

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	
Assumed Prerequisites: Level 3 Structural Mechanics	Optional Class	Academic Level: 5	Suitable for Exchange: Y

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 – LO4

- 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 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/staff/policies/academic/>)

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

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	Weighting	Number	Weighting	Number	Weighting	Number	Weighting
1	December	2 hours	60%	1	40%				
* LO1 - LO4				* LO2 – LO3		*		*	

* **L/Os:** Indicate which Learning Outcomes (LO1, LO2, 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 Friday Week11 at the latest.

Resit Assessment Procedures:

2hr examination in 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 August diet. This re-assessment will consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference (do NOT purchase)**

All *

“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)

16587 Pressurised Systems is a 10 credit first semester class. 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 the elements of the edge bending tutorial sheets or the main design exercises attempted in advance by students (note: to receive this feedback, students should participate in these tutorials but attendance is not mandatory).

Formal, summative feedback will be given after marking of the Design Exercise 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 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 (Tuesdays)	1400-1500	Check timetable webpages for details

Session: 2020/21

Approved:

Course Director Signature: Dr Stuart Grey

Date of Last Modifications: 12 August 2020

(Updated August 2020)

