ADVANCED FLUID MECHANICS AND THERMODYNAMICS - 2024/5

Module code: ENG2134

Module Overview

The FHEQ Level 5 treatment of thermofluids builds on the material taught at FHEQ Level 4. It is presented in three linked sections: Thermodynamics, Heat Transfer and Fluid Mechanics. The Thermodynamics section introduces the second law of thermodynamics, entropy and associated concepts. These are used in understanding cycles and processes, and consideration of common engine cycles.
The Heat Transfer section gives a solid grounding in aspects of heat transfer that are essential for engineers. It covers. fundamental transfer mechanisms for steady state problems. Heat transfer coefficient evaluation and pipe flow problems are considered. Heat exchanger design and simple radiation exchange problems are introduced.
The Fluid Mechanics section considers incompressible, inviscid and viscous flow, and introduces compressible flow. Boundary layer theory is related to external flow around streamlined bodies, such as cars and aeroplanes in high Reynolds number flows. Bluff bodies with flow separation are also considered. Compressible flow theory is related to
aerospace and other applications where flow velocities are high and fluid density changes become significant.

Module provider

Mechanical Engineering Sciences

Module Leader

WEN Jennifer (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 5

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 61.5

Lecture Hours: 33

Tutorial Hours: 11

Laboratory Hours: 1.5

Guided Learning: 10

Captured Content: 33

Module Availability

Semester 1

Prerequisites / Co-requisites

n/a

Module content

Indicative content includes:
Fundamentals: Further treatment of Laws of Thermodynamics, principally the second law, and its corollaries.
Irreversibility. Perfect gases and perfect gas processes.
Reciprocating Engine Cycles: Analysis of air standard cycles for reciprocating engines: Otto, Diesel, dual. Cycle efficiency.
Gas Turbine Cycles: Cycles of steady flow processes - gas turbine cycle, jet engine. Thermal efficiency, net specific work output and work ratio.
Heat Transfer: Introduction to heat transfer, temperature driving force, overall and film heat transfer coefficients, log mean temperature, and thermal resistance; double pipe and more complex heat exchangers; steady state heat conduction; convection mechanisms, thermal boundary layers, dimensionless numbers and HTC correlations;
radiation mechanisms, total enclosure, basic radiation exchange calculations.
External viscous and inviscid flow (incompressible): Streamlines, pressure drag and viscous drag, boundary layer flow for a flat plate, reference to continuity and Navier-Stokes equations as exact equations, boundary conditions.
Compressible inviscid flow: general description of sub and supersonic flow; Bernoulli's equation, stagnation pressure, energy and stagnation temperature; isentropic flow in convergent and divergent ducts, and choking; description of over and under-expansion, and shock waves.

Assessment pattern

Assessment type	Unit of assessment	Weighting
Online Scheduled Summative Class Test	In-semester test (45 minutes)	20
Attendance only	Laboratory Demonstrations and Industry Lecture	Pass/Fail
Examination	2 hr Invigilated (closed book) Examination	80

Alternative Assessment

The live Industry Lecture will not be available in the LSA period, so alternative coursework will be provided,

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate understanding of scientific principles, methodologies and mathematics methods as well as the ability to describe particular systems and processes. The unseen examination includes a range of questions testing the learning outcomes described above.

Thus, the summative assessment for this module consists of:

In-semester test - Learning outcomes 1,2,3

Laboratory demonstrations - Learning outcome 2

Examination - Learning outcomes 1,2,3

Written feedback is given on the class test.

Formative assessment and feedback

Formative assessment is within tutorials and formative verbal feedback is given in tutorials.

Module aims

- Illustrate the need for a thorough understanding of thermodynamics and heat transfer in overcoming problems associated with global warming and energy supply
- Develop understanding of the second law of thermodynamics and its application to internal combustion gas power cycles
- Familiarise students with the mechanisms of heat transfer and with the basic approach to solving steady state heat transfer problems and design calculation methods for a range of heat exchanger types.
- Provide students with the ability to calculate theÂ drag and heat transfer for flow over a flat plate
- Introduce compressible flow behaviour in converging and diverging nozzles.

Learning outcomes

		Attributes Developed
001	On successful completion of the module, students will be able to: Appreciate the need for improved energy efficiency and the use of new fuels and alternative energy sources in order to reduce CO2 emissions and conserve energy resources.	CKPT
002	Demonstrate a comprehensive understanding of thermo-fluid principles applied to various engine cycles, heat exchangers and fluid flows and predict system thermal efficiency.	CKP
003	Analyse heat transfer systems, boundary layer flows and simple compressible flows using analytical and modelling techniques.	CKP

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to:
Introduce thermo-fluid principles through theory with worked examples. This is delivered through lectures, tutorial classes and practical laboratory demonstrations. Tutorial questions complement the lecture material with students expected to attempt the tutorial questions following the lecture and obtain help and feedback during the tutorial sessions.
The learning and teaching methods include:
Lectures
Tutorials
Independant study

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENG2134

Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in Employability, Digital Capabilities, Global and Cultural Capabilities, Sustainability, and Resourcefulness and Resilience. This module is designed to allow students to develop knowledge, skills, and capabilities in the following areas:

Digital capabilities: The students will use Excel for data processing and presentation such as graph plotting and data handling.

Employability: Students will develop fundamental and applied knowledge of Thermofluids as expected for graduate engineers in industry.

Sustainability: Global warming, the role of engineers in meeting environemental targets, and the importance of understanding Thermofluids are discussed in the lectures.

.Resourcefulness and resilience: Through understanding difficult concepts and tackling challenging tutorial problems students will develop confidence, resourcefulness and resilience.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Aerospace Engineering BEng (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Aerospace Engineering MEng	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering BEng (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering MEng	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering BEng (Hons)	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering MEng	1	Compulsory	A weighted aggregate mark of 40% is required to pass the module