MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

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

Module Registrar: Dr Emad Chaparian emad.chaparian@strath.ac.uk	**Taught To (Course): Cohorts for whom class is compulsory / optional**		
Other Lecturers Involved:	**Credit Weighting: 20 (ECTS 10)**	**Semester: 1 and 2**	
Assumed Prerequisites: ME203 Heat and Flow 2	**Compulsory class**	**Academic Level: 3**	**Suitable for Exchange: Y**

Alternative codes and credit values for those taking only one semester:
Semester 1: ME302 Thermodynamics 3 (10 Cr/ECTS 5)
Semester 2: ME303 Fluid Mechanics 3 (10 Cr/ECTS 5)

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
33	22							145	200

Educational Aim

The first semester builds on the students' previous study of thermodynamics and extends this to cover real gas behaviour, mixtures, psychrometry and its applications. It also extends the study of heat transfer. Here, heat transfer by conduction, convection and radiation are covered together with heat exchanger design.

In the second semester this class builds on the study of the laws of conservation of mass, energy and momentum applied to fluid flow, extending them 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

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

LO1 appreciate the problems involved in the design and analysis of thermal systems

LO2 analyse the viscous internal and external flows (involving boundary layers) as well as compressible internal and external flows

Syllabus

The module will teach the following:

Semester 1: 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.

Semester 2: Fluid Mechanics
The first part deals with viscous internal flows and introduces students to use differential control volume approach to solve the fluid flows. Then viscous external flows (boundary layers) are discussed which includes aerodynamic forces and lift & drag calculations.

The second part introduces students to one-dimensional compressible flows: it starts with some principles such as sound waves and isentropic flows. Then flow structure in supersonic nozzles is discussed. Students also learn manipulating the one-dimensional mass continuity, momentum, and energy equations to analyse normal shock waves in internal flows. Then external compressible flows (e.g., oblique shock waves) is taught.

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: To calculate heat transfers, temperatures for fundamental geometries, slabs, cylinders, spheres, fins.
C2: To identify basic heat exchange configurations and carry out basic thermal performance and design calculations.
C3: To define and calculate basic properties of air-water mixtures and by calculation determine the state of simple air conditioning processes.

LO2: Simple compressible flows and fundamentals of fluid flow in boundary layers
C1: The ability to use differential control volume to solve simple internal viscous flows.
C2: The ability to analyse external flows, boundary layers and calculate 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.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic)

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 student should participate in these tutorials but attendance is not mandatory).

Immediate self-directed feedback through in-class polling systems.

Solutions to a few of tutorial questions are provided on Myplace and others are discussed in the tutorial sessions.

Full solutions will be provided for 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). Individual feedback on the exam may be arranged if appropriate.

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

Examination				**Coursework**		**Practical**		**Project**	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Dec	1.5 hrs	40%	1	10%				
1	Apr/May	1.5 hrs	40%	1	10%				
*LO1 and LO2				* LO1and LO2		*		*	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submissions deadlines (*academic weeks*): Online quiz during week 5 of sem1 and week 6 of sem2. Time constrained quizzes will open on a specific date for 24 hours, with a limited completion time of 40-60 minutes (depending on questions). Access will be possible on or off campus.

Resit Assessment Procedures:
ME301: 2hr examination in July/August diet; ME302/ME303: 1hr examination in July/August diet.

PLEASE NOTE:
Students must gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-assessed during the July/August exam diet. This re-assessment will consist entirely of exam. No marks from any previous attempts will be transferred to anew resit attempt.

ME302 (sem1 10 credit module Thermodynamics): Marks will be scaled to 100%
ME303 (sem2 10 credit module Fluid Mechanics): Marks will be scaled to 100%

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference**

*** "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

** “Engineering Thermodynamics” by Burghardt & Harbach, Harper Collins, ISBN 0 06 041049 3

* “Fundamentals of Fluid Mechanics” by Munson, Young & Okiishi, John Wiley & Sons, ISBN 0 471 51746 1

* “Fluid Mechanics” by Douglas, Gasiorek & Swaffield, Pitman, ISBN 0 273 02134 6

* “Mechanics of Fluids” by Massey, 6th edition, Van Nostrand Reinhold, ISBN 0 278 00047 9

* “Solving Problems in Fluid Mechanics”, Vol I and II by J F Douglas, Longman, ISBN 0 582 28643 3

* “Thermal Convection: Patterns, Evolution and Stability”, by M. Lappa, John Wiley & Sons, ISBN: 0470699949.

* “Rotating Thermal Flows in Natural and Industrial Processes”, by M. Lappa, John Wiley & Sons, ISBN: 1119960797

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

Feedback sessions on progress and assessment will be provided during tutorial sessions and will consist of a review of study methods and tutorial progress. The Semester 1 exam results will be reviewed on a class basis at the beginning of Semester 2 and where performance has been unsatisfactory a more student-centred approach will be taken. Feedback will be provided during the following class times.

Date	Time	Room No
Tutorial Sessions sem1 and sem2		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr G Houston-Scott

Date of Last Modifications: 08/08/24

(MAE template updated July 2024)

MODULE TIMETABLE

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

Brief Description of Assessment:

Semester 1 week 5: Time Constrained Quiz (Online Test)
Semester 2 week 6: Time Constrained Quiz (Online Test)

Two Exams:

- December diet (1.5 hours)
- April/May diet (1.5 hours)

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Online Test	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Online Test	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam