UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Term 1 2020

AERO4620

DYNAMICS OF AEROSPACE VEHICLES AND SYSTEMS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Zoran Vulovic
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Consultation times will be announced later. Consultations are possible outside the set times, but a prior appointment is preferred. Email, telephone and Moodle discussions can also be used for solving more general issues.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Name: Ian Mui
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Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

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 should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

	Day	Time	Location
Lectures	Monday	15.00 – 17.00	Ainsworth 102
	Tuesday	12.00 – 15.00	CivEng G1
	Thursday	12.00 – 14.00	Ainsworth 102
Flight Simulation	By appointment	By appointment	Willis Annexe 117 (K-J18-117)
Lab	TBA	Lecture times	Willis Annexe 202 (Kens-J18-202)

Please refer to Moodle announcements to self-enrol into the flight simulation and lab session of your choice.

Summary and Aims of the course

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 – 3 and Modules B and C in Weeks 4 – 10. In addition, there is an individual flight simulation exercise.

The Aerospace Systems part deals with the so-called airframe systems as well as their effect on an aircraft's performance. The Avionics segment studies aircraft electronic systems as well as other systems that directly interface with electronics. The Flight Dynamics 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 steppingstone 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 Linear Systems and Control. The large majority of this class has been involved in flight experiments that provide a crucial link between the theoretical knowledge gained during the class time and real flight situations. Students are also able to observe the functioning of systems found in General Aviation aircraft. All these components largely contribute to developing necessary engineering skills and knowledge.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

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

4. 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.

5. Course schedule

Date	**Topic**	**Location**	**Lecture Content**	**Demonstration/Lab Content**	**Suggested Readings**
Week 1	Control systems. Hydraulic systems and components.	Ainswth 102 CivEng G1	Aerodynamic controls, cockpit controls and transmission media. Hydraulic components.	N/A	Class readings
Week 2	Pneumatic systems and components. Fuel systems and components.	Ainswth 102 CivEng G1	Pneumatic components and comparison with hydraulic counterparts.	N/A	Class readings

Date	Topic	Location	Lecture Content	Demonstration/Lab Content	Suggested Readings
Week 3	Cabin environment control. Electrical systems and components.	Ainswth 102 CivEng G1	Cabin pressurisation and cabin temperature control. DC and AC systems and components.	N/A	Class readings
Week 4	Avionics requirements. Concept of aircraft stability. Static margin.	Ainswth 102 CivEng G1	What qualifies an electronic component for avionics? Definitions of aircraft stability.	N/A	Class readings
Week 5	Test. Aircraft sensors. Elevator effectiveness. Stick-free-case.	Ainswth 102 CivEng G1	Classification of different aircraft sensors. Analysis of static stability parameters.	N/A	Class readings
Week 6	Navigation systems. Handling and flying qualities.	Ainswth 102 CivEng G1	Dead reckoning and position fixing navigation. Relevance of handling and flying qualities.	N/A	Class readings
Week 7	Test. Automatic flight control. Autopilots. Mathematical model of longitudinal dynamic.	Ainswth 102 CivEng G1	Stability augmentation and fly-by-wire.	N/A	Class readings
Week 8	Cockpit electronics. Mathematical model of lateral dynamics.	Ainswth 102 CivEng G1	Displays and communication systems. 3-DOF linear lateral model.	N/A	Class readings
Week 9	Laboratory	Willis Annexe 202		Determination of longitudinal stability using static wind-tunnel measurements.	Lab handout

Date	Topic	Location	Lecture Content	Demonstration/Lab Content	Suggested Readings
Week 10	Avionics standardisation. State variable technique.	Ainswth 102 CivEng G1	ARINC standards. Longitudinal and lateral state-space models.	N/A	Class readings
Week 11	Lab report due. Revision. Contingency time.	Ainswth 102 CivEng G1	TBA	N/A	Class readings

6. Assessment

Assessment overview

Assessment	Group Project?	If Group, # Students per group	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Quiz/Tests (3)	No	N/A	30 minutes (Quiz); 75 minutes (Test A); and 50 minutes (Test C)	42% (0% + 30% + 12%)	1, 2 and 3	Topics assessed include: Module A (aircraft systems) for Quiz and Test A; Module C (static stability, handling and flying qualities) for Test C	Week 4 via Moodle (Quiz); Week 5 class time (Test A); Week 7 class time (Test C)	N/A	Quiz: immediately Tests: Two weeks after the test
Lab report	No	N/A	6 pages	10%	1, 2 and 4	Correct calculation, understanding of theory behind the experiment	Monday 27th April 23:50 (Week 11) via Moodle	Saturday 2nd May 23:50	Two weeks after the submission
Flight Simulation	No	N/A	45 minutes	2%	3	Punctuality, discipline, co-operation (Module B)	Week 5 - 10	N/A	One week from the exercise
Final exam	No	N/A	2 hours	46%	1, 2 and 3	Entire Module B and the Dynamic Stability part of Module C	Exam period, date TBC	N/A	Upon release of final results

This course will include the following hurdle requirements that are closely linked to a set of learning outcomes which demonstrate that you have acquired the required skills and competencies within this discipline:

- Students must demonstrate understanding of Flight Dynamics. A minimum of 40% of marks available for Module C must be obtained in order to pass this course. Module C will be examined in Test 2 and the final exam. Failure to achieve this minimum mark will result in an unsatisfactory fail (UF) grade, regardless of the performance in the rest of the course.

Assignments

The details of the laboratory assessment tasks may be found on Moodle immediately after the last group completes the experiment.

Presentation

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.

Submission

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. In this case 4 marks per day will be deducted from the mark obtained for the assignment.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

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

Marking

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.

Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course 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.

Calculators

You will need to provide your own calculator of a make and model approved by UNSW for the examinations. The list of approved calculators is available at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

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.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you sit 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.

7. Expected resources for students

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 texts

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

8. 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, the 2019 myExperience feedback was highly positive. The only observable recommendation for improvement was the sound quality of the lecture recordings, which will be rectified this term.

9. 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

10. Administrative matters and links

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
- Equitable Learning Services

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (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