UNSW AUSTRALIA

Course Outline

Semester 1, 2015

Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

AERO4620

Dynamics of Aerospace Vehicles and Systems

Contents

Course Outline

1. COURSE STAFF

Contact details and consultation times for course convenor

Dr Zoran Vulovic (course convenor)
Room 107D, Building F21
Tel: (02) 9385 6261
Fax: (02) 9663 1222
Email: z.vulovic@unsw.edu.au

Consultation times will be announced later.

Consultations are possible outside the set time, but a prior appointment would be preferred. Email, telephone and Moodle discussions can also be used for solving more general issues.

Contact details for laboratory demonstrators

Joshua Yen
Email: j.yen@student.unsw.edu.au

2. COURSE INFORMATION

Units of credit

This is a 6 unit-of-credit (UoC) course, and involves 6 hours per week (h/w) of face-to-face contact. In addition, you will do a 30-minute flight simulation, as well as a lab in Week 10.

The UNSW website states "The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work."

For a standard 24 UoC in the semester, this means 600 hours, spread over an effective 15 weeks of the semester (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade. Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case.

Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UoC.

This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 4 h/w of your own time. This should be spent in making sure that you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

UNSW expects that you will put in, on average, 40 h/w for 24 UoC (including both in-class and out-of-class time) for an effective 14 weeks of the session. This means that, for this course, you should aim to spend not less than an additional four hours per week of your own time. This should be spent in making sure that you understand the lecture material, further reading about the course material, and revising and learning for the examinations.

Timetable

Lecture 1:	Mon 15:00 – 13:00	Valentine Annexe 121
Lecture 2:	Tue 16:00 – 18:00	TBC
Lecture 3:	Thu 16:00 – 18:00	Chemical Sc M11 (ex Applied Sc)

Parallel teaching

There is no parallel teaching in this course.

How the course relates to other course offerings and overall program(s) in the discipline

For ease of management the course is organised into three separate parts: Aerospace Systems, Avionics and Flight Dynamics, and they will form Modules A, B and C respectively. Module A will run in Weeks 1 – 4 and Modules B and C in Weeks 5 – 12.

The Aerospace Systems part deals with the so-called airframe systems as well as their effect on aircraft's performance. The Avionics segment studies aircraft electronic systems as well as other systems that directly interface with avionics. 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 stepping stone in aerospace engineering education. The knowledge acquired during this course is directly applicable to the group design in AERO4110/4120. 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 was involved in flight experiments that provided a crucial link between the theoretical knowledge gained during the class time and real flight situations. Students were 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.

Expected student learning outcomes

The course is largely based on previously gained knowledge in core engineering subjects and students will be able to understand functioning of various airframe and avionics systems as well as aircraft stability. The two experiments will give you an opportunity to have a practical insight into the problems addressed in lecture, as well as to demonstrate some analytical skills in obtaining the required results.

By the end of this course it is expected that you will:

- learn what most of the systems and their components are and how they work;
- understand how the aircraft's mission affects the selection of the systems and components;
- understand the effect the systems and components have on the aircraft's performance;
- understand the regulatory aspects of static stability;
- learn the analytical aspects of static stability;
- learn the analytical aspects of dynamic stability;
- learn how to apply methodologies learnt in MMAN3200 to aerospace applications.

Graduate attributes

UNSW's graduate attributes are shown at
https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for ALL UNSW students.

UNSW graduates will be

1. Scholars who are:
   - (a) understanding of their discipline in its interdisciplinary context
   - (b) capable of independent and collaborative enquiry ✓
   - (c) rigorous in their analysis, critique, and reflection ✓
   - (d) able to apply their knowledge and skills to solving problems ✓
   - (e) ethical practitioners
   - (f) capable of effective communication ✓
   - (g) information literate ✓
   - (h) digitally literate

2. Leaders who are:
   - (a) enterprising, innovative and creative
   - (b) capable of initiating as well as embracing change
   - (c) collaborative team workers

3. Professionals who are:
   (a) capable of independent, self-directed practice ✓
   (b) capable of lifelong learning
   (c) capable of operating within an agreed Code of Practice

4. Global Citizens who are:
   (a) capable of applying their discipline in local, national and international contexts ✓
   (b) culturally aware and capable of respecting diversity and acting in socially just/responsible ways ✓
   (c) capable of environmental responsibility

   ✓ = Developed in this course

In this course, you will be encouraged to develop graduate attributes 1(b), 1(c), 1(d), 1(f), 1(g), 3(a), 4(a) and 4(b) by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks, as shown in the assessment table on Page 6.

You will be supported in developing the above attributes through:
(i) the design of academic programs;
(ii) course planning and documentation;
(iii) learning and teaching strategies; and
(iv) assessment strategies.

3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

This course is included to give you the understanding of various airframe and avionics systems as well as the analytical aspect of aircraft stability and dynamics.

Effective learning is supported when you are actively engaged in the learning process and by a climate of enquiry, and these are both an integral part of the lectures and demonstrations.

You become more engaged in the learning process if you can see the relevance of your studies to professional, disciplinary and/or personal contexts, and the relevance is shown in the lectures and assignments by way of most examples being drawn from real applications.

Dialogue is encouraged between you, others in the class and the lecturer. Diversity of experiences is acknowledged, as some students in each class have prior flying, maintenance or other aerospace experience. Your experiences are drawn on to illustrate various aspects, and this helps to increase motivation and engagement.

It is expected that assignments will be marked and handed back in the week following submission. You will have feedback and discussion while fresh in your mind to improve the learning experience.

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 the classes.

It is very important for fourth year student 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. ASSESSMENT

General

Each of the three modules will be worth 30 marks while the experimental part will be worth 10. The final mark will be derived from the following components:

Block test 1 (Week 4) – Module A	30%
Block test 2 (Week 8) – Module C	12%
Lab (Week 10, report due Friday Week 12)	10%
Night flight simulation – Module B	2%
Examination – Modules B and C	46%
Total	**100%**

In order to pass the course, you must achieve:

(a) a minimum total mark of 50 and

(b) a minimum of 12 marks for Module C.

The night simulation exercises will start from approximately Week 7 and will be carried out on the flight simulator in building F21 for each student individually. You will choose the timeslot from the list provided outside the western entrance to building F21. The exercise is booked by writing your surname and name(s) on the list. The pre-requisite for the exercise is a successful completion of the day flight simulation as a part of AERO3640. Those of you who haven’t completed the pre-requisite will be able to do so in weeks 1 – 7. Penalties will be applied for those who book the exercise and don’t turn up on time or for those who don’t comply with OH&S requirements.

Assignment

The assignment will be based on the work completed in the laboratory. The electronic copy of the assignment will be available on Moodle website before the experiment in Week 10.

Presentation

All submissions should have a standard School cover sheet which is available from the School website. All submissions are expected to be neat, and clearly set out. All calculations should be shown as, in the event of incorrect answers, marks are awarded for method and understanding.

The preferred set-out of any numerical calculation is similar to the following:

$p = \frac{1}{2}\rho v^2$	(Equation in symbols)
$= 0.5 \times 1.025 \times 100$	(Numbers substituted)
= 51.25 Pa	(Answer with units)

Submission

Assignments are due on Friday Week 12 by 4:00 PM. They should be submitted in hard copy via the assignment boxes.

Late submission of assignments attracts a penalty of **1 mark per day**, unless prior dispensation has been given.

Criteria

The following criteria will be used to grade assignments:

For written answers:

- Identification of key facts and the integration of those facts in a logical development.
- Clarity of communication—this includes development of a clear and orderly structure and the highlighting of core arguments.
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation.
- Correct referencing in accordance with the prescribed citation and style guide.

For numerical calculations:

- Accuracy of numerical answers.
- All working shown (see *Presentation* above).
- Use of diagrams, where appropriate, to support or illustrate the calculations.
- Use of graphs, were appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.
- Neatness.

Tests and Examination

There will be two one-hour tests in Weeks 4 and 8. Topics for the first test will be those presented in Weeks 1 – 4 (i.e. Module A). Topics for the second test are those related to Static Stability (i.e. first half of Module C).

There will one two-hour examination at the end of the semester, covering material presented in Weeks 5 – 12. It will include topics related to Avionics (i.e. the whole of Module B) and Dynamic Stability (the second half of Module C).

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 shown at https://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 School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see *Administrative Matters for All Courses*, available from the School website.

6. TENTATIVE SYLLABUS

Module A

Week 1: Control systems. Hydraulic systems and components.
Week 2: Pneumatic systems and components. Fuel systems and components.
Week 3: Cabin environment control. Electrical systems and components.
Week 4: Electrical systems and components. Test.

Module B

Week 5: Avionics requirements.
Week 6: Aircraft state sensors.
Week 7: External world sensors.
Week 7: Navigation systems.
Week 8: Automatic flight control.
Week 9: Autopilots.
Week 10: Lab
Week 11: Cockpit electronics.
Week 12: Communication systems. Avionics standardisation. Lab report due.

Module C

Week 5: Concept of aircraft stability. Static stability conditions.
Week 6: Elevator effectiveness. Static margin.
Week 7: Stick-free-case. Handling and flying qualities.
Week 8: Test. Dynamic stability.
Week 9: Mathematical model of longitudinal dynamic. Longitudinal response.
Week 10: Lab

Week 11: Mathematical model of lateral dynamics. Lateral response.
Week 12: State variable technique. Autopilots and stability augmentation systems.
Week 13: Revision. Contingency time.

Some minor adjustments to the lecturing schedule are possible without notice. Major changes will be announced on Moodle.

7. RESOURCES FOR STUDENTS

There is no text book 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"

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

Copies of these books are available in the library.

8. ACADEMIC HONESTY AND PLAGIARISM

Plagiarism is using the words or ideas of others and presenting them 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 booklet which provides essential information for avoiding plagiarism: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid 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. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

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 a honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, *Administrative Matters for All Courses*, available on the School website.

9. COURSE EVALUATION AND DEVELOPMENT

Periodically student evaluative feedback on the course is gathered, using among other means, UNSW's Course and Teaching Evaluation and Improvement (CATEI) process, as well as student-staff meetings and other less formal means. Student feedback is taken seriously, and continual improvements are made to the courses based in part on such feedback. This is the first time AERO4620 is offered, so no direct feedback is available. However, all components of the course were offered up until 2013 within either AERO3200 or AERO3640, so indirect feedback is still available.

In the 2013 survey for AERO3200 the course was rated extremely highly. Still, two issues were identified and hopefully improved this year. The major complaint was about not having more assessments during the semester and, consequently, the weighting of the final exam being too high (65%). This has been addressed this year by introducing a more even mark distribution between the assessments. The less critical remark was the insufficient amount of lecturing material available online. Although the final year students are expected to work more independently and identify the useful literature, this aspect has also been improved by providing online slides both for Modules A and B.

AERO3640 also received a very positive feedback in 2013. However, no major complaints related to Module C were noted.

Specific expectations of students

Attendance in lectures will not be recorded, but is strongly recommended.

Punctuality in attending the lab sessions is essential. Students who miss the beginning of the experiment will not be allowed to participate in the rest of the activity. The issue is even more important when the flight simulation is concerned. As students book their own simulation session they are required to turn up on time. In extreme circumstances, if the student is really unable to attend the previously booked session, they will have to notify the lecturer via the telephone or email. Otherwise they will miss out on that component of the course.

For both laboratory exercises the standard OHS rules apply.

10. ADMINISTRATIVE MATTERS

You are expected to have read and be familiar with *Administrative Matters*, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Zoran Vulovic
5 January 2015