

## Module Template for New and Revised Modules

<b>Module Code</b>	ME5M19
<b>Module Name</b>	Biomechanics
<b>ECTS Weighting</b>	5 ECTS
<b>Semester taught</b>	Semester 1
<b>Module Coordinator/s</b>	Prof. David Hoey
<b>Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline</b>	<p>On successful completion of this module, students should be able to:</p> <p>LO1. Apply the principles of statics to analyse the musculoskeletal system (e.g. determination of muscle forces and joint loads).</p> <p>LO2. Understand how the structure and composition of hard tissues (e.g. bone, teeth) determine their mechanical properties.</p> <p>LO3. Explain how tissues such as bone and cartilage grow, develop, adapt and repair.</p> <p>LO4. Understand how the structure and composition of soft tissues (e.g. cartilage, ligament, tendon, muscle, vascular tissue) determine their mechanical properties.</p> <p>LO5. Explain how synovial joints function and how they are replaced with artificial prostheses.</p> <p>LO6. Analyse the performance of joint replacement prostheses.</p> <p>LO7. Have completed an independent learning assignment unique to them. This requires researching a specific bioengineering problem and producing an electronic report.</p> <p>LO8. Understand the anatomy of joints, soft tissues and the cardiovascular system</p> <p>LO9. Model the cardiovascular system based on mathematical models</p> <p>LO10. Understand basic cellular biology, mechanobiology and mechanotransduction.</p> <p><b>Graduate Attributes: levels of attainment</b></p> <p>To act responsibly - Enhanced</p> <p>To think independently - Enhanced</p> <p>To develop continuously - Enhanced</p> <p>To communicate effectively - Enhanced</p>

## 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 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.

<b>Assessment Details</b> Please include the following: <ul style="list-style-type: none"> <li>• <b>Assessment Component</b></li> <li>• <b>Assessment description</b></li> <li>• <b>Learning Outcome(s) addressed</b></li> <li>• <b>% of total</b></li> <li>• <b>Assessment due date</b></li> </ul>	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
<b>Reassessment Requirements</b>	Reassessment will consist of a 2hr formal written exam.				
<b>Contact Hours and Indicative Student Workload</b>	<b>Contact hours: 44</b>				
	<b>Independent Study (preparation for course and review of materials): 18</b>				
	<b>Independent Study (preparation for assessment, incl. completion of assessment): 54</b>				
<b>Recommended Reading List</b>	<ul style="list-style-type: none"> <li>• Orthopaedic Biomechanics, Bartel, Davy &amp; Keaveny (Pearson Prentice Hall).</li> <li>• Basic Orthopaedic Biomechanics, Mow &amp; Huiskes (Lippencot-Raven)</li> <li>• Biomechanics: Mechanical Properties of Living Tissues, Y.C. Fung (Springer)</li> <li>• Introduction to Cell Mechanics and Mechanobiology, Jacobs, Huang, Kwon (Garland Science)</li> </ul>				
<b>Module Pre-requisite</b>	ME7B04 Basic Medical Sciences				
<b>Module Co-requisite</b>					
<b>Module Website</b>					
<b>Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.</b>	No				

<b>Module Approval Date</b>	08/04/2020
<b>Approved by</b>	Assoc. Prof. David Hoey
<b>Academic Start Year</b>	2013
<b>Academic Year of Date</b>	2025