

Materials Failure Analysis

Module Code:	MAE6012-B
Academic Year:	2018-19
Credit Rating:	20
School:	Department of Mechanical and Energy Systems Engineering
Subject Area:	Mechanical and Automotive Engineering
FHEQ Level:	FHEQ Level 6
Module Leader:	Dr Christopher Wright

Additional Tutors:

Pre-requisites:

Co-requisites:

Contact Hours

Type	Hours
Lectures	36
Tutorials	12
Other (DO NOT USE)	150.5
Examinations DO NOT USE	1.5

Availability Periods

Occurrence	Location/Period
BDA	University of Bradford / Semester 1 (Sep - Jan)

Module Aims

Failure of components & structures can have catastrophic consequences so knowledge of the various means by which engineering structures can fail is crucial in the design, manufacture & operation of engineering systems. This module builds on core knowledge of materials science & structural mechanics acquired in level 4 & 5 modules & aims to provide the integrated knowledge & skills to;

- recognise the important failure mechanisms which lead to catastrophic structural failure

under static & cyclic loading

-select appropriate analytical methods in the design & operation of engineering systems

Outline Syllabus

Description of the micro-mechanisms of failure in metallic materials; abrasive, adhesive and fretting wear, ductile failure, brittle fracture, creep, and fatigue mechanisms. Overview of corrosion, corrosion mechanisms - Stress corrosion cracking. The origins of failure initiating defects in manufactured products. Explanation of the 'failure triangle' and the role that the interaction between design, material properties and service conditions plays in failure of engineering structures.

Illustrative real world case studies of failures in Engineering Structures and components (e.g. Bridges, shafts, bearings, gears, internal combustion engine components, medical implants) caused by degradation failure (wear, corrosion) or catastrophic failure (fracture, creep, fatigue, stress corrosion cracking).

The Principles of linear elastic fracture mechanics and their application in design to avoid failure under static loading - Examples of the application of fracture mechanics in structural design, 'Leak-before-Break'.

Metal Fatigue, Material behaviour under cyclic loading - the Bauschinger effect , cyclic softening /hardening, Factors that influence fatigue life, Fatigue as a damage accumulation process - Miner`s Law. - Strain-life and Stress-life approaches to fatigue life prediction under constant amplitude loading and variable amplitude loading, Notch analysis - Neuber's Rule. Prediction of the effects of mean stress / mean strain on fatigue life- Goodman Equation; Morrow equation; Smith ,Watson Topper (SWT) equation.

Module Learning Outcomes

On successful completion of this module, students will be able to...

- 1 1.1 Differentiate between the important failure mechanisms encountered in engineering structures

1.2 Explain how a particular failure mechanism is influenced by design, loading profile, material and environmental factors.
- 2 2.1 Use analytical techniques to predict or prevent failure of engineering structures or components subjected to static and cyclic loading.
- 3 3.1 Use data analysis and computer modelling techniques to solve engineering problems.

Learning, Teaching and Assessment Strategy

Key lectures will deliver core content; providing students with the opportunity to acquire the information to enhance their knowledge of the subject LOs1.1 and 2.1. The tutorial sessions will allow students to apply this learning to specific engineering problems. The course work will be an individual project requiring the development of a spreadsheet- based life assessment analysis of a specific component.

The examination will assess LOs 1.1, 1.2, 2.1 .The coursework will assess LOs 1.2, 2.1 and LO3.1

Supplementary assessment will involve repairing deficiencies in the original assessment

Mode of Assessment

Type	Method	Description	Length	Weighting	Final Assess'
Summative	Examination - closed book	Examination - closed book	1.5 hours	40%	No
Summative	Coursework	2500 word equivalent Individual project	0 hours	60%	Yes

Legacy Code (if applicable)

ENG3303D

Reading List

To view Reading List, please go to [rebus:list](#).