

## MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

### 16599 AERODYNAMIC PROPULSION SYSTEMS

<b>Module Registrar:</b> Dr Stuart Grey <a href="mailto:stuart.grey@strath.ac.uk">stuart.grey@strath.ac.uk</a>	<b>Taught To (Course):</b> Cohorts for whom class is compulsory / optional (not available if taken ME425)		
<b>Other Lecturers Involved:</b> Dr J Yuan	<b>Credit Weighting:</b> 10	<b>Semester:</b> 2	
<b>Assumed Prerequisites:</b> ME203 Heat and Flow 2; ME301 Heat and Flow 3; ME405 Heat and Flow 4 (or equivalent Fluids/Thermodynamics classes)	<b>Compulsory / optional class</b>	<b>Academic Level:</b> 5	<b>Suitable for Exchange:</b> Y

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	Total
22	11						45	22	100

#### Educational Aim

This module aims to provide an understanding of the principles and design of propulsion systems for aircraft. Throughout the course, the overall procedure and methodology for designing a propulsion device, starting from the aircraft concept and the associated engine requirements, through to the aero-thermal design of engine components is presented and discussed. Using a combination of lectures and project based activities, students will develop an understanding of the overall design process and the performance of aerospace propulsion systems.

#### Learning Outcomes

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

LO1 Understand the propulsion requirements for an aircraft.

LO2 Understand and appreciate the measures of performance of propulsion devices and how they can be determined.

LO3 Appreciate the difference between various types of propulsion devices, the factors affecting the engine performance and the approach to design.

LO4 Understand the role of various engine components within the propulsion device, the design procedures for components and how their performance is calculated.

#### Syllabus

The module will teach the following:

##### Introduction –

- the various types of propulsion systems,
- historical development of gas turbine power units for jet propulsion.

##### The general thrust equation

##### Propulsion performance characteristics

##### Aerothermodynamics of

- intakes,
- combustors and
- nozzles –
- compressible flow governing equations,
- nozzle flows,
- subsonic and supersonic intakes,
- combustion chamber and afterburner design.

##### Analysis of jet propulsion power units –

- the ram jet,

- pure turbojet,
- by-pass turbojets,
- turbofan engines and
- prop fan engines.

## **Design of axial flow compressors and turbines, free vortex designs Off-design 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 Understand the propulsion requirements for an aircraft.

C1 Student should be able to calculate the required thrust for a propulsive device from the aircraft specification.

C2 Student should be able to calculate the basic engine criteria necessary to deliver the required performance of an aircraft.

C3 Demonstrate understanding of principles by calculation of an appropriate engine configuration and performance for an aircraft specification.

LO2 Understand and appreciate the measures of performance of propulsion devices and how they can be determined.

C1 Student should be able to calculate performance criteria for an engine (thrust; fuel usage; efficiency).

C2 Demonstrate understanding by calculating appropriate performance criteria for a given engine

C3 Demonstrate understanding by selecting appropriate engine configuration and performance required to deliver the required aircraft performance.

LO3 Appreciate the difference between various types of propulsion devices, the factors affecting the engine performance and the approach to design.

C1 Student should be able to understand how various engine performance measures (thrust; fuel usage; efficiency) affect the suitability of a particular device for certain flight regimes.

C2 Student should be able to determine and calculate the overall engine performance.

C3 Student should understand and be able to discuss how configuration of various components (e.g. compressor pressure ratio; turbine entry conditions) influence overall engine performance.

LO4 Understand the role of various engine components within the propulsion device, the design procedures for components and how their performance is calculated.

C1 The student should understand how the engine components influence the overall engine performance.

C2 Student should have an understanding of the design methodology for particular components and how their performance can be measured.

C3 Demonstration of understanding of component design through appropriate selection of design parameters to deliver necessary component performance.

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/>)

##### **Deliver high quality feedback information that helps learners self-correct.**

Regular feedback and discussion will be available in tutorial sessions. (note:- to receive this feedback students should participate in these tutorials but attendance is not mandatory) Feedback from courseworks will enable students to reflect on their understanding of the subject material prior to the final examination. Individual feedback will be available by appointment with the course lecturers.

##### **Ensure that summative assessment has a positive impact on learning.**

Coursework will be assessed and detailed feedback on performance given by discussion during group (lecture/tutorial) sessions. Individual feedback on/ discussion of coursework submissions will be available by arrangement with the course lecturers. Full solutions will be provided to the final exam, post assessment, along with reasons for techniques used, and to highlight common errors in the solutions. Formal, summative feedback will be provided by the return of examination marks to students after assessment (note:-exam scripts will not be returned to students and no collective discussion of exam performance will be facilitated). Individual feedback on the exam may be arranged if appropriate.

##### **Encourage interaction and dialogue around learning (peer and teacher-student)**

Discussion of the course material between teacher-student and also amongst peers will be encouraged in tutorial sessions. Students will also be encouraged to discuss courseworks with their peers to improve learning. Students are encouraged to collaborate in the calculations and models provided in the tutorial and coursework exercises and

demonstration calculations provided during the course. However, it is emphasised that the analysis reports they submit must be entirely their own work – i.e. background research plus results they have personally generated and interpreted.

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

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	<i>Weighting</i>	Number	<i>Weighting</i>	Number	<i>Weighting</i>	Number	<i>Weighting</i>
1	Apr/May	2 hours	60%	2	2 x 20%				
* All				* All		*		*	

\* **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*):

Coursework 1 – submission week 6; Coursework 2 – submission week 10

#### Resit Assessment Procedures:

2hr examination in August diet.

#### PLEASE NOTE:

Students must 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 consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.

#### Recommended Reading

\*\*\*Purchase recommended    \*\*Highly recommended reading    \*For reference (do NOT purchase)

\*\*\* “Jet Propulsion” 3<sup>rd</sup> Edition, Cumpsty and Heyes, Cambridge University Press.

#### Additional Student Feedback

(Please specify details of when additional feedback will be provided)

Date	Time	Room No
		Check timetable webpages for details

Session: 2020/21

#### Approved:

**Course Director Signature:** Dr Stuart Grey

**Date of Last Modifications:** 10 September 2020

(Updated August 2020)

## MODULE TIMETABLE

Module Code:

16599

Module Title:

Aerodynamic Propulsion Systems

### Brief Description of Assessment:

1 exam of 2 hours duration in the April/May Exam diet.  
2 courseworks in semester 2 – anticipated timings provided below

### 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.	Choose an item. Choose an item.

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.	Course work Set	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Submit	Choose an item. Choose an item.	Course work Set	Choose an item. Choose an item.	Course work Submit	