UNIVERSITY OF BIRMINGHAM

Module Name:	**Design Against Failure I (5 days)**
Module Code:	**04 17683**
Presenter(s):	**Professor Paul Bowen**
Credit Rating:	**10**
Venue:	**School of Metallurgy & Materials, University of Birmingham**

Description:

The module will describe how stresses are used in combination with materials behaviour to prevent failure under both monotonic and cyclic loading. Failure within the creep regime will not be considered within this module. An in-depth analysis of the intrinsic (materials) factors and extrinsic (geometrical) factors which can affect failure criteria will be presented. Micromechanisms of failure and other influence of microstructure will be highlighted. The units will cover the following: Conventional engineering design, stress systems and assessment methods. Modes of failure: deflection, elastic instability, plastic instability, plastic collapse, fast fracture, fatigue. Safety factors and strength of materials. Principle of superposition, principal planes, yield criteria, stress concentrations. Plasticity - friend or foe? Fracture mechanics: crack shapes and stress sytems - mode I, mode II, mode III. Plane stress and plane strain. Elastic-plastic fracture. Defect tolerance design: S-N curves, notches and pre-cracked testpieces. Paris equation and its use. Micromechanisms of brittle and ductile fracture. Transgranular cleavage: the importance of tensile stress and microstructure. The ductile-brittle transition and ferritic steels. Ductile failure: void initiation, growth and coalescence. Ductile crack growth ahead of a sharp-crack: inclusions and carbides, work-hardening. Accelerated mechanisms of crack growth and degradation mechanisms below the creep regime.

Learning Outcomes:

By the end of the module the student should be able to: Appreciate and categorise modes of failure; Understand yield criteria and their application in conventional engineering design; Apply fracture mechanics concepts and conventional fatigue approaches to ensure fitness for purpose of engineering components; Understand micromechanisms of brittle and ductile failure, including the differences between microstructural features and extrinsic factors on promoting brittle behaviour; Perform quantitative calculations to ensure damage tolerance in specific (simplified) situations.

Assessment:

Two hour open book examination during course presentation.