Liverpool John Moores University

Title:	ADVANCED FINITE ELEMENT ANALYSIS
Status:	Definitive
Code:	**7016MAR** (115912)
Version Start Date:	01-08-2018
Owning School/Faculty:	Maritime and Mechanical Engineering
Teaching School/Faculty:	Maritime and Mechanical Engineering

Team	Leader
Glynn Rothwell	Y

Academic Level:	FHEQ7	**Credit Value:**	10	**Total Delivered Hours:**	33
Total Learning Hours:	100	**Private Study:**	67		

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Lecture	11
Practical	22

Grading Basis: 50 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	AS1	Invigilated Blackboard test	50	
Report	AS2	FEA Project	50	

Aims

The module extends the students existing knowledge of the finite element method to an advanced level with the aid of industry standard software.

Learning Outcomes

After completing the module the student should be able to:

1	Set up and validate efficient and accurate FE models of a range of simple engineering components, assemblies or structures under non-linear and dynamic loading.
2	Set up and validate an efficient and accurate FE model of a complex engineering component, assembly or structure under non-linear and/or dynamic loading.
3	Critically evaluate the output from non linear and general dynamics FE analysis
4	Appreciate the theory underpinning the non linear aspects of commercial FE codes

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

Blackboard test	1	4
FEA Project	2	3

Outline Syllabus

Practical aspects of FEA
Non linear analysis. Planning the analysis. Element selection, plane stress, plane strain, axisymmetric, brick elements, full integration, reduced integration, shear locking, hour glassing. Geometric non linearity. Material non linearity. Managing the solution, incremental solution and convergence of results.

Plastic behavior in metals, von-Mises plasticity, available material models, elastic perfectly plastic, elastic linear strain hardening, piecewise plasticity model. Hardening models, isotropic, kinematic. Practical application to plasticity problems.

Implicit and explicit dynamics analysis, mode superposition, damping, modal dynamics. General dynamics analysis, direct integration, time steps. Practical application to dynamics problems. Application of explicit dynamics to pseudo static situations.

Post processing and results checking. Review of available non linear results, stress, strain, displacement, velocity, acceleration, primary and derived quantities etc. Interpretation of results, checking results, reaction forces, displaced shape, nodal and element plots, energy balance for explicit dynamics, hand calculations.

Theoretical aspects of FEA.

Review of basic theory. Global stiffness matrix assembly and solution. Determination of element stiffness matrix by variational approach. Either minimum potential energy or virtual work. Application to 2 noded bar element. Element formulation, linear and quadratic, shape functions, implicit and explicit for two dimensional elements. Isoparametric elements. Determination of element stiffness matrix, Gaussian quadrature, fully and reduced integration elements.

Obtaining non linear solutions, time and load steps, incremental analysis, Newton Raphson. Methodology for dynamics solutions using implicit and explicit dynamics.

Learning Activities

Lectures and guided computer workshops

Notes

The module extends the students existing knowledge of the finite element method to an advanced level with the aid of industry standard software. Whilst the theoretical aspects of the method will be covered in lectures the module is intended to be practical in nature with students having the opportunity to practice via a range of tutorials and assignments using industry standard software.