Australia's Global University

UNSW SYDNEY

Mechanical and Manufacturing Engineering

Course Outline

Semester 1 2018

MMAN3200

LINEAR SYSTEMS AND CONTROL

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Zoran Vulovic
Office location:
Tel: (02) 9385 6261
Email: z.vulovic@unsw.edu.au
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Consultations will take place in Dr Vulovic's office. The consultation time slots will be announced later.

Consultations are possible outside the set times, but a prior appointment is preferred. Email, telephone 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 Jose Guivant
Office: Room 510D, Building J17
Tel: (02) 9385 5693
Fax: (02) 9663 1222
Email: j.guivant@unsw.edu.au

Consultation with Dr Guivant, concerning this course will by appointment. Direct consultation is preferred; email may also be used.

Please see the course Moodle.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

3. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves 6 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.

Contact hours

	Day	**Time**	**Location**
Lectures	Monday	4pm - 6pm	Ainsworth G03
	Thursday	2pm - 4pm	Ainsworth G03
(Web)	Any	Any	Moodle
Tests	Thursday	6pm – 8pm Weeks 4 and 7	Keith Burrows Theatre, Physics Theatre
Interactive Demonstrations	Thursday	3pm – 4pm Weeks 1, 4, 6, 7, 10, 13	Ainsworth G03
	Thursday	11am – 12noon	Electrical Engineering (G17) room 418
	Friday	10am – 11am	Electrical Engineering (G17) room 224
Standard Demonstrations	Please check your timetable	Please check your timetable	Please check your timetable
Lab	Please check your timetable	Please check your timetable	Please check your timetable

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

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

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 10-15 students will perform one exercise for the semester and each individual will submit the lab-based assignment.

5. Course schedule

Date	**Topic**	**Location**	**Lecture Content**	**Demonstration/ Lab Content**	**Suggested Readings**
Week 1	Classification of engineering systems Linearisation.	Ainsworth G03	Linearisation of non-linear equations and operating curves.	N/A	Class readings
Week 2	Laplace transform.	Ainsworth G03	Laplace transform and inverse Laplace transform. Initial and final value theorems. Shift theorems. Use of tables	Tutorial Sets I and II	Class readings
Week 3	Mathematical models of components and simple systems.	Ainsworth G03	Mechanical, electrical, thermal and fluid components. Input-output relations. Differential equations describing simple systems.	Tutorial Sets II and III	Class readings
Week 4	Mathematical models of complex systems. <u>Quiz.</u>	Ainsworth G03	Mathematical models of complex systems by combining simultaneous equations associated with the physical model.	Tutorial Set III	Class readings

Date	Topic	Location	Lecture Content	Demonstration/ Lab Content	Suggested Readings
Week 5	Use of block diagrams. Time response of first and second order systems.	Ainsworth G03	Reduction of block diagrams. Simple rules for manipulations. Impulse, step, ramp and sinusoidal inputs. Transient process and the steady state.	Tutorial Sets IV and V	Class readings
Week 6	Performance criteria. Analysis in the s-plane. The pole-zero pattern. Concept of control.	Ainsworth G03	The time constant, percentage overshoot, rise time, settling time. The pole position and its relation to stability and other performance characteristics. Open and closed loop systems. Negative feedback loops.	Tutorial Sets V and VI	Class readings
Week 7	Steady state errors. Mid-semester test.	Ainsworth G03	Steady state errors of closed loop systems.	Past Exams (tutorial Set VII)	Class readings
Week 8	Root locus. PID controllers.	Ainsworth G03	Rules for creating root locus. Definitions and applications of PID controllers	Tutorial Set VIII	Class readings
Week 9	Frequency based control system design – Parts A and B.	Ainsworth G03	Bode diagrams; resonant frequency, resonant peak value, gain/phase margin, bandwidth. Bode diagrams; basic factors, gain, integral/derivative factors, first-order factors.	Bode diagrams; quadratic factors.	Class readings

Date	Topic	Location	Lecture Content	Demonstration/ Lab Content	Suggested Readings
Week 10	Frequency based control system design – Part C.	Ainsworth G03	Bode diagrams; resonant frequency, resonant peak value, gain/phase margin, bandwidth.	Bode diagrams; quadratic factors.	Class readings
Week 11	State space design – Part A.	Ainsworth G03	State-space representation; transfer function, controllable canonical form, solution of state space equation.	State-space analysis, eigenvalues, transition matrix.	Class readings
Week 12	State space design – Part B.	Ainsworth G03	Controllability, pole placement design, substitution method, Ackermann's method.	Pole placement design; transform method, Matlab simulation	Class readings
Week 13	Contingency time. Revision	Ainsworth G03	N/A	N/A	N/A

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Tests (2)	50 minutes and 100 minutes respectively	42% (12% and 30% respectively)	1 and 2	Topics assessed include the lectures in Weeks 1-4 and 1-7 respectively	Thursday 22nd March 6:00pm – 7:15pm; Thursday 19th April	N/A	Two weeks after the test
Lab report	8 pages	16%	1 and 2	Lecture material from Weeks 1-8.	Sunday 13th May 23:50 via Moodle	Wednesday 16th May	Two weeks after submission
Assignment	5 pages	10%	1 and 2	Lecture material from Weeks 9-10.	Friday 25th May 2016, 23:50pm via Moodle	Sunday 27th May	Two weeks after submission
Final exam	3 hours	32%	1 and 2	All course content from weeks 2-12 inclusive.	Exam period, date TBC	N/A	Upon release of final results

The lab report requirements will be available on Moodle before the first group is due for the lab exercise.

The assignment will be available on Moodle at least two weeks before the assignment is due.

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

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks 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.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

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 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.

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. 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 are going to 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

9. 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:

- The quiz has been moved to Week 4 (from Week 3);
- The number of interactive tutorials has been reduced to 6 per semester to allow the lecturers to spend more time on difficult concepts;
- The weighting of the final exam has been reduced to 32% (from 40%).

10. 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.

11. Administrative matters and links

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

Zoran Vulovic
1st February 2018

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