AERO4620

Dynamics of Aerospace Vehicles, Systems and Avionics

Term 1, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Zoran Vulovic	z.vulovic@unsw.edu.au	TBA	Room 311D, Building J17	(02) 9385 6261

Demonstrators

Name	Email	Availability	Location	Phone
Ian Mui	i.mui@unsw.edu.au	TBA		

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook

Course Details

Units of Credit 6

Summary of the Course

Power, mass and information transfer. Fluidic, mechanical and electrical systems in aerospace vehicles; environment control. Avionics and advanced aircraft systems; computer-aided vehicle management. Avionics requirements; avionics integration. Airborne sensors. Navigation. Stability and control systems. Cockpit environment. Static and dynamic stability of atmospheric vehicles. Flight control. Handling and flying qualities.

Course Aims

Dynamics of Aerospace Vehicles, Systems and Avionics is a higher level Aerospace Engineering course in which the fundamental concepts grasped in 3rd year are integrated, applied and extended.

This course focuses on how the aircraft behaves as a time-dependent SYSTEM. It aims to teach you about aerospace vehicles' static and dynamics stability as well as the impact that on-board systems and avionics have on the determination and control of the vehicle dynamics. Other systems critical for aircraft performance will also be covered. The course builds heavily on the foundations learnt in Flight Performance, Linear Systems and Control and Aerodynamics.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Learn the analytical aspects of static and dynamic stability	PE1.2, PE2.1
2. Understand the regulatory aspects of static stability	PE1.3
3. Establish the connection between the aircraft’s mission and the selection of systems and components	PE1.3
4. Learn how to apply methodologies learnt in MMAN3200 to aerospace applications	PE1.3, PE2.1

Teaching Strategies

Lectures in the course are designed to provide the basic theory behind the concepts taught. For most classes, PowerPoint slides will be available on-line and beforehand. Students are encouraged to ask questions during classes.

It is very important for fourth year students to be able to use multiple sources. For that reason there is no single textbook to support this course. Instead, only recommended texts are provided, and you will be expected to find other relevant books and make use of them. You are welcome to consult your lecturer on this.

There will be eight hours a week of face-to-face lectures combined with tutorial examples. The

classroom teaching will be supported by lecture notes available online. They will contain brief outlines of the most important points as well as links to the more detailed sources.

Additional Course Information

This is a 6 unit-of-credit (UoC) course and involves seven hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 12 h/w on this course. The additional time, outside the scheduled classes, should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

For ease of management, the course is organised into three separate parts: Aerospace Systems, Avionics and Flight Dynamics; they will form Modules A, B and C respectively. Module A will run in Weeks 1 – 4 and Modules B and C in Weeks 4 – 10. In addition, there is an individual flight simulation exercise (pending the COVID-19 situation).

The Aerospace Systems part (Module A) deals with the so-called airframe systems as well as their effect on aircraft's performance. The Avionics segment (Modula B) studies aircraft electronic systems as well as other systems that directly interface with electronics. The Flight Dynamics part (Module C) covers different aspects of aircraft stability and the parameters that affect it. The wind tunnel experiment demonstrates the longitudinal stability, understanding of which is crucial for flight control systems. It also provides a link between the Flight Dynamics and Avionics modules. Finally, the flight simulation experiment demonstrates the operations of auto-pilots and various navigation and communication systems.

AERO4620 is an important stepping stone in aerospace engineering education. The knowledge acquired during this course is directly applicable to the group design in AERO4110. On the other hand, Module C of this course directly relates to the performance part of AERO3660; at the same time the stability analysis of flying vehicles presented in this module is based on methods learned in MMAN3200. All these components largely contribute to developing necessary engineering skills and knowledge.

Assessment

HURDLE REQUIREMENT

In order to pass the course, you also have to obtain a total of at least 50% (20 marks) for the Module C: Test 2 (10%) + Lab report (12%) + Module C part of the final exam (18%).

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Final exam	48%	Not Applicable	1, 2, 3, 4
2. Tests	40%	Not Applicable	1, 2, 3, 4
3. Lab Report	12%	14/04/2021 11:50 PM	1, 2, 4

Assessment 1: Final exam

Assessment length: Two hours
Marks returned: The marks will be available at the same time when all other exam results are released.

Final exam testing the entire Module B (30 marks) as well as the dynamic stability part of Module C (18 marks).

Assessment 2: Tests

Submission notes: Upload your full answers to test questions.
Marks returned: Two weeks after the test

Test 1 on the entire Module A (30%), Test 2 on the static stability part of Module C (10%).

Both test will run during the lecture time on Tuesdays of Weeks 4 and 7 respectively commencing at 4.05 PM.

Assessment 3: Lab Report

Start date: 08/04/2022 12:00 AM
Due date: 14/04/2021 11:50 PM
Deadline for absolute fail: Five days after the deadline.
Marks returned: Two weeks after the submission deadline.

Wind tunnel measurements will be used for assessing the longitudinal stability parameters.

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 14 February - 18 February	Lecture	Aerodynamic controls, cockpit controls and transmission media. Hydraulic components.
Week 2: 21 February - 25 February	Lecture	*Pneumatic components and comparison with hydraulic counterparts* *Fuel systems and components*
Week 3: 28 February - 4 March	Lecture	*Cabin pressurisation and cabin temperature control* *DC and AC systems and components.*
Week 4: 7 March - 11 March	Lecture	What qualifies an electronic component for avionics? Aircraft sensors Definitions of aircraft stability
	Assessment	TEST 1
Week 5: 14 March - 18 March	Lecture	Navigation systems. Analysis of static stability parameters. Flying and handling qualities.
Week 6: 21 March - 25 March	Online Activity	Flexibility week Consultations
Week 7: 28 March - 1 April	Lecture	Automatic flight control. Autopilots. Mathematical model of longitudinal dynamic.
	Assessment	TEST 2
	Laboratory	Lab briefing
Week 8: 4 April - 8 April	Lecture	Cockpit electronics. Mathematical model of lateral dynamics.

	Laboratory	Determination of longitudinal stability using static wind-tunnel measurements.
Week 9: 11 April - 15 April	Lecture	Avionics standardisation. State variable technique.
	Tut-Lab	Lab de-briefing
Week 10: 18 April - 22 April	Lecture	Block diagrams of flight control systems Contingency time Revision
	Assessment	Lab report due

Resources

Prescribed Resources

There is no textbook for the course. PowerPoint slides will be available on Moodle for Modules A and B lectures but students are expected to use various sources.

Recommended Resources

Aviation Theory Centre (Melbourne, Vic.) 2012a, “Aircraft general knowledge and aerodynamics for the CASA PPL and CPL day VFR syllabus”, Huntingdale, Vic.: Aviation Theory Centre

Collinson, R. – “Introduction to Avionics”, 1st ed., London; New York: Chapman & Hall

Cook, M.V., “Flight Dynamics Principles”, Arnold Publishers, UK, 1997

PowerPoint slides for Modules A and B

UNSW Library website: https://www.library.unsw.edu.au/

Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School’s Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course in 2021 the feedback was mostly positive, statistically above the School's mean. The most prominent remarks were on the structure of on-line tests. Many students indicated they would prefer the answering time and the file upload time to be clearly separated. This change will be implemented this year.

Laboratory Workshop Information

The Flight Stability exercise will be held in the Aerodynamics Laboratory (Room 202, Willis Annex).

Flight Simulation is uncertain at this stage. If it does go ahead, it will be offered as an optional ungraded activity. The flight simulator is located in Room 118, Willis Annex.

All lab activities require a professional attitude. Apart from following the standard WHS rules for laboratories (enclosed shoes, no loose clothing or hair etc.) it is crucial to follow all measures related to the COVID-19 pandemic.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late policy

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day, for a minimum of zero marks.

The late penalty is applied per calendar day (or part thereof), including weekends and public holidays, that the assessment is overdue.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item. For example:

- Your course has an assessment task worth a total of **30 marks (Max Possible Mark)**
- You submit the assessment **2 days after the due date**
- The assessment is marked as usual and achieves a score of **20 marks (Awarded Mark)**
- The late policy is applied using **Late Mark = Awarded Mark - (Days*Penalty per Day)*Max Possible Mark**. Your adjusted final score is **8 marks** (20 - ((2*0.2)*30)).

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

1. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
2. Online quizzes where answers are released to students on completion, or
3. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
4. Pass/Fail assessment tasks.

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates. For further information on

exams, please see the Exams webpage.

Special Consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW now has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID-19 illness or isolation** will be required.

Special Consideration Outcomes

Assessments have default Special Consideration outcomes. The default outcome for the assessment will be advised when you apply for Special Consideration. Below is the list of possible outcomes:

Outcome	Explanation	Example
Time extension	Student provided more time to submit the assessment	e.g. 1 more week of time granted to submit a report
Supplementary assessment	Student provided an alternate assessment at a later date/time	e.g. a supplementary exam is scheduled during the supplementary exam period of the term
Substitute item	The mark for the missed assessment is substituted with the mark of another assessment	e.g. mark for Quiz 1 applied also applied as mark for Quiz 2, meaning if a student achieved a mark of 20/30 for Quiz 1 and was granted Special Consideration for Quiz 2, a mark of 20/30 would be applied for Quiz 2, etc
Exemption	All course marks are recalculated excluding this assessment and its weighting	e.g. The course has an assessment structure of: - Assignments 30%, - Lab report 30%, - Final Exam 40%. If the Lab report is missed and student is granted Special Consideration, then the assessment structure may be reweighted as follows: - Assignments 50% - Final Exam 50% as though the Lab report did not exist
Non-standard	Course Coordinator is contacted for the outcome when special consideration is granted as the outcome differs on a case-by-case basis	e.g. typical for group assessments where time extension supplementary assessment could be granted to the group member, time extension could be granted to the whole group, etc. Clarify with your Course Convenor for

Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

****T1-2022 UPDATE****
- -

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators

- Academic Honesty and Plagiarism

Image Credit

Photo by Stephen Blake March 2017, Willis Annexe (J18) Thermofluids lab

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	