COAP H4601: Aerodynamics and Computational Analysis

Module Title:	Aerodynamics and Computational Analysis
Language of Instruction:	English

Credits:	10

NFQ Level:	8

Module Delivered In	1 programme(s)

Teaching & Learning Strategies:	Teaching will be a blend of lectures and laboratories

Module Aim:	To provide the students with a comprehensive understanding of compressible, incompressible, inviscid and viscous flow, and the skills and techniques required to perform analyse fluid dynamics processes using an industry standard CFD package.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Apply aerodynamic principles including physical quantities of a flowing gas
LO2	Examine various aerodynamic theorems
LO3	Perform calculations for both inviscid and viscous flow
LO4	Calculate lift/drag/moment coefficients in terms of airfoils, wings and other aerodynamic shapes
LO5	Analyse Computational Fluid Dynamics (CFD) processes using industry standard software
LO6	Prepare CAD models to perform meshing processes for CFD analysis

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*
No requirements listed

Module Content & Assessment

Indicative Content
Fundamentals Physical quantities of a flowing gas; Source of all aerodynamic forces; Equation of state for a perfect gas
Standard Atmosphere Hydrostatic equation; Geometric and geopotential altitudes; Standard atmosphere definition; Pressure, temperature and density altitudes
General Aerodynamics Continuity and momentum equations; Thermodynamics; Isentropic flow; Energy equations; Subsonic wind tunnels Airspeed measurement; Viscous flow; Reynolds number; Laminar and turbulent boundary layers; Transition; Flow separation; Viscous effects on drag
Aerofoils, wings and wind turbines Airfoil nomenclature; Lift, Drag and Moment coefficients; Airfoil data (NACA); Infinite versus finite wings; Pressure coefficient; Obtaining lift coefficient from Cp; Compressibility correction for Lift Coefficient; Critical Mach number and Critical Pressure Coefficient; Airfoil drag; Calculation of induced drag; Change in the lift slope; Swept wings; Wind Turbine Aerodynamics
Introduction to Computational Fluid Dynamics • Introduction to the CFD Methodology • Cell Zone and Boundary Conditions • Post-Processing with CFD-Post • Solver Settings • Turbulence Modelling • Heat Transfer • Transient Flows • Moving Zones • Multiphase Flows • HPC • Best Practices
CFD Dynamic Meshing • Dynamic Mesh Zones with UDF’s and Profiles • Layering Mesh Method • Smoothing Mesh Method • Remeshing • Coupled 6DOF • Convergence • Best Practices

Assessment Breakdown	%
Continuous Assessment	60.00%
End of Module Formal Examination	40.00%

Continuous Assessment				
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	Students will sit a mid-term class test in Aerodynamics	1,2,3,4	10.00	n/a
Practical/Skills Evaluation	Students will sit at least 1 test in CFD	1,5,6	20.00	n/a
Practical/Skills Evaluation	Completion of subsonic aerodynamic experiments to demonstrate the principles of lift, drag and moment coefficients using a wind tunnel or suitable simulation software	1,2,3,4	10.00	n/a
Project	Students will complete a project investigating fluid flow around an object using a CFD packages	4,5,6	20.00	n/a

No Project

No Practical

End of Module Formal Examination				
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	n/a	1,2,3,4	40.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	12 Weeks per Stage	4.00
Laboratory	12 Weeks per Stage	4.00
Independent Learning Time	15 Weeks per Stage	10.27
	Total Hours	250.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_EEAER_B	Bachelor of Engineering (Honours) in Aerospace Engineering	7	Mandatory