Course guide
295566 - 295EQ222 - Polymer Transformation Processes

Last modified: 29/01/2025

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

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Elaine Armelin Diggroc

Others:

PRIOR SKILLS

Fundamental klowledge on chemical structure of polymers, classification, polymerization methods and polymer physics.

REQUIREMENTS

Previous knowledge on other subjects related to polymer science (chemical of polymerization, polymer physics, properties).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

Transversal:
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

b.

STUDY LOAD

Type	Hours	Percentage
Self study	108,0	72.00
Hours small group	21,0	14.00
Hours large group	21,0	14.00

Total learning time: 150 h

CONTENTS

Topic 1: Plastics for general purpose (commodity plastics)

Description:
1. Knowledge on plastics for general purpose: Polyethylene (PE), Polipropylene (PP), Polyvinyl chloride (PVC) and Polystyrene (PS).
2. Chemical structures, properties, processing and recycling methods
3. Main aplications and processing techniques

Related activities:
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization

Full-or-part-time: 23h 45m
Theory classes: 9h
Guided activities: 2h
Self study : 12h 45m

Topic 2:Engineering plastics

Description:
1. Knowledge in main family of engieering plastics:
- Polycarbonates (PC)
- Polyesters: Polyethyleneterephtalate (PET), Polybutyleneterephtalate (PBT).
- Polyamides: Nylon 6, Nylon 6,6
- Styrene copolymers: Acrylonitrile-butadiene-styrene (ABS), Styrene-acrylonitrile (SAN)
- Acrylic plastics: Polymethacrylate (PMMA)
- Polyeters: Polyoxymethylene (POM)
2. Chemical structure, properties, recylcling processes.
3. Main applications

Related activities:
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization.

Full-or-part-time: 20h 45m
Theory classes: 6h
Guided activities: 2h
Self study : 12h 45m

Topic 3: Termosets and elastomers

Description:
1. Knowledge on termoset materials: epoxy resins, polyuretanes (PUR), unsaturated polyesters, silicones; and elastomers: natural rubber (latex) and synthetic rubber (SBR, NBR, Neoprene, among others).
2. Chemical structure, properties, processing and recycling.
3. Main applications

Related activities:
Work in the exercises proposed at classroom related to thermosets and elastomers.

Full-or-part-time: 17h 45m
Theory classes: 4h
Guided activities: 1h
Self study : 12h 45m

Topic 4: High performance polymers

Description:
1. Knowledge on main family of high performance plastics: Polyimides (PI), Polyaryletercetones (PAEK), polytetrafluoroetilene (PTFE), polyesters aromatics (APE, PCT, PEN), polysulfones and polysiloxanes.
2. Estructuras, propiedades físico-químicas, procesado y reciclado.
3. Principales aplicaciones

Related activities:
Work in the exercises proposed at classroom related to the plastic properties and polymer characterization.

Full-or-part-time: 15h 45m
Theory classes: 2h
Guided activities: 1h
Self study : 12h 45m

Topic 5: Polymer rheology

Description:
Knowlege on the fundamental of polymer rheology and the main assays carried out for viscosity measurements. Introduction to the fundamentals of plastic transformation.

Related activities:
Laboratory for practice on the measurement of melt flow index.

Full-or-part-time: 17h 15m
Theory classes: 3h
Laboratory classes: 1h 30m
Self study : 12h 45m

Topic 6: Extrusion

Description:
Main equipments and spindles used for the extrusion of plastics. Extrusion nozzles for the manufacture of different profiles as well as the corresponding calibrators. Analysis of the process and the influence of the different variables on the quality of the pieces. Knowledge on the techniques related to extrusion (Coextrusion, multilayer extrusion, extrusion blow, among others)

Related activities:
Extrusion process of thermoplastics.

Full-or-part-time: 17h 15m
Theory classes: 3h
Laboratory classes: 1h 30m
Self study : 12h 45m

Topic 7: Injection

Description:
Knowledge of thermoplastic injection machines. Analysis of the process and the influence of the different variables on the quality of the pieces. Introduction to the design of molds, parts of a mold. Analysis of defects of injected parts, we will work with real pieces in class, and the causes and possible solutions to these defects will be analyzed. Injection by blowing.

Related activities:
Injection process of plastics.

Full-or-part-time: 21h 45m
Theory classes: 6h
Laboratory classes: 3h
Self study : 12h 45m

Topic 8: Other transformation techniques used in plastic processing

Description:
Description of the process of thermoforming and rotational molding. Advanced processing techniques: bicomponent injection, coinjection, gas assisted injection and water injection.
Foaming and micro-foaming processes.

Full-or-part-time: 18h 45m
Theory classes: 3h
Laboratory classes: 3h
Self study : 12h 45m

GRADING SYSTEM

Final marks from formative evaluations:
Non-presencial and presencial activities (AD1+AD2) = 20%
Reports on laboratory practices (AP) = 20%
Middle-term exam (EP) = 30%
Final exam (EF) = 30%
Final marks (Nf): 0.20*AD + 0.20*AP+ 0.30*EP + 0.30*EF

EXAMINATION RULES.

1. There will be supervised activities (type AD), with deliverables corresponding to the theory or problems approached at class, and the students will report the activities of laboratory practices (type AP).
2. There will be a middle-term exam (EP) at the first part of our subject and a final exam (EF), with 2h of duration, to evaluate the individual progress of each student in this subject.
There is not any additional exam, related to recover the abovementioned marks (called "re-avaluació").

BIBLIOGRAPHY

Basic:
- Brown, Roger [ed.]. Handbook of polymer testing : physical methods. New York: Marcel Dekker, cop. 1999. ISBN 0824701712.
- Brydson, J. A. Plastics materials. 7th ed. Oxford: Butterworth-Heinemann, 1999. ISBN 0750641320.
- Fried, Joel R. Polymer science and technology. 3rd ed. Upper Saddle River: Prentice Hall, cop. 2014. ISBN 9780137039555.
- Mark, H. F. [ed.]. Encyclopedia of polymer science and technology. 3rd ed. Hoboken, New Jersey: John Wiley & Sons, cop. 2003. ISBN 0471288241.

Complementary:
- Ramos Carpio, Miguel Angel; Maria Ruiz, M. R. de. Ingeniería de los materiales plásticos. Madrid: Díaz de Santos, 1988. ISBN 8486251850.
- van der Vegt, A.K. From polymers to plastic. Leeghwaterstraat: VSSD, [2018]. ISBN 9789071301629.

RESOURCES

Other resources:
Material to follow the theoretical and experimental classes will be available in Atenea digital platform.