Course guide
240EM033 - 240EM033 - Biomedical Materials

Last modified: 26/06/2025

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

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** Spanish

LECTURER

Coordinating lecturer: MONTSERRAT ESPAÑOL PONS

Others: Primer quadrimestre:
MONTSERRAT ESPAÑOL PONS - T10
JOSE M. MANERO PLANELLA - T10

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEM-01. (ENG) Aplicar coneixements de matemàtiques, física, química, biologia i altres ciències naturals, obtinguts mitjançant estudi, experiènciea i, pràctica, amb raonament crític per a establir solucions viables a problemes tècnics.
CEMCEM-04. (ENG) Realitzar estudis de caracterització, avaluació i certificació de materials segons les seves aplicacions

Transversal:
02 SCS N2. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
06 URI N2. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

TEACHING METHODOLOGY

- Participative lectures.
- Cooperative learning: group work

LEARNING OBJECTIVES OF THE SUBJECT

The aim of the course is that students acquire knowledge of the applications of biomaterials in medicine and dentistry and thus be able to relate properties and biological response of biomaterials, and apply the selection criteria best suited for each application. In addition, students will become familiar with the various techniques of characterization in vitro and in vivo biological biomaterials, as well as interpretation of results obtained using different techniques.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,5	12.00
Self study	72,0	64.00
Hours large group	27,0	24.00

Total learning time: 112.5 h

CONTENTS

Biological characterisation of biomaterials

Description:
- Type of cell cultures: Primary cultures, cell lines, secondary cultures, co-cultures
- Basic cell responses: adhesion, proliferation, differentiation and cell death
- Evaluation of cytotoxicity. Tests measuring the metabolic activity using enzymes: LDH, MTT
- Assays based on the principle of cell exclusion. Immunofluorescence. ELISA assay detecting cell markers. PCR
- Bacterial cultures
- Characterization blood-biomaterial interactions, trombogenicity

Full-or-part-time: 18h
Theory classes: 3h
Laboratory classes: 1h 30m
Guided activities: 1h 30m
Self study : 12h

In vivo characterisation of biomaterials

Description:
- Design of an in vivo animal testing
- Animal models
- Analysis of the in vivo results

Full-or-part-time: 10h
Theory classes: 3h
Laboratory classes: 1h
Self study : 6h

Biomedical materials for cardiovascular applications

Description:
- Cardiovascular Diseases. Endothelitzation and thrombogenicity
- Heart valves
- Vascular Grafts
- Cardiovascular Stents
- Pacemakers

Full-or-part-time: 17h
Theory classes: 5h
Laboratory classes: 2h
Self study : 10h

Biomedical materials for orthopaedic and dental applications

Description:
- The use of biomaterials for bone replacement. Osseointegration
- Dental implants.
- Hip Prosthesis. Knee replacements
- Osteosynthesis material: plates and screws
- Intervertebral discs
- Materials for bone regeneration: bioceramics and bioactive glasses
- Biomaterials for repair and regeneration of cartilage
- Tissue engineering applied to orthopedic and maxillofacial surgery

Full-or-part-time: 25h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 2h
Self study : 15h

Biomedical materials for adhesives, sealants and sutures

Description:
- Mechanisms of adhesion: mechanical interlocking, adsorption, diffusion, electrostatic forces
- Composition and characteristics of adhesive materials. Adhesives soft tissues. Adhesives for hard tissue
- Natural and synthetic Sutures

Full-or-part-time: 13h 30m
Theory classes: 4h
Guided activities: 2h
Self study : 7h 30m

Biomedical materials for ophtalmologic applications

Description:
- Anatomy of the eye
- Soft and hard contact lenses
- Intraocular lenses
- Corneal Implants. Implants for glaucoma

Full-or-part-time: 7h 30m
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h 30m

Biomedical applications for skin regeneration

Description:
- Structure of the dermis
- Absorbable and permanent implants
- Tissue engineering applied to regeneration of skin

Full-or-part-time: 7h 30m
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h 30m

Biomedical materials for controlled drug delivery

Description:
- Control of the release of a drug: between effectiveness and toxicity
- Control of the release by diffusion
- Control Systems to release water penetration device
- Chemically controlled devices

Full-or-part-time: 14h
Theory classes: 4h
Laboratory classes: 2h
Self study : 8h

GRADING SYSTEM

Nfinal = 0.50 Nef + 0. 30 Nep + 0.2 Ntg

Nfinal: final mark
Nef: mark final exam
Nep: mark parcial exam
Ntg: mark grup work

In case of reevaluation, the mark of the reevaluation exam replaces the mark of the final exam in the above equation. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

BIBLIOGRAPHY

Basic:
- Ratner, Buddy D. ; A.S. Hoffman ; F.J. Schoen ; J.E. Lemons. Biomaterials science : an introduction to materials in medicine. 3rd ed. Amsterdam: Elsevier Academic, 2013. ISBN 9780123746269.
- P. Dubruel ; S.V. Vlierberghe. Biomaterials for bone regeneration. New York: Elsevier, 2014. ISBN 9780857098047.

RESOURCES

Audiovisual material:
- Presentacions en PPT disponibles a Atenea. Support material for the lectures