MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

ME537 Atmospheric Flight Dynamics and Control

Module Registrar: Edmondo Minisci edmondo.minisci@strath.ac.uk	**Taught To (Course): Aero-Mechanical Engineering; Mechanical Engineering**	
Other Lecturers Involved:	**Credit Weighting: 10 (ECTS 5)**	**Semester: 2**
Compulsory for Aero-Mechanical Engineering / Optional for Mechanical Engineering	**Academic Level: 5**	**Suitable for Exchange: Y**

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:
- aerodynamics forces and moments;
- aircraft performance and static stability;
- basics of dynamics and control;
- linear algebra;
- ordinary differential equations;
- programming.

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

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
20		20			2		16	42	100

Educational Aim

This module aims to provide an advanced understanding of aircraft dynamics and control system design. The module introduces state-space methods for modelling and analysis, followed by modern control theory principles and their application to flight control systems.

Using a combination of lectures, computer laboratory sessions, and assignments, students will develop the ability to analyse complex aircraft dynamics, design basic control systems, and implement state estimation techniques.

The theoretical concepts are reinforced through MATLAB-based practical exercises and realistic control problems drawn primarily from aircraft applications. Launch vehicle dynamics and control are introduced as a complementary application area, allowing students to see how the same modelling and design principles extend to ascent flight and basic guidance problems.

Learning Outcomes

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

LO1 - Demonstrate comprehensive understanding of aircraft dynamics using state-space methods, including model development, linearisation, and stability analysis, with extension to launch vehicle ascent dynamics.

LO2 - Analyse and design basic feedback control systems for aircraft, applying state feedback and optimal control concepts, with comparative examples from launch vehicle applications.

LO3 - Implement and validate aircraft dynamic models and control systems using industry-standard computational tools, and apply the same methods to simple launch vehicle cases.

LO4 - Evaluate aircraft handling qualities requirements and stability augmentation systems, including an introduction to the fundamentals of launch vehicle guidance and control.

Syllabus

The module will teach the following:

1. Equations of motion for atmospheric flight, with extension to launch vehicle ascent
2. State-space modelling and stability analysis for aircraft and launch vehicles
3. Dynamic stability of aircraft, with comparative examples from launch vehicles
4. Control foundations and control system design, with applications to aircraft and launch vehicles
5. Aircraft handling qualities and stability augmentation systems, including an introduction to the basics of launch vehicle guidance and control

Assessment of Learning Outcomes

Criteria

For each Learning Outcome, here are the corresponding assessment criteria:

LO1

C1 Students should be able to derive, analyse, and interpret state-space models for aircraft motion, with extension to simple launch vehicle ascent dynamics.

C2 Students should be able to analyse aircraft stability characteristics using eigenvalue analysis, and compare with equivalent launch vehicle cases.

LO2

C1 Students should be able to design and analyse basic feedback control systems for aircraft.

C2 Students should be able to apply and evaluate optimal control techniques such as LQR, with illustrative examples drawn from launch vehicle applications.

LO3

C1 Students should be able to implement aircraft models and control systems in MATLAB.

C2 Students should be able to validate and critically assess simulation results, and extend the same methods to basic launch vehicle models.

LO4

C1 Students should be able to analyse and evaluate aircraft handling qualities against established requirements and specifications.

C2 Students should be able to design and assess basic stability augmentation systems for improving aircraft dynamic response, and demonstrate introductory understanding of launch vehicle guidance and control.

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/)

Assessment is by two assignments (week 6 and 11) and one exam.

The assignments verify progressive understanding of core concepts, while the exam provides an integrated design and analysis challenge.

Regular feedback is provided through supervised laboratory sessions, where students can get immediate guidance on their work.

Feedback is provided for both assignments within two weeks, allowing students to address any knowledge gaps before subsequent assessments.

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***
1	Apr/May	1.5hr	50%	2	50% (25% each)				
** LO1, LO2, LO4				* LO3, LO4				*	

* ***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*):
Assignment 1 in week 6, Assignment 2 in week 11

Resit Assessment Procedures:
Students who fail the assignments or the exam will be required to undertake ^^new assessments for the failed components only. The resit assignment and/or 2hr examination (in July/August diet) will be different from the original. The resit assignment submission will take place prior to commencement of the July/August exam diet.

^^Students must contact the module Registrar for details as soon as results confirm that a resit is required.

PLEASE NOTE:
Students must achieve a minimum mark of 50% as an average between the two assignments AND a minimum mark of 50% for the exam, to pass the module. No marks from failed components will be carried forward to the resit diet.

Recommended Reading

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

***"Flight Dynamics Principles" by M.V. Cook, 3rd Edition, Butterworth-Heinemann A comprehensive text covering both the theory and MATLAB implementation. Essential for the course.

**"Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems" by Stevens, Lewis & Johnson, 3rd Edition, Wiley Excellent reference for advanced topics and implementation details.

*"Control System Design" by Goodwin, Graebe & Salgado, Prentice Hall Useful reference for general control theory concepts.

*"Introduction to Aircraft Flight Mechanics" by Thomas R. Yechout, AIAA Education Series

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

Date	Time	Room No
TBC	TBC	Refer to Myplace for details

Session: 2025/26

Approved:

Programme Lead/Director Signature: Dr Andrew McLaren

Date of Last Modifications: 10 September 2025

(MAE template updated June 2025)

MODULE TIMETABLE

Module Code:	**ME537**	**Module Title:**	**ATMOSPHERIC FLIGHT DYNAMICS AND CONTROL**

Brief Description of Assessment:

- Two assignments (25% each, total 50% contribution towards the final module mark) – shown as "coursework" below
  - Assignment 1 (week 6) and Assignment 2 (week 11)
- One final exam (50% contribution towards the final module mark)

Important Requirements: A minimum mark of 50% must be achieved as an average between the two assignments **AND** a minimum mark of 50% must be achieved for the exam.

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