Course guide
295565 - 295EQ221 - Experimentation and Instrumentation

Last modified: 27/05/2024

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 2014). (Optional subject).
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: Elaine Armelin Diggroc

Others:

PRIOR SKILLS

It is a practical course, most of the classes are conducted in the chemical laboratory. Therefore, laboratory experience would be desirable.
The students should have general knowledge of chemical and physicochemical characterization of polymers. It is interesting to have studied topics related to polymers such as those taught in the following subjects: Polymers and Biopolymers, Polymer Physics and Chemistry of Polymerization.

REQUIREMENTS

Mandatory aspects: The students must bring their own individual protection equipment (known as IPE) to work at chemical laboratory. Those are mainly: protection glasses, laboratory coat, protective mask against toxic gases. Protection gloves will be supplied in the laboratory. At web UPC shop, the students can order the most relevant IPE material: http://www.upc-shop.com/epages/1220514.sf/ca_ES/?ObjectPath=/Shops/1220514/Categories/Proteccio_individual_laboratoris or in Amazon, with carefull to by new and no second hand products.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation
CGMUEQ-04. To carry out the appropriate research, undertake the design and manage the development of engineering solutions, in new or little known environments, relating creativity, originality, innovation and technology transfer
CGMUEQ-06. Have the capacity to analyze and synthesize the continuous progress of products, processes, systems and services using safety, economic viability, quality and environmental management criteria

Transversal:
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.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

Laboratory in polymer synthesis with a brief introduction at the beginning of the semester to explain the main polymerizations to be carried out during the course.
Theory and practice are combined in the laboratory.
Experiments are performed in small groups.
Visits to private companies in the plastic sector (depending on company availability)

LEARNING OBJECTIVES OF THE SUBJECT

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STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Topic 1. Syntheses of thermoplastic polymers, commodities (like polystyrene) and engineering (like nylons and polyurethanes)

Description:
In this laboratory practice, the synthesis of polystyrene will be carried out by suspension polymerization, the synthesis of nylon 6.10 by interfacial polymerization and the synthesis of a thermoplastic polyurethane (TPU) by condensation polymerization. We will also work on polymer purification and plastics processing techniques.

Full-or-part-time: 22h 45m
Theory classes: 2h
Laboratory classes: 8h
Self study : 12h 45m

Topic 2. Synthesis of thermoset polymers

Description:
Two types of thermosets will be prepared: a two component epoxy and a polyester resin. Their adhesive properties, after thermal curing treatments, will be evaluated.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

Topic 3. Preparation of elastomers

Description:
The polymerization of the natural rubber is usually carried out in two steps, a pre-vulcanization stage and the complete vulcanization stage, the latter being the main one. In this practice, vulcanized rubber specimens will be fabricated and their degree of crosslinking will be determined using ASTM standards.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

Topic 4. Preparation of glass fiber reinforced plastics: composites

Description:
A commercial polyester resin, with an initiator (peroxide), will be used to obtain a rigid polymer with incorporated glass fiber. Glass-reinforced plastic (GRP), also known as Glass-Fiber Reinforced Plastic (GRP), is a composite material with better mechanical properties than the pure homopolymer.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

Topic 5. Characterization of polymer structure with infrared spectroscopy and nuclear magnetic resonance

Description:
In this practice we will work with the chemical identification of polymers using spectroscopic techniques: FTIR and NMR. The student will learn how to use an infrared spectrophotometer and how to process the graphs in order to analyze the main absorption bands of a given polymer. In the part of RMN, they will know the equipment and how to process and interpret the chemical shifts with the help of a computer program and standard tables, which contain the relation of the different organic functional groups and their theoretical displacements.

Full-or-part-time: 20h 45m
Laboratory classes: 8h
Self study : 12h 45m

Topic 6. Preparation of alginate-based hydrogel polymers: application as a biocatalyst

Description:
In this practice the student will work with another class of polymers, the polysaccharides. The aim is to carry out the hydrolysis reaction of an alginate gel and to evaluate the D-glucose content obtained after the hydrolysis by spectroscopic methods (UV-visible). On the other hand, it is noteworthy that in this practice the student will come into contact with the preparation of a type of biohydrogel and the immobilization of enzymes.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

Topic 7. Determination of the presence of enzymes in a commercial detergent

Description:
Detergents have, in addition to surfactants and bleaches, polycarboxylates and enzymes. Enzymes accelerate certain chemical reactions by acting as a biochemical catalyst. In this practice the student will evaluate the proteolytic activity of enzymes in a commercial detergent using the electrophoresis technique.
Therefore, in this subject the student will have the opportunity to work with SYNTHETIC POLYMERS, NATURAL POLYMERS and BIOPOLYMERS.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

Topic 8- Evaluation of mechanical properties of thermoplastic polymers

Description:
The students will be able to manipulate and familiarize with the stress-strenght machine and will know how calculate the Young's modulus, the maximum strenght, the elongation at break, etc.

Full-or-part-time: 16h 45m
Laboratory classes: 4h
Self study : 12h 45m

GRADING SYSTEM

Final mark= 0.20*EPre + 0.35*AP (reports: = o > 8, during the course) + + 0.45*EF
EPre: Individual score for the preparation of the practices before laboratory.
AP: Report of results obtained on the experimental work (one per group).
EF: Final exam (individual)
In this subject there is no any other exam that replaces the latest ones (called "examen de reavaluació")

EXAMINATION RULES.

Practice reports drawn up by teams of three-four students, depending on the number of students enrolled. The written exam (final exam) will be held individually at the end of the semester. There are no partial exams in this course.
It has a minimum of 70% attendance at the practical classes, in order to be able to collect the qualification of practical reports.

BIBLIOGRAPHY

Basic:
- Sandler, Stanley R. [et al.]. Polymer synthesis and characterization : a laboratory manual [on line]. San Diego: Academic Press, 1998 [Consultation: 12/05/2020]. Available on: http://www.sciencedirect.com/science/book/9780126182408. ISBN 9780126182408.
- Braun, Dietrich [et al.]. Polymer synthesis : theory and practice : fundamentals, methods, experiments. 5th ed. Berlin [etc.]: Springer, cop. 2013. ISBN 9783642289798.
- Hundiwale, D. G. [et al.]. Experiments in polymer science. New Delhi: New Age International, cop. 2009. ISBN 9788122423884.
- Collins, Edward A; Bares, Jan; Billmeyer, Fred W. Experiments in polymer science. New York: Wiley-Interscience, cop. 1973. ISBN 0471165840.
- Saperas, Núria ;Fonfría-Subirós, Elsa. "Proteolytic enzymes in detergents : evidence of their presence through activity measurements based on electrophoresis". Journal of Chemical Education [on line]. 2011, 88 (12), pp 1702-1706 [Consultation: 12/05/2020]. Available on: 10.1021/ed2001285.

Complementary:
- Vullo, Diana L. "Biopolymers, enzyme activity, and biotechnology in an introductory laboratory class experience". Biochemistry and molecular biology education [on line]. Vol. 31, No. 1, pp. 42-45 [Consultation: 12/05/2020]. Available on:

https://doi.org/10.1002/bmb.2003.494031010167.- Odian, George G. Principles of polymerization. 4th ed. Hoboken, N.J: Wiley-Interscience, cop. 2004. ISBN 0471274003.
- Billmeyer, Fred W. Textbook of polymer science. 3rd ed. New York: Wiley-Interscience. Division of John Wiley & Sons, cop. 1984. ISBN 0471031968.

RESOURCES

Other resources:
Internship dossier available at photocopying service EEBE
Model for the writing of the experimental report