Mechanical and Manufacturing Engineering

Course Outline

Term 1 2019

MTRN3020

MODELLING AND CONTROL OF MECHATRONIC SYSTEMS

Contents

1. Staff contact

Contact details and consultation times for course convenor

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Consultation: Please contact the course convenor by email or phone to make appointments when you need consultation.

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

Please see the course Moodle.

2. Important links

Moodle
Lab Access
Computing Facilities
Student Resources
Course Outlines
Engineering Student Support Services Centre

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course, and involves 3 hours per week (h/w) of face-to-face contact.

Contact hours

	Day	**Time**	**Location**
Lectures	Monday	2 – 4pm	Colombo Theatre A
(Web stream)	Any	Any	Moodle

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Summary and Aims of the course

This course focuses on the design of digital control systems and their implementation on linear time invariant systems.

This course will give you a thorough understanding of computer-controlled systems. Its core content can be broadly categorized into mathematical means of modelling Mechatronic Systems, model validation, design of digital controllers using a variety of different methods and the implementation of controllers on real-life systems. The systems being modelled and controlled are largely motion control systems.

The course has laboratory experiments (i) to model an inverted pendulum system and to design a classical controller (ii) to implement digital control systems on speed and position control rigs.

The courses in the Mechatronics discipline are built up on four different areas: mechanical design, computing, electronics and microprocessors, and control systems. The latter three areas are interrelated, and this course forms a cornerstone of the fundamental courses on which the Mechatronic Engineering course at UNSW is built upon. A thorough understanding of the control of dynamical mechanical systems to achieve desired motions is essential for the design and development of any sophisticated Mechatronic System. Using the fundamental classical control system knowledge gained in the third year, this course builds your knowledge on designing and implementing computer-controlled systems. Control systems provide a methodical way of carrying out the motion control that also needs programming and computing. As such the contributions from this course to the Mechatronic Engineering degree program are essential and vital.

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.	Develop an understanding of the purpose of control systems and their use.	PE1.1
2.	Be able to understand that a plant is given and a control system is to be designed to satisfy performance specifications.	PE1.1

3.

4. Teaching strategies

Teaching of this course is through lectures, demonstrations and laboratory sessions. All laboratory work is individual work and attendance is essential.

The tutorial sessions are designed to help you use tools such as Matlab to solve complex control system problems. The tutorials will be partially introduced in the class and will be continued in the computer labs. Though not essential, you are encouraged to bring your own computer with Matlab installed (student version is sufficient) so that you can maintain a seamless continuation of your learning. The provision of the learning environment in the laboratory is to facilitate developing confidence in managing laboratory tasks as projects. The content delivered in the lectures will be used to design controllers and then to apply them to control real-life systems. Demonstrators in the laboratories are there to provide you all the guidance and assistance is managing the laboratory tasks.

5. Course schedule

Topic	Mondays (2pm 4pm)	Location	Lecture Content	Demo/ Lab	Suggested Readings
Introduction	Week 1	Colombo A	Introduction, Qualitative analysis of a control system, simulation of control systems using Matlab	None	Moodle lecture notes
s-Domain to z-Domain	Week 2	Colombo A	Computer controlled systems, Introduction to Discrete-time control systems, z-transforms and inverse z-transforms.	None	Moodle lecture notes

Topic	Mondays (2pm 4pm)	Location	Lecture Content	Demo/ Lab	Suggested Readings
Design Methods for Discrete Time Controllers	Week 6	Colombo A	Root locus, Direct controller design methods: Root Locus	None	Moodle lecture notes
Design Methods for Discrete Time Controllers	Week 7	Colombo A	State space representation, discretization of state space systems, direct design of state feedback controllers in state space.	None	Moodle lecture notes
Design and Implementation of Controllers	Week 8	Colombo A	Frequency domain methods. Indirect design of controllers using frequency domain methods.	None	Moodle lecture notes

6. Assessment

Assessment overview

Assessment	Group Project?	If Group, number of Students per group	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Pendulum experiment†	No	N/A	A full report as per submission specifications.	10%	1 and 2	Refer to laboratory specification for exact details.	Submit electronically to Moodle submission site by 11.59 pm of 29 March 2019 (Week 6 Friday)	11.59 pm of 3 April 2019	By midnight of Friday of week 8
Speed Control Experiment†	No	N/A	A full report as per submission specifications.	15%	3 and 4	Refer to laboratory			

Assignments

Presentation

During experimentations, each student will collect his/her own personalized data. It is essential that each student use his/her personalized data in his/her reports. Marks are awarded for neat, tidy and complete reports with complete content as specified in the laboratory instructions sheets. Your content will not be marked if the reports are not

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 has interfered with your assessment performance, you are eligible to 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. [illegible]

Recommended Textbooks

1. Dorsey, J., “Continuous and Discrete Control Systems”, McGraw Hill
2. Golten, J. and A. Verwer, “Control System Design and Simulation” McGraw Hill

Additional Readings

Worked solutions to computer lab exercises will be made available in the Moodle page for MTRN3020.

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

Appendix A: Engineers Australia (EA) Competencies