Course guide
295760 - 295EM115 - Advanced Surface Engineering

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: GEMMA FARGAS RIBAS

Others: Primer quadrimestre:
GEMMA FARGAS RIBAS - Grup: T1
JAUME PUJANTE AGUDO - Grup: T1
GISELLE RAMIREZ SANDOVAL - Grup: T1

PRIOR SKILLS

Knowledge of materials science and chemistry

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEAM-03. (ENG) Realizar estudios de caracterización y evaluación de materiales según sus aplicaciones

TEACHING METHODOLOGY

-Face-to-face expository classes (Theory)
-Face-to face directed classes (Problem solving)
-Cooperative learning.

LEARNING OBJECTIVES OF THE SUBJECT

To understand the goals, benefits and applications of surface engineering.
To acquire a knowledge of the methods and techniques of surface modification from conventional to the most advanced ones and correlate them with the structure and properties achieved on the surface.

STUDY LOAD

Type	Hours	Percentage
Self study	108,0	72.00
Hours large group	28,0	18.67
Hours small group	14,0	9.33

Total learning time: 150 h

CONTENTS

1. Basic concepts of surface engineering

Description:
- Purpose and Need of Surface Engineering
- Classification of Surface Modification Techniques
- Applications and Limitations

Full-or-part-time: 4h
Guided activities: 2h
Self study : 2h

2. Surface engineering by changing the surface metallurgy

Description:
Mechanical methods: Burnishing y Shot peening
Thermal methods: Flame and induction hardening, Laser and electron beam hardening, Plasma and TIG melting

Full-or-part-time: 18h
Guided activities: 8h
Self study : 10h

3. Surface engineering by changing the composition

Description:
- Diffusion-based processes: Carburizing, Nitriding, Cyaniding, Boronizing, Vanadizing
- Ion implantation
- Laser alloying

Full-or-part-time: 24h
Guided activities: 12h
Self study : 12h

4. Surface modification by developing coatings

Description:
- Diffusion-based processes
- Melting-based methods
- Dipping in hot melt-based methods
- Electrolysis-based methods
- Mechanical methods

Full-or-part-time: 30h
Guided activities: 12h
Self study : 18h

5. Multifunctional surface engineering applications

Description:
- Transparent Conductive Oxide Thin Films
- Thin Film Permeation Barriers
- Photocatalytic Thin Films

Full-or-part-time: 26h
Guided activities: 6h
Self study : 20h

6. Bio-inspired surfaces and coatings

Description:

Full-or-part-time: 24h
Guided activities: 4h
Self study : 20h

7. Surface engineering of nanomaterials

Description:

Full-or-part-time: 24h
Guided activities: 4h
Self study : 20h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

First partial test: 15%
Second partial test: 25%
Third partial test: 35%
Autonomous learning: 15%
Laboratory: 10%

In this subject a reassessment test will be scheduled. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf).

BIBLIOGRAPHY

Basic:
- Dwivedi, Dheerendra Kumar. Surface Engineering : Enhancing Life of Tribological Components [on line]. New Delhi: Springer India, 2018 [Consultation: 06/10/2020]. Available on: https://doi.org/10.1007/978-81-322-3779-2. ISBN 9788132237792.
- Tiwari, Ashutosh; Wang, Rui; Wei, Bingqing. Advanced surface engineering materials [on line]. Beverly: Scrivener Publishing, cop. 2016 [Consultation: 06/10/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119314196. ISBN 9781119314158.
- Chattopadhyay, Ramnarayan. Advance thermally assisted surface engineering processes. Springer Science, 2004. ISBN 9781402077647.
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- Adamson, Arthur W.. Physical chemistry of surfaces. 6th ed. New York [etc.]: John Wiley & Sons, 1997. ISBN 9780471148739.
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