Module Registrar: Dr T Scanlon  
tom.scanlon@strath.ac.uk  
Taught To (Course): Cohorts for whom class is compulsory / optional / elective

Other Lecturers Involved: none  
Credit Weighting: 10 (ECTS 5)

Assumed Prerequisites: ME101, ME203, ME301 Heat and Flow 1, 2 and 3  
Compulsory / optional / elective class  
Academic Level: 4

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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Educational Aim

An understanding of heat, mass and momentum transfer processes is a basic requirement for practising engineers. This class aims to build upon the students' previous exposure to the basic energy transfer mechanisms of conduction, convection and radiation so that multi-dimensional, steady state and transient problems can be recognised and analysed.

Learning Outcomes

A general objective of the class will be to deepen the students' understanding of general transport phenomena of mass and heat transfer processes and to show and give practice in the available solution techniques applied to engineering systems.

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

LO1 understand the fundamental concepts of conduction, convection, radiation and mass transfer
LO2 understand the main formulation methods and the limitations of the equations derived from them
LO3 be able to carry out engineering calculations involving conduction, convection and radiation
LO4 be able to carry out simple calculations involving turbulence

Syllabus

Eulerian, Lagrangian viewpoints; derivation of mass, momentum, energy and species conservation equations for differential control volume, description of terms in equations.


Convection: the convection boundary layers. Order of magnitude analyses; important dimensionless groups; elementary solutions of governing equations; heat and mass transfer analogy; laminar forced convection on a flat plate; Reynolds analogy, introduction to turbulence; external and internal flows; free and forced convection correlations.


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 Understanding the fundamental concepts of conduction, convection, radiation and mass transfer
C1 Students should demonstrate understanding of the differences between the various heat and mass transfer phenomena and be able to perform calculations to demonstrate the key principles

LO2 Understanding the main formulation methods and the limitations of the equations derived from equations derived
C1 Students will comprehend the most important factors in the derived formulae and be able to modify the general equations to suit particular engineering circumstances.

LO3 To be able to carry out engineering calculations involving conduction, convection and radiation
C1 Students will have a thorough appreciation of the physics involved in each mode of heat transfer and be able to accurately assess which mode is pertinent in any given situation.

LO4 To be able to carry out simple calculations involving turbulence
C1 Students will understand the background to the nature of turbulence and how it is treated both analytically and numerically to provide reasonable engineering approximations as to what happens in nature.

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.
Guidance to the solution of certain tutorial questions will be discussed in lectures/tutorial sessions.
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.

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

<table>
<thead>
<tr>
<th>L/Outcomes</th>
<th>Examinations</th>
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<th>Courseworks</th>
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<th>Projects</th>
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<tr>
<td>Number</td>
<td>Month(s)</td>
<td>Duration</td>
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<td>1</td>
<td>Jan</td>
<td>2 hours</td>
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<td>20%</td>
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LO1, LO2, LO3 and LO4s

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

Coursework / Submissions deadlines:
One class exercise will be given counting as 20% of the final mark.

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)
* "Heat Transfer" by Bayley, Owen & Turner – Nelson
* "Engineering Heat Transfer" by Janna - PWS -van Nostrand Reinhold
* "Principles of Heat Transfer" by Kreith & Bohn - Harper & Row
** "Introduction to Fluid Mechanics" by Munson, Young & Okishi - Wiley
*** "Fundamentals of Heat, Mass and Momentum Transfer" by Incropera & De Witt - Wiley
** "Heat, Mass and Momentum Transfer" by Rohsenow & Choi - Prentice Hall
**Additional Student Feedback**  
*Please specify details of when additional feedback will be provided*

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<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Room No</th>
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<tr>
<td>Each Tuesday</td>
<td>1:30pm – 2:30pm</td>
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Session: 2014/15

Approved:

**Course Director Signature:** [Signature]

Date of Last Modifications: 29 August 2014
**MODULE TIMETABLE**

<table>
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<tr>
<th>Module Code:</th>
<th>ME405</th>
<th>Module Title:</th>
<th>Heat &amp; Flow 4</th>
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**Brief Description of Assessment:**

1 Exam (January)
1 Coursework exercise – Dates to be advised during lectures.

**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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<th>WK1</th>
<th>WK2</th>
<th>WK3</th>
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<th>WK8</th>
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<th>WK10</th>
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