School of
Engineering and Computer Science
Te Kura Mātai Pūkaha, Pūrorohiko

Prescription

This course presents the analysis and modelling of linear dynamic systems and the design of linear feedback controllers for such systems. There is a focus on electrical, mechanical and electromechanical systems and the dynamic response of these systems. Properties and advantages of feedback control systems and the design of such systems using various design techniques are covered, as well as the implementation of PID controllers.

Course learning objectives

Students who pass this course will be able to:

1. Understand analogies between different dynamic systems and to be able to mathematically model such systems in continuous time. In addition modelling of dynamic systems using software packages such as Matlab and Simulink will be required. 3(c) .
2. Understand the response of a dynamic system to an input signal and to be able to predict the response of a particular system. This applies the mathematical and engineering sciences, including physics, to real-life problems 3(a).
3. Understand the concept of feedback and how it influences the response of a system 3(a).
4. Understand the operation and implementation of lead, lag and PID compensation and be able to design such compensators in continuous time using Root Locus and frequency response techniques 3(b).
5. To synthesise and demonstrate the efficacy of solutions to part or all of complex engineering problems, including formulating models from first principles of engineering science and mathematics 3(b), 3(c), 3(f).
6. To perform practical experiments, such that an engineering goal is achieved, where additional information requires identification, evaluation and conclusions drawn prior to the goal being reached 3(d). Understand the issues of uncertainty and the limitations of the applied methods, including practical issues in the implementation of PID controllers (such as

Course content

The course studies dynamic systems encountered in a variety of instrumentation and mechatronic systems. It will begin with a study of mathematical modelling of such systems which allows the response of these systems to disturbances to be predicted and their stability to be assessed. The effects of feedback on dynamic systems will be studied, leading to the development of a number of different design techniques for producing control systems.

In 2021, it will be possible to take this course remotely, and distance-based versions of the lectures, labs, and all other material will be available. However, the resources for the remote alternative to the labs are limited, and the remote option will only be available for students with a good justification (for example, enrolling from overseas). Students who can be in Wellington must participate in the face-to-face labs to develop the critical practical lab knowledge and skills for the course.

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Students taking this course remotely must have access to a computer with camera and microphone and a reliable high speed internet connection that will support real-time video plus audio connections and screen sharing. Students must be able to use Zoom; other communication applications may also be

used. A mobile phone connection only is not considered sufficient. The comuputer must be adequate to support the programming required by the course: almost any modern windows, macintosh, or unix laptop or desktop computer will be sufficient, but an Android or IOS tablet will not.

If the assessment of the course includes tests, the tests will generally be run in-person on the Kelburn campus. There will be a remote option for students who cannot attend in-person, but the remote option imposes extra costs on the School and will be limited to students with a strong justification (for example, being enrolled from overseas). The remote test option will use the ProctorU system for online supervision of the tests. ProctorU requires installation of monitoring software on your computer which also uses your camera and microphone, and monitors your test-taking in real-time. Students who will need to use the remote test option must contact the course coordinator in the first two weeks to get permission and make arrangements.

Withdrawal from Course

Withdrawal dates and process:
https://www.wgtn.ac.nz/students/study/course-additions-withdrawals

Lecturers

Will Browne (Coordinator)

will.browne@vuw.ac.nz 04 4635233 ext 8489

418 Alan MacDiarmid Building, Kelburn

Christopher Hollitt

christopher.hollitt@vuw.ac.nz 04 4636965

223 Alan MacDiarmid Building, Kelburn

Daniel Burmester

daniel.burmester@vuw.ac.nz 04 4639998

404 Alan MacDiarmid Building, Kelburn

Teaching Format

This course will be offered in-person and online. For students in Wellington, there will be a combination of in-person components and web/internet based resources. It will also be possible to take the course entirely online for those who cannot attend on campus, with all the components provided in-person also made available online.

During the trimester there will be three lectures and one lab per week. One of the lecture sessions will typically be used for a tutorial.

Student feedback

Student feedback on University courses may be found at:
www.cad.vuw.ac.nz/feedback/feedback_display.php

Dates (trimester, teaching & break dates)

- Teaching: 22 February 2021 - 28 May 2021
- Break: 05 April 2021 - 18 April 2021

- Study period: 31 May 2021 - 03 June 2021
- Exam period: 04 June 2021 - 19 June 2021

Class Times and Room Numbers

22 February 2021 - 04 April 2021

- **Monday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn
- **Wednesday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn
- **Friday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn

19 April 2021 - 30 May 2021

- **Monday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn
- **Wednesday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn
- **Friday** 09:00 - 09:50 – 102, Alan MacDiarmid Building, Kelburn

Other Classes

A weekly laboratory session will be in Cotton 249. A laboratory demonstrator will be available for a subset of that time, but there should be no expectation of demonstrator assistance at other times. Students may make use of the laboratories outside of the specified time when the lab is otherwise unoccupied, though there will be restrictions in the use of the propellor systems for safety reasons.

Set Texts and Recommended Readings

Required

We do not closely follow a particular textbook for this course, though students are *strongly* advised to routinely use a text to gain a different perspective on the material. We mostly follow the notation used in the recommended text by Nise, so that is the most obvious option. However, different texts suit different students, so a visit to the library is suggested to peruse the different possibilities. Some additional recommendations may be found in the course reading list.

Recommended

The library contains a number of other excellent control engineering texts which can be consulted for additional explanation or practice problems. Some additional reading material is also listed in the course reading list, as may be found on the wiki page.

Lecture notes, laboratory scripts and assignments will be posted to the course's ECS wiki page. While notes will be provided, students are advised to also take down their own notes in class. These should then be supplementeded with further reading from the recommended reading for the course.

- "*Control Systems Engineering*" by Norman S. Nise. Any edition is fine.

Mandatory Course Requirements

In addition to achieving an overall pass mark of at least 50%, students must:

- Achieve a grade of at least 40% over the two project reports.

If you believe that exceptional circumstances may prevent you from meeting the mandatory course requirements, contact the Course Coordinator for advice as soon as possible.

Assessment

This course will be assessed through project reports, assignments, a mid-term test, and a final test. The mid-term test will cover all material from the first six weeks of the course. The final test will cover the whole course with an emphasis on the second half of the trimester.

Assessment Item	Due Date or Test Date	CLO(s)	Percentage
Project Reports (counted equally)	Weeks 6 and 12.	CLO: 5,6	28%
Assignments (counted equally)	Weeks 4,6,8 and 10.	CLO: 1,2,3,4	24%
Mid-trimester Test	Week 7	CLO: 1,2,3,4	24%
Final test (2 hours)	Assessment Period	CLO: 1,2,3,4	24%

Penalties

Work submitted after the due date will incur a penalty of 10% of the full mark per working day. Late work will not be marked after the model solutions have been made available or if more than one week late.

Extensions

Extensions will be given only in exceptional circumstances, and if agreed **before** the due date.

Submission & Return

Assignments should be submitted by using the online submission system (or with agreement from the lecturer, submitted into the labelled box on level 2 of the Cotton building by 5 pm of the specified date). Details for the correct submission mechanism will be provided with each item. Any late work should **not** be submitted into the boxes, as they will not be regularly checked. Rather submit late work directly to the appropriate lecturer.

Assessment items will be returned during classes. If you miss the collection of an item please see the lecturer. . Students should be aware that the length of marking of the midtimester laboratory report means that the reports will not be returned as swiftly as other assessment items.

Bachelor of Engineering students should be aware that copies of their assessed work may be retained for inspection by an accreditation panel.

Required Equipment

Students must have a ruler and a protractor. Several coloured writing instruments of some form will also be required. Availability of a scientific calculator having the capacity to perform trigonometric and complex number calculations will be assumed.

Workload

On average, students should plan to spend 10 hours per week on in this course.

Teaching Plan

See https://ecs.wgtn.ac.nz/Courses/ECEN315_2021T1/LectureSchedule

Communication of Additional Information

Any additional information regarding this course will be posted on the course wiki:
https://ecs.wgtn.ac.nz/Courses/ECEN315_2021T1/

Links to General Course Information

- Academic Integrity and Plagiarism: https://www.wgtn.ac.nz/students/study/exams/integrity-plagiarism
- Academic Progress: https://www.wgtn.ac.nz/students/study/progress/academic-progess (including restrictions and non-engagement)
- Dates and deadlines: https://www.wgtn.ac.nz/students/study/dates
- Grades: https://www.wgtn.ac.nz/students/study/progress/grades
- Special passes: Refer to the Assessment Handbook, at https://www.wgtn.ac.nz/documents/policy/staff-policy/assessment-handbook.pdf
- Statutes and policies, e.g. Student Conduct Statute: https://www.wgtn.ac.nz/about/governance/strategy
- Student support: https://www.wgtn.ac.nz/students/support
- Students with disabilities: https://www.wgtn.ac.nz/st_services/disability/
- Student Charter: https://www.wgtn.ac.nz/learning-teaching/learning-partnerships/student-charter
- Terms and Conditions: https://www.wgtn.ac.nz/study/apply-enrol/terms-conditions/student-contract
- Turnitin: http://www.cad.vuw.ac.nz/wiki/index.php/Turnitin
- University structure: https://www.wgtn.ac.nz/about/governance/structure
- VUWSA: http://www.vuwsa.org.nz

Offering CRN: 18516

Points: 15
Prerequisites: ECEN 203 (or 220 prior to 2016);
Restrictions: PHYS 422
Duration: 22 February 2021 - 20 June 2021
Starts: Trimester 1
Campus: Kelburn