Course guide
295583 - 295PB021 - Characterisation of Polymers

Last modified: 04/06/2026

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: 2026 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: CARLOS ENRIQUE ALEMAN LLANSO

Others: Segon quadrimestre:
CARLOS ENRIQUE ALEMAN LLANSO - Grup: T1
ADRIÁN FONTANA ESCARTIN - Grup: T1
MARIA LEONOR MATOS RESINA - Grup: T1

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.

LEARNING RESULTS

Knowledges:
K1. Identify the molecular chemical structure of polymers and biopolymers.
K2. Identify the physical principles that govern the behaviour of polymers and underlie many of the techniques used in polymer analysis.
K4. Apply the necessary criteria for the analysis and characterisation of macromolecular materials and for the selection of technologies required for their production and processing.

Skills:
S3. Interpret the results of polymer analysis and characterisation techniques.
S1. Work rigorously and safely in a polymer laboratory.
S2. Make appropriate use of a range of polymer analysis and characterisation techniques.

Competences:
C3. Apply acquired knowledge and problem-solving skills both in discipline-specific environments and in new or unfamiliar environments in broader (or multidisciplinary) contexts related to the field of study.
C2. Apply appropriate methods of analysis, production and management in the field of polymers and biopolymers.
C4. Make effective use of information resources, managing the acquisition, structuring, analysis and visualisation of data and information within the field of specialisation and critically evaluating the results of this process.

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 diffractión
- 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).
- Synchroton radiation
- Examples applied to polymers

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

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**.

Midterm theoretical tests – MTT – (60%)
Group Projects – GP – (40%)

Final grade: 0.4*GP (average) + (MTT1*0.3 + MTT2*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").