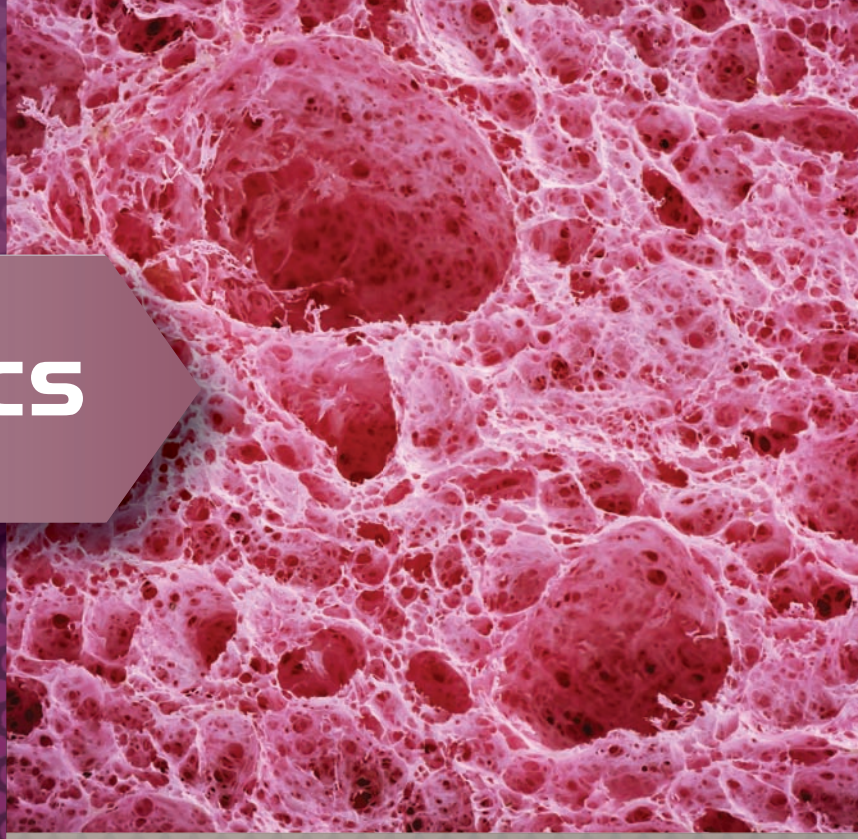
NUI Galway
OÉ Gaillimh

Biomechanics



Why study this module?

Take this module if you wish to gain a solid grounding in the concepts underlying the biomechanical properties of human tissues. How mechanical forces (loaded and unloaded) on bones, joints and soft tissue are modelled is presented, as are the affects of aging on bone density and strength. Muscle control of forces on joints and of the cardiovascular system, is covered.

Module content

The mechanical behaviour of biological tissues and systems will be explained in terms of the principles of solid and fluid mechanics. In particular, the way in which the properties of elasticity and visco-elasticity are incorporated into the mechanical characterisation of tissue, will be explained.

Learning outcomes

On completion of this module you will be able to:

- Explain how the laws of solid and fluid mechanics can be applied to describe the mechanical behaviour of biological tissues and systems
- Summarise how the properties of elasticity and visco-elasticity are incorporated into the mechanical characterisation of tissues
- Describe the application of force and stress analyses on anatomical structures including limbs and joints
- Biomechanically differentiate between various tissues of the body, including blood vessels, muscles, ligaments, cartilage and bone

Who is the target audience?

Graduate biological scientitsts and those without a degree in mechanical engineering, who wish to understand the basic principles of mechanical loading in human body tissue. This module will be particularly useful to individuals who wish to cross over from a biological to a more engineering discipline, or who simply wish to further their specialist education.

Module facts

Course level: Level 9

Module credit: 5 ECTS. Gain transcript or use towards PG Cert/PG Dip/MSc qualification in Biomedical Science

Duration: Over one semester

Entry Requirements: Please refer to the application section of the programme brochure

Fees: €1,000

Applying: www.nuigalway.ie/apply

Closing date: 2 – 8 weeks prior to module start date.

Module topics

Introduction and Anatomical Concepts

- Definition of Biomechanics
- Research Activities in Biomechanics
- Steps in Studying Problems in Biomechanics
- Mechanical & Anatomical Concept

Bone Biomechanics

- Bone Composition
- The Role of Skeleton
- Mechanical Properties of Bone
- Bone Remodelling
- Biomechanical Behaviour of Bone
- Bone Fractures
- Degenerative Changes in Bone Associated with Aging

Analysis of the muscles and joint loads

- Skeletal Muscles, Joints

Spine Biomechanics

- Spine Anatomy and Kinematics
- Loads in the Spine and Pathology of the Spine

Biomechanics of the Cardiovascular System

- Introduction to Basic Fluid Mechanics Concept
- Overview of the Cardiovascular System

Student testimonial

Jacqui Roche

Current position:
QC Biochemist & Microbiologist.

Position held when completing module:
QC Biochemist.

"I found the Biomechanics module particularly interesting and stimulating because I got to use skills I have do not commonly use in my chosen field. There are a lot of equations and problem solving which I enjoy though are not applicable in my current position. I found the module challenging as this was unlike anything I had experienced throughout my academic career previously.

The section on forces was particularly interesting and though not highly relevant to the activities of my company was something that can be considered useful and practical for future endeavours. The unit on the Biomechanics of the Cardiovascular system I found particularly interesting as this is related to my current role in haemostasis though not currently directly applicable. This unit I found also tied in well with the coursework on biomaterials which I also found very interesting. The best thing about the Biomechanics module, was the combination of the engineering and biological elements of the course. I felt this module was the one in which these two primary elements of the MSc programme integrated the best. I also liked how the subject covers such a variety of areas with the principles of biomechanics applying from a molecular level to a whole body level.

I found this module particularly interesting because the elements I was studying were relatively new to me. I thoroughly enjoyed the engineering aspects that were incorporated into this module as these were the most accessible I found throughout the MSc programme."

Module Director

Dr. Laoise McNamara, BE, PhD

The module will be delivered by Dr Laoise MacNamara, from the discipline of Mechanical Engineering. Dr. McNamara was recruited to the Department of Mechanical and Biomedical Engineering at NUI Galway through the Science Foundation Ireland Stokes Lectureship program in 2009. She holds a PhD in Biomedical Engineering from Trinity College Dublin, Ireland and a first class honours degree in Mechanical Engineering from NUI Galway. Following her PhD she completed a postdoctoral fellowship in bone cell biology at the Department of Orthopaedic Research at Mount Sinai School of Medicine, New York. Upon completing this research she was appointed to a fixed-term lectureship in Biomedical Engineering at NUI Galway. From 2007-2009 she was a lecturer in Mechanobiology and Musculoskeletal Biomechanics at the University of Southampton in the United Kingdom before taking up her current position.

Dr. McNamara's research group consists of eight PhD students and three postdoctoral fellows. She has been awarded funding by the European Research Council, under the Starting Independant Research Grant Program 2010, the Health Research Board Ireland and Science Foundation Ireland. She lectures and co-ordinates courses on the Introduction to Biomedical Engineering, Biomechanics, Medical Implant and Device Design for Biomedical Engineering Undergraduate Degree Program.

Dr. McNamara has developed an exceptional research track record in her field, as is evident from international awards and peer-reviewed publications. Her PhD research was internationally recognised with a first prize for a student paper at the European Society of Biomechanics conference in 2002. Her research was awarded a New Investigator Research Award at the Orthopaedic Research Society, 2006 and the American Society for Bone and Mineral Research (ASBMR) Harold B. Frost Young Investigator Award in 2005. In addition her research findings were published in the major international multidisciplinary peer-reviewed journals and her research achievements have been recognised through invited presentations at international conferences and schools. She has served on the awards and program committee for the European Society of Biomechanics and as an international reviewer for the Royal Academy of Engineering (UK) to act to evaluate funding applications. She written book chapters, review articles and is a reviewer for many peer-reviewed journals in her field.

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