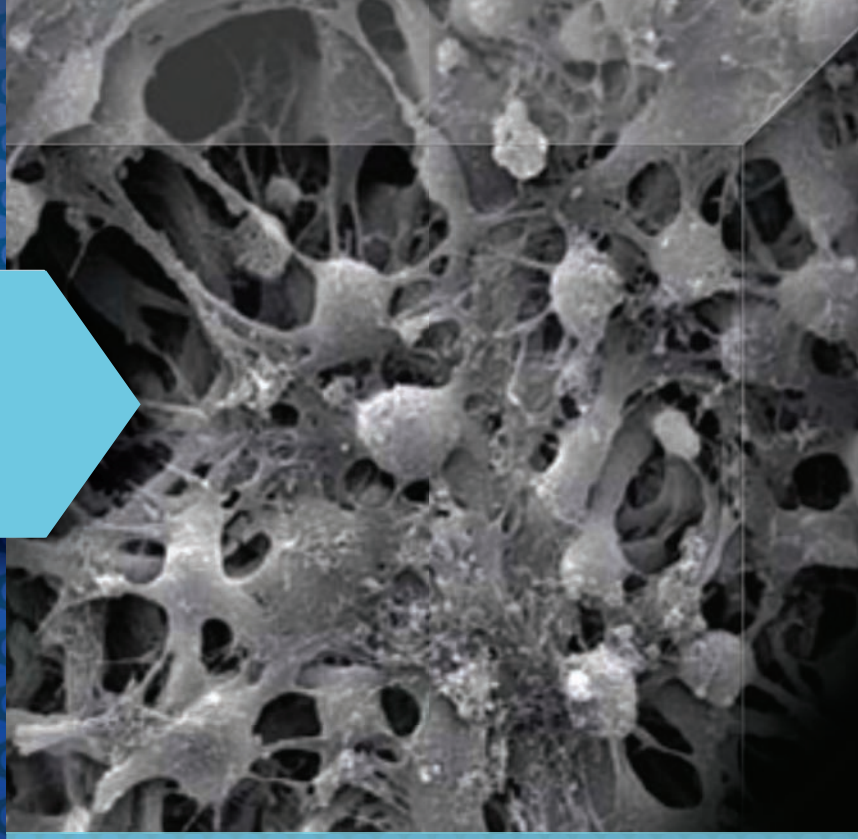
NUI Galway
OÉ Gaillimh

Tissue Engineering



Tissue Engineering (TE) is a multidisciplinary approach to a critical problem in modern medicine – the supply of organs and tissues for transplant. One of the goals of tissue engineering is to develop methods to construct organs in the laboratory that can subsequently be used in medical applications. Another goal is to produce organs or tissues that can be used for research purposes such as testing new drugs and simulating diseases in order to develop better treatments.

Why study this module?

Tissue Engineering represents a new era of medicine that provides the potential to significantly improve the lives of many people. With successful collaboration between clinicians, scientists and engineers, Tissue Engineering shows much potential to alleviate the suffering of many by providing treatments (i.e. replacement or repair of tissues/organs) for a myriad of pathological conditions. This module provides the necessary tools for the learner to be able to conduct a Tissue Engineering based project in their own respective field of interest.

Module content

This course integrates the principles and methods of engineering and life sciences towards the fundamental understanding of structure-function relationships in normal and pathological mammalian tissues especially as they relate to the development of biological tissues to restore, maintain, or improve tissue/organ function. TE-based treatment strategies are founded on the combination of cells, scaffolds and signals. Determining the appropriate balance between these three factors remains one of the key issues in converting promising TE research into viable tissue engineered products (TEPs).

Who is the target audience?

The target audience is anyone from industry wanting to have more knowledge about the use and design of biomaterials and medical devices and how they are used in biological systems.

Learning outcomes

On successful completion of this subject, you will be able to:

- Specify the different types of biodegradable biomaterials that can be used in tissue engineering applications
- Discuss the complex interactions between biomaterials, cells and signals in biological systems
- Demonstrate awareness of contemporary topics such as gene therapy, stem cells, proteonomics, genomics and bioreactors
- Demonstrate their capability in conducting a multidisciplinary project

Module facts

Course level: Level 9

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

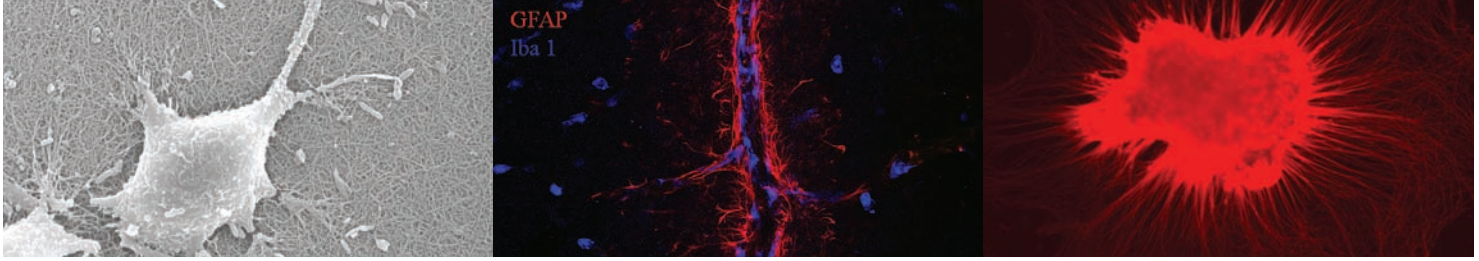
Duration: Over one semester

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 to Tissue Engineering

Cells and Tissue Engineering
- Cell Function – Role of Tissue Engineering
- Cells – Integration in Tissue Engineering
- Cells - Sources
- Stem Cells – Future in Tissue Engineering
- Cells – Immunogenicity & Preservation

Scaffolds I
- The Extracellular Matrix
- Cell-Extracellular Matrix Interactions
- Scaffolds in Tissue Engineering

Scaffolds II
- Synthetic, Natural & Composite Biomaterials
- Synthetic Bioerodible Scaffold Biomaterials
- Natural Bioerodible Scaffold Biomaterials
- Composite Bioerodible Scaffold Biomaterials
- Scaffold Fabrication Technique

Signals
- Soluble Biochemical Signals – Growth Factors
- How to Incorporate Biochemical Signals in TEPs?
- Growth Factor Delivery
- Biomechanical Signals
- Bioreactors

Ethics
- Background
- Ethical Issues in Tissue Engineering

Status of Tissue Engineering
- Overview of Current Status of Tissue Engineering
- Case Study

Student testimonials

Patrick Power
Position held:
Aerosol Scientist at Aerogen.

"I found the Tissue Engineering module offered as part of NUI Galway's MSc in Biomedical Science particularly stimulating due to the strong involvement of the world leading NFB institute. The exposure to cutting edge research explained by those directly involved in it inspired and motivated the class to further explore the discipline. This drive was facilitated by a broadly scoped final assignment that challenged us to directly apply their knowledge in the development and application of our own unique tissue engineering treatment (combining cells, scaffolds and signals) for a disease of our choice. This focus on autonomous scientific thinking was highly rewarding.

The Tissue Engineering module also served to highlight areas of potential collaboration between NUI Galway researchers and my own company, Aerogen. The NFB and Aerogen have fostered a strong relationship and are now involved several novel collaborations with potential IP and financial reward."

Brian de Souza
Position held:
Research Fellow Synthesis and
Solid State Pharmaceutical Cluster
University of Limerick.

"Of all the biological science modules I undertook as part of the MSc program, I found tissue engineering to be my favourite.

In addition to classroom learning, there was a strong practical element to this module. I was able to observe common processing techniques such as freeze drying and extrusion. FTIR, an analysis method which I learned during this module,is now essential to my current work. Tissue engineering is without doubt, the way of the future. I would highly recommend the module ME511 Tissue Engineering to all."

Module Director

Prof. Abhay Pandit

This module is delivered by Prof. Abhay Pandit, who is Director of the Network of Functional Biomaterials, a Science Foundation Ireland funded Strategic Research Cluster and Professor in Biomedical Engineering at NUI Galway. Prof. Pandit is also affiliated with the National Centre for Biomedical Engineering Science at NUI Galway. He has over twenty years of experience in the field of tissue engineering. After graduating with a First Class honours BE degree in Biomedical Engineering from the University of Bombay, India, he pursued his postgraduate degrees (Biomaterials Track) under the guidance of Prof. Dale Feldman at the University of Alabama at Birmingham, USA. His postgraduate work focused on developing a scaffold for wound healing applications. Prof. Pandit's subsequent research in the Wound Care R & D Group at The Kendall Company resulted in a patent and FDA approval for a commercial wound dressing. Prof. Pandit also led the Biomaterials Research Group at Surgical Sealants, Inc. where he received IDE approval for a collagen-based vascular sealant. His research is currently funded by Science Foundation Ireland, the 7th EU Framework, Enterprise Ireland, Health Research Board, Dystrophic Epidermal Bullosa Research Association, the European Molecular Biology Organisation and the AO Foundation amongst others. He has generated research contracts from industry and government funding agencies totaling €25,241,940 in the last 11 years. He has been recognised as one of "Ireland's Champions of EU Research" for his achievements as leaders of major research projects in the 7th EU Framework Programme – he currently coordinates two EU proposals "NeuroGraft" and "AngioMatTrain". He is the author of 4 granted patents with 17 patent applications pending. He has published 129 papers in high-impact factor publications. Prof. Pandit has published an average of 17 papers per year in the last 5 years. Despite his research commitments, he enjoys teaching Tissue Engineering to the eager students in the Masters' program in Biomedical Science at the NCBES.

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