Module Descriptor

Title	Structural Integrity		
Session	2025/26	**Status**	Published
Code	ENGG11041	**SCQF Level**	11
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	T Murmu		

Summary of Module

This module will explore the complex theories of advanced mechanics of materials and structural integrity when allied to structures and components.

Advanced failure theories will be revisited with introduction to the theory of elasticity.

The theory of shells will be investigated for axisymmetric loading on axisymmetric vessels; considering primary and secondary stresses in cylinders.

Fracture and fatigue will explore linear elastic fracture mechanics (LEFM) & elastoplastic fracture mechanics (EPFM), J-Integral, and failure assessment diagrams. Experimental laboratory study will be conducted on mechanical behavior of fractured components.

Non-linear behavior such as creep, stress relaxation, stress redistribution, creep rupture and creep laws will be applied to high temperature components. Plastic behavior will be investigated such as the stress- strain relationships, incremental theory, plastic deformation theory, residual stresses, and shakedown theorems.

The module will be delivered via traditional lectures, tutorials, with the theories exemplified using real design situations. The module will integrate advanced mechanics of materials with techniques being delivered in applied finite element analysis.

The assessment for this module will be by one major coursework and a final exam During the course of this module students will develop their UWS Graduate Attributes

(https://www.uws.ac.uk/current-students/your-graduate-attributes/). Universal: Academic attributes - critical thinking and analytical & inquiring mind, Professional: research minded; Work-Ready: Academic attributes - knowledge of complex mechanics of materials and structural integrity theories and industrial applications and relevant ICT skills; Successful : autonomous, driven and resilient.

This module has been reviewed and updated, taking cognizance of the University's Curriculum Framework principles. Examples of this are found within the module such as active and engaging practical testing laboratory, module assessment which reflects industry design activities, learning synergies across modules and levels of study, recorded lecture content supporting students to organize their own study time and the use of real-world practical student generated data with to compare with and validate simulation activity developing digital intelligence meta- skills.

Module Delivery Method	On-Campus[1] ☒	Hybrid[2] ☐	Online[3] ☐	Work -Based Learning[4] ☐
Campuses for Module Delivery	☐ Ayr ☐ Dumfries	☐ Lanarkshire ☐ London ☒ Paisley	☐ Online / Distance Learning ☐ Other (specify)	

Terms for Module Delivery	Term 1 ☐		Term 2 ☒	Term 3 ☐	
Long-thin Delivery over more than one Term	Term 1 – Term 2 ☐		Term 2 – Term 3 ☐	Term 3 – Term 1 ☐	

Learning Outcomes	
L1	Develop a critical and comprehensive understanding a a range of complex and specialised theories and concepts.
L2	Apply advanced theories and concepts to the design and analysis of components to reach substantiated conclusions, discussing the limitations of techniques employed
L3	Apply fracture mechanics to the design and assessment of components and systems
L4	Apply theory to the design of pressure vessels and compare to experimental testing
L5	Apply nonlinear material behaviour to the design and assessment of components and systems

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	**During completion of this module, there will be an opportunity to achieve core skills in:**
Knowledge and Understanding (K and U)	**SCQF 11** A critical knowledge and understanding of advanced mechanics of materials and structural integrity theories and concepts, and how these fit into engineering and design strategies. Specific and detailed knowledge and understanding of the application, techniques and practices associated with structural analysis of engineering and design problems. Detailed knowledge of appropriateness of methods and techniques to different problems/scenarios

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

Practice: Applied Knowledge and Understanding	**SCQF 11** Select and critically evaluate technical literature and other sources of information to solve complex problems Design solutions for complex problems that evidence some originality and meet a combination of societal, user, business and customer needs as appropriate. This will involve consideration of applicable health & safety, diversity, inclusion, cultural, societal, environmental and commercial matters, codes of practice and industry standards Applying knowledge and understanding to develop modelling and analysis strategies for a wide range of engineering and design problems, using finite element method techniques. Assessing different strategies with respect to obtaining appropriate efficient solutions to engineering and design problems. Making use of failure theories to solve engineering and design problems such as optimisation methods or open ended problems.
Generic Cognitive skills	**SCQF 11** Undertaking, evaluating and assessing component behaviour. Making judgements on appropriate analytical approaches and their findings. Being able to develop conceptual solutions and strategies to complex design problems. Dealing with idealisation of problems in relation to results and making critical comparative assessments between theoretical, simulation, and experimental predictions. Bringing information together from a variety of sources during problem solving and being able to perceive potential problems with methods and strategies.
Communication, ICT and Numeracy Skills	**SCQF 11** Ability to perform, interpret and evaluate complex numerical, geometrical and graphical data and using it to solve problems. Ability to use variables and equations. Ability to integrate existing software with other applications such as spread sheets. Make use of multi-purpose integrated software systems to solve complex problems. Using communications skills to write detailed, critical technical reports, including text and illustration. Using software and associated ICT equipment and systems such as networks to support and perform a wide range of problem solving tasks.
Autonomy, Accountability and Working with Others	**SCQF 11** Identifying and addressing their own learning needs both during and out with class time. Identifying solution routes and strategies using their own initiative and informed judgements.

Prerequisites	**Module Code**	**Module Title**
	Other	
Co-requisites	**Module Code**	**Module Title**

Learning and Teaching

In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.

This module will be delivered via a blend of lectures, laboratory examples of real engineering problems. Assessment will be via a major coursework/case investigation assignment of a real design problem which will be compared with actual test results.

The module will also be assessed via a final examination.

The examination/case study will only assess any LO once, thus allowing variability in the question paper.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture / Core Content Delivery	18
Tutorial / Synchronous Support Activity	18
Laboratory / Practical Demonstration / Workshop	12
Independent Study	152
n/a	0
n/a	0
TOTAL	200

Indicative Resources

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

Saxena, A. (2019) Advanced Fracture Mechanics and Structural Integrity. 1st edn. Boca Raton: CRC Press.

Anderson, T. L. (2017) Fracture Mechanics: Fundamentals and Applications. 4th edn. Boca Raton : CRC Press/Taylor & Francis.

Calladine, C.R. (2010) Theory of Shell Structures. Cambridge: Cambridge University Press.

Chakrabarty, J. (2006) Theory of Plasticity. 3rd edn. Amsterdam ; Boston ; Oxford: Elsevier/Butterworth-Heinemann

Boyle, J. T. and Spence, J. (1983) Stress Analysis for Creep, London ; Boston : Butterworths.

(N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure, Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

For the purposes of this module, academic engagement equates to the following:

The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. Students will scan their attendance, via the attendance scanners, each time they are on-campus, they will have their attendance recorded in class and they will be expected to login to the VLE several times per week. Students who are unable to attend a timetabled session, due to illness or other circumstance, should notify their Programme Leader. Across the School an 80% attendance threshold is set. Students who fall below this, will be referred to the Student Success Team to see how they can be best supported in their studies.

Equality and Diversity
The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. This module has laboratory-based teaching and as such you are advised to speak to the Module Co-ordinator to ensure that specialist assistive equipment, support provision and adjustment to assessment practice can be put in place, in accordance with the University's policies and regulations.
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	**Engineering Physical Sciences**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☐ **Yes** ☒ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Design
Moderator	T Leslie
External Examiner	M Ghaleeh
Accreditation Details	This module is part of the IMechE accredited programmes MEng (Hons) Mechanical Engineering.
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.14 (was 1.13) Module Descriptor copied to 2025/26 template, LOs resources list updated to reflect ILR feedback, Attendance and Engagement and EDI statements updated.

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
Unseen Open Book Examination-50%

Assessment 2
Case Study and Laboratory- 50%
Assessment 3
N/A
(N.B. (i) Assessment Outcomes Grids for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An indicative schedule listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Unseen Open Book Examination	☒	☒	☒	☒	☒	50	2

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Case Study and Laboratory- 50%	☒	☒	☒	☒	☐	50	4

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
N/A	☐	☐	☐	☐	☐		
Combined total for all components						100%	6 hours

Change Control

What	**When**	**Who**
Module Descriptor copied to 2025/26 template, PDP, resources list updated to reflect ILR feedback, Attendance and Engagement and EDI statements updated.	March 2025	T. Murmu