ENEE20004 *Digital Control Systems*
Term 1 - 2020

Profile information current as at 01/07/2022 02:47 pm

General Information

Overview
This unit will enable you to develop an advanced understanding of digital control techniques applied in industrial control systems. The unit will introduce you to Z-transforms and Z Domain analysis of control systems through transformations. You will design and implement digital filters. You will learn discrete state space modeling and analysis of control systems. The unit will also equip you with knowledge of optimal control techniques such as linear quadratic and Kalman filtering. You will also learn about important digital control implementation techniques such as controller anti-windup and bumpless transfer. You will be required to successfully complete a digital control systems design team project. Online students will be required to attend a compulsory residential school in order to complete the laboratory experiments. Prior knowledge of the basic concepts of electrical circuit analysis, signals and linear systems, and control systems is assumed.

Details
Career Level: *Postgraduate*
Unit Level: *Level 9*
Credit Points: *12*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.25*

Pre-requisites or Co-requisites
There are no requisites for this unit.
Important note: Students enrolled in a subsequent unit who failed their pre-requisite unit, should drop the subsequent unit before the census date or within 10 working days of Fail grade notification. Students who do not drop the unit in this timeframe cannot later drop the unit without academic and financial liability. See details in the Assessment Policy and Procedure (Higher Education Coursework).

Offerings For Term 1 - 2020

- Melbourne
- Perth
- Rockhampton

Attendance Requirements
All on-campus students are expected to attend scheduled classes – in some units, these classes are identified as a mandatory (pass/fail) component and attendance is compulsory. International students, on a student visa, must maintain a full time study load and meet both attendance and academic progress requirements in each study period (satisfactory attendance for International students is defined as maintaining at least an 80% attendance record).

Residential Schools
This unit has a Compulsory Residential School for distance mode students and the details are:
Click here to see your Residential School Timetable.

Website
This unit has a website, within the Moodle system, which is available two weeks before the start of term. It is important that you visit your Moodle site throughout the term. Please visit Moodle for more information.

Class and Assessment Overview

Recommended Student Time Commitment

Each 12-credit Postgraduate unit at CQUniversity requires an overall time commitment of an average of 25 hours of study per week, making a total of 300 hours for the unit.

Class Timetable

Regional Campuses
Bundaberg, Cairns, Emerald, Gladstone, Mackay, Rockhampton, Townsville

Metropolitan Campuses
Adelaide, Brisbane, Melbourne, Perth, Sydney

Assessment Overview

1. **Written Assessment**
Weighting: 15%
2. **Written Assessment**
Weighting: 30%
3. **Portfolio**
Weighting: 35%
4. **Practical Assessment**
Weighting: 20%

Assessment Grading

This is a graded unit: your overall grade will be calculated from the marks or grades for each assessment task, based on the relative weightings shown in the table above. You must obtain an overall mark for the unit of at least 50%, or an overall grade of 'pass' in order to pass the unit. If any 'pass/fail' tasks are shown in the table above they must also be completed successfully ('pass' grade). You must also meet any minimum mark requirements specified for a particular assessment task, as detailed in the 'assessment task' section (note that in some instances, the minimum mark for a task may be greater than 50%). Consult the University's Grades and Results Policy for more details of interim results and final grades.

CQUniversity Policies

All University policies are available on the CQUniversity Policy site.
You may wish to view these policies:

- Grades and Results Policy
- Assessment Policy and Procedure (Higher Education Coursework)
- Review of Grade Procedure
- Student Academic Integrity Policy and Procedure
- Monitoring Academic Progress (MAP) Policy and Procedure – Domestic Students
- Monitoring Academic Progress (MAP) Policy and Procedure – International Students
- Student Refund and Credit Balance Policy and Procedure
- Student Feedback – Compliments and Complaints Policy and Procedure
- Information and Communications Technology Acceptable Use Policy and Procedure

This list is not an exhaustive list of all University policies. The full list of University policies are available on the CQUniversity Policy site.

Previous Student Feedback

Feedback, Recommendations and Responses

Every unit is reviewed for enhancement each year. At the most recent review, the following staff and student feedback items were identified and recommendations were made.

Feedback from Unit evaluation

Feedback
The students appreciated the simplicity of Moodle navigation in this unit.

Recommendation
This good practice will be continued.

Feedback from Unit evaluation

Feedback
The students found the feedback given on the assessment work helped them to learn better.

Recommendation
This good practice will be continued.

Feedback from Unit coordinator

Feedback
Some of students in this unit do not have the Engineering knowledge background necessary for this unit.

Recommendation
A quiz type evaluation will be added early in the term to evaluate which students need help to boost their engineering knowledge acquired from the undergraduate study.

Feedback from Unit coordinator

Feedback
Some unit content need to be revisited in order to include more examples for students to practice.

Recommendation
The content will be revised accordingly.

Unit Learning Outcomes

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

1. Apply Z-transforms and Z Domain analysis of control systems through transformations
2. Design and implement various digital filters
3. Model, analyse stability and design control systems in discrete state space
4. Apply advanced optimal control techniques in industrial control systems
5. Design and implement digital control systems considering stakeholder requirements
6. Document and communicate professional engineering information, including computer-based simulations and drawings, risk assessments and Work Health and Safety requirements using appropriate electrical engineering standards, terminology and symbols
7. Scope, plan, manage and successfully complete engineering projects autonomously and in teams with responsible, ethical and professional attitude regarding the role of engineers.

Learning outcomes will be linked to Engineers Australia stage 1 competency standards for Professional Engineers.

Alignment of Learning Outcomes, Assessment and Graduate Attributes

— N/A Level | ∘ Introductory Level | • Intermediate Level | • Graduate Level | ∘ Professional Level | ∘ Advanced Level

Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes						
	1	2	3	4	5	6	7
1 - Written Assessment - 15%	•	•					
2 - Written Assessment - 30%	•	•	•	•			
3 - Portfolio - 35%			•	•	•	•	•
4 - Practical Assessment - 20%					•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes						
	1	2	3	4	5	6	7
1 - Knowledge	○	○	○	○	○	○	○
2 - Communication	○	○	○	○	○	○	○
3 - Cognitive, technical and creative skills	○	○	○	○	○		
4 - Research				○	○		
5 - Self-management						○	○
6 - Ethical and Professional Responsibility						○	○
7 - Leadership						○	○
8 - Aboriginal and Torres Strait Islander Cultures							

Alignment of Assessment Tasks to Graduate Attributes

Assessment Tasks	Graduate Attributes							
	1	2	3	4	5	6	7	8
1 - Written Assessment - 15%	○	○	○					
2 - Written Assessment - 30%	○	○	○					
3 - Portfolio - 35%	○	○	○	○	○	○	○	
4 - Practical Assessment - 20%	○	○	○	○	○	○	○	

Textbooks and Resources

Textbooks

ENEE20004

Prescribed

Digital Control
Edition: 1 (2007)
Authors: Kannan Moudgalya
Wiley
Chichester , Sussex , England
ISBN: 978-0-470-03144-5
Binding: Paperback

Additional Textbook Information
Copies can be purchased from the CQUni Bookshop here: http://bookshop.cqu.edu.au (search on the Unit code)

View textbooks at the CQUniversity Bookshop

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)
- MATLAB and Simulink Suite Software

Referencing Style

All submissions for this unit must use the referencing style: Harvard (author-date)
For further information, see the Assessment Tasks.

Teaching Contacts

Kianoush Emami Unit Coordinator
k.emami@cqu.edu.au

Schedule

Week 1 - 09 Mar 2020

Module/Topic	Chapter	Events and Submissions/Topic
Modelling of Sampled Data Systems	Chapter 1 and Chapter 2	

Week 2 - 16 Mar 2020

Module/Topic	Chapter	Events and Submissions/Topic
Linear System	Chapter 3	

Week 3 - 23 Mar 2020

Module/Topic	Chapter	Events and Submissions/Topic
Z-Transform	Chapter 4	A Class Test to assess students' knowledge that is required for this unit. The test will be scheduled in Week 3. Please refer to the Moodle for more information.

Week 4 - 30 Mar 2020

Module/Topic	Chapter	Events and Submissions/Topic
Z-Transform	Chapter 4	

Week 5 - 06 Apr 2020

Module/Topic	Chapter	Events and Submissions/Topic
Frequency Domain Analysis	Chapter 5	

Vacation Week - 13 Apr 2020

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 20 Apr 2020

Module/Topic	Chapter	Events and Submissions/Topic
Transfer Function Based Controller Design - Structures and Specifications	Chapter 7	

Week 7 - 27 Apr 2020

Module/Topic	Chapter	Events and Submissions/Topic
Proportional, Integral, Derivative Controllers	Chapter 8	**Assignment 1** Due: Week 7 Friday (1 May 2020) 11:45 pm AEST

Week 8 - 04 May 2020

Module/Topic	Chapter	Events and Submissions/Topic
Pole Placement Controllers	Chapter 9 and Chapter 10	

Week 9 - 11 May 2020

Module/Topic	Chapter	Events and Submissions/Topic
Linear Quadratic Gaussian Control	Chapter 13	

Week 10 - 18 May 2020

Module/Topic	Chapter	Events and Submissions/Topic
State Space Techniques in Controller Design	Chapter 14	**Laboratory/Residential School and Lab Reports** Due: Week 10 Friday (22 May 2020) 11:45 pm AEST

Week 11 - 25 May 2020

Module/Topic	Chapter	Events and Submissions/Topic
State Space Techniques in Controller Design	Chapter 14	**Team Project** Due: Week 11 Friday (29 May 2020) 11:45 pm AEST

Week 12 - 01 Jun 2020

Module/Topic	Chapter	Events and Submissions/Topic
Identification	Chapter 6	**Assignment 2** Due: Week 12 Friday (5 June 2020) 11:45 pm AEST

Review/Exam Week - 08 Jun 2020

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 15 Jun 2020

Module/Topic	Chapter	Events and Submissions/Topic

Assessment Tasks

1 Assignment 1

Assessment Type
Written Assessment

Task Description
This assignment is designed to assess the learning outcomes 1 and 2 of this unit. The assignment will have 4 - 8 problems associated with first five weeks of learning in this unit. The students will work individually and make individual submissions.

Assessment Due Date
Week 7 Friday (1 May 2020) 11:45 pm AEST
Make your individual submission to the link provided in Moodle site as a PDF/WORD file.

Return Date to Students
Week 9 Friday (15 May 2020)
Feedback will be provided through unit Moodle site.

Weighting
15%

Minimum mark or grade
50% of the marks allocated for this assignment

Assessment Criteria
Each question in this assignment will be assessed separately for the criterion accuracy and correct results and given a mark as specified in the assessment that will be published in the unit Moodle site. 10% of the total marks for this assignment are based on accuracy and correct results, including:

- Correct application of maths and arithmetic
- Answers clearly identified
- Correct results

In addition, the assignment as a whole will be assessed against the following criteria:
Evidence of correct procedures (50% of the total marks for the assignment)

- All necessary steps in analysis are present on correct order
- Clear presentation of mathematical and arithmetical working linking given details of the problem to the results
- obtained.
- Evidence of checking results (mathematical, graphical, logic-common sense)

Evidence of understanding of the topic (30% of the total marks for the assignment)

- Explanation of choices made in the analysis (why is procedure required, why this particular procedure)
- Interpretation of results, eg limitations, direction of vectors

Professional presentation (10% of the total marks for the assignment)

- The work (job) is clearly identified (problem, date, analyst)
- Clear statement of each problem and its details and requirements
- Logical layout of analysis
- Appropriate use of diagrams, clear diagrams
- Correct use of terminology, conventions
- Clear English in the explanation of procedure and interpretation of results.
- Referencing of authoritative sources of equations and data

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your individual submission to the link provided in Moodle site as a PDF/WORD file.

Learning Outcomes Assessed

- Apply Z-transforms and Z Domain analysis of control systems through transformations
- Design and implement various digital filters

Graduate Attributes

- Knowledge
- Communication
- Cognitive, technical and creative skills

2 Assignment 2

Assessment Type
Written Assessment

Task Description
This assignment is designed to assess the learning outcomes 1, 2, 3 and 4 of this unit. The assignment will have 3 - 5 design problems associated with the learning of all 12 weeks of this unit. The students will work individually and make individual submissions.

Assessment Due Date
Week 12 Friday (5 June 2020) 11:45 pm AEST
Make your individual submission to the link provided in Moodle site as a PDF/WORD file.

Return Date to Students
Exam Week Friday (19 June 2020)
Feedback will be provided through unit Moodle site.

Weighting
30%

Minimum mark or grade
50% of the marks allocated for this assignment

Assessment Criteria
Each question in this assignment will be assessed separately for the criterion accuracy and correct results and given a mark as specified in the assessment that will be published in the unit Moodle site. 10% of the total marks for this assignment are based on accuracy and correct results, including:

- Correct application of maths and arithmetic
- Answers clearly identified
- Correct results

In addition, the assignment as a whole will be assessed against the following criteria:
Evidence of correct procedures (50% of the total marks for the assignment)

- All necessary steps in analysis are present on correct order
- Clear presentation of mathematical and arithmetical working linking given details of the problem to the results obtained.
- Evidence of checking results (mathematical, graphical, logic-common sense)

Evidence of understanding of the topic (30% of the total marks for the assignment)

- Explanation of choices made in the analysis (why is procedure required, why this particular procedure)
- Interpretation of results, eg limitations, direction of vectors

Professional presentation (10% of the total marks for the assignment)

- The work (job) is clearly identified (problem, date, analyst)
- Clear statement of each problem and its details and requirements
- Logical layout of analysis
- Appropriate use of diagrams, clear diagrams
- Correct use of terminology, conventions
- Clear English in the explanation of procedure and interpretation of results.
- Referencing of authoritative sources of equations and data

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your individual submission to the link provided in Moodle site as a PDF/WORD file.

Learning Outcomes Assessed

- Apply Z-transforms and Z Domain analysis of control systems through transformations
- Design and implement various digital filters
- Model, analyse stability and design control systems in discrete state space

- Apply advanced optimal control techniques in industrial control systems

Graduate Attributes

- Knowledge
- Communication
- Cognitive, technical and creative skills

3 Team Project

Assessment Type
Portfolio

Task Description
This compulsory assessment item is the project component of the unit. Students will carry out this in teams. Complete details of a digital control design project will be provided in unit Moodle site in the beginning of the term. Students will be carrying out the project in teams through out the term and submit a professionally done team report. The teams are supposed to attend a debriefing meeting in the mid-way of the project execution. Final reports that must be prepared as one submission per team are expected before the deadline specified below.

Assessment Due Date
Week 11 Friday (29 May 2020) 11:45 pm AEST
Make your team submission to the link provided in Moodle site as a PDF/WORD file.

Return Date to Students
Review/Exam Week Friday (12 June 2020)
Feedback will be provided through unit Moodle site.

Weighting
35%

Minimum mark or grade
50% of the marks allocated for this assignment

Assessment Criteria
Marks for the project will be given marks out of 100 based on the quality of each project activity; i.e. Debriefing meeting (10%), project report (80%), Peer assessment (10%). The marking schemes for each of those will be published in the Moodle site.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your team submission to the link provided in Moodle site as a PDF/WORD file.

Learning Outcomes Assessed

- Model, analyse stability and design control systems in discrete state space
- Apply advanced optimal control techniques in industrial control systems
- Design and implement digital control systems considering stakeholder requirements
- Document and communicate professional engineering information, including computer-based simulations and drawings, risk assessments and Work Health and Safety requirements using appropriate electrical engineering standards, terminology and symbols
- Scope, plan, manage and successfully complete engineering projects autonomously and in teams with responsible, ethical and professional attitude regarding the role of engineers.

Graduate Attributes

- Knowledge
- Communication
- Cognitive, technical and creative skills
- Research
- Self-management
- Ethical and Professional Responsibility
- Leadership

4 Laboratory/Residential School and Lab Reports

Assessment Type
Practical Assessment

Task Description
This compulsory assessment item covers the laboratory experiment component of the unit. On-campus students will carry out the experiments during laboratory experiment sessions scheduled each week (attendance is compulsory) while the distance students are supposed to attend a compulsory residential school. Students will be formed into teams and each team must submit separate professional technical laboratory reports on each experiment. The details of the experiments will be notified to students through the course Website. Please also refer to assessment criteria for more details.
For distance/mixed mode students a residential school will be organised during the term. The scheduled date for the residential school will be announced later in the unit website.

Assessment Due Date
Week 10 Friday (22 May 2020) 11:45 pm AEST
Make your team submission to the link provided in Moodle site as a PDF/WORD file.

Return Date to Students
Week 12 Friday (5 June 2020)
Feedback will be provided through unit Moodle site.

Weighting
20%

Minimum mark or grade
50% of the marks allocated for this unit

Assessment Criteria
Marking of the team reports will be done according to the following criteria.

- The accuracy and relevance of information
- Application of knowledge
- Language and grammar used in answering questions
- Proper referencing of sources of information
- Inclusion of all relevant Equations, images, data and tables, and the quality of presentation and layout.
- The marking scheme will be published in Moodle site together with Laboratory instruction sheets.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Make your team submission to the link provided in Moodle site as a PDF/WORD file.

Learning Outcomes Assessed

- Design and implement digital control systems considering stakeholder requirements
- Document and communicate professional engineering information, including computer-based simulations and drawings, risk assessments and Work Health and Safety requirements using appropriate electrical engineering standards, terminology and symbols
- Scope, plan, manage and successfully complete engineering projects autonomously and in teams with responsible, ethical and professional attitude regarding the role of engineers.

Graduate Attributes

- Knowledge
- Communication
- Cognitive, technical and creative skills
- Research
- Self-management
- Ethical and Professional Responsibility
- Leadership

Academic Integrity Statement

As a CQUniversity student you are expected to act honestly in all aspects of your academic work.

Any assessable work undertaken or submitted for review or assessment must be your own work. Assessable work is any type of work you do to meet the assessment requirements in the unit, including draft work submitted for review and feedback and final work to be assessed.

When you use the ideas, words or data of others in your assessment, you must thoroughly and clearly acknowledge the source of this information by using the correct referencing style for your unit. Using others' work without proper acknowledgement may be considered a form of intellectual dishonesty.

Participating honestly, respectfully, responsibly, and fairly in your university study ensures the CQUniversity qualification you earn will be valued as a true indication of your individual academic achievement and will continue to receive the respect and recognition it deserves.

As a student, you are responsible for reading and following CQUniversity's policies, including the **Student Academic Integrity Policy and Procedure**. This policy sets out CQUniversity's expectations of you to act with integrity, examples of academic integrity breaches to avoid, the processes used to address alleged breaches of academic integrity, and potential penalties.

What is a breach of academic integrity?
A breach of academic integrity includes but is not limited to plagiarism, self-plagiarism, collusion, cheating, contract cheating, and academic misconduct. The Student Academic Integrity Policy and Procedure defines what these terms mean and gives examples.

Why is academic integrity important?
A breach of academic integrity may result in one or more penalties, including suspension or even expulsion from the University. It can also have negative implications for student visas and future enrolment at CQUniversity or elsewhere. Students who engage in contract cheating also risk being blackmailed by contract cheating services.

Where can I get assistance?
For academic advice and guidance, the Academic Learning Centre (ALC) can support you in becoming confident in completing assessments with integrity and of high standard.

What can you do to act with integrity?

Be Honest
If your assessment task is done by someone else, it would be dishonest of you to claim it as your own

Seek Help
If you are not sure about how to cite or reference in essays, reports etc, then seek help from your lecturer, the library or the Academic Learning Centre (ALC)

Produce Original Work
Originality comes from your ability to read widely, think critically, and apply your gained knowledge to address a question or problem