Module Template for New and Revised Modules

Module Code	ME5M19
Module Name	Biomechanics
ECTS Weighting	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Assoc. Prof. David Hoey
Module Learning Outcomes 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. Apply the principles of statics to analyse the musculoskeletal system (e.g. determination of muscle forces and joint loads). LO2. Understand how the structure and composition of hard tissues (e.g. bone, teeth) determine their mechanical properties. LO3. Explain how tissues such as bone and cartilage grow, develop, adapt and repair. LO4. Understand how the structure and composition of soft tissues (e.g. cartilage, ligament, tendon, muscle, vascular tissue) determine their mechanical properties. LO5. Explain how synovial joints function and how they are replaced with artificial prostheses. LO6. Analyse the performance of joint replacement prostheses. LO7. Have completed an independent learning assignment unique to them. This requires researching a specific bioengineering problem and producing an electronic report. LO8. Understand the anatomy of joints, soft tissues and the cardiovascular system LO9. Model the cardiovascular system based on mathematical models LO10. Understand basic cellular biology, mechanobiology and mechanotransduction. **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 the biomechanics of human cells, tissues and joints, how they change with age and disease and how implants can be used to either replace or repair tissues and joints following injury or degeneration. A strong focus is placed on understanding the biomechanics of the musculoskeletal and cardiovascular system. The module begins with a description of how the mechanical properties of different tissues are derived from their structure and composition which leads to an introduction to the forces and moments that act on the musculoskeletal system. Concepts of tissue remodelling and repair are explored. Next, the biomechanics of the main joints of the body are studied. Finally, the student is introduced to the use of implants and medical devices for reconstruction and repair of human tissues and systems. Throughout the module students will use engineering principles to analyse tissues, organs and implants, from the use of solid mechanics theory to analyse bone-implant interfaces, to the use of fluid mechanics theory to model blood flow through the cardiovascular system. The module also aims to promote independent and lifelong learning through the use of individualised assignments. • Bone Development, Growth and Biomechanics • Articular Cartilage Biomechanics • Intervertebral Disc Biomechanics • Ligament and Tendon Biomechanics • Muscle Biomechanics • Vascular Tissue Mechanics • Biofluid Mechanics • Friction and lubrication in synovial joints • Gait Analysis • Loads and Motion in the in the Musculoskeletal System • Biomechanics of the Hip • Biomechanics of the Knee • Biomechanics of the Shoulder and Elbow • Biomechanics of the Spine • Total Hip Replacements • Total Knee Replacements • Fracture Fixation Devices • Repair and restoration of the cardiovascular system • Cell Biomechanics • Mechanobiology and Mechanotransduction

Teaching and Learning Methods	The module is taught using a combination of lectures, laboratories, tutorials and assignments. Students are given an independent learning assignment which introduces the students to research skills necessary for life-long learning.

Assessment Details
Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Teaching week due
Exam	2hr formal written exam	LO1-10	75	14
Exam	30min on-line exam	LO1-10	10	8
Assignment	Self-learning assignment	LO1-10	15	11

Reassessment Requirements

Reassessment will consist of a 2hr formal written exam.

Contact Hours and Indicative Student Workload

Contact hours: 44
Independent Study (preparation for course and review of materials): 18
Independent Study (preparation for assessment, incl. completion of assessment): 54

Recommended Reading List

- Orthopaedic Biomechanics, Bartel, Davy & Keaveny (Pearson Prentice Hall).
- Basic Orthopaedic Biomechanics, Mow & Huiskes (Lippencot-Raven)
- Biomechanics: Mechanical Properties of Living Tissues, Y.C. Fung (Springer)
- Introduction to Cell Mechanics and Mechanobiology, Jacobs, Huang, Kwon (Garland Science)

Module Pre-requisite

ME7B04 Basic Medical Sciences

Module Co-requisite

Module Website

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.

No

Module Approval Date	08/04/2020
Approved by	Assoc. Prof. David Hoey
Academic Start Year	2013
Academic Year of Date	2023