

MODULE TITLE: 4B16 Biomechanics of Tissues and Implants

CODE: ME4B16

LEVEL: Senior Sophister (Optional module)

CREDITS: 5

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MODULE ORGANISATION

This module runs for the 12 weeks of semester two (except during study/assignment week) and comprises three lectures plus one one-hour tutorial per week. Total contact time is 44 hours.

Semester	Start Week	End Week	Associated Practical Hours	Lectures		Tutorials	
				Per week	Total	Per week	Total
2	1	12	0	3	33	1	11
Total Contact Hours: 44							

MODULE DESCRIPTION, AIMS AND CONTRIBUTION TO THE PROGRAMME

This module studies the biomechanics of human tissues and joints, and implants that are used to replace or repair damaged tissues and joints. It begins with an introduction to human anatomy and physiology and the biology of cells and tissues and goes on to discuss the mechanical behaviour of human tissues and joints. Concepts of tissue remodelling and repair are explored. Finally, the student is introduced to the use of implants and medical devices for reconstruction and repair of human tissues and systems. The module aims to promote independent and lifelong learning through the use of individualised assignments.

LEARNING OUTCOMES

On completion of this module, the student will be able to:

- describe the basics of human anatomy and physiology;
- explain how tissues such as bone and cartilage grow, develop, adapt and repair;
- develop mathematical frameworks to describe biological events such as bone remodelling;
- explain how the structure and components of tissues determine their mechanical properties (structure-function relationships). This will be facilitated by laboratory assignment where students will determine the aggregate modulus of articular cartilage using a stress relaxation test;
- use constitutive equations to describe the visco-elastic response of a tissue;
- describe the biomechanics of human joints (the knee, hip, shoulder, elbow and spine);
- understand the basics of the human gait cycle;
- explain the design principles behind orthopaedic implants used for joint replacement and bone fracture repair. The students will also gain an understanding of the consequences of a poorly designed implant, as well as the benefits of well designed implant;
- use mechanics of solids theory to analyze different orthopaedic implants;
- appreciate how medical devices designed by engineers are used by clinicians (the customer);
- develop constitutive equations to model large deformations of soft tissues;
- complete an independent learning assignment unique to them. This requires researching a specific bioengineering problem and producing an electronic report.

MODULE SYLLABUS

- cell physiology;
- tissue differentiation, growth, adaptation and repair;
- mechanical properties of bone and soft tissues;

- musculoskeletal biomechanics, design of joint replacements and orthopaedic;
- constitutive modelling of tissues;
- gait analysis;
- biomechanics of man-machine interaction.

TEACHING STRATEGIES

The course is taught using a combination of lectures, laboratories and tutorials. Each student is given an independent learning assignment which introduces the student to research skills necessary for life-long learning.

RECOMMENDED TEXT(S)

- *Basic Orthopaedic Biomechanics*, VC Mow and WC Hayes, Lippencot-Raven
- *Bone Mechanics Handbook*, SC Cowin, CRC Press, Boca Raton, 2001
- *Essentials of Anatomy and Physiology*, FH Martini, EF Bartholomew, Prentice-Hall, 1997
- *Biomechanics: Mechanical Properties of Living Tissues*, YC Fung, Springer 1991

ASSESSMENT

Assessment is by means of a formal written end-of-year two-hour examination (70%), laboratory experiment and individual learning assignment (30%).