Liverpool John Moores University

Title:	DESIGNING AGAINST FAILURE
Status:	Definitive
Code:	**6125ENG** (117174)
Version Start Date:	01-08-2016
Owning School/Faculty:	Maritime and Mechanical Engineering
Teaching School/Faculty:	Maritime and Mechanical Engineering

Team	Leader
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Academic Level:	FHEQ6	**Credit Value:**	24	**Total Delivered Hours:**	60
Total Learning Hours:	240	**Private Study:**	180		

Delivery Options
Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	20
Practical	40

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	Rpt		25	
Report	Rpt		25	
Test	Test		50	

Aims

To enable students to design products, components and assemblies that are resistant to failure.

Learning Outcomes

After completing the module the student should be able to:

1 Identify the relevant modes of failure for components and assemblies under load.
2 Undertake a finite element failure assessment
3 Predict the lifetime of a product or assembly under a range of conditions
4 Optimise the design solution to minimise the risk of failure.

Learning Outcomes of Assessments

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

Report 1	1	
Report 2	2	
Time constrained	3	4

Outline Syllabus

Basic concepts of failure
Review of basic concepts of stress and strain, direct strain, bending and torsion. Failure mechanisms in metals and polymers. Design against yielding in metals - material properties; Tesca; von Mises; stress concentrations and factors of safety. Design against fatigue failure - basic mechanisms of fatigue and fracture in metals and polymers; S-N curves; modification factors due to geometric, surface and environmental factors. Fatigue life prediction; goodmans rule for effect of mean stress; minors rule for cumulative damage. Joining methods and review of load paths.
Design against brittle fracture-ductile to brittle transition for metals and polymers; temperature effects.
Design against corrosion and wear, galvanic series; mechanisms of corrosion; crevice, fretting; wear mechanisms; effect of work hardening.

Finite Element Analysis for Design
Modelling strategy. Planning the analysis. Analysis types, static, thermal, modal. 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.

Learning Activities

A range of case studies, visual laboratories, practicals and a structured lecture programme will be employed in the delivery of this module.

Notes

A very traditional syllabus combined with modern analysis techniques. Students will gain a thorough understanding of how to design consumer products that will not fail in service.