MODULE DESCRIPTION FORM

ME918 Advanced Boiler Technologies II

Module Registrar: Prof D H Nash

Taught To (Course): Power Plant Engineering and Power Plant Technologies

Other Lecturers Involved: Prof D MacKenzie, (external) visiting Prof S Cameron, Mr W Bell (Doosan)

Credit Weighting: 10

Semester: 2 (self-directed learning)

Assumed Prerequisites: Engineering Mechanics to BEng level

Optional class

Academic Level: 5

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

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Tutorial</th>
<th>Laboratory</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>50</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Educational Aim

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.

An overview of the main elements of power plant will be given. Attention will be given to the design of the boiler and associated equipment. In addition the design of piping systems will be addressed. Each of the key elements of the power plant will be review in the light of current standards, PD5500 and EN13445 for Vessels, EN12952 for boiler and EN13480 for piping.

In addition, some reference will be made to the Pressure Equipment Directive PED EN/97/23

Learning Outcomes

The main learning outcome is the provision of a basic understanding of the main factors influencing the design of boilers, pressure vessels and piping associated with modern power plant. In addition, behaviour of components used in boilers, pressure systems and storage containment will be addressed.

Part 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 and EU Boiler and Pressure Vessel Design Codes. Some comments on American standard will be included. In these, ‘design by rule’, ‘design-by-analysis’, stress analysis procedures will be expanded and an understanding of their relevance in the power plant sector will be achieved.

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

**LO1** - understand the basic philosophy behind boiler and pressure systems Codes, Standards and design manuals

**LO2** - know their way around such Standards - since they will have undertaken an industrial design exercise using the appropriate standards and design manuals and have some ability to examine the unusual non-standard pressure vessels

**LO3** - be aware of the limitations of such Standards and appreciate the assumptions contained and appreciate the use of current computer-based design tools.

**LO4** - understand the importance of legislation governing power plant and the drivers for new power plant

Syllabus

The module will teach the following:

- Introduction and Overview of Advanced Boilers
- Introduction to Pressure Equipment
The Basics of Stress Analysis
The PED, PSSR and CDR (Pressure Equipment Directive, Pressure Systems Safety Regulations and Construction Design and management Regulations)
Shell Theory (Background and Edge Bending)
Plastic Design Concepts
Materials for Pressure
Nozzles and Openings
Design-by-Analysis for Pressure Systems
EN12952 Pressure Calculations
Overview of ASME1
Local Loads
Creep-Fatigue (with case studies)
Bolted Joints
Piping Systems
Fatigue 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 - understand the basic philosophy behind boiler and pressure systems Codes, Standards and design manuals
C1 – be able to undertake simple boiler component designs using Codes and Standards
C2 – understand the background stress analysis
C3 – be able to derive fundamental equations from shell theory first principles
C4 – appreciate component failure mechanisms including short and long term effects (creep)

LO2 - know their way around such Standards - since they will have undertaken an industrial design exercise using the appropriate standards and design manuals and have some ability to examine the unusual non-standard pressure vessels
C1 – appreciate the structure of modern pressure vessel codes
C2 – be able to deal with and design non-standard pressure systems and non-pressure components

LO3 - be aware of the limitations of such Standards and appreciate the assumptions contained and appreciate the use of current computer-based design tools.
C1 – understand the limits of the design methods within code and standards
C2 – know where and when design by analysis methods should be used
C3 – have some practical experience of finite element analysis for pressure systems

LO4 - understand the importance of legislation governing power plant and the drivers for new power plant
C1 – appreciate the main legislation items pertaining to boilers and pressure systems
C2 – understand and apply the EU Pressure Equipment Directive (PED) and other items

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

12 Principles of Assessment and Feedback
(on Learning & Teaching web pages: www.strath.ac.uk/learnteach/teaching/staff/assessfeedback/12principles/)

Deliver high quality feedback information that helps learners self-correct.
The assessment is by online open book examination. Students are invited and encouraged to contact staff with draft submissions upon which specific formative feedback is given, including advice on style as well as content.

Ensure that summative assessment has a positive impact on learning.
The open book nature of the exam encourages students to read and research widely in preparation of their written answers. Tutorials and exercises will build on this

Give choice in the topic, method, criteria, weighting or timing of assessments.
Students are generally part time, working full time for their company. The online exam has a one month submission window, allowing students to schedule their coursework around employment related tasks.

Involve students in decision-making about assessment policy and practice.
The timing of the exam is negotiated with the student body when they attend for the intensive module week.
Assessment Method(s) Including Percentage Breakdown and Duration of Exams

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Duration</td>
<td>Weighting</td>
</tr>
<tr>
<td>All</td>
<td>1</td>
<td>4 weeks</td>
<td>60%</td>
</tr>
</tbody>
</table>

Indicate which learning outcomes (L01, L02 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Resit Assessment Procedures:
Resit exam (2hrs) in August examination diet.

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Recommended Reading

Full notes are provided and no other document is mandatory.
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 and Hall)

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

ME918 Advanced Boiler Technologies 2 class is a 10 credit block delivery module. Feedback is given on an ongoing basis during class discussion and tutorials sessions.
Informal feedback will be provided at regular tutorial sessions primarily through verbal discussion with individuals or groups during the block.
An edge bending exercise will be undertaken during the block and one submitted via MyPlace within 4 weeks of the block. Assessment and written feedback will be may via MyPlace within 2 weeks thereafter.
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).

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
</tr>
</thead>
<tbody>
<tr>
<td>April - May 2015</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Session: 2014/15

Approved:

Course Director Signature: P. Strachan
Date of Last Modifications: 29 August 2014
**Module Code:** ME918  
**Module Title:** Advanced Boiler Technologies II

**Brief Description of Assessment:**

**Assessment Timing:**

Indicate on the table below the Start/Submission dates for each Assignment/Project and the timing of each Exam/Class Test(s).

<table>
<thead>
<tr>
<th>Semester One</th>
<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
<th>WK4</th>
<th>WK5</th>
<th>WK6</th>
<th>WK7</th>
<th>WK8</th>
<th>WK9</th>
<th>WK10</th>
<th>WK11</th>
<th>WK12</th>
<th>Exam Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester Two</td>
<td>WK1</td>
<td>WK2</td>
<td>WK3</td>
<td>WK4</td>
<td>WK5</td>
<td>WK6</td>
<td>WK7</td>
<td>WK8</td>
<td>WK9</td>
<td>WK10</td>
<td>WK11</td>
<td>WK12</td>
<td>Exam Period</td>
</tr>
</tbody>
</table>