



## MODULE SPECIFICATION

### Faculty of Engineering

Last Updated 5<sup>th</sup> June 2017

1. **Module Title**  
Finite Element Analysis

2. **Module Code**  
EM4303

3. **Number of credits**  
10

4. **Level**  
4

5. **Semester**  
7

6. **Pre-requisites for admission to the module**  
Normal progression rules

7. **Module Coordinator**  
Prof Dr Ardeshir Bahreininejad

8. **Aim**  
To develop knowledge on the theory and applications of finite element analysis (FEA) for solving mechanical engineering problems. In this module, deep and comprehensive elaborations of the theory would reveal several different aspects and applications of finite elements analysis in practical manners. The required steps toward clear understanding, presentation, and computer modelling for relevant engineering problems are given.

9. **Summary of Contents**

This module covers the following topics:

- **Review of matrix algebra:** Row and Column Vectors; Matrix Multiplication; Transposition; Differentiation and Integration; Types of Matrices; Upper Triangular Matrix; Determinant of a Matrix; Matrix Inversion
- **Basic theory of FEA:** Introduction to Finite Element Modeling; Shape Functions and Local Coordinates; Element Stiffness Matrix; Assembly of the Global Stiffness Matrix and Load Vector; Quadratic Shape Functions; Temperature Effects; Problem Modeling and Boundary Conditions
- **The uses of various types of finite elements:** Spring, Bar, Beam, Two-Dimensional Solid, Plate/Shell, and Three-Dimensional Solid
- **Boundary conditions:** Treatment of Boundary Conditions; Types of Boundary Conditions
- **Finite element modelling and solution techniques:** Elimination Approach; Multipoint Constraint; Gaussian Elimination; General Algorithm for Gaussian Elimination; Direct and Iterative methods
- **Stress-strain relations:** Displacements; Strains; Stresses; Plane Stress and Stress Conditions; Applications, Analyses and Interpretations

## 10. Module Intended Learning Outcomes (MILOs)

Upon successful completion of this module, students will be able to:

No.	MILOs	Weightage (%)
1	Explain basic principles and applications of finite element analysis.	20
2	Apply suitable types of elements, boundary conditions, materials and analysis for solving engineering problems	20
3	Build the element stiffness matrices, and the local and global systems of equations.	20
4	Construct a suitable finite element model for a given engineering problem.	20
5	Interpret the results of the finite element analysis for given engineering problems.	20

## 11. Teaching and Learning Activities (TLAs)

MILO No.	TLAs	Functions	Hours/Week
1-5	Lectures	To show and build the finite element models for solving engineering problems	2
1-5	Tutorials	To provide extra examples/problems on finite element models.	1
1-5	Laboratory	To gain experiences and competences in solving engineering problems using finite element method.	1

## 12. Assessment Tasks/Activities

MILO No.	Type of Assessment Tasks/Activities	Weightage (%)
1-5	University Examination	50
1-3	1 Class Test	10
1-5	3 Assignments	15
1-5	2 Laboratory Reports	25

### Assessment Criteria:

Assessment components of the module shall be University Examination and Coursework. To achieve a pass in the module students must obtain a minimum overall mark of 40% and a minimum of 30% in each assessment component.

**Resit:** Students eligible for resit shall be assessed according to the programme area examination board recommendation.

## 13. Attendance Requirements

Students are required to attend all lectures, tutorials and laboratory sessions.

#### 14. Contribution to Programme Intended Learning Outcomes

	<b>Knowledge &amp; Understanding</b>	<b>Application</b>	<b>Analysis &amp; Evaluation</b>	<b>Creativity &amp; Design</b>
<b>Maths and Science</b> Underpinning Science and Mathematics for the study of Engineering	✓	✓	✓	
<b>Core Engineering</b> The main principles and core subjects of the relevant Engineering Discipline	✓	✓	✓	
<b>Computing and IT</b> Computer-based methods for the analysis and modeling of Engineering problems	✓	✓	✓	
<b>Communication Skills</b> Communicate effectively using a variety of techniques both written and oral	✓	✓		
<b>Engineering Practice</b> Practical application of engineering skills combining theory and experience	✓	✓	✓	✓
<b>Design</b> Creation, design and development of a product, process or system	✓	✓	✓	✓
<b>Management &amp; Economics</b> Management and financial methods to achieve objectives in production and projects				
<b>Social &amp; Environmental</b> Professional and ethical conduct; sustainable development; health and safety; environmental impact				

## 15. Grading of Student Achievement

Letter Grade	% Mark	Grade Definitions
A+	90-100	Excellent
A	85-89	
A-	80-84	
B+	75-79	Good
B	70-74	
B-	65-69	
C+	60-64	Adequate
C	55-59	
C-	50-54	
D+	45-49	Marginal
D	40-44	
F (Fail)	<40%	Fail

## 16. Resources

### Primary texts

No	Name of Authors	Year of Publication	Title of Book	Edition	Publisher's Name	ISBN
1	Daryl L. Logan	2011	A First Course in the Finite Element Method	5th	CL Engineering	9780495668251
2	Tirupathi R. Chandrupatla, Ashok D. Belegundu	2012	Introduction to Finite Elements in Engineering	4th	Pearson	9780132162746

### Secondary text

No	Name of Author	Year of Publication	Title of Book	Edition	Publisher's Name	ISBN
1	Erdogan Madenci, Ibrahim Guven	2006	The Finite Element Method and Applications in Engineering Using ANSYS®	1st	Springer	9781489975508

Note:

- Module specification valid for BEng Mechanical Engineering Intake 06 and 07.
- BEng Mechanical Engineering Intake 08 will use the updated grading system of 16<sup>th</sup> May 2017.