and electrochemical corrosion, Metallurgical cells, Environmental cells, Corrosive-mechanical interactions, Corrosion in some important environments, Materials selection, Cathodic and anodic protection, Corrosion inhibitors, Corrosion tests, Corrosion and design
- Thermal oxidation: Thermodynamics and kinetics, Oxidation control by alloying and coatings

- Surface technology: Objectives of surface treatments and introduction to surface related properties of metals and the concepts of the full surface processing, illustrated for industrial applications;
- Mechanisms, properties and applications for the following surface treatments are discussed, including technological and ecological issues:
  - Electrochemical conversion: chromate conversion, zirconium-titanium conversion, phosphating;
  - Chemical deposition/passivation: silane coatings, self-healing coatings, plasma coatings, including hybrid layers;
  - Electrolytic conversion: anodising, electrolytic colouring;
  - Metal deposition: electroplating (Cr, Sn, Ni, ...), (electroless) plating, galvanizing, aluminizing.

Initial competences

Basic knowledge of chemistry and physics

Final competences

1 Fundamental understanding of corrosion and corrosion control.
2 Insights in the enormous possible applications of surface techniques with special emphasis on their properties
3 To be able to make a justified material choice taking into account the environment in which the material is used and being able to interpret corrosion case studies.
4 Choosing the most appropriate surface treatment technique.

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

Lecture, seminar, practical

Learning materials and price

Syllabus + Handouts slides

References

- Corrosion Engineering Handbook, P.A. Schweitzer

Course content-related study coaching

Evaluation methods

end-of-term assessment

Examination methods in case of periodic evaluation during the first examination period

Participation, oral assessment, written assessment

Examination methods in case of periodic evaluation during the second examination period

Participation, oral assessment, written assessment

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

During examination period: written closed-book exam (partly with oral explanation).

Calculation of the examination mark

At the start of the semester, several classes (e.g. practica, possible company visit) are labeled as classes with obligatory presence of the students. This corresponds with 10% of the final score. Students who take this course as an elective course and who have classes of an obligatory course overlapping with these classes of this course are not obliged to attend these classes.
On the exam, for the remaining points: 50% partim corrosion, 50% partim surface engineering