AERO3630

AERODYNAMICS
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1. Staff contact details

Contact details and consultation times for course convenor

Name: Professor Con Doolan
Office location: Ainsworth 408
Tel: (02) 9385 5696
Email: c.doolan@unsw.edu.au

Name: Dr Danielle Moreau
Office location: Ainsworth 408
Tel: (02) 9385 5428
Email: d.moreau@unsw.edu.au

For any course administrative matters or to arrange an appointment outside of scheduled teaching and consultation times, please contact Dr Moreau via email.

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

Additional lecturers:
Name: Dr Yendrew Yauwanas
Email: yendrew@unsw.edu.au

Name: Dr Manuj Awasthi
Email: m.awasthi@unsw.edu.au

Name: Dr Jeoffrey Fischer
Email: jeoffrey.fischer@unsw.edu.au

Please see the course Moodle for demonstrator and lab staff information.

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 6 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 15 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

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>Tuesday 2pm – 4pm</td>
<td>Ainsworth G02</td>
</tr>
<tr>
<td></td>
<td>Wednesday 9am – 10am</td>
<td>Ainsworth 202</td>
</tr>
<tr>
<td>Demonstrations</td>
<td>Wednesday 10am – 12pm</td>
<td>Ainsworth 202</td>
</tr>
<tr>
<td></td>
<td>Wednesday 10am – 12pm</td>
<td>Ainsworth G02</td>
</tr>
<tr>
<td>Lab</td>
<td>Tuesday 4pm – 6pm</td>
<td>UTL (weeks 2, 5, 8, 9 only)</td>
</tr>
</tbody>
</table>

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

This course will focus on the fundamental principles and application of aerodynamics – the science and engineering of flight. The course aims to (1) provide the understanding you need to communicate with other aerospace engineers regarding aerodynamic matters, (2) analyse the aerodynamic performance of aerospace vehicles and (3) provide the basis for further advanced study of aerodynamics in your career. If I can give you an appreciation of the excitement and beauty of aerodynamics, then I will regard this course as a success.

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. Use the basic principles of fluid motion to describe aerodynamic phenomenon | PE 1.1, 1.2, 3.4
2. Analyse and predict the low speed aerodynamic performance of wings | PE 1.3, 2.1, 2.2, 3.4
3. Analyse and predict the high-speed aerodynamic performance of objects (wings and other relevant devices) | PE 1.3, 2.1, 2.2, 3.4
4. Describe and analyse viscous flow over aerodynamic surfaces | PE 1.1, 1.2, 2.1, 2.2, 3.4

4. Teaching strategies

The course is taught using a combination of face-to-face and on-line instruction: workshops, where worked examples are provided to students in an interactive environment, and demonstrations, where students work on problems in an environment where they can ask teaching staff for guidance and feedback. Practical experience in aerodynamic measurements is provided in the laboratory component of the course.

The teaching philosophy of the course can be summarised as “learning by doing”: instruction is provided for core material which is reinforced through regular assignments. Students are provided support to learn the material via worked examples (face-to-face and on-line), and through demonstrations where support is given and feedback provided. Laboratories provide practical, hands-on learning of the course material. A small design project allows students to combine technical and creative skills.

5. Course schedule

<table>
<thead>
<tr>
<th>WK</th>
<th>Topic</th>
<th>Location</th>
<th>Laboratory topic</th>
<th>Laboratory location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to course; Fundamentals, governing equations, fluid motion, experimental/wind tunnel testing <em>(Prof Doolan/Dr Yauwenas)</em></td>
<td>Ainsworth G02 Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Potential flow <em>(Prof Doolan)</em>  <em>Take-home test on assumed knowledge + week 1</em></td>
<td>Ainsworth G02 Ainsworth 202</td>
<td>1. Flow visualisation 2. Pressure distribution over cylinder</td>
<td>UTL</td>
</tr>
<tr>
<td>3</td>
<td>Incompressible flow over airfoils <em>(Prof Doolan)</em></td>
<td>Ainsworth G02 Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WK</td>
<td>Topic</td>
<td>Location</td>
<td>Laboratory topic</td>
<td>Laboratory location</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>4</td>
<td>Incompressible flow over wings <em>(Prof Doolan)</em></td>
<td>Ainsworth G02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>In-class test on weeks 2 &amp; 3</em></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Fundamentals of aeroacoustics <em>(Dr Moreau)</em></td>
<td>Ainsworth G02</td>
<td>3. Pressure Distribution over a 2D airfoil</td>
<td>UTL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Flexibility Week</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Compressible flow, shock and expansion waves <em>(Dr Awasthi)</em></td>
<td>Ainsworth G02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>In-class test on weeks 4 + 5</em></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nozzle flows, linearised compressible flow <em>(Dr Awasthi)</em></td>
<td>Ainsworth G02</td>
<td>4. Drag of an airfoil</td>
<td>UTL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hypersonic aerodynamics <em>(Dr Awasthi)</em></td>
<td>Ainsworth G02</td>
<td>5. Compressible nozzle flow</td>
<td>UTL</td>
</tr>
<tr>
<td></td>
<td><em>In-class test on weeks 7 + 8</em></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Viscous flow <em>(Dr Fischer)</em></td>
<td>Ainsworth G02</td>
<td>Lab report due</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ainsworth 202</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 6. Assessment

### Assessment overview

<table>
<thead>
<tr>
<th>Task</th>
<th>Assessment</th>
<th>Group Project? (# Students per group)</th>
<th>Length</th>
<th>Weight</th>
<th>Learning outcomes assessed</th>
<th>Assessment criteria</th>
<th>Due date and submission requirements</th>
<th>Deadline for absolute fail</th>
<th>Marks returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Take-home Test*</td>
<td>No</td>
<td>1, 50 mins</td>
<td>7.5%</td>
<td>1 through 4</td>
<td>Solution process and correct numerical answer</td>
<td>Friday Week 2 at 5pm via Moodle</td>
<td>5 working days after submission</td>
<td>Two weeks after submission</td>
</tr>
<tr>
<td></td>
<td>In-Class Tests*</td>
<td>No</td>
<td>4, each 50 mins</td>
<td>22.5%</td>
<td>1 through 4</td>
<td>Solution process and correct numerical answer</td>
<td>In-Class Weeks 4, 7 and 9</td>
<td>N/A</td>
<td>Two weeks after submission</td>
</tr>
<tr>
<td>T2</td>
<td>Laboratory*</td>
<td>No (but you will perform the laboratory as a group)</td>
<td>Two reports as per instructions on Moodle</td>
<td>25%</td>
<td>1 through 4</td>
<td>Rubric</td>
<td>End Week 10, via Moodle</td>
<td>5 working days after submission</td>
<td>Two weeks after submission</td>
</tr>
<tr>
<td>T3</td>
<td>Final exam</td>
<td>No</td>
<td>2 hours</td>
<td>45%</td>
<td>1 through 4</td>
<td>All course content</td>
<td>Exam period, date TBC</td>
<td>N/A</td>
<td>Upon release of final results</td>
</tr>
</tbody>
</table>

*Please make sure you read instructions carefully and complete ALL components of each Assessment. You MUST attend the laboratory to be eligible to submit a laboratory report.*
**Assignments**

Assignments will be due regularly throughout the term. Each assignment will provide challenges that will enable you to understand the material, your skill at applying it and your ability to communicate it effectively.

The take-home test will be placed on the course Moodle page in Week 2. The in-class tests will be provided during class in Weeks 4, 7 and 9. The laboratory report requirements may be found on Moodle.

**Presentation**

Some submissions will be electronic via Moodle. Some will be via in-class test.

All non-electronic submissions should have a standard School cover sheet, which is available from this course’s Moodle page.

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.

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.

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:

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

Course materials will also be provided on Moodle.

I recommend that you search the resources on aerodynamics in the UNSW Library.

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

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.

Feedback from 2019 and improvements implemented in 2020 will be summarised and posted on the course Moodle page.

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:

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

<table>
<thead>
<tr>
<th>Program Intended Learning Outcomes</th>
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</thead>
<tbody>
<tr>
<td>PE1: Knowledge and Skill Base</td>
</tr>
<tr>
<td>PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals</td>
</tr>
<tr>
<td>PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing</td>
</tr>
<tr>
<td>PE1.3 In-depth understanding of specialist bodies of knowledge</td>
</tr>
<tr>
<td>PE1.4 Discernment of knowledge development and research directions</td>
</tr>
<tr>
<td>PE1.5 Knowledge of engineering design practice</td>
</tr>
<tr>
<td>PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice</td>
</tr>
<tr>
<td>PE2: Engineering Application Ability</td>
</tr>
<tr>
<td>PE2.1 Application of established engineering methods to complex problem solving</td>
</tr>
<tr>
<td>PE2.2 Fluent application of engineering techniques, tools and resources</td>
</tr>
<tr>
<td>PE2.3 Application of systematic engineering synthesis and design processes</td>
</tr>
<tr>
<td>PE2.4 Application of systematic approaches to the conduct and management of engineering projects</td>
</tr>
<tr>
<td>PE3: Professional and Personal Attributes</td>
</tr>
<tr>
<td>PE3.1 Ethical conduct and professional accountability</td>
</tr>
<tr>
<td>PE3.2 Effective oral and written communication (professional and lay domains)</td>
</tr>
<tr>
<td>PE3.3 Creative, innovative and pro-active demeanour</td>
</tr>
<tr>
<td>PE3.4 Professional use and management of information</td>
</tr>
<tr>
<td>PE3.5 Orderly management of self, and professional conduct</td>
</tr>
<tr>
<td>PE3.6 Effective team membership and team leadership</td>
</tr>
</tbody>
</table>