MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME946 PRESSURISED SYSTEMS

Module Registrar: Prof D Nash d.nash@strath.ac.uk	**Taught To (Course): MSc and Exchange Students**	
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 1 (online learning)**
Optional Class	**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 confidently to manipulate large complex 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 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, 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 (quiz)
C2 know and be able to apply the background to thin shell theory (edge bending exercises and quiz)
C3 understand the design philosophy include the rationale for safety and know the key failure mechanisms/modes (quiz)

LO2 – LO5
C1 be able to design a range of pressure equipment on a component by component basis to industry standards (by quiz and design coursework)
C2 know and articulate the weaknesses of the main design methods (design coursework and quiz)
C3 be able to assess the safety of pressurised system 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/)

ME946 Pressurised Systems is a 10 credit first semester class. Assessment is via a major practical design exercise and two online time constrained quizzes at mid and end semester. Feedback is given on an on-going basis via online sessions.

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

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

Formal, summative feedback will be given after marking of the Design Coursework and feedback will be provided by the return of assignment marks to students after assessment. This will be done via MyPlace.

Formal, summative feedback will be provided by the return of quiz marks to students after assessment (note:- online quiz screens will not be available to students and no individual or collective discussion of quiz performance will be facilitated).

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

Online Assessment				Coursework		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***
2 time constrained quizzes	Week 6 & Week 11	1 hour each	2 x 25%	1	50%		
* LO1 – LO5				* LO2 – LO3		*	

* ***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.
Submission by 12noon on Monday week11 at the latest.
Online time constrained quizzes will be run in week 6 (shell theory) and 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.

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 before the August 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**

* "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)

Date	Time	Room No
Weekly forums	TBC	Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr A McLaren

Date of Last Modifications: 19/08/2024

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME946**	**Module Title:**	**Pressurised Systems**

Brief Description of Assessment:

Design Coursework – a major, structured design report with fully typed or handwritten calculations and sketches
Time constrained quizzes

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	Class Test (quiz)	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 Class Test (quiz)	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.	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.