



## Guia docent [Codi UD] – [Sigles UD] – Biomaterials Avançats

<b>Unitat responsable:</b>	Escola d'Enginyeria de Barcelona Est		
<b>Unitat que imparteix:</b>	<i>Ciència i Enginyeria de Materials</i>		
<b>Curs</b>	2025	<b>Crèdits</b>	6
<b>Idiomes</b>		<i>Català</i>	

### PROFESSORAT

<b>Professorat responsable:</b>	Cristina Canal
<b>Altres:</b>	Marta Pegueroles Carles Mas Xavier Gil Mur

### CAPACITATS PRÈVIES

Knowledge of the fundamental concepts and principles of the application of biomaterials and be able to apply them to problems in the field of biomedical engineering. Understanding of the fundamental criteria that must be met for a material to be implanted. Fundamental knowledge of functional biomaterials, and drug release.

### METODOLOGIES DOCENTS

AF.1.- Presentation of theoretical content.  
AF.3.- Practical work sessions in the laboratory.  
AF.4.- Discussion of cases and scientific articles.  
AF.5.- Participation in seminars and conferences.  
AF.6.- Completion of individual and cooperative work.

### OBJECTIUS D'APRENTATGE DE L'ASSIGNATURA

- Analyze the advanced properties of biomaterials to adapt them to specific clinical needs.
- Understand the dynamic interactions between biomaterials and biological systems.
- Apply innovative technologies for the design and modification of biomaterials.
- Propose solutions to medical challenges through the use of advanced biomaterials.

### HORES TOTALES DE DEDICACIÓ DE L'ESTUDIANTAT

Tipus	Hores	Percentatge
Hores grup gran	32,0 h	21.00 %
Hores grup petit	24,0 h	16.00 %
Hores aprenentatge autònom	94,0	63.00 %
<b>Dedicació total:</b>	150 h	

### CONTINGUTS

#### Temari 1: Introduction and background

##### Descripció:

1. Types, properties and applications of biomaterials.
2. Advanced properties adapted to clinical needs.
3. Dynamic interactions between biomaterials and biology.
4. Pioneering applications and future of biomaterials.

##### Activitats vinculades:

- Analysis of scientific articles.
- Exercises on advanced properties of biomaterials..

##### Dedicació: hores totals

Grup gran/Teoria: 2 h  
Activitats dirigides: 1 h  
Aprenentatge autònom: 4 h

**Temari 2: Biomaterials in plasma medicine**

**Descripció:**

1. Introduction to Plasma Medicine: definition and classification of plasma, methods of plasma diagnosis and mechanisms of biological interactions of plasma.
2. Modification of the plasma surface of biomaterials: Mechanisms of surface modification, hard materials and soft materials, examples and practical cases of implants and biomaterials modified with plasma.
3. Applications of Plasma Medicine with Biomaterials. Plasma in wound healing and regeneration. Plasma therapy in cancer. Antimicrobial applications. Plasma in immunomodulation.
4. Challenges and emerging areas in Plasma Medicine, clinical trials.

**Activitats vinculades:**

- Discussion of practical cases.
- Laboratory practices:
  - P1. Surface modification with plasma.
  - P2. Diffusion of reactive species in tissues.

**Dedicació: hores totals**

Grup gran/Teoria: 6 h  
Activitats dirigides / en grup petit: 8 h  
Aprentatge autònom: 22 h

**Temari 3: Biodegradable materials**

**Descripció:**

1. Biodegradable polymers with shape memory. Physico-chemical properties, auxetic design, applications in medicine: implants for pediatrics.
2. Biodegradable metals. Degradation - mechanical properties and biocompatibility. Biodegradable metal alloys. Electrochemical tests.
3. Medical applications of biodegradable materials in orthopedic implants, bioabsorbable stents, tissue engineering, drug release and nerve regeneration.

**Activitats vinculades:**

- Interpretation of results of characterization of biodegradable materials.
- Laboratory practices:
  - P3 - Degradation of metallic materials (Mg, Zn and Fe).
  - P4 - Adaptability of a shape memory polymer and auxetic design.

**Dedicació: hores totals**

Grup gran/Teoria: 8 h  
Activitats dirigides / en grup petit: 8 h  
Aprentatge autònom: 22 h

**Temari 4: Advanced Functional Biomaterials**

**Descripció:**

1. Introduction. Evolution of materials and new needs. Mimeticism, functionalization and dynamism in materials.
2. Biomaterials based on growth factors for tissue regeneration. Integrins, growth factors and the extracellular matrix. Growth factors in medical practice – limitations, Scavenger materials, immobilization and functionalization with mimetics of growth factors.
3. Multifunctional antibacterial biomaterials. Classic strategies – limitations. Multifunctionality, applications. Bactericidal nano-topographies and multifunctional peptides.
4. Intelligent stimulus-sensitive biomaterials - dynamic biomaterials. Intelligent hydrogels, Materials sensitive to pH and temperature, to enzymes. Practical case: Intelligent materials in infection control.

**Activitats vinculades:**

Discussion of scientific articles.  
Laboratory practices.

**Dedicació: hores totals**

Grup gran/Teoria: 8 h  
Activitats dirigides / en grup petit: 8 h  
Aprentatge autònom: 23 h

**Temari 5: Regulatòria i retirades del mercat**



<b>Descripció:</b> <ol style="list-style-type: none"><li>1. Introduction to regulatory: Regulatory bodies and classification of biomaterials, medical devices.</li><li>2. Commercialization – considerations in sterilization and conditioning.</li><li>3. Withdrawals of biomaterials and medical devices: introduction and real cases. Intellectual property and marketing strategies.</li></ol>
<b>Activitats vinculades:</b> <ul style="list-style-type: none"><li>• Work with the case method.</li><li>• Guest speaker.</li></ul>
<b>Dedicació: hores totals</b> Grup gran/Teoria: 9 h Activitats dirigides / en grup petit: h Aprentatge autònom: 23 h

<b>SISTEMA DE QUALIFICACIÓ</b>
Grades of directed activities = 15% Grades of lab practice reports (AP) = 25% Partial exam (EP) = 15% Final Exam (EF) = 45%  Final grade (Nf): $0.15*AD + 0.25*AP + 0.15*EP + 0.45*EF$
<b>Especificació</b> <ol style="list-style-type: none"><li>1. There will be evaluation of directed activities (face-to-face or non-face-to-face) corresponding to the delivery of proposed works (type AD) and the delivery of practice reports (type AP).</li><li>2. There will be a partial exam (EP) in the first half of the course and a final exam (EF).</li><li>3. Attendance at practices is mandatory.</li><li>4. There will be no re-evaluation exam in this subject.</li></ol>

<b>BIBLIOGRAFIA</b>
<b>Bàsica:</b> <p>Sander Bekeschus, S., &amp; Thomas von Woedtke, T. (Eds.). (2024). Redox Biology in Plasma Medicine (1st ed.). CRC Press. <a href="https://doi.org/10.1201/9781003328056">https://doi.org/10.1201/9781003328056</a></p> <p>William R. Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J. Yaszemski (Eds. (2020)). Academic Press, 2020, ISBN 9780128161371, <a href="https://doi.org/10.1016/B978-0-12-816137-1.00021-0">https://doi.org/10.1016/B978-0-12-816137-1.00021-0</a></p>
<b>Complementaria:</b>

<b>RECURSOS</b>
<b>Altres recursos:</b> <p>Class material available in ATENEA</p>