MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME532 AERODYNAMICS OF SUPERSONIC AIRCRAFT

Module Registrar: Dr M Fossati **marco.fossati@strath.ac.uk**	**Taught To (Course): Cohorts for whom class is optional/elective**	
Other Lecturers Involved: n/a	**Credit Weighting: 10**	**Semester: 2**
Optional class	**Academic Level: 5**	**Suitable for Exchange: N**

Required prerequisites
Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

Knowledge of:

- principles of fluid mechanics and aerodynamics such as Navier-Stokes conservation equations,
- Lift and Drag,
- turbulent regime,
- fundamentals of compressible aerodynamics,
- boundary layer flows,
- aircraft aerodynamics.

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
20	5							75	100

Educational Aim

The module introduces physical concepts and mathematical models of compressible aerodynamics in the supersonic regime. These principles are then applied to explain the characteristics and performance of canonical shapes of supersonic air-vehicles.

Learning Outcomes

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

LO1 Understand the physical principles and mathematical models for supersonic aerodynamics;
LO2 Critically analyse nonlinear shock waves patterns generated by supersonic vehicles;
LO3 Use compressible gas dynamics concepts to select specific geometries and shapes for supersonic vehicles.

Syllabus

1. Shock waves theory: normal, oblique and jump relations;
2. Linearised flow and small perturbation theory;
3. Wave drag modelling: Karman-Moore theory;
4. Compressible boundary layer and shock wave boundary layer interaction;
5. Body of revolution and slender body theory, Sears-Haack body;
6. Supersonic aerofoils: Thin aerofoils;
7. Supersonic wings: Swept and delta wings;
8. Waveriders and compression Lift.

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 physical principles and mathematical models for supersonic aerodynamics
C1 Understand the physics of compressible flows and the implication of compressibility effects on the aerodynamics interaction.
C2 Understand the assumptions and limits of the mathematical models for supersonic flows.

LO2 Critically analyse nonlinear shock waves patterns generated by supersonic vehicles:
C1 Ability to explain the genesis of shock waves in compressible flows;
C2 Understanding of shock wave interaction mechanisms: with other waves and with boundary layers;

LO3 Use compressible gas dynamics concepts to select specific geometries and shapes for supersonic vehicles:
C1 Understand the physics behind the definition of aerofoils and wings suitable for supersonic flight;
C2 Understanding the operating conditions of waveriders and the use of compression Lift.

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/professionalservices/staff/policies/academic/)

Feedback will be provided as part of the lectures in the form of small exercises and worked examples that will allow students to prepare for the coursework. Questions raised by students will be discussed with them on a one-to-one basis.

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

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Apr/May	1hr	50%	1	50%				
* LO1, LO2, LO3				* LO1, LO2, LO3		*		*	

* ***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*): Semester 2, week 11

Resit Assessment Procedures:

2hr examination (quiz via Myplace) in July/August diet (on campus)

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 July/August exam diet. This re-assessment will consist entirely of exam. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

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

1. J.G. Leishman, “Introduction to aerospace flight vehicles”, e-book ISBN 979-8-9852614-0-0 https://eaglepubs.erau.edu/introductiontoaerospaceflightvehicles (**);
2. J.D. Anderson, “Fundamentals of Aerodynamics”, McGraw Hill series in Aeronautical and Aerospace Engineering, 5th edition, 2010 (**);
3. H.W. Liepmann, A. Roshko, “Elements of Gasdynamics”, Dover, 1993 (*);
4. I.H. Abbot, A.E. Von Doenhoff, “Theory of Wing Sections”, Dover, 1959 (*).

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

Date	Time	Room No
		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr A McLaren
Date of Last Modifications: 06/08/2024

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME532**	**Module Title:**	**Aerodynamics of Supersonic Aircraft**

Brief Description of Assessment:

- Group coursework to be set on week 7 and to be submitted by week 11 (worth 50% of final mark)
- 1 hour exam in the exam diet (worth 50% of final mark) – on campus, invigilated online quiz via Myplace.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; 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.

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