

# Advanced Control Systems Engineering - Course Outline

## ECEN 415: 2016 Trimester 2

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This document sets out the workload and assessment requirements for ECEN 415. It also provides contact information for staff involved in the course. If the contents of this document are altered during the course, you will be advised of the change by an announcement in lectures and/or on the course web site. A printed copy of this document is held in the School Office.

### Course Description

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The course studies the behaviour and control of multi-input multi-output dynamical systems in both continuous and discrete time. 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. Feedback observers and Kalman filters will be introduced to estimate the internal dynamics of the systems being studied. Finally, linear quadratic regulators will be used to provide tools to design optimal controllers - feedback systems that produce the best possible controller for a given cost functional.

### Objectives

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By the end of the course, students should be able to

1. Produce state-space models of a variety of linear and nonlinear electronic and mechanical systems (BE graduate attributes [3\(a\)](#),[3\(c\)](#)),
2. Design continuous and discrete time controllers using state-space techniques, including optimal control methods such as LQR (BE graduate attributes [3\(a\)](#),[3\(b\)](#)),
3. Design Luenberger state observers and Kalman filters, (BE graduate attributes [3\(a\)](#),[3\(b\)](#),[3\(e\)](#)),
4. Use the Matlab software package to solve practical problems in control engineering (BE graduate attributes [3\(d\)](#),[3\(f\)](#)).

### Textbook

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The notional textbook for ECEN 415 is Astrom and Murray "Feedback Systems: An Introduction for Scientists and Engineers", though we will not follow it closely. The text is freely available on the web as listed in the reading list.

The reading list also contains some other useful references, particularly for the second half of the course. Most introductory control texts will have include some treatment of state space methods, so these could be consulted for additional material for the first half of the course.

### Lectures, Tutorials, Laboratories, and Practical work

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A [schedule](#) of lecture topics, readings, and assignment due dates is available online.

Lectures for ECEN 415 are nominally held on Monday, Tuesday and Thursday at 3:10pm in VZ107. On occasions we may move sessions to CO249 or CO250. After the mid-trimester break we will not use one of the sessions for lectures, but may use it for occasional tutorials or catch-up sessions as necessary. In addition you will need access to Matlab to work on the assignments. However, there is no set time or place for the assignment work.

### Assignments

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The assignments will consist of a mixture of computational and analytical problems. They will be due at or before the Thursday lecture and can be submitted in the box in CO250 or brought to the lecture.

### Workload

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In order to maintain satisfactory progress in ECEN 415, you should plan to spend an average of at least ten hours per week on this paper. A plausible and approximate breakdown for these hours would be:

- Lectures and tutorials: 3 hours
- Reading and Extra Problems: 2 hours
- Assignments: 5 hours

### School of Engineering and Computer Science

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The School office is located on level three of the Cotton Building ([Cotton 358](#)).

## Staff

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The course organiser for ECEN 415 is [Christopher Hollitt](#). Contact details are:

- [Christopher Hollitt](#)
- [Alan MacDiarmid 223](#)
- +64 4 463 6730
- [Christopher.Hollitt@vuw.ac.nz](mailto:Christopher.Hollitt@vuw.ac.nz)

## Announcements and Communication

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The main means of communication outside of lectures will be the ECEN 415 web area at [http://ecs.victoria.ac.nz/Courses/ECEN415\\_2016T2/](http://ecs.victoria.ac.nz/Courses/ECEN415_2016T2/). There you will find, among other things, this document, the [lecture schedule](#) and the [assignment handouts](#).

## Assessment

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Your grade for ECEN 415 will be determined based on the following assessment weightings:

| Item                                                | Weight |
|-----------------------------------------------------|--------|
| Assignments (4)                                     | 40%    |
| Test 1 (Controller and Observer design with Matlab) | 10%    |
| Test 2 (Matlab design exercise)                     | 10%    |
| Final Examination                                   | 40%    |

The assignments will have equal weighting in determining the overall assignment mark.

Work submitted late will be subject to a penalty of 10% of the total mark per day (or part thereof). No work will be accepted once the solutions have been posted and we may post the solutions immediately after the due date.

The assignments will test mastery of all course objectives. The tests and examination will assess the students' mastery of course objectives two through five, while the exam will test objectives one to four.

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

## Tests and Exams

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The tests for this course will be open book and students will have access to Matlab. Non-programmable, non-graphical calculators without a full alphanumeric keyboard will be permitted in the test and examination. Paper non-English to English dictionaries will also be permitted. The tests will cover the use of Matlab to design control systems.

The examination will be an open book and focused on the conceptual material in the course. The [timetable for final examinations](#) will be available from the University web site. The final examination will be three hours long and cover material from the entire course. The examination period for trimester 2 is 21 October - 12 November.

## Plagiarism

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### Working Together and Plagiarism

We encourage you to discuss the principles of the course and assignments with other students, to help and seek help with programming details and problems involving the lab machines. However, any work you hand in must be your own work.

The [School policy on Plagiarism](#) (claiming other people's work as your own) is available from the course home page. Please read it. We will penalise anyone we find plagiarising, whether from students currently doing the course, or from other sources. Students who knowingly allow other students to copy their work may also be penalised. If you have had help from someone else (other than a tutor), it is always safe to state the help that you got. For example, if you had help from someone else in writing a component of your code, it is not plagiarism as long as you state (eg, as a comment in the code) who helped you in writing the method.

## Mandatory Requirement

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To be awarded a passing grade a student must achieve a mark of at least 40% on the final exam.

## Passing ECEN 415

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To pass ECEN 415, a student must achieve at least a **C-** grade overall.

## Withdrawal

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The last date for withdrawal from ECEN 415 with entitlement to a refund of tuition fees is Friday 22 July 2016. The last date for withdrawal without being regarded as having failed the course is Friday 23 September 2016 -- though later withdrawals may be approved by the Dean in special circumstances.

## Rules & Policies

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Find key dates, explanations of grades and other useful information at <http://www.victoria.ac.nz/home/study>.

Find out about academic progress and restricted enrolment at <http://www.victoria.ac.nz/home/study/academic-progress>.

The University's statutes and policies are available at <http://www.victoria.ac.nz/home/about/policy>, except qualification statutes, which are available via the Calendar webpage at <http://www.victoria.ac.nz/home/study/calendar> (See Section C).

Further information about the University's academic processes can be found on the website of the Assistant Vice-Chancellor (Academic) at <http://www.victoria.ac.nz/home/about/avcacademic>

All students are expected to be familiar with the following regulations and policies, which are available from the school web site:

[Grievances](#)

[Student and Staff Conduct](#)

[Meeting the Needs of Students with Disabilities](#)

[Student Support](#)

[Academic Integrity and Plagiarism](#)

[Dates and Deadlines including Withdrawal dates](#)

[School Laboratory Hours and Rules](#)

[Printing Allocations](#)

[Expectations of Students in ECS courses](#)

The School of Engineering and Computer Science strives to anticipate all problems associated with its courses, laboratories and equipment. We hope you will find that your courses meet your expectations of a quality learning experience.

If you think we have overlooked something or would like to make a suggestion feel free to talk to your course organiser or lecturer.

[Course Outline as PDF](#)

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