

## Course guide

### 295583 - 295PB021 - Polymer Characterization

**Last modified:** 31/01/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).  
MASTER'S DEGREE IN POLYMERS AND BIOPLASTICS (Syllabus 2024). (Compulsory subject).

**Academic year:** 2024    **ECTS Credits:** 6.0    **Languages:** English

#### LECTURER

**Coordinating lecturer:** Carles Alemán

**Others:** Adrián Fontana

#### PRIOR SKILLS

Fundamentals of organic chemistry, analytical chemistry, and materials science acquired during undergraduate studies.  
Specific knowledge of polymer chemistry and physics acquired in the first semester of the master's program.

#### TEACHING METHODOLOGY

MD.1 - Participative lecture;  
MD.2 - Project-based learning;  
MD.3 - Case studies;  
MD.4 - Cooperative group work.

#### LEARNING OBJECTIVES OF THE SUBJECT

To know the most important characterization techniques in the field of polymers. To understand the physical principles that give rise to measurements and to know how to interpret them.

#### STUDY LOAD

Type	Hours	Percentage
Self study	108,0	72.00
Hours large group	42,0	28.00

**Total learning time:** 150 h

## CONTENTS

### Surface characterization techniques

**Description:**

- Atomic force microscopy.
- Scanning electron microscopy
- Transmission electron microscopy
- Static and dynamic contact angle and models to evaluate the surface energy.

**Specific objectives:**

- To get an overview of different microscopy techniques and their applications in the field of polymers
- To understand the basic physical concepts associated to such Surface characterization techniques
- To interpret the observations derived from such Surface characterization methods

**Related activities:**

To solve exercises related with the studied techniques.

**Full-or-part-time:** 32h

Theory classes: 10h

Guided activities: 20h

Self study : 2h

### Spectroscopic characterization and diffraction

**Description:**

- Raman microscopy
- FTIR spectroscopy
- UV-Vis spectroscopy
- Nuclear Magnetic Resonance (NMR) Spectroscopy
- X ray diffracción
- Mass Spectrometry (MS)

**Specific objectives:**

- To get an overview of different spectroscopy techniques and their applications in the field of polymers
- To understand the basic physical concepts associated to such spectroscopy techniques
- To interpret the observations derived from such spectroscopic methods

**Related activities:**

To solve exercises related with the studied techniques.

**Full-or-part-time:** 32h

Theory classes: 10h

Guided activities: 20h

Self study : 2h

### Physical Characterization

**Description:**

- Gel Permeation Chromatography (GPC) / Size Exclusion Chromatography (SEC)
- Differential Scanning Calorimetry (DSC)
- Thermogravimetric Analysis (TGA)
- Techniques for measuring Mechanical and Rheological Properties

**Specific objectives:**

- To get an overview of different techniques related with the physical properties of the polymers and their applications in the field.
- To understand the basic physical concepts associated to such techniques
- To interpret the observations derived from such methods

**Related activities:**

To solve exercises related with the studied techniques.

**Full-or-part-time:** 30h

Theory classes: 8h

Guided activities: 20h

Self study : 2h

### Electrochemical characterization

**Description:**

- Chronoamperometry
- Linear and cyclic voltammetry
- Electrochemical impedance spectroscopy
- Charge-discharge curves

**Specific objectives:**

- To get an overview of different electrochemical techniques and their applications in the field of polymers
- To understand the basic physical concepts associated to such electrochemical techniques
- To interpret the observations derived from such electrochemical methods

**Related activities:**

To solve exercises related with the studied techniques

**Full-or-part-time:** 30h

Theory classes: 8h

Guided activities: 20h

Self study : 2h

### Biological characterization

**Description:**

- Optical microscopy (e.g. inverted, fluorescence)
- Protein identification techniques (e.g. chromatography, gel electrophoresis)
- Polymerase chain reaction (PCR) and related techniques

**Specific objectives:**

- To get an overview of different biological characterization techniques and their applications in the field of polymers
- To understand the basic physical-chemical concepts associated with such techniques
- To interpret the observations derived from such biological assessment methods

**Related activities:**

To solve exercises related with the studied techniques.

**Full-or-part-time:** 30h

Theory classes: 8h

Guided activities: 20h

Self study : 2h

### X-Ray diffracton and electron diffraction

**Description:**

- Crystallography
- Introduction to X-ray and electron diffraction.
- Types of measurements (powder, fibers, single crystals).
- Synchrotron radiation
- Examples applied to polymers

**Full-or-part-time:** 30h

Theory classes: 30h

## GRADING SYSTEM

Midterm theoretical tests – MTT – (60%)

Group Projects – GP – (40%)

Final grade:  $0.4 \cdot GP \text{ (average)} + (MTT1 \cdot 0.3 + MTT2 \cdot 0.3)$ .

## EXAMINATION RULES.

1. There will be two middle-term exams (MTT) at with 2h of duration, to evaluate the individual progress of each student in this subject.
2. There will be five group projects (GP) after the conclusion of each theoretical block. The students will have to present their projects in groups.
3. There is not any additional exam, related to recover the abovementioned marks (called "re-avaluació").