



## Course guide

# 295754 - 295EM032 - Advances in the Processing of Plastic Materials

Last modified: 27/05/2024

<b>Unit in charge:</b>	Barcelona East School of Engineering
<b>Teaching unit:</b>	702 - CEM - Department of Materials Science and Engineering.
<b>Degree:</b>	MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Compulsory subject). ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

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

## LECTURER

---

<b>Coordinating lecturer:</b>	MARIA LLUÏSA MASPOCH RULDUA
<b>Others:</b>	Primer quadrimestre: TOBIAS MARTIN ABT - Grup: T10 NICOLAS CANDAU - Grup: T10 NOEL LEÓN ALBITER - Grup: T10 MARIA LLUÏSA MASPOCH RULDUA - Grup: T10 ORLANDO ONOFRE SANTANA PEREZ - Grup: T10

## PRIOR SKILLS

---

Knowledge about structure and properties of polymeric materials, transport phenomena.

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

### Specific:

CEMCEAM-01. (ENG) Dissenyar i desenvolupar productes, processos i sistemes, així com l'optimització d'altres ja desenvolupats, atenent a la selecció de materials per aplicacions específiques.

CEMCEAM-02. (ENG) Aplicar métodos innovadores para el diseño, simulación, optimización y control de procesos de producción y transformación de materiales

CEMCEAM-06. (ENG) Evaluar el tiempo de vida en servicio, la reutilización, la recuperación y el reciclaje de productos atendiendo a las características de los materiales que lo conforman

### Transversal:

01 EIN. ENTREPRENEURSHIP AND INNOVATION: Knowing about and understanding how businesses are run and the sciences that govern their activity. Having the ability to understand labor laws and how planning, industrial and marketing strategies, quality and profits relate to each other.

02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.



## TEACHING METHODOLOGY

---

MD1: Lecture class with material available on the digital campus  
MD2: Carrying out laboratory practices  
MD3: Oral presentation of a topic  
MD4: Carrying out guided activities

## LEARNING OBJECTIVES OF THE SUBJECT

---

- To deepen in the rheological behavior of polymers and their relation with the molecular structure.
- To study the techniques of characterization of the rheological behavior of polymeric materials.
- To Study the techniques of processing plastic materials by analyzing the production lines and the relationship between the process parameters and the quality of the piece obtained.

## STUDY LOAD

---

Type	Hours	Percentage
Hours large group	45,0	30.00
Hours small group	9,0	6.00
Self study	96,0	64.00

**Total learning time:** 150 h

## CONTENTS

---

### 1.- Flow of polymeric systems

**Description:**

Rheological behavior of polymers.  
Techniques of rheological characterization.  
Factors that determine rheological behavior.  
Elastic effects on the fluid

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

Theory classes: 10h  
Self study : 20h



## 2.-Extrusion and main lines of production

### Description:

- The extrusion process
- Description of the machine
- Operation curves: parameters and effects
- Main production lines and typical defects:
  - Production of Multicapas: Coextrusion, lamination and coating.
  - Sheetl Production
  - Fiber production
  - Production of pipes
  - Film production (calendering and blowing)
  - Production of hollow bodies (blown extension)

### Related activities:

- Lab. 1
- Lab. 2
- Lab. 3

**Full-or-part-time:** 41h 20m

Theory classes: 12h

Laboratory classes: 6h

Self study : 23h 20m

## 3.- Thermoforming

### Description:

- Process description.
- Types of thermoforming.
- Material requirements.
- Typical defects and solutions.

**Full-or-part-time:** 4h 30m

Theory classes: 2h

Self study : 2h 30m

## 4.- Rotational Molding

### Description:

- Descripción del Proceso.
- Requerimientos del material.
- Defectos típicos y soluciones.

**Full-or-part-time:** 4h 30m

Practical classes: 2h

Self study : 2h 30m

## 5.- Injection molding

### Description:

- Machines and parameters of the process
- Description of the mold and functionalities
- Defects and solutions in injected parts

### Related activities:

- Lab. 4
- Lab. 5
- Lab. 6

### Full-or-part-time: 41h 20m

Theory classes: 12h

Laboratory classes: 6h

Self study : 23h 20m

## 6.-Advanced Processing Techniques

### Description:

- Over-injection
- Co-Injection
- Fluid Assisted Injection
- Injection + Microfoam

### Full-or-part-time: 6h 10m

Theory classes: 2h

Self study : 4h 10m

## 7.- Additive manufacturing

### Description:

Historical introduction. General advantages and disadvantages of this type of manufacturing. Productivity aspects.

Review and technical aspects of the main techniques. Comparison between them:

- Fused deposition modeling (FFF).
- Selective laser sintering (SLS). Special case: HP Multi Jet Fusion (MJF)
- Stereolithography (SL)
- Material jetting (PolyJet)
- Binder jetting (3DP)
- Laminated object manufacturing (LOM)

### Full-or-part-time: 4h

Theory classes: 2h

Self study : 2h

## GRADING SYSTEM

---

2 partial exams (NPP-1 and NPP-2) + Evaluation of group activities (NAG).

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:

$$NF = 0.64N_{Tory} + 0.36 NAG \text{ (Activity in groups)}$$

NAG: Average mark of group activity reports: 2 activities with experimental data, analysis and interpretation of results, 6 laboratory sessions and report writing according to the template (available at ATENEA).

Option 1: Assumed to exceed the minimum mark in both partial tests (4/10 in each one).

$$N_{Theory} = 0.5 N_{pp-1} + 0.5 N_{PP-2} \text{ (if it is } < 4, \text{ a Final Exam (EF) must be presented)}$$

Option 2: Assumption of NOT obtaining a minimum grade of 4 in Preliminary theory

$$N_{Theory} = 0.25 N_{pp-1} + 0.25 N_{PP-2} + 0.5 EF$$

Remark: For option 1, the final exam can be presented (optional) so the theory mark will be calculated according to option 2, invalidating relation 1.

## EXAMINATION RULES.

---

The partial exams (ExPr) will be carried out within the timetable of the subject and will have a maximum duration of 75 minutes. Notes will not be used, unless indicated by the teacher. If a calculator is required, it should not be the one included in mobile devices or tablets, nor programmable.

The laboratory reports will be presented in groups of a maximum of 4 students, agreeing on the date with the session teacher. You will have a template for your writing.

## BIBLIOGRAPHY

---

### Basic:

- Osswald, T.A. ; Menges, G. Materials science of Polymers for Engineers. 2nd ed. Munich: Hanser Publishers, 2003. ISBN 1569903484.
- McCrum, N.G. ; Buckley, C.P. ; Bucknall, C.B. Principles of polymer engineering. 2nd ed. Oxford: Oxford University Press, 1997. ISBN 0198565267.
- Dealy, J. M. ; Wissbrun, K. F. Melt rheology and its role in plastics processing : theory and applications. Dordrecht: Kluwer, 1999. ISBN 0792358864.
- Gibson, I.; Rosen, D. W.; Stucker, B. Additive manufacturing technologies: 3D Printing, rapid prototyping, and direct digital manufacturing. USA: Springer, S.L, 2014. ISBN 9781493921126.

## RESOURCES

---

### Audiovisual material:

- Nom recurs. Resource

### Hyperlink:

- Videos. Selected videos from the documentary series: How its made. <http://science.discovery.com/tv/how-its-made/> Selected videos of youtube processes.