UNSW AUSTRALIA

Course outline

Semester 2 2016

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

AERO9610

THE SPACE SEGMENT

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Naomi Tsafnat
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Consultation will primarily take place during lectures and demonstrations. Please email to make an appointment for consultation outside of course hours.

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

Name: Alexander Von Brasch
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2. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves 3 hours per week (h/w) of face-to-face contact.

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. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 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.

There is no parallel teaching in this course.

Contact hours

	Day	Time	Location
Lectures	Monday	3pm - 6pm	Business School 216 (K-E12-216)

Summary of the course

This course will give you a basis in the design issues involved in the engineering of the space segment to fulfil a space mission. This course is intended to deliver a broad overview of the engineering principles involved with the design, development, testing and implementation of the space segment of a space mission.

Aims of the course

This course will cover the following areas of space segment design:

1. Design methodology for satellites;
2. Operational environment including the thermal, structural, and electromagnetic environment;
3. Hardware implementation of the space segment, incorporating payload types and satellite support subsystems;
4. The design, integration and testing procedures used in developing the space segment.

Examples of current and past space missions are used to illustrate the design process and design implementation associated with the space segment of the mission. Where appropriate, theory associated with preliminary analysis of the operation and performance of the space segment is also presented.

The Space Segment course is a Core Specialisation Course within the Masters of Engineering Science Extended -Satellite Systems Engineering program (ELECSS 8539). It is a recommended elective which can be taken in either the first or second year of the program, although It is intended (though not required) that this be taken early in the Satellite Systems Engineering Masters program.

The course is also available as a 4th year technical elective within a Bachelor of Engineering.

There are no prerequisite courses leading into this course, however it is expected that enrolling students will have the third stage of a bachelor of engineering from a related discipline (Electrical, Mechanical, Aerospace, Surveying, Computer Science) or equivalent and have prior undergraduate learning in Mechanics, Mathematics and Physics.

Student learning outcomes

This course is designed to address the below learning outcomes 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.	Discuss and apply space systems engineering methodology to the space segment	1.1, 1.5, 1.6, 2.3, 2.4, 3.2
2.	Assess the impact of the space environment on spacecraft and space mission design	1.1, 2.3, 3.3
3.	Select and design space power systems, telecommunication links and systems, structures, propulsion systems, attitude determination and control systems and thermal control systems for a space mission	1.2, 1.5, 2.1, 3.3
4.	Have a thorough understanding of the different subsystems that make up a spacecraft, and how they function and interact in each stage of development	1.1, 1.3, 1.5, 2.3, 2.4

3. Teaching strategies

The material of this course will be presented through a combination of lectures and in class demonstrations. The lectures will focus on the presentation of the core content of the course. The fundamental principles of and the specific system implementation cases will be illustrated with examples, demonstrations and simulations. Students are expected to prepare for the lecture in advance, as the sections of the textbook to be read will be available prior to each lecture. The lecture slides will take a different perspective from these written notes, and both the textbook and lecture overheads together constitute examinable material.

There will be no formal demonstration or laboratory sessions in this course.

Please note that classes start exactly on the hour. During a three hour session there will normally be a ten-minute break.

Lectures are recorded and available for download through the Echo360 widget on this subject's Moodle site.

4. Course schedule

Wk	Topic	Date	Suggested Readings	Lectr
1	Course introduction, Space Systems Engineering	25/7	*Spacecraft Systems Engineering*, ch. 1, 20 *Elements of Spacecraft Design*, ch. 2.1	AVB
2	The spacecraft environment	1/8	*Spacecraft Systems Engineering*, ch. 2 *Space Vehicle Design*, ch. 3	NT
3	Mass properties, structures and mechanisms	8/8	*Spacecraft Systems Engineering*, ch. 8, 15 *Space Vehicle Design*, ch. 8 *Elements of Spacecraft Design*, ch. 2.2, 10	NT
4	Thermal subsystem	15/8	*Spacecraft Systems Engineering*, ch. 11 *Space Vehicle Design*, Ch. 9 *Elements of Spacecraft Design*, ch. 7	NT
5	Propulsion	22/8	*Space Vehicle Design*, Ch. 5.1 *Elements of Spacecraft Design*, Ch. 4, p153 – 249	NT
6	Power systems	29/8	*Spacecraft Systems Engineering*, ch. 10 *Elements of Spacecraft Design*, ch. 6	AVB
7	**Mid-Semester Exam**	5/9	Covering all material from weeks 1-6.	AVB
8	Attitude Determination and Control	12/9	*Space Vehicle Design*, ch. 7 p325-376 *Elements of Spacecraft Design*, ch.5	AVB
9	Space law and regulations	19/9		SF/DL/ NT
Mid-semester break				
10	Public Holiday – no class			
11	Launch Vehicles	10/10	**Assignment due** *Spacecraft Systems Engineering*, ch. 7.1 – 7.3	
12	CDH and TT&C	17/10	*Spacecraft Systems Engineering*, ch. 13 *Elements of Spacecraft Design*, ch. 8	AVB
13	Subsystem interactions, Revision	24/10	*Spacecraft Systems Engineering*, ch. 20, p643-666	NT

Note: the course schedule is subject to change at short notice. Please make sure to keep updated during the lectures and via the course Moodle news forum regarding any changes to the schedule.

5. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
Mid-Semester Exam	2 hours	25%	1,2,3	All course content from weeks 1-6	Week 7, September 5, in-class	Week 9
Assignment	Less than 10 pages (content only, excluding title, bibliography etc.)	25%	1,2,3,4	Understanding of course material and its application to a current space mission. Technical content, design capability and report writing skills.	By week 10, Monday 10/10 15:00, submitted on Moodle.	Week 13
Final exam	3 hours	50%	1, 2, 3, 4	All course content from weeks 1-13 inclusive.	Exam period, date TBC	Upon release of final results

Assignments

Presentation

All 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. Presenting them clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Assessment Criteria

The following criteria will be used to grade assignments:

For reports:

- 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.
- 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.

Examinations

Final Exam: The final exam will be three hours in duration, covering all topics in the course, held during the end-of-semester exam period. The final exam accounts for 50% of the available course grade.

Mid-Semester Exam: There will be an in-class exam in week 7, covering all material from weeks 1-6. The mid-semester exam is worth 25% of the course grade.

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2.

For further information on exams, please see the Exams section on the intranet.

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 shown 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 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 the School intranet, and the information on UNSW's Special Consideration page.

6. Expected resources for students

Textbooks

1. *Space Vehicle Design* (2nd Edition), Griffin, Michael D and French James R, American Institute of Aeronautics and Astronautics

2. *Spacecraft Systems Engineering (4th ed)* – Fortescue, Stark and Swinherd

3. *Elements of Spacecraft Design*, C. D. Brown.

These books are in addition to course notes. You will be told which sections of the text and/or handouts to read before each class so that you are prepared for the subject material and can ask questions about any topics that you are unsure about.

All three books are available at the UNSW library and UNSW book shop (in limited quantity), and are also **available for download in PDF format** from the UNSW Library's web site.

Handouts will be provided for those subjects covered in the classes which are not taken from the course texts. You are recommended to take your own notes or annotate your own copy of the course text and your handouts.

This course has a website on Moodle which includes lecture notes, lecture recordings and a discussion forum.

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 *http://info.library.unsw.edu.au/web/services/services.html*

7. Course evaluation 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. This course is under constant revision in order to improve the learning outcomes for the students. Any constructive feedback would be greatly appreciated and can be communicated to the lecturer in charge.

In this course, recent improvements resulting from student feedback include changes to lecture topics, and inclusion of more guest lecturers to speak about their field of expertise.

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.*

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: 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

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

9. Administrative matters

All students are expected to read and be familiar with School guidelines and polices, available on the intranet. In particular, students should be familiar with the following:

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Naomi Tsafnat
July 7, 2016

Appendix A: Engineers Australia (EA) 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