MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME533 LIGHTWEIGHT STRUCTURES

Module Registrar: Dr Chris Triantafyllou chris.triantafyllou@strath.ac.uk	**Taught To (Course): Aero-Mechanical Engineering (compulsory), Mechanical Engineering (optional)**	
Other Lecturers Involved:	**Credit Weighting: 10 (ECTS 5)**	**Semester: 2**
Compulsory / optional / elective module	**Academic Level: 5**	**Suitable for Exchange: Y**

Required pre-requisites

Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

CAD & FEA skills:
Ability to construct and modify geometries for mechanical systems of varying complexity.
Experience in setting up, carrying out and analysing FEA results, preferably using ANSYS Mechanical.
Familiarity with topology optimisation and/or parametric studies is advantageous but not essential.

Numerical Methods:
Some experience with MATLAB/Python or similar would be beneficial in carrying out certain design checks/parameters.

Engineering Mechanics & Structural Analysis:
A solid understanding of mechanics of materials, including stress, strain, bending, torsion, and buckling in structural components.
Ability to carry out hand calculations for basic structural elements such as beams, trusses, and frames.

Materials & Manufacturing:
Familiarity with the mechanical behaviour of engineering materials (e.g., metals, composites, polymers), particularly in relation to stiffness, strength, and weight.

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
16					1		60	23	100

Educational Aim

This module aims to:

- develop the students' ability to apply analytical techniques to the solution of engineering problems where both the structural integrity and weight considerations are critical. This includes the use of lightweight materials and the effective geometric arrangement of that material.
- provide practical experience in designing lightweight structures to ensure that they have sufficient strength and stiffness to prevent failure when in service. This experience will be obtained by undertaking an aerospace themed or similar design, analysis and optimisation activity.

Learning Outcomes

On completion of the module the student is expected to be able to:

- **LO1** Identify and analyse structural failure modes that are specific to lightweight structures
- **LO2** Carry out a critical assessment of the function and application of different structural elements in lightweight structures, as well as their material selection considerations
- **LO3** Design, analyse and optimise a structure of this type that satisfactorily precludes such failures

Syllabus

The module will teach the following:

- Overview of truss structures, space frames, in-plane efficiency of 2D lattices, sandwich structures and applications. Introduction to deployable structures for use in aerospace.
- Topology optimisation, coupled with FEA structural analysis, optimisation of sheet/shell thickness, optimisation by introducing corrugations, parametric optimisation.
- Grid shell structures, hierarchical structures, biomimetic examples combining different structural elements/materials.
- Lightweight structures applications in civil, mechanical, automotive, aerospace and wind energy: components, analysis, design considerations, manufacturing processes

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 & LO2 will be assessed by performance in the mid semester class test (30%).
C1 Demonstrate an understanding of failure modes of complex structures, typical of lightweight designs.
C2 Demonstrate critical thinking regarding the impact of the chosen materials and the applicable manufacturing techniques for certain applications.

LO3 will be assessed through a short presentation (20%) a final report (50%). Both will outline the design process, optimisation techniques used, weight saving and demonstration of structural integrity.
C1 Obtain practical experience in designing structural elements that need to make use of some of the taught methodologies to result in a weight reduction.
C2 The ability to critically evaluate the role of different structural elements, both through simple hand calculations and by means of FEA.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

Summative assessments: a) Time constrained quiz (Online Myplace quiz), b) Individual report on design and optimisation coursework, c) Individual presentation

Formal feedback: a) Automatically generated feedback will be provided including the correct answer and a short explanation, and the student's mark will be given for the online quiz, released at a minimum of 72 hours after the quiz deadline. b) Written feedback for the report will be provided. c) Oral feedback will be provided after the presentations.

Informal feedback: Verbal feedback will be provided to the students during the lectures. Additional verbal feedback during the on-campus sessions will be given to support the provided Myplace quiz feedback.
Written feedback will be given via Myplace forum and email to personal inquiries to the lecturers.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1 quiz (Time constrained)	sem2 week 7	1hr	30%	1 Report 1 Pres.	50% 20%				
LO1 & LO2				LO3		*		*	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submission deadlines (*academic weeks*):
1 individual report submitted upon completion of the module (week 11).

Resit Assessment Procedures:
Submission of alternate ^^coursework(s) prior to commencement of the July/August exam diet.

^^Students must contact the module Registrar for details as soon as results confirm that a resit is required.

***NOTE: Assessment details apply under normal circumstances; alternative arrangements may be required during unforeseen periods of disruption.*

PLEASE NOTE:
Students must gain a summative mark of at least 50% to pass the module. Students who fail the module at the first attempt will be re-assessed prior to the July/August exam diet. This re-assessment will consist entirely of coursework. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference**

** "Forms and Concepts for Lightweight Structures" – Cambridge University Press by Koryo Miura & Sergio Pellegrino

* "Structural Mechanics in Lightweight Engineering" – Springer, by Christian Mittelstedt

* "Evolution of Lightweight Structures, Analyses and Technical Applications" – Springer, by Christian Hamm

Additional Student Feedback

Date	Time	Room No
tbc	tbc	Check timetable webpages / app for details

Session: 2025_26

Approved:

Programme Lead/Director Signature: Dr Andrew McLaren

Date of Last Modifications: 04 August 2025

(MAE template updated June 2025)

MODULE TIMETABLE

Module Code:	**ME533**	**Module Title:**	**LIGHTWEIGHT STRUCTURES**

Brief Description of Assessment:

1x coursework report (50%), 1x Presentation (20%), weeks 10-11
1x time-constrained quiz, duration of 1 hour (via Myplace; 30% of overall mark), week 7.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item.

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item.	Choose an item.	Choose an item.	Choose an item.	Course work Set	Choose an item.	Choose an item.	Online Test	Choose an item.	Choose an item.	Present ation	Course work Submit	Choose an item.