AERODYNAMICS - 2024/5

Module code: ENG3167

Module Overview

Third year module in Aerospace Engineering.

The module is lecture and tutorial based and continues to develop the understanding of aircraft aerodynamics and design started in ENG2089 and ENG2091 by concentrating on the prediction of lift in incompressible flow, the characteristics of laminar and turbulent boundary layers, compressibility effects in subsonic and transonic flow, and the impact of these topics on the design of aircraft in civil aviation.

Module provider

Mechanical Engineering Sciences

Module Leader

CARPENTIERI Matteo (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 6

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

Overall student workload

Independent Learning Hours: 64

Lecture Hours: 33

Tutorial Hours: 11

Guided Learning: 9

Captured Content: 33

Module Availability

Semester 1

Prerequisites / Co-requisites

None

Module content

Indicative content includes:

Incompressible wing theory - Stream function, velocity potential, source, sink, vortex and doublet flows; thin airfoil theory, the Kutta condition, classical theory for symmetrical and cambered aerofoils; Prandtl's lifting-line theory, finite aspect ratio wing theory, downwash and induced drag. Use of incompressible inviscid flow methods in aircraft design.

Viscous flows - Simple viscous flow, laminar boundary layer, transition, turbulent boundary layer, turbulence. Use of viscous flow methods in aircraft design.

Compressible subsonic flow – subsonic similarity theory, critical Mach number, transonic flight. Design for the transonic regime.

Experimental methods - low-speed wind tunnels, anemometry and instrumentation

Assessment pattern

Assessment type	Unit of assessment	Weighting
School-timetabled exam/test	Class test (40 min)	20
Examination	Exam (2 hours)	80

Alternative Assessment

n/a

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate understanding of scientific principles, the ability to adapt and apply those principles to specific calculations and the ability to describe aspects of aerodynamic phenomena and aircraft design. The class test demonstrates the ability to perform a specific calculation and interpret its results.

Summative assessment

In-semester class test (Learning outcome 1)

Final examination (Learning outcomes 1-5)

Formative assessment and feedback

Verbal feedback and discussion is provided during tutorial classes

Written feedback is provided on the class test

Feedback is also provided via material on SurreyLearn

Module aims

- To provide an understanding of methods for predicting lift in incompressible flow, including the effects of finite aspect ratio.
- To provide an introduction to laminar and turbulent boundary layers and their importance in determining drag on an aircraft.
- To bring these strands together in a broad discussion of the design of subsonic, civil aviation aircraft.
- To provide a general appreciation of the aerodynamics of transonic flow and understanding of means of estimating the extent of the transonic regime for any particular streamlined body.

Learning outcomes

Ref		Attributes Developed	
001	Understand and be able to apply theories for predicting lift on finite aspect ratio wings in incompressible flow	KC	C1,C2
002	Understand the physics of laminar and turbulent boundary layers and the prediction of viscous drag	KC	C1
003	Demonstrate a comprehensive understanding of the underlying theoretical basis of the methods used	K	C1,C3
004	Be able to predict the onset of compressibility effects and be aware of the general features of wing aerodynamics in the transonic regime	KC	C1,C/M6
005	Understand and be able to apply this knowledge to the general design of subsonic, civil aircraft	KC	C5

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 develop subject knowledge through theory, applications and worked examples. The module content is delivered through lectures, tutorial classes, guided learning activities and other SurreyLearn material.

The learning and teaching methods include:

- lectures, where theory and applications are discussed with practical examples presented
- tutorials, where students can try to solve aerodynamics problems and prepare for the class test and the final exam

- guided learning activities, proposed to reinforce weekly learning; this includes formative assessment

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: ENG3167

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;

Employability: This module provides students with knowledge about aerodynamics, and in particular about aircraft aerodynamics. The module builds on this to develop the student's understanding of aircraft design and in particular their aerodynamical elements.

Digital capabilities: Students will use digital platforms to model and design inviscid, incompressible aerodynamics systems (potential flow). This is conducted as part of the guided learning activities which then feed into the class discussions and solving problems in tutorials.

Sustainability: Student will learn about the effect of aerodynamics on the environment within the discussion on aircraft design. Advanced aerodynamics currently experimented in research to improve aircraft sustainability and fuel consumption are also explored.

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