

## ME5M20 BIOMATERIALS – [5 Credits]

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**Semester:** 1

### Module Organisation

The module runs for 12 weeks of the academic year and comprises three lectures and one tutorial per week (except the study week). Total contact time is 40 hours.

Start Week	End Week	Lectures per week	Lectures total	Tutorials per week	Tutorials total
1	12	3	33	1	7

### Module Description

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 emphasized throughout the module. Advanced manufacturing and fabrication technologies to generate biomaterials with specialized 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 be introduced.

### Learning Outcomes

On successful completion of this module, students will be able to:

1. Describe the structure, composition and biocompatibility of commonly employed biomaterials and be capable of selecting an appropriate biomaterial for a given implant design
2. Describe methods of manufacture of the different types of materials used in medicine and biosciences, their properties and their suitability for a particular function
3. Describe the various common causes of failure in biomaterial components and explain how components are designed/modified so as to prevent failure.
4. Describe the various methods of sterilisation for biomaterials
5. Decide what is the best test protocol to use in characterising a biomaterial.
6. Knowledge of the regulatory hurdles, challenges and routes to market

7. Develop an awareness of emerging technologies/biomaterials and their impact on the field
8. Have performed a group laboratory biomaterials experiment using state of the art technology, performed analysis and produce a technical report

### **Module Content**

- Biomaterial classifications
- Hydrogel systems
- Biocompatibility, sterilization 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
- Failure and analysis of implants
- Biomaterials for cardiovascular intervention
- Advanced fabrication methods and technologies
- Drug delivery systems
- Regulatory classification of biomaterials and medical devices

### **Module Notes**

Provided via blackboard

### **Teaching Strategies**

The module is taught using a combination of lectures, laboratories and tutorials.

### **Assessment Modes**

Written examination (80%) and laboratory technical report (20%)

### **Recommended Texts**

- Biomaterials- An Introduction, Park, Joon & Lakes, R. S., 3rd ed., 2007 (Springer)
- An Introduction to Biomaterials, Guelcher & Hollinger (Eds), 2006, (Taylor & Francis Group)

### **Laboratory**

Hydrogels for Biomaterial Applications