Module Registrar: Dr Ian J Taylor
ian.taylor@strath.ac.uk

Other Lecturers Involved: Dr Yonghao Zhang; Dr Monica Oliveira

Credit Weighting: 20 (ECTS 10)
Semester: 1 and 2

Assumed Prerequisites: ME101 Heat and Flow 1
Compulsory class
Academic Level: 2

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>Groupwork</th>
<th>External</th>
<th>Online</th>
<th>Project</th>
<th>Assignments</th>
<th>Private Study</th>
<th>Total</th>
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<tr>
<td>48</td>
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Educational Aim

This module aims to deliver fundamental knowledge on fluid mechanics and thermodynamics and illustrate their importance to engineering systems. Thermodynamics is the science that is devoted to understanding energy in all its forms and how energy changes form. The aim of the first semester of this class is to supply the necessary analytical tools to study these energy changes when applied in engineering situations, in particular for transportation and power production. Fluid mechanics and the behaviour of fluids is an important aspect in the performance of engineering systems. In the second semester the underlying physics of fluid flow and its application to simple systems is presented.

Learning Outcomes

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

LO1 To understand the fundamentals of the laws of thermodynamics and how they can be used to both design, and assess the performance of engineering power systems.

LO2 To understand the thermodynamic behaviour of different fluids and their importance in power cycles.

LO3 Understand the behaviour of different fluids in a range of applications and to understand how to investigate their properties both experimentally and numerically.

LO4 To understand and analyse the influence of fluid properties on the behaviour of engineering systems and to be able to analyse systems using the concepts of conservation of mass, energy and momentum.

Syllabus

The module will teach the following:

1st Semester: Thermodynamics
a) 1st law of thermodynamics applied to non-flow and steady flow systems
b) the properties of perfect gases
c) the properties of liquids and vapours
d) the 2nd law of thermodynamics, its implications and thermal efficiency
e) entropy and the concepts of the principle of increasing entropy, isentropic efficiency
g) assessment of the performance of vapour and gas power cycles

2nd Semester: Fluid Mechanics
a) the influence of fluid properties on the behaviour of engineering systems
b) the concepts of conservation of mass, energy and momentum
c) dimensional analysis of an engineering process
d) significance of dimensionless parameters such as Reynolds and Mach numbers, and dimensional analysis.
e) design of simple pipe systems
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 To understand the fundamentals of the laws of thermodynamics and how they can be used to both design, and assess the performance of engineering power systems.
   C1 Demonstrate ability to select correct energy equation for the problem and perform calculations to determine how properties change during a process due to energy transfers
   C2 Be able to perform calculations of heat and work for various fundamental processes, demonstrating understanding of how different processes use differing assumptions to determine correct energy transfer.
   C3 Demonstrate understanding of how laws of thermodynamics affect engineering cycles power through calculations of how properties varying during cycle, of energy transfers and by determining appropriate measures of cycle performance.

LO2 To understand the thermodynamic behaviour of different fluids and their importance in power cycles.
   C1 Demonstrate ability to determine appropriate assumptions and analysis procedures for calculations using different fluids
   C2 Demonstrate ability to determine thermodynamic property changes for a perfect gas using Gas Law and energy equation.
   C3 Demonstrate ability to determine thermodynamic property changes for liquids and vapours using thermodynamic property tables and energy equation.

LO3 Understand the behaviour of different fluids in a range of applications and to understand how to investigate their properties both experimentally and numerically.
   C1 Demonstrate ability to identify how to identify different fluids, apply appropriate assumptions for their properties and determine their behaviour through calculations.
   C2 Determine key parameters that quantify properties of a fluid (e.g. Viscosity etc.) and that affect the fluid behaviour (e.g. Mach number, Reynolds number etc.)
   C3 Demonstrate understanding of dimensional analysis and how it can be used to compare fluids and fluid behaviour in engineering systems.

LO4 To understand and analyse the influence of fluid properties on the behaviour of engineering systems and to be able to analyse systems using the concepts of conservation of mass, energy and momentum.
   C1 Perform calculations to demonstrate understanding of how conservation of mass, energy and momentum determine the performance of an engineering system.
   C2 Demonstrate understanding of the principles of conservation of fundamental quantities by making appropriate assumptions when undertaking analysis of systems.

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/informationforstaff/staff/assessfeedback/12principles/)

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).

Solutions to selected tutorial questions are presented and discussed in the tutorial sessions.

Laboratory reports and results are discussed with students.

Online assignment/quizzes – solutions are given to questions along with reasons for correct answers and why certain approaches are incorrect.

Full solutions will be provided to all courseworks and exams, post assessment, along with reasons for techniques used, and to highlight common errors in the solution.

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 collective discussion of exam performance will be facilitated). Individual feedback on the exam may be arranged if appropriate.

Students are encouraged to collaborate in the calculations and models provided in the tutorial exercise and demonstration calculations provided during the course. However, it is emphasised that the analysis reports they submit must be entirely their own work – i.e. background research plus results they have personally generated and interpreted.
Assessment Method(s) Including Percentage Breakdown and Duration of Exams

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<thead>
<tr>
<th>Examinations</th>
<th>Courseworks</th>
<th>Projects</th>
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<tbody>
<tr>
<td>Number</td>
<td>Month(s)</td>
<td>Duration</td>
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<tr>
<td>2</td>
<td>January &amp; May</td>
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L/Outcomes

Lo1, Lo2, Lo3, Lo4

LO1, LO2 and Lo4

Indicate which learning outcomes (Lo1, Lo2 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

Laboratory hand in – within two weeks of the laboratory being attended.
Online coursework, week 11 of first semester.
Online assignments/quizzes – usually 1 week allowed for each assignment.

Resit Assessment Procedures: 3hr August resit examination (ME204 & ME205: 2hr August resit examination).

PLEASE NOTE:
Students need to gain a summative mark of 40% 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

***Purchase essential; ***Purchase recommended; **Highly recommended reading;
*Simply for reference (do NOT purchase)

*** Thermodynamics: Purchase recommended:
"Fundamentals of Thermal-Fluid Sciences" by Cengel, Cimbala & Turner, McGraw-Hill, ISBN 9780071325110

** Thermodynamics: Highly recommended reading:

*** Fluid Mechanics: Purchase recommended of ONE only from:
"Fundamentals of Fluid Mechanics" by Munson, Young & Okiishi, John Wiley & Son, ISBN 0471517461
"Fluid Mechanics" by Douglas, Gasirek & Swaffield, Pitman, ISBN 0 273 02134 6

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

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<th>Time</th>
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Session: 2014/15

Approved:

Course Director Signature: Prof J Boyle

Date of Last Modifications: 28 August 2014
**MODULE TIMETABLE**

**Module Code:** ME203  
**Module Title:** Heat & Flow 2

**Brief Description of Assessment:**
- 2 Exams (January & May)
- Laboratory sessions (various dates throughout semester)
- Online coursework
- Online quizzes (various dates throughout semester)

**Assessment Timing:**

Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment(s).

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