MODULE SPECIFICATION PROFORMA

Module Code:	ENG766

Module Title:	Structural Integrity & Optimisation

Level:	7	**Credit Value:**	20

Cost Centre(s):	GSAC	JACS3 **code**:	J500

School:	Applied Science, Computing & Engineering	**Module Leader:**	Martyn Jones

Scheduled learning and teaching hours	40 hrs
Guided independent study	160 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered (not including exit awards)	Core	Option
MSc Engineering (Aeronautical) MSc Engineering (Mechanical Manufacture) MSc Engineering (Automotive)	✓	☐

Pre-requisites

Office use only
Initial approval: 19/06/2018 Version no:1
With effect from: 01/09/2018
Date and details of revision: Version no:

Module Aims

- To enable students to understand how material allowables are formulated in order to design structures
- To develop further the students' knowledge of failure mechanisms in static structures
- To provide students with the critical awareness of temporal failures of materials, such as creep and environmental factors such as thermal loads
- To enable students to critically understand fracture and crack propagation in metals
- To allow students to develop their understanding of how material degrade over time and how this affects their structural strength.

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Demonstrate a conceptual understanding of material allowables and how they are developed	KS1	KS3
		KS6	
2	Be able to recognise failure mechanisms in metallic structures and state the suitability of their use in applications	KS1	KS2
		KS6	KS8
		KS10	
3	Identify the temporal failure mechanisms in systems and of how thermo-mechanical loading can change material properties	KS1	KS2
		KS5	KS6
4	Demonstrate a critical understanding of fatigue failure in structures and how design can be used to reduce the effect of cyclic loading.	KS1	KS3
		KS5	KS6
		KS9	KS10
5	Discuss how failure due to cyclic loading can be predicted and measured using new and innovative methods	KS1	KS3
		KS4	KS5
		KS6	KS8
6	Use Finite Element Analysis (FEA) to estimate crack propagation and fatigue life	KS1	KS5
		KS6	KS8
		KS9	KS10

Transferable skills and other attributes

1. Communication
2. ICT Technologies
3. Time management and organisation
4. Interpersonal skills
5. Problem solving
6. Information handling including numeracy

Derogations

Credits shall be awarded by an assessment board for those Level 7 modules in which an overall mark of at least 50% has been achieved with a minimum mark of 40% in each assessment element.

Assessment:

Indicative Assessment Tasks:

Assessment One: A examination topics including (but not limited to) allowables, failure mechanisms in metallic structures, environmental factors that affect structural integrity and damage tolerance in design

Assessment Two: A report solving a dynamic structural loading problem. The report will include how failure is predicted, how it is analysed computationally and a prescribed solution to the problems.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1, 2, 3	Examination	50	2hrs	
2	4, 5, 6	Report	50	N/A	2000

Learning and Teaching Strategies:

A series of workshop style lectures with student-led seminars and computer tutiorials. Directed learning using library and internet resources will be facilitated using Moodle.

Syllabus outline:

- Metallic structures, how does the crystalline structure affect the property of the material
- Alloying and material processing effect on properties, with reference to cold working, annealing etc
- Pyramid of testing, A and B basis allowables.
- Outline of different failure criterion and how they are used in design and optimisation
- Temporal and environmental related failure, including creep, corrosion fatigue, thermal shock and cycling
- Fatigue failure, to inluce S-N and E-N curves, stress concentrations etc
- Crack propagation and methods to limit its structural affect.

- Computational modelling of fatigue and crack propagation using Finite Element Analysis.
- Traditional and advanced methods on how to monitor structural integrity

Indicative Bibliography:

Essential reading

Askeland, DR. (2017), Essentials of materials science and engineering, Stamford, CT : Cengage Learning

Other indicative reading

Anderson, L. (2017), Fracture Mechanics: Fundamentals and Applications, Fourth Edition, CRC Press

Pytel, A (2012): Mechanics of materials, Stamford, CT ; Singapore : Cengage Learning

Tada, H. (2000) The stress analysis of cracks handbook. New York : ASME Press

Blake, A, (1990) Practical stress analysis in engineering design. New York: M. Dekker.

Plus various others to be signposted on Moodle.