Liverpool John Moores University

Title:	OFFSHORE STRUCTURAL ANALYSIS
Status:	Definitive
Code:	**7039ENG** (106111)
Version Start Date:	01-08-2011
Owning School/Faculty:	Engineering
Teaching School/Faculty:	Engineering

Team	Leader
Andrew Cunningham	Y

Academic Level:	FHEQ7	**Credit Value:**	20.00	**Total Delivered Hours:**	48.00
Total Learning Hours:	200	**Private Study:**	152		

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Lecture	12.000
Practical	24.000
Tutorial	12.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Essay	AS1	Coursework - basic FEA study	30.0	
Essay	AS2	Coursework - major FEA project	70.0	

Aims

The module will introduce the students to the finite element method and extend their experience and skill in engineering analysis of offshore structures and plant equipment with the aid of industry standard software.

Learning Outcomes

After completing the module the student should be able to:

1 Create and validate an efficient and accurate FE model of an offshore engineering component, assembly or structure
2 Explain the use and limitations of FEA as part of the design process
3 Critically evaluate the output from FE analysis
4 Recount the theory underpinning commercial FE codes

Learning Outcomes of Assessments

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

CW	1	2	3	
CW	1	2	3	4

Outline Syllabus

Practical aspects of FEA
Modelling strategy. Planning the analysis. Loading, point loads, stress singularities, pressure loading, examples. Boundary conditions, use of symmetry, balanced loading and minimum constraint avoidance of free body motion, problems associated with inappropriate boundary conditions, basic contact in assemblies, examples.

Choice of element, mesh controls and mesh density, convergence of results, problems with element distortion, adaptive meshing. Managing the solution, types of solver, analysis of errors and warnings.

Post processing and results checking. Review of available results, stress, strain, displacement, primary and derived quantities etc. Interpretation of results, checking results, reaction forces, displaced shape, nodal and element plots, hand calculations.

Thermal analysis and thermal stress analysis. Planning the analysis, steady state, transient. Boundary conditions, temperature, convection, heat flux, radiation, solution output, temperature distribution, derived field quantities. Thermal stress analysis, sequential, coupled (description only) transfer of mesh and nodal temperatures to structural analysis. Examples

Modal Dynamics. Brief description of eigenvalue extraction techniques. Planning the analysis, boundary conditions, number of modes to extract, symmetry conditions, interpretation of results output. Examples

Shell and beam modelling. Modelling thin components, shells. Modelling using beam elements. Mixed meshing, solids, shells and beams.

Theoretical aspects of FEA.
Review of matrix algebra, matrix representation of linear simultaneous equations, types of matrix, multiplication, transpose, inverse, quadratic form, solution of

equations using Gaussian elimination or equivalent. General FEA principles, application to simple one dimensional problems, comparison with traditional methods. Example using two stepped bar elements represented as springs, concept of nodes and elements, element stiffness matrix determination by direct approach, incorporation of loads and BC's, solution.

Global stiffness matrix assembly and solution. Example using three or more springs, derivation of element stiffness matrix using direct approach, element connectivity and assembly of global stiffness matrix, incorporation of loads and BC's to remove singularity, solution. Bandwidth and alternative element connectivity. Multiple load cases.

Truss elements (2D), local coordinates, coordinate transformation, transformation matrix, solution.

Learning Activities

Formal Lectures, Tutorials and Computer Laboratory Work.

References

Course Material	Book
Author	Fagan M. J
Publishing Year	1992
Title	Finite Element Analysis: Theory and Practice
Subtitle	
Edition	
Publisher	Prentice Hall
ISBN	0582022479

Course Material	Book
Author	Mac Donald B. J
Publishing Year	2007
Title	Practical Stress Analysis with Finite Elements
Subtitle	
Edition	
Publisher	Glasnevin Publishing
ISBN	0955578108

Course Material	Book
Author	Cook R. D.
Publishing Year	2001
Title	Concepts and Applications of Finite Element Analysis
Subtitle	
Edition	

Publisher	John Wiley & Sons
ISBN	0471356050

Course Material	Book
Author	Chakrabati S. K.
Publishing Year	2005
Title	Handbook of Offshore Engineering
Subtitle	
Edition	
Publisher	Elsevier
ISBN	

Course Material	Book
Author	Chakrabati S.K
Publishing Year	1994
Title	Offshore Structure Modelling
Subtitle	
Edition	
Publisher	World Scientific
ISBN	

Course Material	Book
Author	Ellings et al
Publishing Year	1984
Title	Buckling of offshore structures: A State of the Art Review of the Buckling of Offshore Structures
Subtitle	
Edition	
Publisher	Granada Technical
ISBN	

Notes

The module will introduce the students to the finite element method. 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. The practical assignments will be presented in the context of offshore structures and equipment.