Module specification

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Module Code	ENG779
Module Title	Applied Aerodynamics
Level	7
Credit value	20
Faculty	FAST
HECoS Code	100428
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
MSc Engineering (Aeronautical) MSc Engineering (Aeronautical) with Advanced Practice MEng Aeronautical Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	25 hrs
Placement tutor support	0 hrs
Supervised learning e.g., practical classes, workshops	5 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**30** hrs
Placement / work-based learning	0 hrs
Guided independent study	170 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	22nd Aug 2022
With effect from date	Sept 2022
Date and details of revision	
Version number	1

Module aims

- Develop a rigorous understanding of practical aerodynamic external flows relevant to aeronautical engineering and other branches of engineering.
- Critically analyse the application of classic and modern aerodynamic devices.

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

In addition to the module learning outcomes, students will also cover the following accreditation of higher education programme (AHEP) fourth edition learning outcomes: **M1, M2** & **M3**

1	Critically evaluate the governing equations for aerodynamics and methodologies for solving them computationally.
2	Analyse and apply theories for predicting lift on finite aspect ratio wings in incompressible flow and fully supersonic flow.
3	Critically assess and be able to predict induced drag in incompressible flow and wave drag in compressible flow and apply analysis to boundary layer flow and skin friction.

Assessment

Indicative Assessment Tasks:

This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment One: An individually prepared coursework for the critique of the principles and theory of Applied Aerodynamics. Students will have the opportunity to use equipment such as the Supersonic Wind Tunnel and software such as ANSYS Fluent to aid analysis. Assessment one is a written coursework (5000 words) and represents 100% of the overall mark

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1-3	Coursework	100%

Derogations

Credits shall be awarded by an assessment board for those Level 7 modules in which an overall mark of at least 50% has been achieved with a minimum mark of 40% in each assessment element

Learning and Teaching Strategies

A series of workshop style lectures with student-led seminars and small group activities. Directed learning using library and internet resources will be facilitated using Moodle and MS

Teams. This module will also follow the ALF (Active Learning Framework) guidelines, which will include alternative methods of assessment and a blended approach to delivery, with some theory and software sessions being delivered online (depending on requirements and student experience).

Indicative Syllabus Outline

- Aerofoil aerodynamic characteristics: properties of the atmosphere. Circulation, vorticity, potential and rotational flow, and lift. Generalised thin aerofoil theory. Pressure distribution and aerodynamic characteristics.
- Finite wing theory: Vortices: starting, trailing, bound and horseshoe. Equivalent systems, Biot Savart law and lifting line method. Lifting surface method.
- Boundary layer: Development of the boundary layer, viscosity, laminar and turbulent flow. Boundary layer separation. Laminar-turbulent transition. Skin friction drag, profile drag. Boundary layer control to prevent separation.
- Flow at high Mach number and compressibility effects: subsonic flow at high Mach number, Glauert correction factor. Supersonic flow, normal shockwave, oblique shockwave, Mach wave, Prandtl-Meyer expansion, shock-expansion technique, Ackeret theory. Supersonic wings. Current design techniques to minimise the effect of the shockwaves impact on the environment.
- Flow in engine intakes, subsonic and supersonic intake design, pressure recovery, Oswartich style intakes, aerodynamics of ramjets and scramjets.

Indicative Bibliography:

Essential Reads

J. D. Anderson, *Fundamentals of Aerodynamics.* 6th ed. McGraw-Hill, 2016.

Other indicative reading

E. L. Houghton and P. W. Carpenter, *Aerodynamics for Engineering Students.* 7th ed. Butterworth-Heinemann, 2016.

B.W. McCormick, *Aerodynamics, Aeronautics and Flight Mechanics,* 2nd ed. John Wiley & Sons, 1995.

The Aeronautical Journal RAeS

Journal of Aircraft AIAA

Plus, various others to be signposted on Moodle.

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
Enterprising
Creative

Key Attitudes
Commitment
Curiosity
Resilience
Confidence
Adaptability

Practical Skillsets
Digital Fluency
Organisation
Critical Thinking
Communication