Liverpool John Moores University

Title:	Finite Element Analysis
Status:	Definitive
Code:	**7107MECH** (121494)
Version Start Date:	01-08-2021
Owning School/Faculty:	Engineering
Teaching School/Faculty:	Engineering

Team	Leader
Ariyan Ashkanfar	Y
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Academic Level:	FHEQ7	**Credit Value:**	20	**Total Delivered Hours:**	44
Total Learning Hours:	200	**Private Study:**	156		

Delivery Options
Course typically offered: Semester 1

Component	Contact Hours
Lecture	11
Online	11
Tutorial	22

Grading Basis: 50 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Test	AS1	Invigilated V.L.E. Test	40	
Report	AS2	FEA Project	60	

Aims

The module extends the students existing knowledge of the finite element method to an advanced level. 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.

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 loading.
2. Set up and validate an efficient and accurate FE model of a complex engineering component, assembly or structure under non-linear loading.
3. Critically evaluate the output from non-linear 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:

Invigilated V.L.E 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 behaviour 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.

Application of explicit dynamics to impact and pseudo static situations such as metal forming.

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.

Learning Activities

Lectures, tutorial and practicals

Notes

The module will provide students with an in depth understanding of the application of FEA to non-linear static together with impact and quasi-static loading using explicit dynamics.