AERO3660

FLIGHT PERFORMANCE AND PROPULSION

1. Staff contact details

Name:

limits its validity and secondly to suggest approaches to improve the accuracy of range prediction;
- to introduce a mathematical approximation to the behaviour of gas turbine engines so as to enable students to develop a deeper understanding of how these engines work;
- to review air-standard analysis of Otto cycle reciprocating piston engines and to introduce the air-standard analysis of the Dual cycle;
- to introduce students to actuator disk theory and blade element theory for propeller analysis to ensure that students understand why propellers are shaped the way they are;
- to introduce students to methods for calculating the properties of gas mixtures and to the basics of chemical reaction thermodynamics;

Student learning outcomes
- To clearly differentiate between true and equivalent airspeeds.
- To understand how the properties of the atmosphere change with altitude.
- To understand when and how to use compressible flow analysis.
- To develop a deeper understanding of how gas turbine engines work.
- To appreciate the benefits of Dual cycle analysis over Otto cycle analysis.
- To understand actuator disk theory and blade element theory for propeller analysis and to be able to articulate why propellers are shaped the way they are.
- To gain an initial understanding of how wings develop lift and to understand the limitations of the usual approach to the decomposition of drag.
- To be able to calculate the properties of gas mixtures and the energy released during chemical reactions.
- To estimate range and endurance but more importantly understand the limits to the validity of the current methods.
- To be able to analyse steady-state climb and descent, turning flight and gliding flight.
- To calculate take-off and landing distances and to see which parameters have to greatest influence.

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	Understand the difference between true and equivalent airspeeds.	PE1.1, PE1.2.
2	Understand compressible flow analysis.	PE1.1, PE1.2, PE1.3.
3	Understand how to apply mathematical analysis to predict flight performance and to recognise the shortcomings of analysis.	PE1.1, PE1.2, PE1.3.
4	Understand the workings of modern propulsion systems (gas turbines, reciprocating piston engines, propellers, chemical rockets and ion thrusters)	PE2.1, PE2.2.
5	To appreciate the strengths and weaknesses of Cumpsty’s approach in analysing the behaviour of gas turbines.	PE1.1, PE1.2, PE1.3, PE2.1, PE2.2.

Learning Outcome		EA Stage 1 Competencies
6	Understand further thermodynamic analysis and the basic mechanisms of heat transfer.	PE1.1, PE1.2, PE1.3, PE2.1.
7	Understand the effects of altitude on propulsion.	PE1.1, PE1.2, PE1.3, PE2.1.

4. Teaching strategies

“Give a man a fish and you feed him for a day. Teach him how to fish and you feed him for a lifetime.” **Lao Tzu**

Presentation of the material in lectures and discussions enables students know how to approach complex engineering calculations required in industry.

The problems I suggest you look atBT/F1 11BT/F1 11.04 Tf1 0 rm0 G[ )]Tg 5951kBT/F1 11 1 72.1 0 rm0BD

6. Assessment

Assessment overview

Task	Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
T1	Assignments (2)	N/A	One short, One long	40% (1 x 10% and 1 x 30%)	1 - 7	All course content up to the date of the assignments.	At the start of the Tuesday lecture in weeks 3 and 10.	The start of the Tuesday lecture in weeks 4 and 11.	Two weeks after submission
T2	Flight Simulation	N/A	1 hours	2%	1 – 7	-	On the day.	N/A	On the day
	Bankstown Flight Experiments	N/A	4 days	8%	1 – 7	All course content from weeks 1-10 inclusive.	One week after the flight exercises.	Two weeks after the flight exercises.	Two weeks after submission.
T3	Final exam	N/A	2 hours	50%	1 – 7	All course content from weeks 1-10 inclusive.	Exam period, date TBC.	N/A	Upon release of final results
			TOTAL	100%					

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

J. Kurzke & I. Halliwell, 2018, Propulsion and Power, Springer International Publishing AG.

G. P. Sutton & O. Biblarz, 2017, Rocket propulsion elements, 9th edition, Wiley.

A. Miele, 2016, Flight Mechanics, Theory of flight paths, Dover Publications Inc, Mineola, New York.

C. B. Millikan, 1941, Aerodynamics of the airplane, Dover Publications, Inc, Mineola, New York.

A. Filippone, 2012, *Advanced aircraft flight performance*, Cambridge University Press.

D. P. Raymer, 1992, *Aircraft design: A conceptual approach*, 2nd edition, AIAA, Washington, DC.

J. D. Anderson Jr., 2012, *Introduction to flight*, McGraw Hill, New York, 10020NY.

R. D. Archer & M. Saarlas, 1996, *An introduction to aerospace propulsion*, Prentice-Hall, Inc., Upper Saddle River, New Jersey, 07458.

T. S. Taylor, 2009, *Introduction to rocket science and engineering*, CRC Press, Boca Raton, FL 33487-2742.

D. F. Anderson & S. Eberhardt, 2010, Understanding flight, 2nd edition, McGraw Hill.

B. Gunston, 2006, *The development of jet and turbine aero engines*, 4th edition, Patrick Stephens Limited (an imprint of Haynes publishing).

B. Gunston, 1999, *Development of piston aero engines*, 2nd edition, Patrick Stephens Limited (an imprint of Haynes publishing).

K. Hünecke, 1997, Jet engines. *Fundamentals of theory, design and operation*, Airlife Publishing Limited, Shrewsbury, England.

A. Bejan, 2006, *Advanced engineering thermodynamics*, 3rd edition, John Wiley & Sons, Hoboken, New Jersey.

E. L. Houghton & P. W. Carpenter, 2003, *Aerodynamics for engineering students*, Butterworth-Heinemann (an imprint of Elsevier Science), Oxford.

J. A. Camberos & D. J. Moorhouse, 2011, *Exergy analysis and design optimization for aerospace vehicles and systems*, Editor-in-chief, F. K. Lu, Vol. 28, Progress in astronautics and aeronautics, AIAA, resto, Virginia.

M. H. Sadraey, 2013, *Aircraft design, A systems engineering approach*, Wiley.

Some of these books are available in the UNSW Library and are useful as additional reading material.

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

Additional materials provided in Moodle

This course has a website on UNSW Moodle which includes:

- course notes
- assignments
- consultation notes (questions and numerical answers);

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.

This course undergoes continual upgrading and improvement based on student feedback.

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

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-