Course Outline

Semester 1 2016

Never Stand Still

Engineering | Mechanical and Manufacturing Engineering

AERO3410

Aerospace Structures

Contents

Summary of the Course

This course is broken into three modules which will be taught in series:

Aerospace Materials and their Properties: This module introduces the materials that aerospace structures are constructed from: primarily aluminium alloys and composites. The performance of these materials will be assessed relative to the important design drivers for aircraft structures.

Analysis of Thin-walled Structures: This module gives you the capability to analyse simple airframe structures and develops an intuitive understanding of why aircraft structures have evolved into the current configurations. The lectures and supporting material introduce bending, shear, torsion and deflection of open and closed thin-walled beams and multi-cell structures. The methods developed are applied to the analysis of the fuselage, fuselage frames, wings and wing ribs.

Structural Instability and Aeroelasticity: Many structural components are designed to meet criteria other than strength. Buckling, for instance, is instability in the response of thin walled stiffened panels under compression which relates to instability of the geometry of structure. Aeroelasticity is a relationship between the stiffness, mass and aerodynamic forces generated by a wing which can lead to catastrophic structural failure. This module will cover the advanced analysis methods for structural instability and aeroelasticity; which provide additional design constraints over and above structural strength requirements.

There will be one hour of demonstrations a week to cover example problems from all modules. Two laboratories will be available on a flexible timeframe to assist with your understanding of unsymmetrical beams loaded in bending and shear. A mini research project into an aerospace structures related discipline will run over the entire semester.

Aims of the Course

The aims of this course are to develop:

- an understanding of and justifications for the configuration and materials used in airframes;
- the ability to analyse aerospace structures using classical analysis techniques;
- the ability to design aerospace structures against failure, degradation, instability and aeroelasticity.

Student learning outcomes

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

1. decide upon materials to be used for specific aerospace applications based on component function, design drivers, material properties and ageing constraints;
2. use methods for determining stress and deflections of thin walled single and multi-celled stiffened structures for axial, bending and shear loads and apply these techniques to the analysis of wing and fuselage structures in aircraft;
3. predict the onset of instability of thin-walled structures under static, dynamic and aeroelastic loads and be able to recommend amendments to the structural design to avoid instability and/or improve efficiency;

4. generate and critique a research proposal based on state-of-the-art aerospace structures research.

This course is designed to address the below learning outcomes and the corresponding

- *Laboratory Demonstrations:* Laboratory demonstrations of some core concepts will be provided. Laboratories allow you to physically experience the theoretical concepts taught in class.
- *Assignments (with Peer Feedback):* Assignments allow you to apply your new skills to challenging tasks that may involve synthesis of multiple concurrent conceptual approaches. Peer feedback and self-reflection on submissions will develop critical professional skills.

Weekly Form [(3/)-1.1(03487-92 (16)]10J 0 Tc 0-13.1(rTJ 0 0 d)Tj EMC/P90</MCI

4. Course schedule

Date	Week	Mod	Topic	Lecture Content	Suggested Readings
3/03/16	1	N/A	Airframe Basics	Flight Loads, Loads on the Airframe, Load Paths, Role of Components, Airframe types, Stressed Skin Design	

12/05/16	10	3	Buckling	Columns, Shells	Megson A4, B6 Flabel
19/05/16	11		Stiffened Panel Buckling	Modes of Buckling, Crippling, Limit and Ultimate Buckling, Shear Buckling, Curved Panel Buckling	
26/05/16	12		Aeroelasticity	Divergence, Control Reversal, Flutter	

5. Assessment

Assessment Overview

Assessment	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
Demonstration Problems	10	1-3	Correct results, working and attempted solutions	Thursday Week 13 (during demonstration)	1 week after collection
Mid Semester Exam	15	1-2	Correct answer, Correct working, Logical approach	Thursday Week 8 (12-2pm)	2 weeks after exam
Major Assignment	20	1-3	Technical Results, Report writing and communication skills, creative problem solving	Week 12	3 weeks after submission

The mini research project will assess learning outcome 4. Research is a feature of all professional engineering practice, although it comes in many forms. The research skills you learn during this task a specifically targeted at scholarly academic research but will be applicable for the future pursuit of all knowledge. This task includes peer assessment and personal reflect

Pertinent calculations should be shown (not exhaustive pages of numerical substitution) as, in the event of incorrect answers, marks may be awarded for method and understanding. Calculations should be shown professionally in any report; *scans of hand calculations will not be accepted.* The submission of online material should follow the instructions given on the appropriate Moodle page.

Submission

Adaptive demonstrations are online resources available through the Moodle page. They are similar to traditional demonstrations but will provide immediate feedback on your progress as you go along. These demonstrations have been very popular with students and new ones are constantly being developed to support the course.

Your demonstration mark will be assigned based on the quality of you demonstration book (progress throughout the semester, completion rate, score on adaptive demonstrations, etc.). No demonstrations are compulsory, but you should complete as many as you can to show your progress through the course.

The demonstrations will assess learning outcomes 1-3.

Examinations

Mid-Semester Exam

There is a 1h 30 min mid-session exam in week 8. The exam will overlap with class hours but will not fall completely within them. Please consult Moodle to ensure you are aware of the location and timing of this exam. If you have any clashes with other classes, please let GaratG0.56uB-6.6(11.2(e)-2(l)2.T*l[(N(o)(wow(o)8)2(,wasb)11-5Th(11i46 4ot)-6.6( )1c 0.1(i)2.S).5de6(p2(s)

Special Consideration and Supplementary Assessment

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

6. Expected Resources for students

Learning Management System

The Moodle LMS, https://moodle.telt.unsw.edu.au/ will be used for this course. Lecture notes, demonstrations, assignments, links and forums will be available on Moodle. Moodle is a powerful tool that you are encouraged to use for all course needs.

Textbooks

Required Textbook

- Megson, T.H.G. *Aircraft Structures for Engineering Students,* Fifth Edition. Elsevier 2012. (4th Edition will suffice with minor inconvenience)

Recommended Background Knowledge

- Cutler, J. Understanding Aircraft Structures, Fourth Edition. Blackwell, 2005.

Suggested Textbooks

- Flabel, J.C. *Practical Stress Analysis for Design Engineers*. Lake City Publishing Company, 1997.

Recommended Reading

- Daniel, I.M. and Ishai, O. *Engineering Mechanics of Composite Materials*. Oxford University Press, 1994.
- Niu, M.C.Y. *Airframe Structural Design*. Conmilit Press, 1988.
- Niu, M.C.Y. *Composite Airframe Structures*. Conmilit Press, 1992.
- Baker A., Dutton S. and Kelly, D. *Composite Materials for Aircraft Structures*, 2nd Edition. AIAA Education Series, 2004.

Recommended Internet sites

There are many websites giving lectures, papers and data. These websites will be identified in the lectures and on Moodle.

Other Resources

If you wish to explore any of the lecture topics in more depth, then other resources are available and assistance may be obtained from the UNSW Library. One starting point for assistance is the library website: http://info.library.unsw.edu.au/web/services/services.html

7. Course evaluation and development

This section is crucially .88 2.l5aio4 Tw9(t)-6.6(ur)-5.9(es)8.9(ac2(ed)]TJ -35 -1. 5S/CS0 CS 0 SCN 0em [(

each course outline reinforces to students that their feedback is taken seriously and incorporated into course design and development.

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) 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, recent improvements resulting from student feedback include the addition of more demonstration questions and solutions to aid you with your personal study.

8. 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.*

a Plagiarism is a type of intellectual theft. I le3 0 Td [(t)-6.6(he)]TJn1.7(.p11.2(i)2)2.6(a2t)-6.6(o0 T2(adeI)4Q.2

9. Administrative Matters

Appendix A: Engineers Australia (EA) Professional Engineer