AERO9500

Space Systems Architectures and Orbits

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Summary of the course

This course gives an overview of satellite systems from the space segment to the ground segment, describing the main applications of satellite systems, as well as providing a detailed introduction into the principles of orbital mechanics.

3. Teaching strategies

Lectures in the course are designed to cover the terminology and core concepts and theories. The lectures are intended as a foundation for further investigation. The fundamental principles of and the specific system implementation cases will be illustrated with examples and simulations. The lecture slides will take a different perspective from the written notes, and both the lecture notes and lecture overheads together constitute examinable material. This course will be delivered by lectures, nominally three hours per week. Students are expected to prepare for lectures in advance by reading the appropriate sections of the textbook prior to the lesson.

Worked tutorial-type questions will be presented in the course of the lecture program, to expose students to the techniques involved in solving exam-style questions in this topic. There will be no formal tutorial classes scheduled, however the solutions to certain tutorial questions will be presented in the lecture classes, at the lecturer's discretion. A list of suggested problems and their answers (though not worked-out full solutions) will be posted for each topic. It is highly recommended that you make use of these problem sets and make sure you understand how to solve them.

Laboratories: There will be laboratories scheduled throughout the session. The laboratory exercises consist of simulation scenarios performed using the Systems Toolkit (STK) software. These laboratory exercises aim to illustrate the main concepts taught in the lectures and covered by the tutorial problems and to provide a further means of understanding the material. STK is industry-standard software for space mission design and analysis. Labs will be at the Ainsworth building computer lab (room 204) starting Week 7, on Tuesdays after the lecture, 18:30 – 19:30.

4. Course schedule

Date	**Topic**	**Location**	**Lecture Content**	**Lab Content**	**Suggested Reading**
Wk 1 1/3	Course introduction	202	Administrative matters Space technologies Elements of a space mission		Ch. 1
2/3		202	Satellite applications, examples of current/past missions		
Wk 2 8/3	Space systems architectures	202	Space mission design Space system architectures		(AVB notes)
9/3		202	Principles of space systems engineering		
Wk 3 15/3	The space segment		Space Mission Design Space System Architectures		(AVB notes)
16/3		202	Principles of space systems engineering		

Wk 4 22/3	The ground segment	202	Ground Segment Design and Operation		(AVB notes)
23/3		202	Ground Segment Design and Operation (cont.)		
Wk 5 5/4	Orbits	202	**Quiz 1** Covering weeks 1 - 4		
6/4		202	Historical overview of astrodynamics Kepler's Laws Orbit geometry and nomenclature		2.1 Ch. 3 (intro) 3.1
Wk 6 12/4	Orbit equation	202	Conic sections Constants of orbital motion 2 body problem		3.1 – 3.15 3.1.7
13/4		202	Orbit equation Coordinate systems Lagrange points		

5. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Marks returned
5 STK tutorial assignments	1 hour	2 each = 10 total	5	Successful completion of lab tutorials	Weeks 7-11 in room 204 during STK lab	One week after tutorial
5 Homework assignments	1-2 questions each, total 1-3 pagotomeworeek assit10.24f 42					

All assessments will involve calculations and descriptive material.
Cover sheets are available on the course Moodle site.

STK tutorial assignments will be conducted during the lab on Tuesdays and are due by the end of the lab session. These will be marked and returned in the next week.

Homework assignments will be 1-2 short questions that will test your understanding of the lecture material. These are due one week after the lecture on or before Tuesday 17:00 with a signed cover sheet included. Assignments may be **neatly** handwritten or typed.

Quizzes will be conducted in-class and cover the material from previous weeks as advised above. These will be up to 1.5 hours in duration and will include several ques

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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

Textbook

There is a **required** textbook for this course which is available as an e-book via the UNSW library:

- *Elements of Spacecraft Design*, C. Brown

The relevant chapters are shown in the course schedule and will also be posted on Moodle. It is expected that students read the relevant chapters prior to the lecture and refer to them when studying.

Suggested additional readings

There are also a number of recommended books that a closely related to course content. Many of these books are available through the library.

- *Astronautics*, second edition, U. Walter.
- *Spacecraft Systems Engineering*, fourth edition, P. Fortescue, G. Swinerd and J.

Additional materials provided in Moodle

This course has a website on Moodle which includes:

- x lecture notes
- x handouts
- x recommended problem sets
- x a discussion forum

The discussion forum is intended for you to use with other students enrolled in this course. The course convenor will occasionally look at the forum, monitor the language used and take note of any frequently-asked questions, and may respond to questions on the

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

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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