MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

16587 PRESSURISED SYSTEMS

Module Registrar: Prof D Nash d.nash@strath.ac.uk	**Taught To (Course): Year 5, MSc and Exchange Students**	
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 1**
Optional module	**Academic Level: 5**	**Suitable for Exchange: Y**

Required prerequisites

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.

Good understanding of structural and solid mechanics
- Material failure mechanisms – yield criterion
- Yielding, buckling, fracture, fatigue
- 2D stress and strain

Able to tackle differential calculus to manipulate equilibrium equations

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
20	10						30	40	100

Educational Aim

This module aims to introduce the subject of industrial Pressurised Systems and ensure competency in the use of relevant Standards and Design Codes. Pressurised Systems are inherently dangerous since they contain stored energy which must be carefully controlled.
The class aims to set down a methodology whereby a range of pressurised components (spheres, cylinders, cones, etc.) can be designed, analysed, manufactured, installed and operated to a high degree of safety.

Learning Outcomes

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

LO1 understand the basic philosophy behind Pressure Vessel Codes and Standards

LO2 be able to carry out a complex design assessment and know their way around such a Standard - since they will have undertaken an industrial design exercise using the appropriate British Standard (PD 5500)

LO3 have some ability to examine the unusual non-standard pressure vessels and the interaction between components of different stiffness configuration and understand the use of design-by-analysis and finite element assessment for complex systems

LO4 be able to undertake thin shell and edge bending analysis and appreciate the strengths and weaknesses of thin-shell analysis and know its important role in pressure vessel code development

LO5 be aware of the limitations of such Standards and appreciate the safety assumptions and restrictions contained therein

Syllabus

The module will teach the following:

Provide a basic understanding of the behaviour of components used in pressure and storage containment.
30% of the class is devoted to a fundamental development of the appropriate stress analysis of thin shells, including spheres, cylinders, cones, etc. under pressure, temperature and local loadings; discontinuity analysis is employed to derive the forces and moments that arise at nozzle/shell, shell/head junctions, etc.
The remainder of the class uses the ideas developed above to examine design methodologies established in the British/American and EU Pressure Vessel Design Codes. In these, 'design-by-rule', 'design-by-analysis', stress categorisation - primary and secondary stresses and peak stresses are explored. These are applied to the design of pressure and storage vessels of various geometries, treatment of local loads, openings and branches, supports, heads and the design for external pressure loading and stability and design for fatigue.

The syllabus is as follows:

An introduction to the design philosophy, the manufacture of pressurised systems and the history of pressure vessel code and standards development. The stress analysis of thin shells including cylinders, cones and spheres under pressure and temperature. Pressure vessel design: British, European and American Design Codes, design by rule, design by analysis. Stress categorisation - primary and secondary stresses, peak stress. Applications to the design of pressure vessel components, cylindrical and spherical pressure vessels, treatment of local loadings, openings, supports and heads. External pressure loading, buckling and stability. Local loads, supports and fatigue assessment. Simple piping systems design. Use of computer packages for pipework and pressure vessel design.

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
C1 understand the historical development of codes and standards (exam)
C2 know and be able to apply the background to thin shell theory (edge bending exercises and exam)
C3 understand the design philosophy include the rationale for safety and know the key failure mechanisms/modes (exam)

LO2 – LO5
C1 be able to design a range of pressure equipment on a component-by-component basis to industry standards by exam and design coursework)
C2 know and articulate the weaknesses of the main design methods (design coursework and exam)
C3 be able to assess the safety of pressurised systems, know code limitations and deal with non-standard arrangements (design coursework)

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/)

16587 Pressurised Systems is a 10 credit first semester class. Assessment is via an exam and design exercise/coursework at 50% for each element. The Design Exercise is issued in Week 5 but undertaken over the second part of the module.
Feedback is given on an on-going basis during class discussion and tutorials sessions.

Informal feedback will be provided at regular tutorial sessions primarily through verbal discussion with individuals or groups on tutorial exercises attempted in advance by students (Note: to receive this feedback students should participate in these tutorials but attendance is not mandatory).

Written comments and feedback on the Design Coursework will also be given via Myplace.

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	Dec	2hr	50%	1	50%				
* LO1 - LO4				* LO2 – LO3, LO5		*		*	

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

Coursework / Submissions deadlines (*academic weeks*):

Design Exercise assignment to be issued in Week 5 – online submission windows will be given via Myplace. Submitted by 3.30pm on Thursday Week11.

Resit Assessment Procedures:
2hr examination in July/August diet.

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

Recommended Reading

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

***** "Guide to Pressure Equipment", by S W Earland, D H Nash & W Garden, PE Publishing
***** "Stresses in Shells" by W Flügge, Springer Verlag
***** "Pressure Vessel Design" by H H Bednar, Van Nostrand Reinhold
***** "Pressure Vessel Design - Principles and Concepts" by J Spence and A S Tooth, E & F Spon (in imprint of Chapman & Hall)

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Formal, summative feedback will be provided by the return of examination marks to students after assessment (note: exam scripts will not be returned to students and no individual or collective discussion of exam performance will be facilitated).

Date	Time	Room No
Weekly classes and tutorials		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead / Director Signature: Dr A McLaren and Dr G Houston-Scott

Date of Last Modifications: 02/08/2024

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**16587**	**Module Title:**	**Pressurised Systems**

Brief Description of Assessment:

Design Coursework – a major, structured design report with fully typed or handwritten calculations and sketches – 50% weighting
Exam – 2hr open book format – 50% weighting

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.	Design Course work Set	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.	Design Course work Submit	Exam

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.	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.