Module descriptor for 4BM6/5M20: Biomaterials

Module code	MEU44BM6/ME5M20
Module name	Biomaterials
ECTS weighting	5 ECTS
Semester taught	Semester 1
Module coordinator/s	Professor Conor Buckley
Module learning outcomes (LO) with reference to the graduate attributes and how they are developed in discipline	On successful completion of this module, students should be able to: LO1. Describe the structure, composition and biocompatibility of commonly employed biomaterials and be capable of selecting an appropriate biomaterial for a given implant design. LO2. Describe methods of manufacture of the different types of materials used in medicine and biosciences, their properties and their suitability for a particular function. LO3. Describe the various common causes of failure in biomaterial components and explain how components are designed/modified so as to prevent failure. LO4. Describe the various methods of sterilisation for biomaterials. LO5. Decide what is the best test protocol to use in characterising a biomaterial. LO6. Knowledge of the regulatory hurdles, challenges and routes to market. LO7. Develop an awareness of emerging technologies/biomaterials and their impact on the field. LO8. Have performed a group laboratory biomaterials experiment using state of the art technology, performed analysis and produce a technical assignment. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Enhanced

Module content	This module explores currently used materials in tissue replacement including metallic, ceramic, and natural/synthetic polymeric materials. Implant applications and design considerations for these materials as well as the associated problems with long term survival will be described so that the mechanical, chemical and physiological interactions between in vivo host environment and the implanted biomaterial can be better understood. Integration of biomaterial structure and function will be emphasised throughout the module. Advanced manufacturing and fabrication technologies to generate biomaterials with specialised structural and interfacial properties will also be introduced. At the end of this module, it is anticipated that students will have obtained a detailed understanding of the composition and properties of the major classes of biomaterial used in medical devices. The required functionality for a range of synthetic implantable biomaterials and how this relates to material choice for specific applications will also be covered. Associated failure modes are introduced through a series of real-life case studies. Sterilisation techniques, regulatory aspects and standards with relation to quality and safety will also be introduced. • Biomaterial classifications • Hydrogel systems • Biocompatibility, sterilisation and materials selection for implant design • Metals for medical implants • Ceramic implant materials • Dental Materials • Polymer based biomaterials • Composite biomaterials • Natural biomaterials • Tissue response to biomaterial implants • Biological testing of biomaterials • Advanced fabrication methods and technologies • Drug delivery systems • Regulatory classification of biomaterials and medical devices

Teaching and learning methods

This module is taught using a combination of lectures, laboratories and tutorials. Assessment is through assignments and a final written examination.

Assessment details

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Written examination	End of semester examination	1-7	80	S1 Exam Period
Laboratory Assignment	Technical laboratory assignment	8	20	Within two weeks of scheduled laboratory session

Attendance to lectures, tutorials and laboratory session is mandatory. Students who attend less than 80% of lectures may be deemed unsatisfactory and ineligible to sit the exam, except in cases of a valid medical note.

Technical laboratory assignment submission: All submissions must be made through blackboard within two weeks of your scheduled laboratory session. Penalties: Up to 1 week late = minus 15%. From 1 week to 2 weeks late = minus 25%. Any submissions received two weeks after the due date will receive a zero grade.

Reassment requirements

In the case of reassessment, candidates must retake a written examination, with 100% of the module mark based on this examination.

Indicative student workload

Contact hours: 30 lecture hours + 5 tutorial hours.

Independent study: 50 hours (preparation and review of lecture material).

Independent study: 10 hours (preparation and completion of technical assignment).

Recommended reading list

- Lecture notes will be provided via blackboard.
- Mechanics of Biomaterials: Fundamental Principles for Implant Design, Pruitt & Chakravartula, Cambridge. University Press,2011
- Biomaterials- An Introduction,Park, Joon & Lakes, R. S., 3rd ed., 2007 (Springer).
- Biomaterials A Basic Introduction, Qizhi Chen, George Thouas, 1st Edition, 2015 (Routledge).

Module pre-requisite	None
Module co-requisite	None
Module website	https://www.tcd.ie/engineering/current-students/undergraduate/engineering/year-four/
Other schools/departments involved in delivery of this module?	N/A
Module approval date	15/07/2025
Approved by	Conor Buckley
Academic start year	2024
Academic year of date	2025/2026