UNSW Course Outline

ZEIT3505 Flight Dynamics and Aircraft Control - 2024

Published on the 30 Jun 2024

General Course Information

Course Code : ZEIT3505
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course is looked upon as an integrating course to bring in the concepts of statics and dynamics as applied to aircraft under the influence of aerodynamic forces and moments. The initial part of the course deals with the basics associated with vibration and control of dynamic

systems including the concepts of natural frequency, damping ratio, transfer functions, specifications and their relationship to natural frequency and damping ratios. This part also introduces the basic control systems and their analysis using the root locus technique. The main part of the course deals with the dynamics of the aircraft under the influence of aerodynamic forces and moments. The mathematical modelling of the aircraft, its transfer functions and aerodynamic stability derivatives are discussed. The simplified analysis using short period and phugoid motions for longitudinal dynamics is discussed. This is used to relate the longitudinal dynamics to the spring-mass-damper system from the vibrations part . The natural frequency and damping ratio are correlated with the design of the aircraft and the aerodynamic properties. Stability augmentation and autopilots along with Handling Qualities of the aircraft as specifications for control design is discussed next. The lateral dynamics, in particular to the Dutch roll motion and its damping, are discussed. The effects of gust and practical implementation of control systems in aircraft is also introduced.

Course Aims

This course aims to provide an understanding of flight dynamics and aircraft control including some of the practical aspects of aircraft control.

Relationship to Other Courses

Prerequisite: ZEIT2502

The course builds upon the dynamics, introduction to flight and basic aerodynamics courses.

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Engineering Technologist (Stage 1)
CLO1 : Ability to use the principles of dynamics to look at single degree freedom systems and their applications	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
CLO2 : To model the aircraft using differential equations and transfer functions	• ET2.1 : Application of established engineering methods to broadly-defined problem solving within the technology domain
CLO3 : To analyse the stability and response of the aircraft using simplified dynamics	• ET1.3 : In-depth understanding of specialist bodies of knowledge within the technology domain
CLO4 : Ability to use the root locus technique to improve the dynamics of the aircraft to meet the handling qualities	• ET1.3 : In-depth understanding of specialist bodies of knowledge within the technology domain
CLO5 : To look at autopilots as simple control systems to augment the aircraft dynamics	• ET2.2 : Application of engineering techniques, tools and resources within the technology domain

Course Learning Outcomes	Assessment Item
CLO1 : Ability to use the principles of dynamics to look at single degree freedom systems and their applications	• Class Test 1 • Surprise Quiz • Final Exam
CLO2 : To model the aircraft using differential equations and transfer functions	• Class Test 2 • Class Test 1 • Surprise Quiz • Final Exam
CLO3 : To analyse the stability and response of the aircraft using simplified dynamics	• Class Test 2 • Surprise Quiz • Final Exam
CLO4 : Ability to use the root locus technique to improve the dynamics of the aircraft to meet the handling qualities	• Class Test 2 • Surprise Quiz • Final Exam
CLO5 : To look at autopilots as simple control systems to augment the aircraft dynamics	• Class Test 2 • Surprise Quiz • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Lectures will be delivered using power point presentations of the course notes. Tutorials will be conducted to help in solving numerical problems. The solutions for the tests will be discussed and posted on Moodle.

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:
IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au

Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

Every class builds on the material discussed in the previous classes. Hence, it is advised that the students keep up with the course content regularly.

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. *It is defined as using the words or ideas of others and passing them off as your own, and* can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters

- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Engineers Australia - Engineering Technologist (Stage 1)
Class Test 1 Assessment Format: Individual	20%	Start Date: 14/08/2024 12:00 PM Due Date: Not Applicable	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
Surprise Quiz Assessment Format: Individual	10%	Start Date: Not Applicable Due Date: Not Applicable	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
Class Test 2 Assessment Format: Individual	20%	Start Date: 02/10/2024 12:00 PM Due Date: Not Applicable	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain
Final Exam Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: Not Applicable	• ET1.1 : Systematic, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the technology domain

Assessment Details

Class Test 1

Assessment Overview

The test involves both qualitative and quantitative questions to assess the basics of vibration and control. The conceptual questions require brief answers. The solution of the test will be discussed in the class and will be posted on the MOODLE as well. The marked test papers will also have briefs to indicate 'why' something is 'right' or 'wrong'.

Course Learning Outcomes

- CLO1 : Ability to use the principles of dynamics to look at single degree freedom systems and their applications
- CLO2 : To model the aircraft using differential equations and transfer functions

Detailed Assessment Description

Thsi test will look at the flight dynamics component of the course. The assessement is aimed at the first half of the flight dynamics course.

Assessment Length

one hour

Submission notes

The test will be conducted face to face.

Assessment information

This test will cover the flight dynamics and flight controls part of the course

Assignment submission Turnitin type

Not Applicable

Surprise Quiz

Assessment Overview

These are simple, multi-choice quizzes. The questions are simple and try to emphasise the understanding in the class. Six of them will be conducted over the semester during the class time. Then best of five will be taken towards the assessment. The solutions to the quiz are discussed in the class.

Course Learning Outcomes

- CLO1 : Ability to use the principles of dynamics to look at single degree freedom systems and

their applications
- CLO2 : To model the aircraft using differential equations and transfer functions
- CLO3 : To analyse the stability and response of the aircraft using simplified dynamics
- CLO4 : Ability to use the root locus technique to improve the dynamics of the aircraft to meet the handling qualities
- CLO5 : To look at autopilots as simple control systems to augment the aircraft dynamics

Detailed Assessment Description

These are beneficial to keep up to date with the course content.

Assessment Length

variable

Submission notes

the quiz will be conducted face to face.

Assessment information

The quiz are designed to keep up with the course content.

Assignment submission Turnitin type

Not Applicable

Class Test 2

Assessment Overview

The test involves both qualitative and quantitative questions to assess the basics of flight dynamics and control. The conceptual questions require brief answers. The solution of the test will be discussed in the class and will be posted on the MOODLE as well. .

Course Learning Outcomes

- CLO2 : To model the aircraft using differential equations and transfer functions
- CLO3 : To analyse the stability and response of the aircraft using simplified dynamics
- CLO4 : Ability to use the root locus technique to improve the dynamics of the aircraft to meet the handling qualities
- CLO5 : To look at autopilots as simple control systems to augment the aircraft dynamics

Detailed Assessment Description

This test covers the vibration and control component of the course.

Assessment Length

one hour

Submission notes

Face to face test with answers submitted on books provided during the test

Assessment information

This test involves the vibration and control component of the course.

Assignment submission Turnitin type

Not Applicable

Final Exam

Assessment Overview

This will cover the whole course. The format will be similar to the class tests, with both conceptual questions and numerical problems. Brief answers are expected for the conceptual questions.

Course Learning Outcomes

- CLO1 : Ability to use the principles of dynamics to look at single degree freedom systems and their applications
- CLO2 : To model the aircraft using differential equations and transfer functions
- CLO3 : To analyse the stability and response of the aircraft using simplified dynamics
- CLO4 : Ability to use the root locus technique to improve the dynamics of the aircraft to meet the handling qualities
- CLO5 : To look at autopilots as simple control systems to augment the aircraft dynamics

Detailed Assessment Description

This will cover the whole course content.

Assessment Length

three hours

Submission notes

The exam will be conducted face to face.

Assessment information

The exam will cover all the components of the course. The questions involve conceptual as well as numerical problems.

Assignment submission Turnitin type

Not Applicable

General Assessment Information

The solutions for the assessments will be discussed in the class. The solutions to the two class tests will also be posted on the Moodle. The written feedback to the first quiz will be given to the students by the census date.

Since there are no assignments in the course, the late submission doesnot arise. The students can use Generative AI for their learning.

Grading Basis

Standard

Requirements to pass course

Overall 50% is required to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Basics of Vibration/Control
Week 2 : 22 July - 26 July	Lecture	Block diagrams, transfer functions and finding systems equations for complete systems.
Week 3 : 29 July - 2 August	Lecture	Basics of Control and Quiz 1 during the tutorial hour
Week 4 : 5 August - 9 August	Lecture	Root locus, steady state errors and transient response specifications.
Week 5 : 12 August - 16 August	Lecture	Control Revision and Class Test 1 during the tutorial hour.
	Assessment	Class test 1
Week 6 : 19 August - 23 August	Lecture	Equations of Motion of aircraft, Linear equations from the full equations
Week 7 : 9 September - 13 September	Lecture	Short period and phugoid motions Approximation to short period motion
Week 8 : 16 September - 20 September	Lecture	Handling qualities of aircraft Autopilots for longitudinal dynamics
Week 9 : 23 September - 27 September	Lecture	Pitch Damper and Pitch hold autopilot
Week 10 : 30 September - 4 October	Lecture	Pitch hold autopilot for fighter aircraft and other autopilots
	Assessment	Class test 2
Week 11 : 7 October - 11 October	Lecture	Lateral Dynamics Monday 7th : Lost due to Labour day
Week 12 : 14 October - 18 October	Lecture	Roll, Dutch roll and spiral motions and approximation to dutch roll motion
Week 13 : 21 October - 25 October	Lecture	Autopilots for lateral dynamics, co-ordinated turn and practical aspects of flight control

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The course has two, two hours of lecture and one, two hour tutorial class every week.

13th August lost due to Friday classes

18th September lost due to Military training day

7th October lost due to Labour day

Course Resources

Prescribed Resources

Robert C. Nelson, *Flight stability and Automatic Control*, Mcgraw-Hill.

Ogata K., *Modern Control Engineering*, Prentice Hall.

Additional resources provided via the course Moodle site

Recommended Resources

Recommended books:

John D. Anderson, Jr., *Introduction to Flight*, Mcgraw-Hill.

Cook M.V., *Flight Dynamics Principles*, Arnold Publishers, UK.

Etkin and Reid, *Dynamics of Flight-Stability and Control*, Wiley & Sons.

Raven F.H., *Automatic Control Engineering*, McGraw-Hill.

Additional Costs

None

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Sreenatha Anavatti		203, building 17		through email appointment	No	Yes