Course guide
295702 - PCO - Plastic and Composites

Last modified: 19/08/2025

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

Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: ORLANDO ONOFRE SANTANA PEREZ

Others: Primer quadrimestre:
TOBIAS MARTIN ABT - Grup: M11
NICOLAS CANDAU - Grup: M11, Grup: M12
NOEL LEÓN ALBITER - Grup: M12
ORLANDO ONOFRE SANTANA PEREZ - Grup: M11, Grup: M12

REQUIREMENTS

FONAMENTS DE POLÍMERS - Precorequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
2. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
3. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Transversal:
06 URI N3. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

TEACHING METHODOLOGY

During the course there will be three types of sessions: theory, problems, and laboratory practices. In addition autonomous learning to relate knowledge acquired in practices with theoretical fundaments. Two exams will take place.

LEARNING OBJECTIVES OF THE SUBJECT

The objective is that the student acquires basic knowledge on the structure, properties, manufacturing, design and service behaviour of polymeric materials and composite materials.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours small group	10,0	6.67
Hours large group	50,0	33.33

Total learning time: 150 h

CONTENTS

Topic 1. Structure and classification of polymeric materials

Description:
Aspects on evaluation and bibliography of the course.
History of polymer technology. Production and consumption. Market applications.
Monomer Vs. Cómero.
Homopolymers Vs. Copolymers.
Idealization of macromolecules. Molecular conformations and configurations.
Molecular architecture.
Classification of polymeric materials according to the relationship between performance and architecture.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

TOPIC II: Plastics Technology

Description:
Classification of plastic materials according to their molecular structure and to their consumption. Natural polymers. Description of plastic material families: polyolefines, styrenic, halogenated polymers, polyamides, linear polyesters, PMMA, POM. High performance polymers. Thermostables and elastomers. Polymers obtained from renewable sources and biodegradable (biopolymers). Additives.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 26h
Theory classes: 8h
Laboratory classes: 3h
Self study : 15h

TOPIC III: Structure-properties relation

Description:
Relation between structure and the following properties: mechanics, chemicali, optical and electric. Service behaviour.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 20h
Theory classes: 7h
Practical classes: 1h
Self study : 12h

TOPIC IV: Thermoplastics processing technology

Description:
Rheology principles. Extrusion process: machine, process variables, defects and applications. Extrusion related technologies. Injection process: machine, casts, process variables, defects and applications. Thermoforming. Rotational casting. Advanced processing techniques. Design principles in plastic materials.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 47h
Theory classes: 13h
Practical classes: 3h
Laboratory classes: 3h
Self study : 28h

TOPIC VI: Environmental aspects

Description:
Post-consumption waste. Waste alternatives. Ecodesign principles. ACV. Primary, secondary, tertiary and quaternary recycling. Practical cases.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 20h
Theory classes: 5h
Laboratory classes: 3h
Self study : 12h

TOPIC V: Composite materials

Description:
Matrices. Second phases: microloads, nanoloads. Interphases. Critical parameters. Applications. Manufacturing technologies of compounds with composite materials.

Related competencies :
CE9. Knowledge of science, technology and materials' chemistry fundaments. Understanding the relation between microstructure, synthesis or processing and materials' properties.
CEM5. Knowledge and application of materials' technology in the following fields: production, transformation, processing, selection, control, maintenance, recycling, and storage of any type of materials.
CEM7. Knowledge and capacities to evaluate security, durability, and structural integrity of materials and components manufactured with these materials.

Full-or-part-time: 23h
Theory classes: 5h
Practical classes: 1h
Laboratory classes: 3h
Self study : 14h

GRADING SYSTEM

3 partial exams (NPP-1; NPP-2 and NPP-3) + Continuous evaluation (NEC).

All evaluations will be on a scale of 10. IMPORTANT: ALL EVALUATION ITEMS ARE MANDATORY IN ORDER TO PASS THE SUBJECT.

The final grade (NF) will be calculated from the following expression:

NF = 0.7NTory + 0.3 NEC (Continuous Assessment)

NEC: average of group activities (homework/lab reports, a total of 5).

NTheory = average of the 3 partial tests

In case of NTheory < 5, a final exam must be presented. In this case, the "new" Ntheory to be considered for the calculation of the Final Grade (NF, according to the initial equation) of the subject:
NTheory= 0.3*(Average Partial Tests) + 0.7*EF

EXAMINATION RULES.

The partial exams (ExPr) will be done within the schedule of the subject. No notes, unless instructed to do so by the teacher. They will have a maximum duration of 75 min.
Laboratory reports will be presented in groups of up to 3 students one week after the session. A template for writing will be available

BIBLIOGRAPHY

Basic:
- Hull, Derek. Materiales compuestos. Barcelona: Reverté, 1987. ISBN 8429148396.
- Ehrenstein, G. W. Polymeric materials : structure, properties, applications . Munich [etc.] : Hanser [etc.], cop. 2001. ISBN 3-446-21461-5.

Complementary:
- Brydson, J. A. Plastics materials. Oxford: Butterworth-Heinemann, 1999.
- Kinloch, A. J. Fracture behaviour of polymers. London: Chapman And Hall, 1995. ISBN 0412540703.
- Ward, Ian Macmillan; Sweeney, John. An Introduction to the mechanical properties of solid polymers . 2nd ed. Chichester : John

Wiley & Sons, cop. 2004. ISBN 9780471496267.
- McCrum, N.G; Buckley, C.P.; Bucknall, C.B. Principles of polymer engineering. 2nd ed. Oxford: Oxford University Press, 1997. ISBN 0198565267.
- Michaeli, W. Tecnología de los composites/plásticos reforzados. Barcelona: Hanser, 1992. ISBN 8487454046.
- Callister, William D; Rethwisch, David G. . Materials science and engineering : an introduction . Hoboken : John Wiley & Sons, [2020].
- Young, Robert Joseph. Introduction to polymers. 2nd ed. London: Chapman and Hall, 1991. ISBN 0412306409.

RESOURCES

Other resources:
Visual support and animated self-learning material available on the digital campus.
Collection of videos selected from network platforms.