MODULE DESCRIPTION FORM

ME301 (ME303 sem1/ ME302 sem2)  HEAT AND FLOW 3

Module Registrar: Dr W Dempster  william.dempster@strath.ac.uk

Taught To (Course): Mechanical and Electrical/Mechanical students

Other Lecturers Involved: Dr T Scanlon

Assumed Prerequisites: ME203 Heat and Flow 2

Credit Weighting: 20 (ECTS 10)

Semester: 1 and 2

Compulsory / optional/ elective class

Academic Level: 3

Alternative codes and credit values for those taking only one semester:
Semester 1: ME303 Fluid Mechanics 3 (10 Cr/ECTS 5)
Semester 2: ME302 Thermodynamics 3 (10 Cr/ECTS 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>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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<tbody>
<tr>
<td>48</td>
<td>72</td>
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Educational Aim

The class builds on the students’ previous study of thermodynamics and extends this to cover mixtures, psychrometry exergy and its applications. It also extends the study of heat transfer. Here, heat transfer by conduction, convection and radiation is covered together with heat exchanger design.

In addition, this class takes the study of the laws of conservation of mass, energy and momentum applied to fluid flow to a more advanced level. The knowledge and understanding of fluid flow is extended and this class supplies the analytical tools to provide an appreciation of boundary layers and compressible fluid flow.

Learning Outcomes

LO1 Student will be able to appreciate the problems involved in the design and analysis of thermal systems.

LO2 The student will be able to analyse problems involving boundary layers flow and the flow of compressible

Syllabus

**Semester1: Fluid Mechanics**

This class aims mainly to prepare students to tackle high speed flow systems.

The first part introduces students to one-dimensional compressible flows: sound/shock waves, flow structure in supersonic nozzles. Students also learn manipulating the one-dimensional mass continuity, momentum and energy equations.

The second part deals with subsonic/incompressible flows and introduces students to: boundary layers (both laminar and turbulent), aerodynamic forces, lift and drag, calculation from different flow structures.

Students are introduced also during this class to solving numerically some standard fluid dynamic problems in internal/external flows (Poiseuille, Couette, Shear-driven flow.)

**Semester2: Thermodynamics**

Heat transfer, one-dimensional conduction through plates, cylinders and spheres.

Forced and natural convection, convection correlations. Radiation, black surfaces, emissivity, simple configurations.

Overall transfer of heat, extended surfaces. Heat exchangers.

Review of basic concepts, property relations, gas mixtures, psychrometry with applications to air conditioning systems.

Review of the Second Law of Thermodynamics, Kelvin-Plank and Clausius statements, corollaries, thermodynamic temperature, Carnot cycle, exergy and its application.
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 Appreciating the problems involved in the design and analysis of thermal systems.
   C1 The ability to describe heat transfer mechanisms and relate these to working equations.
   C2 To calculate heat transfers, temperatures for fundamental geometries, slabs, cylinders, spheres, fins.
   C3 To identify basic heat exchange configurations and carry out basic thermal performance and design calculations
   C4 To define and calculate basic properties of air-water mixtures and by calculation determine the state of simple air conditioning processes

LO2 Fundamentals of fluid flow in boundary Layers and simple compressible flows
   C1 The understanding of the role boundary layers play in fluid flow
   C2 The ability to analyse boundary layers and calculate b.l. thickness for laminar and turbulent conditions
   C3 An understanding of the consequences of compressible flow in simple geometries and around surfaces.
   C4 The ability to calculate the flow conditions for compressible flow with area change, friction and heat transfer and across shocks.

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/)

Students are encouraged to collaborate in the calculations and models provided in the tutorial exercise and demonstration calculations provided during the course.

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 few of tutorial questions are provided on myplace and others are discussed in the tutorial sessions.

Full solutions will be provided exams, post assessment, along with reasons for techniques used, and to emphasize 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 but collective discussion of exam performance will be facilitated)

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

<table>
<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>Jan &amp; May/Jun</td>
<td>2 hours each</td>
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LO1 and LO2

Indicate which learning outcomes (LO1, LO2 etc) are to be assessed by exam/coursework/project as required.

Coursework / Submissions deadlines:

None

Resit Assessment Procedures:

3 hour examination in August

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)

*** "Fundamentals of Thermal-Fluid Sciences" by Cengel, Turner & Cimbala, McGraw-Hill

** Thermodynamics; An Engineering Approach, Cengel and Boles 7th edition

** J John, T Keith “Gas Dynamics”, 3rd edition, Prentice Hall

** RW Fox, AT McDonald, PJ Pritchard “Introduction to Fluid Mechanics”, 6th edition, Wiley


Additional Student Feedback

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

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<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
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<tr>
<td>Each Friday</td>
<td>3pm - 5pm</td>
<td>TBC</td>
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Session: 2014/15

Approved:

Course Director Signature: [Signature]

Date of Last Modifications: 03 September 2014
## MODULE TIMETABLE

**Module Code:** ME301/302/303  
**Module Title:** Heat & Flow 3

### Brief Description of Assessment:
2 Exams (January & May/June)

### 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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