

Course guide

240378 - 240IQU39 - Bioplastics: Experimental

Last modified: 16/04/2024

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

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: DOMINGO ANTUXON MARTINEZ DE ILARDUYA SAEZ DE ASTEASU

Others: García Alvarez, Montserrat
Perez Gonzalez, Juan Jesus
Alla Bedahnane, Abdelilah
Tinajero Diaz, Ernesto
Antxon Martínez de Ilarduya

PRIOR SKILLS

Bachelor of Science or Engineering with knowledge of chemistry

REQUIREMENTS

Preferably, due to space limitations in laboratories and maintenance of safety distances, have enrolled in the specialty of chemistry of the MUEI.

TEACHING METHODOLOGY

- 1) Theoretical classes will be taught about the introduction to the different practical classes.
- 2) Laboratory practices about synthesis and characterization of polymers and biopolymers will be carried out.
- 3) If student group is large (> 10 students) a visit to a company in the polymers industry sector will be performed.
- 4) Self study: Implementation and reporting laboratory practices.

LEARNING OBJECTIVES OF THE SUBJECT

Introduction to the knowledge of basic concepts of polymers and eventually of biotechnology, by laboratory experimentation and instrumental analysis.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	40,5	36.00

Total learning time: 112.5 h



CONTENTS

Introduction to polymers

Description:

Clasification. Bioplastic definition. Polymerization reactions. Molecular weights. Viscometry. GPC.

Full-or-part-time: 3h

Theory classes: 3h

Synthesis of a polyester by melt polycondensation

Description:

Synthesis of a polyester by polycondensation reaction in bulk. Spectroscopic characterization of the end product

Full-or-part-time: 3h

Laboratory classes: 3h

Characterization of polymers 2. NMR. Session 2

Description:

Characterization of polymers by NMR. Session 2.

Full-or-part-time: 3h

Laboratory classes: 3h

Polymer characterization 1. FTIR

Description:

Introduction to FTIR. Polymer applications. Practice session with commercial polymers

Full-or-part-time: 3h

Theory classes: 1h

Laboratory classes: 2h

Synthesis of a polyester by enzymatic ring opening polymerization (ROP)

Description:

A polyester will be synthesized through ring-opening reaction from a macrolactone and different proportions of initiator. The effect of the initiator content on the obtained molecular weight will be studied.

Full-or-part-time: 3h

Laboratory classes: 3h

Polymer characterization 2. NMR. Session 1

Description:

Introduction to Nuclear Magnetic Resonance. Polymer applications. Practical sessions in a 300 MHz NMR equipment.

Full-or-part-time: 3h

Theory classes: 1h 30m

Laboratory classes: 1h 30m



Determination of thermal properties. DSC and TGA

Description:

Thermal analysis of synthesized polymers by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA).

Full-or-part-time: 3h

Laboratory classes: 3h

Preparation of polymeric nanoparticles. Determination of sizes and zeta potentials (DLS)

Description:

Polymeric nanoparticles will be prepared with polymers synthesized in the laboratory using the emulsion/evaporation method. Various factors that affect their final size will be studied.

Full-or-part-time: 3h

Laboratory classes: 3h

Molecular weight determination. Viscometry and GPC

Description:

Molecular weight determination. Viscometry and GPC

Specific objectives:

Determinación de los pesos moleculares promedio en número, peso, viscosimétrico y dispersidad mediante viscosimetría capilar y GPC.

Full-or-part-time: 3h

Laboratory classes: 3h

Determination of mechanical properties

Description:

Determination of mechanical properties of polymers by stress-strain tests.

Full-or-part-time: 3h

Laboratory classes: 3h

Biotechnology. Structure of proteins.

Description:

Determination of protein structure by molecular simulation programs

Full-or-part-time: 3h

Laboratory classes: 3h

Visiting a company.

Description:

Visit a company of polymers

Full-or-part-time: 4h

Laboratory classes: 4h

Final exam

Description:

Examen final de la asignatura

Full-or-part-time: 2h

Theory classes: 2h

GRADING SYSTEM

1) Evaluation of practices and practical reports (NP)

2) Final exam (EF)

Final note: $0.7 \text{ NP} + 0.3 \text{ EF}$

Reassessment only replaces final exam grade

BIBLIOGRAPHY

Basic:

- Odian, George G. Principles of polymerization [on line]. Fourth edition. Hoboken, N.J.: Wiley-Interscience, a John Wiley & Sons, Inc., Publication, [2004] [Consultation: 02/07/2021]. Available on: <https://onlinelibrary.wiley.com/doi/book/10.1002/047147875X>. ISBN 0471274003.

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- Collins, Edward A; Bares, Jan; Billmeyer, Fred W. Experiments in polymer science. New York: Wiley-Interscience, cop. 1973. ISBN 0471165840.

- Hundiware, D.G. Experiments in polymer science. New Delhi: New Age International, cop. 2009. ISBN 9788122423884.

- Sandler, Stanley R. Polymer synthesis and characterization : a laboratory manual [on line]. San Diego [etc.]: Academic Press, cop. 1998 [Consultation: 06/07/2021]. Available on: <https://www.sciencedirect.com/science/book/9780126182408>. ISBN 012618240X.

- Pretsch, E.. Tablas para la elucidación estructural de compuestos orgánicos por métodos espectroscópicos. Madrid: Alhambra, 1980. ISBN 8420507628.

- Koenig, Jack L. Spectroscopy of polymers [on line]. 2nd ed. Amsterdam [etc.]: Elsevier, 1999 [Consultation: 02/07/2021]. Available on: <https://www.sciencedirect.com/science/book/9780444100313>. ISBN 0444100318.

- Menczel, Joseph D; R. Bruce Prime. Thermal analysis of polymers : fundamentals and applications [on line]. Hoboken, N.J.: John Wiley, cop. 2009 [Consultation: 02/07/2021]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=427633>. ISBN 9780471769170.

- Loos, Katja. Biocatalysis in polymer chemistry [on line]. Weinheim, Germany: Wiley-VCH, cop. 2011 [Consultation: 25/10/2024]. Available on: <https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9783527632534>. ISBN 9783527326181.

RESOURCES

Other resources:

Synthesis laboratory fully equipped. Instrumentation: DSC (Perkin Elmer), TGA (Mettler), NMR (Bruker), GPC (Waters), DLS (Malvern), Ultrasounds (Hielscher), Universal Testing Machine (Zwick)