AERO9610

The Space Segment

Term 1, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
John Olsen	j.olsen@unsw.edu.au	On-line	Ainsworth Level 3	02 9385 5217

Lecturers

Name	Email	Availability	Location	Phone
Alex von Brasch	a.vonbrasch@unsw.edu.au	TBA	via Teams	
Naomi Tsafnat	n.tsafnat@unsw.edu.au	TBA	Off Campus	N/A

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook

Course Details

Units of Credit 6

Summary of the Course

This course gives the students a basis in the design issues involved in the engineering of the space segment in order to enable to fulfil the mission. This course covers three areas of the space segment design: 1. Design methodology for satellites; 2. Operational environment, including orbits, orbital manoeuvres, interplanetary transfers as well as the thermal, structural, electromagnetic environment and 3. The hardware implementation of the space segment, incorporating the payload types and satellite support subsystems. 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 the preliminary analysis of the operation and performance of the space segment is also presented. This course delivers to the student a broad overview of the engineering principles involved with the design, development, testing and implementation of the space segment of a space mission.

Course Aims

This course aims give students an understanding of the space segment, its components and the issues and challenges involved in its design for the space environment. Specific aims include:

1. Describe to students the space segment and its components.
2. Give students an understanding of the orbits and the manoeuvres required to achieve those orbits.
3. Explain in depth the communications links, link budgets and comms systems.
4. Explain critical spacecraft systems, like the computer and the attitude determination.
5. Provide a solid understanding of the thermal constraints and thermal control systems.

Course Learning Outcomes

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	PE1.1, PE1.5, PE1.6, PE2.3, PE2.4, PE3.2
2. Assess the impact of the space environment on spacecraft and space mission design	PE1.1, PE2.3, PE3.3
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	PE1.2, PE1.5, PE2.1, PE3.3
4. Have a thorough understanding of the different subsystems that make up a spacecraft, and how they function and interact in	PE1.1, PE1.3, PE1.5, PE2.3, PE2.4

Learning Outcome	EA Stage 1 Competencies
each stage of development	

Teaching Strategies

The material of this course will be presented through a combination of lectures and in-class demonstrations. The fundamental principles of and the specific system implementation cases will be illustrated with examples. 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. As a masters-level class, you are expected to read the assigned materials and attempt a few sample problems on your own prior to the start of 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.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment	60%	5pm Friday Wk 2,7,10	1, 2, 3, 4
2. Quiz	15%	Friday Wk 5 - Time TBA	1, 2, 3
3. Final Exam	25%	Exam period	1, 2, 3, 4

Assessment 1: Assignment

Assessment length: N/A
Due date: 5pm Friday Wk 2,7,10
Deadline for absolute fail: 4 days after each due date
Marks returned: Less than 2 weeks after due dates

The assignment will have you present a preliminary design of a spacecraft. To support student learning, the assignment will have three deliverables: a proposal, a draft, and the final report.

In the assignment proposal, you will lay out your plan for the assignment: the mission you chose to design, its main goals, and the main systems of the spacecraft (payload and major subsystems). You should also list the sources of information you will be using. This will go on to form the main part of your final report introduction.

The assignment draft will allow you to present your research findings for the subsystems covered so far in the course and receive feedback and suggestions from the demonstrators on your progress and on how to best complete your assignment. It is intended to make sure that you are progressing well with your design project, and to give you feedback on your work.

The final report will include your preliminary spacecraft design, including payload and all subsystems, updated and completed based on your draft feedback, and a conclusion presenting the space segment analysis of your space mission, showing how it addresses the mission requirements and user needs.

Assessment criteria

Component	Weight	Due
Proposal	5%	Friday Week 2
Draft	15%	Friday Week 7
Final Report	40%	Friday Week 10

Assessment 2: Quiz

Due date: Friday Wk 5 - Time TBA
Marks returned: 2 weeks after deadline

Midterm quiz for all content in Weeks 1-4 inclusive.

Assessment 3: Final Exam

Assessment length: 2 hours
Due date: Exam period
Marks returned: With course results

An online final exam

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

Day	Time	Location	Activity
Wed	1400-1600	Online (Teams)	Lecture
Fri	1200-1400	Online (Teams)	Lecture

View class timetable

Timetable

Date	Type	Content
O-Week: 7 February - 11 February		
Week 1: 14 February - 18 February	Topic	• Introduction • Design process • Systems engineering
	Reading	• Fortescue 1, 20 • Brown 2.1
Week 2: 21 February - 25 February	Topic	• Mission design • The space environment
	Reading	• Brown 2 • Griffin 3
Week 3: 28 February - 4 March	Topic	• Mass budgets • Structures and Mechanisms
	Reading	• Brown 2.2, 10 • Fortescue 8, 15 • Griffin 8
Week 4: 7 March - 11 March	Topic	• Thermal subsystem
	Reading	• Brown 7 • Fortescue 11 • Griffin 8
Week 5: 14 March - 18 March	Topic	• Power subsystem • EPS budgets
	Reading	• Brown 6 • Fortescue 10

Week 6: 21 March - 25 March	Reading	Flex Week
Week 7: 28 March - 1 April	Topic	• Attitude Determination and Control
	Reading	• Brown 5 • Griffin 7 (pp325-376)
Week 8: 4 April - 8 April	Topic	• Propulsion
	Reading	• Brown 4 (pp153-249) • Griffin 5.1
Week 9: 11 April - 15 April	Topic	• Command and Data Handling (CDH) • Communications (TT&C)
	Reading	• Brown 8 • Fortescue 13
Week 10: 18 April - 22 April	Topic	• Launch Vehicles • Design Methodology
	Reading	• Fortescue 7.1-7.3

Resources

Prescribed Resources

Textbooks

1. Elements of Spacecraft Design, C. D. Brown.
2. Spacecraft Systems Engineering (4th ed) – Fortescue, Stark and Swinherd
3. Space Vehicle Design (2nd Edition), Griffin, Michael D and French James R, American Institute of Aeronautics and Astronautics

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

Handouts and lecture slides will be provided on Moodle for any 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.
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Recommended Resources

Another great resource is Space Mission Analysis and Design, J.R. Wertz and W.J. Larson (affectionately known as SMAD), available in the library and online.

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.

In this course, recent improvements resulting from student feedback include changes to lecture topics and provision of more feedback to students throughout the course.

Submission of Assessment Tasks

Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

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.

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.

Late policy

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, for a minimum of zero marks.

The late penalty is applied per calendar day (or part thereof), including weekends and public holidays, that the assessment is overdue.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item. For example:

- Your course has an assessment task worth a total of **30 marks (Max Possible Mark)**
- You submit the assessment **2 days after the due date**
- The assessment is marked as usual and achieves a score of **20 marks (Awarded Mark)**
- The late policy is applied using **Late Mark = Awarded Mark - (Days*Penalty per Day)*Max Possible Mark**. Your adjusted final score is **8 marks** (20 - ((2*0.2)*30)).

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:

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

Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these 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.

Special Consideration

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.

UNSW now has a Fit to Sit / Submit rule, which means that if you attempt 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.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID-19 illness or isolation** will be required.

Special Consideration Outcomes

Assessments have default Special Consideration outcomes. The default outcome for the assessment will be advised when you apply for Special Consideration. Below is the list of possible outcomes:

Outcome	Explanation	Example
Time extension	Student provided more time to submit the assessment	e.g. 1 more week of time granted to submit a report
Supplementary assessment	Student provided an alternate assessment at a later date/time	e.g. a supplementary exam is scheduled during the supplementary exam period of the term
Substitute item	The mark for the missed assessment is substituted with the mark of another assessment	e.g. mark for Quiz 1 applied also applied as mark for Quiz 2, meaning if a student achieved a mark of 20/30 for Quiz 1 and was granted Special Consideration for Quiz 2, a mark of 20/30 would be applied for Quiz 2, etc
Exemption	All course marks are recalculated excluding this assessment and its weighting	e.g. The course has an assessment structure of: - Assignments 30%, - Lab report 30%, - Final Exam 40%. If the Lab report is missed and student is granted Special Consideration, then the assessment structure may be reweighted as follows: - Assignments 50% - Final Exam 50% as though the Lab report did not exist
Non-standard	Course Coordinator is contacted for the outcome when special consideration is granted as the outcome differs on a case-by-case basis	e.g. typical for group assessments where time extension supplementary assessment could be granted to the group member, time extension could be granted to the whole group, etc. Clarify with your Course Convenor for

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:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Academic Information

Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

****T1-2022 UPDATE****
- -

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the
FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Guidelines

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

Image Credit

Photo by Stephen Blake March 2017, Willis Annexe (J18) Thermofluids lab

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	