Applied Finite Element Analysis

Module Information

2022.01, Approved

Summary Information

Module Code	7501UCEPG
Formal Module Title	Applied Finite Element Analysis
Owning School	Civil Engineering and Built Environment
Career	Postgraduate Taught
Credits	20
Academic level	FHEQ Level 7
Grading Schema	50

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
Unicaf

Learning Methods

Learning Method Type	Hours
Online	55

Module Offering(s)

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

Aims and Outcomes

Aims	The module will introduce students to the finite element method and explore the underlying theory of finite element methods. Students will investigate the performance and reliability of finite element methods in civil engineering applications, such as structural problems including material nonlinearity. The theoretical aspects of the method will be covered in a form of weekly topic overviews and other reading materials - the module is intended to be "practical" in nature with students having the opportunity to practice via a range of tutorials and assignments using commercial finite element software.

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Formulate element stiffness matrices and analyse simple structures using the direct stiffness method.
MLO2	2	Evaluate different material models and element types to approximate the behaviour of different materials and structures.
MLO3	3	Critically analyse fundamental concepts of the finite element theory.
MLO4	4	Apply commercial Finite Element Analysis software for linear and nonlinear analysis of structures
MLO5	5	Critically apply elastoplastic constitutive models.

Module Content

Outline Syllabus	Practical aspects of Finite Element Analysis including: Non-linear analysis. Planning the analysis. Element selection, plane stress, plane strain, brick elements, full integration, reduced integration, 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. Implicit and explicit dynamics analysis, General dynamics analysis, direct integration, time steps. Application of explicit dynamics to pseudo static situations. Obtaining non-linear solutions, time and load steps, incremental analysis, Newton Raphson. Use of commercial finite element software to solve structural problems. 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 Finite Element Analysis including: 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. Determination of element stiffness matrix.
Module Overview	
Additional Information	The module will introduce students to the use of the finite element method and explore the underlying theory of finite element methods.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Essay	Summative Assessment 1	70	0	MLO1, MLO2, MLO3, MLO5
Report	Summative Assessment 2	30	0	MLO4, MLO5

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
Michaela Gkantou	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings