

Structural Integrity

Module Information

2022.01, Approved

Summary Information

Module Code	6111MECH
Formal Module Title	Structural Integrity
Owning School	Engineering
Career	Undergraduate
Credits	10
Academic level	FHEQ Level 6
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
Engineering

Learning Methods

Learning Method Type	Hours
Lecture	11
Online	11
Practical	6
Tutorial	11

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
JAN-CTY	CTY	January	12 Weeks

Aims and Outcomes

Aims	To enable students to develop an understanding of the performance of materials and structures subjected to load in terms of deformation based failure, fracture and fatigue.
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After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Undertake a deformation based structural integrity analysis.
MLO2	2	Undertake a fracture and fatigue based structural integrity analysis.
MLO3	3	Use software tools to predict failure.

Module Content

Outline Syllabus	Deformation Based Failure Plastic Deformation Basic plasticity, review of yield criteria, von-Mises, Tresca, yield locus – 2D and 3D representation. Post yield behaviour, hardening rules, elastic perfectly plastic, elastic linear strain hardening. Application to beams in bending, shape functions, plastic collapse, limit loads. Application to pressure vessels, bursting of thin walled vessels, bursting of thick walled vessels. Application to the bursting of spinning discs. Buckling Review of basic theory for struts, extension to deep walled beam sections and thin walled tubes under torsional loading. FEA methodology for buckling, eigenvalue extraction. Creep Deformation The classical creep curve, creep mechanisms, stages of creep, creep (Arrhenius) equation, effects of temperature and applied stress, creep testing. Fatigue and Fracture Linear Elastic Fracture Mechanics Stresses at a crack tip, energy approach, stress intensity factor approach, effects of finite geometry, compendia solutions. Crack tip plasticity, effects of material thickness on fracture. LEFM testing. Elastic Plastic Fracture Mechanics J integral, effects of constraint. Failure assessment diagrams, application to real structures EPFM testing Finite Element Analysis of Fracture Modelling stress singularities, the need for crack tip elements, determination of K and J, use of software. Fatigue Review of high cycle fatigue, S-N curve approach, mechanisms of fatigue, crack initiation and growth, Paris law and LEFM approach to fatigue. Non-destructive testing methods.
Module Overview	This module will enable you to develop an understanding of the performance of materials and structures subjected to load in terms of deformation based failure, fracture and fatigue.
Additional Information	The module will provide students with an in depth understanding of structural integrity and the assessment of materials and structures under load.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Centralised Exam	Examination	70	2	MLO1, MLO2, MLO3
Test	Portfolio	30	0	MLO1, MLO2, MLO3

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
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Russell English	Yes	N/A
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Partner Module Team

Contact Name	Applies to all offerings	Offerings
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