MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

16598 AERODYNAMIC PERFORMANCE

Module Registrar: Dr M T Stickland matt.stickland@strath.ac.uk	**Taught To (Course):Cohorts for whom class is compulsory; MSc Advanced Mechanical Engineering**		
Other Lecturers Involved: Dr M Macdonald Dr M Fossati, Dr M Afsar, Dr C Lowe	**Credit Weighting:10 (ECTS 5)**	**Semester:1 and 2**	
Assumed Prerequisites:	**Compulsory(MScAME with Aero) /optional class**	**Academic Level:5**	**Suitable for Exchange: N**

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
48	36						16		100

Educational Aim

This module is intended for students on the Advanced Mechanical Engineering with Aeronautics MSc program who have no prior experience of aerodynamics and flight mechanics. It uses the lectures, tutorials and assessments of classes 16231, Flight and Spaceflight 1, and 16259, Aero Design 1. It is therefore a “broadening” rather than “deepening” class which is reflected in the larger than usual number of lectures and assessments.

This module introduces students to the principles of aerodynamics, flight mechanics and propulsion. The aim is to provide students with an understanding of subsonic aircraft aerodynamics, propulsion and how the stability and control and performance of an aircraft are calculated.

Topics covered include:

- Aerodynamics
- Propulsion
- Aircraft design.
- Airworthiness and the flight envelope.
- Static, longitudinal stability and control of aircraft is considered.
- The standard atmosphere – variation of temperature, pressure and density with height is explained.

The calculation of the performance of aircraft is studied: Indicated and true airspeed. Steady level flight – minimum drag and minimum power flight speed. Steady glide and climb. Take-off and landing. Steady turning flight. Range and endurance. Flight and gust envelopes.

Learning Outcomes

On completion of the module the student is expected to be able to:

LO1 Describe the history of flight, aircraft propulsion, and spaceflight.

LO2 Understand the generation of lift, drag and thrust.

LO3 Understand and describe aircraft flight instruments.

LO4 Understand and describe bluff body aerodynamics

LO5 Understand aircraft and rocket propulsion and rocket staging.

LO6 Understand the link between aircraft performance and efficient aerodynamics

LO7 Understand the effect of the centre of gravity location and the stability and controllability of conventional aircraft.

Syllabus

The module will teach the following:

Sem 1 & 2:

1. History of flight.
2. Theoretical aerodynamics: aircraft layout and nomenclature, lift and drag coefficients, Bernoulli's equation.
3. Generation of lift: aerofoil aerodynamics, boundary layers, stall, and high lift devices.
4. Generation of drag: lift induced, wave, form, skin friction, interference, trim, cooling.
5. Flight instruments: airspeed indicator, indicated and equivalent airspeed, altimeter, rate of climb meter, International Standard Atmosphere.
6. Bluff body aerodynamics: flows past cylinders, spheres and bluff bodies, vortex shedding industrial aerodynamics.
7. Generation of thrust: propeller theory, history of turbojet development, gas turbines, inlets, compressors, combustion chambers, turbines and afterburners.
8. Spaceflight: history of rocket development, rocket engines, multistaging, escape velocity.

Sem 2:

- Aircraft design process.
- Airworthiness and regulation.
- Longitudinal stability and control.
- Flight performance.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 The history of flight, aircraft propulsion, and spaceflight.
C1 Have a sound knowledge of the history of aviation and be able to discuss this.

LO2 The generation of lift, drag and thrust.
C1 Be able to explain how lift is created and what causes flow separation.
C2 Understand non dimensional numbers in relation to lift drag and Reynolds effects.
C3 Be able to calculate lift and drag forces using lift and drag coefficients.

LO3 Aircraft flight instruments.
C1 Understand how flight instruments work and be able to describe them in detail.
C2 Be able to explain the difference between true, indicated and equivalent airspeed.

LO4 Bluff body aerodynamics
C1 Understand the difference in aerodynamics of streamlined and bluff objects
C2 Understand the effect of Reynolds number on Bluff body aerodynamics
C3 Be able to explain how vortex shedding occurs and the effect it may have on structures.

LO5 Aircraft and rocket propulsion and rocket staging.
C1 be able to describe how jet and rocket engines produce thrust.
C2 be able to describe the purpose of both constant pitch and variable pitch propeller.
C3 calculate burnout velocities for multiple stage rockets.

LO6 Aircraft performance and efficient aerodynamics
C1 Understanding of principles demonstrated through calculations and written descriptions.
C2 Through calculations and written descriptions, demonstrate understanding of how overall performance is affected by design selections – e.g. wing sections and wing configuration.

LO7 Stability and control
C1 Understanding of principles demonstrated through calculations and written descriptions.
C2 Through calculations and written descriptions, demonstrate understanding of how overall stability and control effectiveness is affected by design selections and aircraft configuration.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/staff/policies/academic/)

Please state briefly how these are incorporated in this module.

LO1-5 will be assessed by on line examination

LO6-7 will be assessed by two course works during term time

Informal feedback is provided directly within lectures, with self and peer-directed feedback encouraged during the course to the extent that it does not impinge on collaborative working.

Students will be able to assess their progress and obtain feedback by a number of online quizzes that will not be assessed.

Assessment by coursework; students should expect to spend a considerable amount of effort completing these course works as they form an important learning exercise as well as an assessment unit. Written feedback is provided on returned coursework reports.

Assessment Method(s) Including Percentage Breakdown and Duration of Exams

Examination				**Coursework**		**Practical**		**Project**	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
2 (online)	Dec & Apr/May	30mins each	50%	2	50%				
*LO1-5				*LO6-7		*		*	

* ***L/Os:****Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submissions deadlines (*academic weeks*): Students should refer to the MyPlace pages for the relevant classes.

Resit Assessment Procedures:

It is expected that the resit will consist of sitting an online examination in August for 16231 and submission of alternate coursework **by 12 noon on the Thursday of the week prior to commencement of** the August exam diet for 16259. ***Students requiring a resit should contact the registrars of classes 16231 and 16259 to confirm this as soon as they are aware of the requirement.***

PLEASE NOTE:
Students need to gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-assessed during the August diet. This re-assessment will be according to the resit procedures given in this MDF. No marks from previous attempts will be transferred to new attempts.

Recommended Reading

*****Purchase recommended **Highly recommended reading*For reference**

*** "Aircraft Flight" by R H Barnard & D R Philpott, Longman, ISBN 0-582-00338-5
*** "Introduction to Flight" by Anderson, McGraw Hill, ISBN 0-07-109282-X

Additional Student Feedback

Date	Time	Room No
		Check timetable webpages for details

Session: 2019/20

Approved:

Course Director Signature: ***E Henderson***

Date of Last Modifications: **05/09/2019**

(Updated July2019)

MODULE TIMETABLE

Module Code:	**16598**	**Module Title:**	**Aerodynamic Performance**

Brief Description of Assessment:

2 courseworks
2 examinations (online examinations)

Assessment Timing:-

Indicate on the table below the start/submission dates for each assignment/project and the timing of each exam/assessment using the dropdowns provided. Dropdowns can be left blank. Add extra notes below the dropdowns.

Please note: Timings can and will change, this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam 16231

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Set (16259 CW1)	Choose an item. Choose an item.	Course work Submit (16259 CW1) Course work Set (16259 CW2)	Choose an item. Choose an item.	Course work Submit (16259 CW2)	Choose an item. Choose an item.	Exam 16231