Module specification

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Module Code	ENG538
Module Title	Thermo-fluids and Propulsion
Level	5
Credit value	20
Faculty	FAST
HECoS Code	100431
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BEng / MEng Aeronautical Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	30 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	10 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**40** hrs
Placement / work based learning	0 hrs
Guided independent study	160 hrs
Module duration (total hours)	**200** hrs

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Initial approval date	Feb 2017
With effect from date	September 2022
Date and details of revision	Aug 22: module update in engineering revalidation
Version number	2

Module aims

- To develop an in-depth understanding of non-flow and flow processes, liquids, vapours and two phase substances, polytropic processes using gases and vapours, the first and second laws of thermodynamics pressure and flow measurement.
- To further develop principles and applications of fluid momentum as applied to aircraft propulsion units, the design and operation of real gas turbine and jet engine cycles and their component parts, gas turbine engine intakes and nozzles, propulsion units and analysis of gas turbine engines.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Solve problems involving non-flow and steady flow processes.
2	Define the properties of working fluids and hence analyse two phase systems using tables and represent processes on property diagrams; Apply the first and second laws of thermodynamics and compare the performance of real and ideal cycles.
3	Apply the laws of fluid mechanics, Bernoulli's equation and the momentum equation to the flow of incompressible fluids.
4	Derive relationships for the thrust, power and efficiency of aircraft propulsion systems, including axial and radial turbines and compressors.

Assessment

Indicative Assessment Tasks:
Assessment One: Is by means of an examination covering learning outcomes 1, 2 and 4. It is an unseen time-constrained examination. Duration: 2 hours.

Assessment Two: Is by means of a coursework with several exercises applying concepts such as thrust, power and efficiency of aircraft propulsion systems, supersonic nozzles and thermodynamics laws. It covers learning outcome 3. Word count: 1,500 words.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1,2,4	Examination	70
2	3	Coursework	30

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Learning and Teaching Strategies

The module is taught through a combination of lectures and workshops. An active and inclusive approach is used to engage learners in the topics and will involve individual, group work and flipped learning experiences aligned to the university's Active Learning Framework (ALF). The approach offers students a flexible and adaptive learning experience that can accommodate a range of options that includes both on campus learning and remote learning where appropriate.

The Moodle VLE and other on-line materials and resources will be available to support learning. ALF offers a balance between the classroom elements and digitally enabled activity incorporating flexible and accessible resources and flexible and accessible feedback to support learning.

Detailed printed lecture notes provided for the student will allow the optimisation of lecture time, with good opportunity for self-study and tutorials. The module will also contain practical laboratory-based exercises supported by introductory lectures and demonstrations.

This module will be presented to students through a series of lecture materials including videos, demonstrations and structured technical visits to suitable establishments (e.g.: RAF, Cosford). Laboratory investigations and tutorials will be used to support lectures and to provide an opportunity for students to work on problems with individual attention if needed.

Indicative Syllabus Outline

- Basic Concepts and the First Law.
- Properties of Pure Substances and Use of Property Diagrams and Tables.
- The relationships between the properties of a perfect gas.
- Description and analysis of polytropic processes.
- The relationship between ideal and actual power plant cycles.
- Analysis of heat pump and refrigeration cycles.
- Principles involved in pressure measurement.
- Laws of mechanics, Bernouilli's equation and the momentum equation to the flow of incompressible fluids.
- Propulsive Efficiency and Propellers.
- Gas turbine and jet engine cycles: practical cycles, closed and open cycles; shaft power cycles, jet engine, prop-engine cycles.
- Centrifugal and axial flow compressors.
- Axial flow gas turbines.
- Gas turbine engine intakes and nozzles.

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

Y.A. Cengel, and R.H. Turner, Fundamentals of Thermal-Fluid Sciences, 4th ed. Singapore: McGraw-Hill Higher Education, 2012.
J.F. Douglas, Fluid Mechanics, 6th ed. New York: Prentice Hall, Harlow, 2011.
H.I.H. Saravanamutto, et al., Gas Turbine Theory. 6th ed. Harlow: Pearson Education, 2008.

Other indicative reading

N.A. Cumpsty and A.L. Heyes, Jet propulsion: A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of Jet Engines, 5th ed. New York: Cambridge University Press, 2015.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas.

Core Attributes
Engaged
Creative
Ethical
Key Attitudes
Commitment
Curiosity
Resilience
Confidence
Adaptability
Practical Skillsets
Organisation