

<b>Module Code</b>	<b>MEU55BM4 – 5BIO4</b>
<b>Module Name</b>	Finite Element Analysis
<b>ECTS Weighting<sup>1</sup></b>	5 ECTS
<b>Semester taught</b>	Semester 1
<b>Module Coordinator/s</b>	Asst. Prof. Breiffni Fitzgerald
<b><a href="#">Module Learning Outcomes</a> with reference to the <a href="#">Graduate Attributes</a> and how they are developed in discipline</b>	<p>On successful completion of this module, students should be able to:</p> <p>LO1. Perform analytical numerical solutions and also create the finite element code and implement it in Matlab for a range of solid mechanics problems, e.g. trusses, beams, frames, 2D plane strain/plane stress, thermal strain problem.</p> <p>LO2. Clearly demonstrate the matrix relationships between the forces and nodal displacements for different element types.</p> <p>LO3. Calculate the stiffness matrices for triangular and quadrilateral elements.</p> <p>LO4. Implement a linear and non-linear material model in a finite element code.</p> <p>LO5. Be able to critically evaluate the correct boundary/initial conditions for various problems.</p> <p>LO6. Understand the requirements of computational grid/mesh generation for FE applications.</p> <p>LO7. Gain hands-on user experience with well-known FE software packages</p> <p>LO8. Analyse different numerical techniques used to enhance the quality of the simulations.</p> <p>LO9. Implement comprehensive post-processing of numerical simulation results</p> <p>LO10. Assess numerical results both quantitatively and qualitatively to improve accuracy</p> <p>Graduate Attributes: levels of attainment To act responsibly - Enhanced</p>

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To think independently - Enhanced  
To develop continuously - Enhanced  
To communicate effectively - Enhanced

### **Module Content**

Finite element (FE) modelling is wide-ranging in its application and is regularly employed across the engineering industry in areas such as biomedical engineering, manufacturing, aeronautical engineering, architecture, automotive, civil and structural engineering. In this module, FE theory and implementation will be introduced and thoroughly covered. The module will focus on linear elastic materials initially then subsequently cover more advanced non-linear materials encountered in bioengineering (e.g. anisotropic soft tissues, metal plasticity). The module will also include hands-on practical classes using MATLAB and a commercial finite element software. Overall, this module will provide the student with the required theoretical basis underpinning finite element simulations, as well as the practical skills to use this simulation tool effectively and accurately.

### **Teaching and Learning Methods**

Finite Element Analysis is an optional course which is offered to 5<sup>th</sup> year MAI students and graduate students and equips students to apply FE methods as a tool for design, analysis and engineering applications. The course material is presented in a series of lectures. The teaching material is supplemented by frequent laboratory sessions during which the students will apply the information provided during lectures to FE simulations using Matlab and existing College-licensed commercial FE software package(s). With a strong emphasis on understanding and application of the underlying methods, enthusiastic students will gain experience using commercial FE software packages by analysing well established FE problems as well as applying their knowledge to current research projects within the School of Engineering.

<b>Assessment Details<sup>2</sup></b> <b>Please include the following:</b> <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	Week due
	Exam	Written exam	LO1-LO3, LO5-LO6, LO8, LO10	50%	End of term
	Assignments	Continuous assessments will include MATLAB based assignments throughout the semester and a project which will require the use of a commercial FE software package	LO4, LO7, LO9, LO10	25%	Weekly
	Group project	Design project using commercial FE software package	LO4, LO7, LO9, LO10	25%	Week 12

**Reassessment Requirements**

N/A

**Contact Hours and Indicative Student Workload<sup>2</sup>**

**Contact hours: 48**

**Independent Study (preparation for course and review of materials): 20**

**Independent Study (preparation for assessment, incl. completion of assessment): 60**

**Recommended Reading List**

*Finite Element Analysis: theory and practice* by M.J. Fagan,  
*Introduction to Finite Element Analysis Using MATLAB® and Abaqus* by Amar Khennane

**Module Pre-requisite**

**Module Co-requisite**

N/A

**Module Website**

N/A

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

Dept. of Civil, Structural & Environmental Engineering delivers module.

**Module Approval Date**

**Approved by**

**Academic Start Year**

**Academic Year of Date**