ELEC3024
Control Systems
Session 1, In person-scheduled-weekday, North Ryde 2022

School of Engineering

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**General Information**

Unit convenor and teaching staff

Convenor
A/Prof. Ray Eaton
ray.eaton@mq.edu.au
Contact via email
Level 1, 50 Waterloo Rd, Macquarie Park, 2113
Thursday 2:00-4:00pm, upon email appointment

Co-Convenor & Senior Lecturer
Dr. Mihai Ciobotaru
mihai.ciobotaru@mq.edu.au
Contact via email
Online
Monday 3:00-5:00 pm, upon email appointment

Lecturer
Dr. Leonardo Callegaro
leonardo.callegaro@mq.edu.au
Contact via email
1st floor, Room 123, 44 Waterloo Road, Macquarie Park, 2113
Wednesday 2:00-4:00 pm, upon email appointment

Lecturer
Dr. Seyedfoad Taghizadeh
seyedfoad.taghizadeh@mq.edu.au
Contact via email
1st floor, Desk 23, 44 Waterloo Road, Macquarie Park, 2113
Thursday 2:00-4:00pm, upon email appointment

Credit points
10

Prerequisites
((ELEC2040 or ELEC240) or (MTRN2060 or ELEC260)) and (MATH2055 or MATH235) and (ELEC2070 or ELEC270)

Corequisites

Co-badged status
Unit description
This unit develops fundamental knowledge and skills in the area of control design and analysis of dynamic systems. Topics covered include: an introduction to control system design process and applications; mathematical modelling of electrical and mechanical systems in the frequency domain; performance and stability analysis of single-input single-output linear control systems; design of feedback control systems using root locus and frequency response techniques; an introduction to digital control systems; and design of digital versus analogue control systems. This unit uses problem/team based learning approach, where students have to choose a project topic and their team members. Each team performs the modelling, analysis, control design, and simulation of the control system related to their project. Simulink/MATLAB and a control board are used to implement a real-time digital control system.

Important Academic Dates
Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes
On successful completion of this unit, you will be able to:

ULO1: Describe a control system’s design process and control systems analysis
ULO2: Develop appropriate mathematical models of electrical and mechanical systems to be controlled in the frequency domain
ULO3: Analyse the performance and stability of single-input single-output linear control systems
ULO4: Design feedback control systems using tools such as MATLAB & Simulink to achieve specific performance requirements
ULO5: Characterise the behaviour of elementary feedback control systems using microcontroller based experiments

General Assessment Information
Grading and Passing Requirement for Unit

• In order to pass this Unit a student must obtain a mark of 50 or more for the Unit (i.e. obtain a passing grade P, CR, D, or HD).
• For further details about grading, please refer below in the policies and procedures section.
• If you receive special consideration for the oral presentation and demonstration of the Project, a supplementary conventional exam will be scheduled by the faculty during a supplementary exam period, typically about 3 to 4 weeks after the normal exam period.
By making a special consideration application for the oral presentation and
demonstration of the Project you are declaring yourself available for a conventional exam
during the supplementary examination period and will not be eligible for a second special
consideration approval based on pre-existing commitments. Please ensure you are
familiar with the policy prior to applying. Approved applicants will receive an individual
notification one week prior to the exam with the exact date and time of their
supplementary examination.

Hurdle Requirements

• Students must attend and participate in at least 6 of the 7 weekly PC Labs (Weeks 1-7)
to pass this unit.
• Students must attend and participate in at least 5 of the 6 weekly Project Labs (Weeks
8-13) to pass this unit.

Late Submissions and Re-submissions

• Online quizzes, in-class activities, or scheduled tests and exam must be undertaken at
the time indicated in the unit guide. Should these activities be missed due to illness or
misadventure, students may apply for Special Consideration.
• All other assessments must be submitted by 5:00 pm on their due date.
• Should these assessments be missed due to illness or misadventure, students should
apply for Special Consideration.
• Assessments not submitted by the due date will receive a mark in accordance with the
late submission policy as follows:
  ◦ A 12-hour grace period will be given after which the following deductions will be
  applied to the awarded assessment mark: 12 to 24 hours late = 10% deduction;
  for each day thereafter, an additional 10% per day or part thereof will be applied
  until five days beyond the due date. After this time, a mark of zero (0) will be
given. For example, an assessment worth 20% is due 5 pm on 1 January.
  Student A submits the assessment at 1 pm, 3 January. The assessment
  received a mark of 15/20. A 20% deduction is then applied to the mark of 15,
  resulting in the loss of three (3) marks. Student A is then awarded a final mark of
  12/20.
  ◦ Re-submissions of work are not allowed.

Students are reminded of the University policies regarding assessment, academic integrity and disruption to studies.

Requests for extension on assessable work are to be made to the Unit Coordinator, but will only
Pre-Class Quiz (Lectorials)
Assessment Type 1: Quiz/Test
Indicative Time on Task 2: 5 hours
Due: Weeks 2-7
Weighting: 10%

Students are expected to go through the iLearn content, understand the theory and attempt the online quiz each week prior to attending the class activities of that week.

On successful completion you will be able to:
- Describe a control system’s design process and control systems analysis
- Develop appropriate mathematical models of electrical and mechanical systems to be controlled in the frequency domain
- Analyse the performance and stability of single-input single-output linear control systems

Assignments (PC Labs)
Assessment Type 1: Problem set
Indicative Time on Task 2: 12 hours
Due: Weeks 2-7
Weighting: 20%

Evaluation of Lab activity during first part of the semester. This evaluation focuses on students ability to solve problems and perform modelling, design and implementation of control systems using MATLAB/Simulink.
On successful completion you will be able to:

- Develop appropriate mathematical models of electrical and mechanical systems to be controlled in the frequency domain
- Analyse the performance and stability of single-input single-output linear control systems
- Design feedback control systems using tools such as MATLAB & Simulink to achieve specific performance requirements

Class Quiz (Lectorials)
Assessment Type 1: Quiz/Test
Indicative Time on Task 2: 5 hours
Due: Week 8
Weighting: 20%

A quiz is scheduled right after the mid-semester break. The quiz will assess both factual knowledge and problem solving.

On successful completion you will be able to:

- Describe a control system's design process and control systems analysis
- Develop appropriate mathematical models of electrical and mechanical systems to be controlled in the frequency domain
- Analyse the performance and stability of single-input single-output linear control systems

Assessment (Project)
Assessment Type 1: Project
Indicative Time on Task 2: 20 hours
Due: Weeks 13-14
Weighting: 50%

This is the major assessment of this Unit. It will consist of 3 individual assessments and 1 team assessment, as follows: - Individual assessments: ◦ Oral presentation and demonstration of the project; ◦ Peer assessment regarding the actual contribution of each team member; ◦ Evaluation of project log book of each team member. - Team assessment: ◦ Project report to be submitted in iLearn by each team.

On successful completion you will be able to:
Describe a control system’s design process and control systems analysis
Develop appropriate mathematical models of electrical and mechanical systems to be controlled in the frequency domain
Analyse the performance and stability of single-input single-output linear control systems
Design feedback control systems using tools such as MATLAB & Simulink to achieve specific performance requirements
Characterise the behaviour of elementary feedback control systems using microcontroller based experiments

1 If you need help with your assignment, please contact:
   - the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
   - the Writing Centre for academic skills support.

2 Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

UNIT WEBSITE

• The iLearn website for this unit can be found at: https://ilearn.mq.edu.au/login/
  - Note! All information and communications relevant to this Unit will be via the iLearn website.

TEXTBOOK

  - Note! Links will be provided to specific sections of the Digital version in iLearn for each Lectorial.
  - Note! Only if you already have this textbook.
• Remark: All students are expected to have access to this textbook.

LECTORIALS

• There will be a Lectorial (3 hours) for every week in the first part of the semester (Weeks
The Lectorial will comprise of: - discussion session on fundamental knowledge. - practical examples. - interactive problem solving involving students.

- Lectorials are a combination of traditional lecture and tutorial teaching modes and are designed to improve student engagement inside/outside classes.
- The Lectorials are organised in a flipped classroom fashion.

- **Outside class**
  - links to E-Text specific sections, brief videos and/or lecture notes are posted in iLearn each week.
  - students are expected to read these E-Text sections, try to solve any given examples, and watch any videos and/or read any posted notes prior to attending the Lectorials.

- **Inside class**
  - brief discussion sessions on fundamental principles.
  - plenty of practical examples.
  - interactive problem solving involving students.

### LABORATORIES

- PC Lab activities start from Week 1 and take place once a week (Weeks 1-7) according to the Unit schedule.
  - *Note! Students must enrol in one of the available weekly Lab sessions.*
- Interactive PC Labs use MATLAB/Simulink software platform to assist with the modelling and design of control systems.

On-campus activities commence in Week 1. Students should contact the Unit convenor as soon as possible if they are unable to get back to campus in time.

### PROJECTS

- Project activities take place once a week (Weeks 8-13) according to the Unit schedule.
  - *Note! Teams must enrol in one of the available weekly Project sessions.*
- The team Project is the core component of this Unit. The Project covers practical aspects of control theory to be used in future Electrical, Electronics and Mechatronics units.
- Students are required to form teams to work on the Project.
  - *Note! When forming teams, students should agree in which weekly Project session they want to enrol.*
  - *All Project activities are performed in teams.*

### TECHNOLOGY

- The laboratory work will rely on the use of MATLAB/Simulink software platform.
• The software is available through AppStream and/or on Faculty PCs.
• Each team will be given an Arduino kit for the second half of the semester to perform experimental activities.

COMMUNICATIONS

• Students are reminded the University will communicate all official notices by email to official MQ student's account. Students should read their @student.mq.edu.au email regularly or forward it to an account they check regularly.
• All announcements and other communications regarding this Unit will be via iLearn platform.

WEB RESOURCES

• Control Tutorials for MATLAB and Simulink (CTMS):
  • These tutorials are designed to help students learn how to use MATLAB/Simulink for the analysis and design of automatic control systems.
  • They cover the basics of MATLAB/Simulink and introduce the most common classical and modern control design techniques.

• MathWorks Website (MATLAB, Simulink, user-guides, tutorials, etc):
  • MATLAB Courseware
  • MATLAB Onramp

Unit Schedule

Refer to iLearn website for a detailed Unit schedule.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central ([https://policies.mq.edu.au](https://policies.mq.edu.au)). Students should be aware of the following policies in particular with regard to Learning and Teaching:

• Academic Appeals Policy
• Academic Integrity Policy
• Academic Progression Policy
• Assessment Policy
• Fitness to Practice Procedure
• Assessment Procedure
• Complaints Resolution Procedure for Students and Members of the Public
• Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

**Student Code of Conduct**

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

**Results**

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

**Academic Integrity**

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

**Student Support**

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

**The Writing Centre**

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

• Workshops
• Chat with a WriteWISE peer writing leader
• Access StudyWISE
• Upload an assignment to Studiosity
• Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.
Macquarie University offers a range of **Student Support Services** including:

- **IT Support**
- **Accessibility and disability support** with study
- **Mental health support**
- **Safety support** to respond to bullying, harassment, sexual harassment and sexual assault
- **Social support** including information about finances, tenancy and legal issues

**Student Enquiries**

Got a question? Ask us via **AskMQ**, or contact **Service Connect**.

**IT Help**

For help with University computer systems and technology, visit [http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University’s IT, you must adhere to the **Acceptable Use of IT Resources Policy**. The policy applies to all who connect to the MQ network including students.

### Engineers Australia (EA) Competency Mapping

<table>
<thead>
<tr>
<th>EA Competency Standard</th>
<th>Unit Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and Skill Base</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>1.3 In-depth understanding of specialist bodies of knowledge</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>1.4 Discernment of knowledge development and research directions</td>
<td>ULO1</td>
</tr>
<tr>
<td>1.5 Knowledge of engineering design practice</td>
<td>ULO1, ULO2, ULO3, ULO5</td>
</tr>
<tr>
<td>1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.</td>
<td>ULO5</td>
</tr>
</tbody>
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### Engineering Application Ability

<table>
<thead>
<tr>
<th>2.1 Application of established engineering methods to complex problem solving</th>
<th>ULO1, ULO2, ULO3, ULO4, ULO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 Fluent application of engineering techniques, tools and resources.</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>2.3 Application of systematic engineering synthesis and design processes.</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
</tr>
<tr>
<td>2.4 Application of systematic approaches to the conduct and management of engineering projects.</td>
<td>ULO1, ULO2, ULO3, ULO4, ULO5</td>
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### Professional and Personal Attributes

| 3.1 Ethical conduct and professional accountability. |
| 3.2 Effective oral and written communication in professional and lay domains. |
| 3.3 Creative, innovative and pro-active demeanour. | ULO5 |
| 3.4 Professional use and management of information. | ULO1, ULO3, ULO4, ULO5 |
| 3.5 Orderly management of self, and professional conduct. | ULO4, ULO5 |
| 3.6 Effective team membership and team leadership | ULO5 |