Liverpool John Moores University

Title:	Structural Integrity
Status:	Definitive
Code:	**6511USST** (126449)
Version Start Date:	01-08-2021
Owning School/Faculty:	Engineering
Teaching School/Faculty:	University of Shanghai For Science and Technology

Team	Leader
Russell English	Y
Glynn Rothwell	

Academic Level:	FHEQ6	**Credit Value:**	10	**Total Delivered Hours:**	41
Total Learning Hours:	100	**Private Study:**	59		

Delivery Options
Course typically offered: Semester 2

Component	Contact Hours
Lecture	22
Practical	6
Tutorial	11

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	AS1	Examination	70	2
Portfolio	AS2	Portfolio	30	

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.

Learning Outcomes

After completing the module the student should be able to:

1 Apply deformation based structural integrity analysis.
2 Apply fracture and fatigue based structural integrity analysis.
3 Evaluate and apply software tools to predict failure.

Learning Outcomes of Assessments

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

Examination	1	2	3
Portfolio	1	2	3

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 bucking, 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.

Learning Activities

Lectures, tutorial and practicals

Notes

The module will provide students with an in depth understanding of structural integrity and the assessment of materials and structures under load.