Course Staff

Course Convener: Professor Andrey Savkin  Room 341  a.savkin@unsw.edu.au
Consultation Time: Tuesday 16:00 – 18:00

Consultations: You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. ALL email inquiries should be made from your student email address with ELEC9731 in the subject line, otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Course Summary

Contact Hours

The course consists of 3 hours of lectures.

<table>
<thead>
<tr>
<th>Days</th>
<th>Time</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>Tuesday 18:00 - 21:00</td>
<td>ColomboThB</td>
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Context and Aims

Aims of the course: Provide an introduction to linear system theory. Provide an introduction to robust and optimal control theory. Provide an introduction to optimal and robust filtering. The course covers the design of practical control systems.

Particular topics include:

1. Review of Matrix Methods and SISO State Space Methods.
3. Tracking and Disturbance Rejection, Introduction to MIMO systems.
5. MIMO Decomposition and Balanced Realizations.
6. Introduction to Robust control, Kharitonov theorem, edge theorem.
7. Classical approach to robust control design, robust PID controllers, case studies.
8. Optimal control: dynamic programming; linear quadratic optimal control problem; Riccati equations.

Aspects of implementation are constantly emphasized.

**Assessment**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Due Date</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>out - week 4 ; due - week 6</td>
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<tr>
<td>25%</td>
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<tr>
<td>Assignment 2</td>
<td>out - week 6 ; due - week 8</td>
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<tr>
<td>25%</td>
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<tr>
<td>Final Exam (take home)</td>
<td>out - week 9 ; due - 20 days later</td>
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<td>50%</td>
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**Course Details**

**Credits**

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 10 week term.

**Relationship to Other Courses**

This is a postgraduate course in the School of Electrical Engineering and Telecommunications.

**Prerequisites and Assumed Knowledge**

The main prerequisite for this course is ELEC3114. It is essential that you are familiar with a standard introductory undergraduate course on control engineering such as ELEC3114 before this course is attempted. The prerequisites also include some undergraduate courses on Linear Algebra and Probability.

**Learning outcomes**

After successful completion of this course, you should be able to:

1. be familiar with basic aspects of linear system theory;
2. be familiar with basic aspects of robust control theory;
3. be familiar with basic aspects of optimal and robust filtering;
4. be familiar with case studies from biomedical engineering and power systems;
5. solve basic problems in linear system theory;
6. solve basic problems in robust control;
7. solve basic problems in optimal and robust filtering.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in Appendix A. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in Appendix B). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in Appendix C.
Teaching Strategies

Delivery Mode
The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding.
- Assignments to practice in problem solving, and to assess your progress.
- Take home examination to give the final test of competency.

Learning in this Course
You are expected to attend all lectures in order to maximise learning. You must prepare well for all lectures. In addition to the lecture notes, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW assumes that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Assessment
The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the assignments and the final take home examination.

Relationship of Assessment Methods to Learning Outcomes

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignments</td>
<td>✓✓✓✓✓</td>
</tr>
<tr>
<td>Final exam</td>
<td>✓✓✓✓✓</td>
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</tbody>
</table>

Course Resources

Software:
- Matlab (including Simulink)

Textbooks

Prescribed textbooks:

Reference books:
On-line resources

Moodle
As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list
Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Other Matters

Academic Honesty and Plagiarism
Plagiarism is the unacknowledged use of other people’s work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see: https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct
Students are expected to be familiar with and adhere to all UNSW policies (see https://my.unsw.edu.au/student/atoz/ABC.html), and particular attention is drawn to the following:

Workload
It is expected that you will spend at least ten to twelve hours per week studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and independent, self-directed study. In periods where you need to complete assignments, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance
Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour
Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety
UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations
You must submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your course
progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult: https://student.unsw.edu.au/special-consideration.

**Continual Course Improvement**

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

In particular, several practical case studies have been developed based on past students’ feedback. During the last two years, two new case studies have been developed/significantly modified.

**Administrative Matters**

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures

https://my.unsw.edu.au/student/atoz/ABC.html
**Appendices**

**Appendix A: Targeted Graduate Capabilities**

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

**Appendix B: UNSW Graduate Capabilities**

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through home work.
### Program Intended Learning Outcomes

<table>
<thead>
<tr>
<th>PE1: Knowledge and Skill Base</th>
<th>PE2: Engineering Application</th>
<th>PE3: Professional and Personal Attributes</th>
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</thead>
<tbody>
<tr>
<td>PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals</td>
<td>PE2.1 Application of established engineering methods to complex problem solving</td>
<td>PE3.1 Ethical conduct and professional accountability</td>
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<tr>
<td>PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing</td>
<td>PE2.2 Fluent application of engineering techniques, tools and resources</td>
<td>PE3.2 Effective oral and written communication (professional and lay domains)</td>
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<tr>
<td>PE1.3 In-depth understanding of specialist bodies of knowledge</td>
<td>PE2.3 Application of systematic engineering synthesis and design processes</td>
<td>PE3.3 Creative, innovative and pro-active demeanour</td>
</tr>
<tr>
<td>PE1.4 Discernment of knowledge development and research directions</td>
<td>PE2.4 Application of systematic approaches to the conduct and management of engineering projects</td>
<td>PE3.4 Professional use and management of information</td>
</tr>
<tr>
<td>PE1.5 Knowledge of engineering design practice</td>
<td></td>
<td>PE3.5 Orderly management of self, and professional conduct</td>
</tr>
<tr>
<td>PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice</td>
<td></td>
<td>PE3.6 Effective team membership and team leadership</td>
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