# Structural Integrity

# Module Information

**2022.01, Approved**

## Summary Information

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|---|---|
| Module Code | 6311MECH |
| 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 |
| Practical | 3 |
| Tutorial | 11 |

## Module Offering(s)

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

## Aims and Outcomes

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| 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. |

**After completing the module the student should be able to:**

**Learning Outcomes**

| Code | Number | Description |
|---|---|---|
| MLO1 | 1 | Undertake and evaluate deformation based structural integrity analysis. |
| MLO2 | 2 | Undertake and evaluate fracture and fatigue based structural integrity analysis. |

## Module Content

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| Outline Syllabus | 1. Deformation Based Failure Plastic Deformation - Basic plasticity: review of yield criteria (von-Mises, Tresca, yield locus 2D/3D). Post yield: hardening rules (elastic perfectly plastic, elastic linear strain hardening). Application: beams in bending, shape functions, plastic collapse, limit loads. Application: shafts, pressure vessels, spinning discs. FEA methodology for limit load analysis. Buckling - Basic theory for struts, extension to deep walled beam sections and thin walled tubes under torsional loading. Creep Deformation - The classical creep curve, creep mechanisms, stages of creep, creep (Arrhenius) equation, effects of temperature and applied stress, creep testing, material design for creep resistance and case study. 2. 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. Linear Elastic Fracture Mechanics (LEFM) testing. Elastic Plastic Fracture Mechanics - J integral, effects of constraint. Failure assessment diagrams, application to real structures. Elastic Plastic Fracture Mechanics (EPFM) testing. Fatigue - Review of high and low cycle fatigue, S-N curve approach, mechanisms of fatigue, crack initiation and growth. Paris law and LEFM approach to fatigue. Fatigue fracture surface investigation, and case study. Stress corrosion cracking, growth of crack formation, environment and case studies. Non-destructive testing methods: X-ray, Ultrasound, Acoustic emission. |
| Module Overview | |
| Additional Information | The module will provide students with an in depth understanding of structural integrity and the assessment of materials and structures under load. UN Sustainable Development Goals: SDG12 – This module considers the issues of waste and recycling when designing engineering solutions. |

## Assessments

| Assignment Category | Assessment Name | Weight | Exam/Test Length (hours) | Module Learning Outcome Mapping |
|---|---|---|---|---|
| Centralised Exam | Examination | 100 | 2 | MLO1, MLO2 |

## Module Contacts

**Module Leader**

| Contact Name | Applies to all offerings | Offerings |
|---|---|---|
| Russell English | Yes | N/A |

**Partner Module Team**

| Contact Name | Applies to all offerings | Offerings |
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