Mechanical and Manufacturing Engineering

Course Outline

Term 1 2020

MMAN3200

LINEAR SYSTEMS AND CONTROL

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1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Jose Guivant
Office location: Building J17, Room 510D
Tel: (02) 9385 5693
Email: j.guivant@unsw.edu.au

Consultations will take place in L212/J18. The consultation timeslots will be announced later. Consultations are possible outside the set times, but a prior appointment is preferred. Email and Moodle discussions can also be used for solving more general issues.

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

Name: Dr Ngai Ming Kwok
Office location: Building J17, Room 510C
Tel: (02) 9385 6091
Email: nmkwok@unsw.edu.au
Consultation by email appointment.

2. Important links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves 7 hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 12 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.

Contact hours

	Day	**Time**	**Location**
Lectures	Monday	10:00 – 12:00	ChemicalSc M17 (F10-M17)
	Wednesday	15:00 – 17:00	Ritchie Theatre (G19-LG02)
(Web stream)	Any	Any	Moodle
Interactive tutorials	Wednesday	17:00 –18:00 (after lecture)	Ritchie Theatre (G19-LG02)
Tutorials		(*)	(note 1)
Lab (week 7)		(*)	L212 / J18 (note 2)
OTH (Tests) Week 3	Tuesday	18:00–19:00	Colombo Theatre A (B16-LG03), G1 Civil Engineering (H20-G1), Myers Theatre (M15-1001) (note 3)
Week 6	Tuesday	18:00–20:00	Colombo Theatre A (B16-LG03), G1 Civil Engineering (H20-G1), Myers Theatre (M15-1001) (note 3)

(*) Please see variations of the nominal timetable (due to holidays, etc) here: http://timetable.unsw.edu.au/2020/MMAN3200.html

(1) Please refer to your class timetable for the learning activities in which you are enrolled and attend only those classes.

(2) This place may be reassigned (to be in other lab, in building J18) before week 7. In such a case, it will be informed, well in advance, via Moodle.

(3) Please see Moodle for your allocated room.

Summary and Aims of the course

The primary function of Linear Systems and Control is to serve as the first step towards mastering control engineering. The ultimate purpose of control engineering is to approach various systems from the stability point of view, with special attention given to transient processes. With that in mind, MMAN3200 endeavours to provide students with analytical tools that are easily applied to a wide spectrum of engineering problems.

Some components of this module have other roles. Systems modelling for example, which occupies a major part, helps you acquire knowledge necessary for simulation, analysis or design of numerous systems. It helps you consolidate the knowledge gained so far in courses dealing with Mechanics, Design, Fluids, Thermodynamics, Solids and Electrical Engineering. Linearisation provides a useful tool for simplification of complex systems while at the same time points out possible problems that could arise from oversimplification. In the

latter part of the course, you will learn state space analysis, a powerful and general technique for studying dynamic systems.

The aim of MMAN3200, as an important part of control engineering, is to offer the knowledge of methodologies specifically designed for Laplace domain, which in turn enables easier and more efficient analysis of complex engineering systems. Numerous types of systems from real engineering applications will be used throughout the course to give you the practical aspects of the methods covered.

Student learning outcomes

This course is designed to address the learning outcomes below 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.	Create linear mathematical models of a variety of systems;	PE1.2, PE2.1, PE2.2
2.	Analyse linear time invariant continuous systems in both time- and complex- domains;	PE1.2, PE2.1, PE2.2
3.	Understand and model systems through state space representation	PE1.2, PE2.1, PE2.2

4. Teaching strategies

Lectures in the course are designed to provide the basic theory behind the concepts taught. For most classes, lecture notes slides will be available online and beforehand. Students are encouraged to ask questions during the classes.

It is very important for third year students to be able to use multiple sources. For that reason, apart from the textbook, several recommended texts are listed. You are welcome to consult your lecturers on this.

Classroom demonstrations are designed for practical applications of the theoretical concepts introduced in lectures. A comprehensive set of tutorial problems will be provided beforehand. Two types of demonstrations will be organised, standard and interactive.

In “standard” demonstrations, it is the demonstrator who sets the pace and works on select examples. The times and locations of those classes are found in your timetables.

In ‘interactive” demonstrations, it is students who work individually or in small groups, and therefore it is up to them to select the examples and dictate the pace. The demonstrators and the lecturer will be on hand to provide guidance.

Finally, the lab exercises are important in giving you the practical application of some of the

concepts learnt in classes. Groups of 3-4 students will perform one exercise for the term, and each student will individually submit a lab-based assignment, which will additionally include the interpretation of the experimental results, based on the learned theory.

In this session (T1), the experiment will be more related to Mechatronic Engineering; it will involve controlling a low scale monorail.

5. Course schedule

Date	Topic	Location	Demonstration/Lab Content	Suggested Readings
Week 1	Introduction to control systems Laplace transform Initial/final-value theorem	(1)	Tutorial related to the lecture topics	Class readings
Week 2	Block diagram processing Transfer function Linearization	(1)	Tutorial related to the lecture topics	Class readings
Week 3	System modelling Mechanical/electrical systems Fluid/thermal systems	(1)	Tutorial related to the lecture topics	Class readings
Week 4	Transient and steady-state response First/second-order systems Stability	(1)	Tutorial related to the lecture topics	Class readings
Week 5	System design Root-locus method Control system design	(1)	Tutorial related to the lecture topics	Class readings
Week 6	Half Flexibility week / Extra Consultation Mid-term test	(1)	N/A	N/A
Week 7	PID controllers. Frequency. Domain.	(1)	Tutorial related to the lecture topics. Laboratory work.	Class readings
Week 8	Frequency Domain (part B)	(1)	Tutorial related to the lecture topics.	Class readings
Week 9	State space Part A.	(1)	Tutorial related to the lecture topics	Class readings
Week 10	State space Part B.	(1)	Tutorial related to the lecture topics	Class readings
Week 11	Contingency time. Revision	(1)	N/A	N/A

(1): classrooms are specified in the table about contact hours.

6. Assessment

Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Tests (2)	No	25 minutes and 55 minutes respectively	35% (8% and 27% respectively)	1 and 2	Topics assessed include the lectures in Weeks 1-3 and 1-5 respectively	Tuesday, week 3, 18:00–19:00; Tuesday, week 6, 18:00–20:00;	N/A	Two weeks after the tests.
Lab report	No (see 4)	8 pages	20%	1 and 2	Lecture material from Weeks 1-9.	Sunday, week 10, 11:55pm via Moodle	Subsequent Wednesday, 11:55pm.	1.5 weeks after submission
Final exam	No	2 hours	45%	1, 2 and 3	All course content from weeks 2-11 inclusive.	Exam period, date TBA	N/A	Upon release of final results

(4) The work on the experiment will be performed in groups of three students. The data generated by the experiments will be shared by the team members; however, the interpretation of results and the report will be developed individually.

This course will include the following hurdle requirements that are closely linked to a set of learning outcomes which demonstrate that you have acquired the required skills and competencies within this discipline:

- A minimum mark of 40% (of the exam mark) must be obtained for the final exam in order to pass this subject. Failure to achieve this minimum mark will result in an unsatisfactory fail (UF) grade, regardless of the performance in the rest of the course.

Assignments

Presentation

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.

Submission

Submission of the lab report will be done electronically (PDF file), via Moodle. Specifications about the report will be given with the release of the lab work. Late submissions 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.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.
Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

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:

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

Marking

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.

Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course 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.

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 available 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 Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

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.

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

7. Expected resources for students

Textbook

Ogata, K. "Modern Control Engineering" (Copies are available in the UNSW library.)

Recommended texts

Palm, W. J. "Modelling, Analysis, and Control of Dynamic Systems"
J. Wilkie, M. Johnson and R. Katebi, "Control Engineering - an introductory course," Palgrave.
N. S. Nise, "Control Systems Engineering," Wiley.
F. Powell and E. Naeini, "Feedback Control of Dynamic Systems," Addison Wesley.

(Most of these books are available in the library)

Lecture notes

Lecture notes and tutorials will be available on Moodle, before the class.

Other Resources

Although most of the material taught in the course is covered in the textbook, some deviations are inevitable. 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.

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. 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:

- Interactive tutorials will run every week (i.e. more frequently than in previous years);
- The scope of the lab work and its report will be focused on controlling an electromechanical system, which is well related to Mechatronics. The work in this experiment will give the students a stronger (than previous years) experience tuning a controller for controlling an interesting real system (monorail in low scale); and
- An improved version of lecture notes and slides will be provided. Tutorial problems will be oriented to more usual systems in Mechatronics.

9. 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

10. Administrative matters and links

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
- Equitable Learning Services

Appendix A: Engineers Australia (EA) Competencies

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