

## MODULE SPECIFICATION FORM

Module Title:	<b>FE Analysis and Failure</b>	Level:	<b>5</b>	Credit Value:	<b>10</b>
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Module code: (if known)	<b>ENG50J</b>	Cost Centre:	<b>GAME</b>	JACS2 code:	<b>H210</b>
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Semester(s) in which to be offered:	<b>2</b>	With effect from:	<b>July 2015</b>
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<b>Office use only:</b> To be completed by AQSU:	Date approved:	<b>July 2015</b>
	Date revised:	
	Version No:	<b>1</b>

Existing/New:	<b>New</b>	Title of module being replaced (if any):	<b>N/A</b>
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Originating Academic area:	<b>Engineering and Applied Physics</b>	Module Leader:	<b>R. Grant</b>
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Module duration (total hours)	100	Status:	<b>Free-standing 10-credit component comprising second half of ENG522 (Structures, Failure Analysis and FEA).</b>
Scheduled learning and teaching hours	36	core/option/elective (identify programme where appropriate):	
Independent study hours	64		
Placement hours	0		

Percentage taught by Subjects other than originating Subject (please name other Subjects):	<b>0%</b>
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<b>Programme(s) in which to be offered:</b>	Pre-requisites per programme (between levels):	<b>None</b>
<b>Engineering European Programme (Non Award Bearing)</b>		

<b>Module Aims:</b>
<ol style="list-style-type: none"> <li>To understand the theory of linear elastic fracture mechanics and plane stress and strain at the crack-tip;</li> <li>To develop an understanding of fast fracture leading onto fatigue with S/N diagrams and crack growth laws to determine component life are considered;</li> <li>To gain a basic theoretical and practical understanding of the technique of finite elements with knowledge of how to apply the technique to simple problems.</li> </ol>

<b>Expected Learning Outcomes</b>		
<u>Knowledge and Understanding:</u> At the completion of this module, the student should be able to:		
<ol style="list-style-type: none"> <li>Develop the theory of linear elastic fracture mechanics along with concepts of plane stress and plane strain at the crack-tip;</li> <li>Ascertain where failure might occur, including the conditions that might produce the failure and evaluate the relevance of results; <span style="float: right;">(KS 3)</span></li> <li>Be able to simulate with an appropriately specified finite element model a very simple structure and be able to interpret the results. Hence to evaluate whether the model offers a converged solution. <span style="float: right;">(KS 4)</span></li> </ol>		
<u>Key skills for employability</u>		
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <ol style="list-style-type: none"> <li>Written, oral and media communication skills,</li> <li>Leadership, team working and networking skills</li> <li>Opportunity, creativity and problem solving skills</li> <li>Information technology skills and digital literacy</li> <li>Information management skills</li> <li>Research skills</li> </ol> </td> <td style="width: 50%; border: none;"> <ol style="list-style-type: none"> <li>Intercultural and sustainability skills</li> <li>Career management skills</li> <li>Learning to learn (managing personal and professional development, self management)</li> <li>Numeracy</li> </ol> </td> </tr> </table>	<ol style="list-style-type: none"> <li>Written, oral and media communication skills,</li> <li>Leadership, team working and networking skills</li> <li>Opportunity, creativity and problem solving skills</li> <li>Information technology skills and digital literacy</li> <li>Information management skills</li> <li>Research skills</li> </ol>	<ol style="list-style-type: none"> <li>Intercultural and sustainability skills</li> <li>Career management skills</li> <li>Learning to learn (managing personal and professional development, self management)</li> <li>Numeracy</li> </ol>
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**Assessment:**

Please indicate the type(s) of assessment (eg examination, oral, coursework, project) and the weighting of each (%). **Details of indicative assessment should also be included.**

Assessment is 100% in-course and is by means of a written assignment covering all outcomes.  
(This corresponds to 'Assessment 1' of ENG552.)

Assessment number (use as appropriate)	Learning Outcomes met	Type of assessment	Weighting	Duration (if exam)	Word count (if coursework)
Assessment One:	1, 2, 3	Report	100%		2000 words

**Learning and Teaching Strategies:**

The failure and finite element work will be primarily computer laboratory based with practical exercises supported by introductory lectures and demonstrations. The emphasis will be directed towards on hand-on learning via a commercial software package. It is probable that a problem-based learning exercise will provide the basis for the main assessment.

**Syllabus outline:**

**Shear Stress:** The shear stress distribution due to bending for a given section. Thin-walled sections. Position of the shear centre for open thin-walled sections. The concept of shear flow.

**Fatigue:** The concept of a Griffith crack and Linear Elastic Fracture Mechanics. Fast fracture, strain energy release rate, stress intensity factors. Conditions of plane stress and plane strain at the crack tip. Crack growth laws such as Paris and their use in crack growth rate predictions.

**Finite Element Analysis:** Introductory lecture(s) into the technique of finite elements. An initial experience with proprietary finite element software package such as ABAQUS and its use to solve simple problem(s).

**Bibliography**Essential reading:

Case, J. Et al. (1999) *Strength of Materials and Structures*, 4<sup>th</sup> Edn., Elsevier.

Dassault Systems Simulia; *ABAQUS User Manual, Version 6.11*; 2012 ABAQUS Software.

Dassault Systems Simulia; *ABAQUS Getting Started Manual, Version 6.11*; 2012 ABAQUS Software.

Recommended reading:

Megson, T.H.G. (2007) *Aircraft Structures for Engineering Students*, 4<sup>th</sup> Edn., Arnold.

Jones, D.R.H. (2003) *Materials Failure Analysis*, 3<sup>rd</sup> Edn., Pergamon.

Ashby, M.F. (2005) *Materials Selection in Mechanical Design*, 3<sup>rd</sup> Edn., Butterworth-Heinemann.

Zienkiewicz, O.C. et al. (2004) *The Finite Element Method: Its Basis and Fundamentals*, Elsevier.