Course guide
295754 - 295EM032 - Advances in the Processing of Plastic Materials

Last modified: 08/08/2024

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

Degree: 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

Coordinating lecturer: MARIA LLUÏSA MASPOCH RULDUA

Others: Primer quadrimestre:
TOBIAS MARTIN ABT - Grup: T1
NICOLAS CANDAU - Grup: T1
NOEL LEÓN ALBITER - Grup: T1
ALFONSO DAVID LOAEZA BECERRIL - Grup: T1
MARIA LLUÏSA MASPOCH RULDUA - Grup: T1
ORLANDO ONOFRE SANTANA PEREZ - Grup: T1

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, això 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 = 0.64NTory + 0.36 NAG (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).
NTheory = 0.5 Npp-1 + 0.5 NPP-2 (if it is < 4, a Final Exam (EF) must be presented)
Option 2: Assumption of NOT obtaining a minimum grade of 4 in Preliminary theory
NTheory = 0.25 Npp-1 + 0.25 NPP-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.