Advanced Finite Element Analysis

Module Information

2022.01, Approved

Summary Information

Module Code	7307MECH
Formal Module Title	Advanced Finite Element Analysis
Owning School	Engineering
Career	Undergraduate
Credits	10
Academic level	FHEQ Level 7
Grading Schema	50

Teaching Responsibility

LJMU Schools involved in Delivery
Engineering

Learning Methods

Learning Method Type	Hours
Lecture	22
Tutorial	11

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
SEP-CTY	CTY	September	12 Weeks

Aims and Outcomes

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.

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Set up and validate efficient and accurate FE models of a range of simple engineering components, assemblies or structures under non-linear loading.
MLO2	2	Set up and validate an efficient and accurate FE model of a complex engineering component, assembly or structure under non-linear loading.
MLO3	3	Critically evaluate the output from non-linear FE analysis.
MLO4	4	Appreciate the theory underpinning the non-linear aspects of commercial FE codes.

Module Content

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.
Module Overview	
Additional Information	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.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Report	FEA Project	100	0	MLO1, MLO2, MLO3, MLO4

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Ariyan Ashkanfar	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings