ENEX14001 *Mechatronics Systems Design*
Term 1 - 2025

Profile information current as at 25/04/2025 09:42 am

General Information

Overview
This unit will introduce you to supervisory control and data acquisition (SCADA) system design and development using industry standard SCADA software. You will also learn how to analyse system requirements for a given mechatronics system task, evaluate and select mechatronics modules and components from a pool of mechatronics modules and components. You will design custom components and fabricate them, develop concept designs and select the best option, design and develop a mechatronics solution for a given complex task. You will also program the developed mechatronics system using industry standard control systems and SCADA software, and commission the system. In this unit, you must complete compulsory practical activities. Refer to the Engineering Undergraduate Course Moodle site for proposed dates.

Details
Career Level: *Undergraduate*
Unit Level: *Level 4*
Credit Points: *12*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.25*

Pre-requisites or Co-requisites
Prerequisites: ENEX13001 Instrumentation and Industrial Automation AND ENEX13003 Design of Mechatronics Elements
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 - 2025

- Mackay
- Mixed Mode

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).

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 Undergraduate 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: 25%
2. **Practical Assessment**
Weighting: 25%
3. **Portfolio**
Weighting: 50%

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 Student in-class feedback

Feedback

The unit’s learning and assessment requirements are not clear,

Recommendation

The learning and assessment requirements should be frequently discussed in the weekly class.

Feedback from SUTE

Feedback

Students have not completed the unit evaluation surveys

Recommendation

Students should be encouraged to participate in the unit evaluation surveys by highlighting the importance of their feedback in shaping future improvements.

Unit Learning Outcomes

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

1. Apply skills in industry standard data acquisition and control software to acquire sensor signals and control actuators
2. Apply the design process to propose a mechatronics system for a real-world application
3. Assemble a mechatronics system designed and fabricated from custom components
4. Develop industry-standard control systems and SCADA systems to operate the designed mechatronic system
5. Work individually and collaboratively in teams, communicate professionally using mechatronics engineering terminology, symbols and diagrams that conform to Australian and international standards.

The Learning Outcomes for this unit are linked with the Engineers Australia Stage 1 Competency Standards for Professional Engineers in the areas of 1. Knowledge and Skill Base, 2. Engineering Application Ability and 3. Professional and Personal Attributes at the following levels:

Intermediate 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. (LO: 5I)

Advanced 1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. (LO: 1I 2I 3A 4A 5A) 1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 1I 2I 3I 4A 5A) 1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1I 2I 4A 5A) 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 1A 2I 4A 5A) 1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline. (LO: 1A 2I 4A 5A) 2.1 Application of established engineering methods to complex engineering problem solving. (LO: 1I 2I 3I 4A 5A) 2.2 Fluent application of engineering techniques, tools and resources. (LO: 1I 2I 3I 4A 5A) 2.3 Application of systematic engineering synthesis and design processes. (LO: 1I 2I 3I 4A 5A) 2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 1I 2I 3I 4A 5A) 3.1 Ethical conduct and professional accountability. (LO: 5A 6A) 3.2 Effective oral and written communication in professional and lay domains. (LO: 5A 6A) 3.3 Creative, innovative and pro-active demeanour. (LO: 5A 6A) 3.4 Professional use and management of information. (LO: 1A 2A 5I 6A) 3.5 Orderly management of self, and professional conduct. (LO: 5A 6A) 3.6 Effective team membership and team leadership. (LO: 5A 6A)

Note: LO refers to the Learning Outcome number(s) which link to the competency and the levels: N – Introductory, I – Intermediate and A - Advanced.

Refer to the Engineering Undergraduate Course Moodle site for further information on the Engineers Australia's Stage 1 Competency Standard for Professional Engineers and course level mapping informationhttps://moodle.cqu.edu.au/course/view.php?id=1511

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
1 - Written Assessment - 25%			•		
2 - Practical Assessment - 25%	•	•		•	•

Assessment Tasks	Learning Outcomes				
	1	2	3	4	5
3 - Portfolio - 50%	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes				
	1	2	3	4	5
1 - Communication					•
2 - Problem Solving	•	•	•	•	
3 - Critical Thinking	•	•	•	•	
4 - Information Literacy		•			•
5 - Team Work					•
6 - Information Technology Competence	•			•	
7 - Cross Cultural Competence					
8 - Ethical practice					
9 - Social Innovation					
10 - 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	9	10
1 - Written Assessment - 25%		•	•							
2 - Practical Assessment - 25%		•	•			•				
3 - Portfolio - 50%	•	•	•	•	•	•		•		

Textbooks and Resources

Textbooks

There are no required textbooks.

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)
- Access to a document scanner and a software that can create pdf documents
- LabView 2019 or latest (provided by CQU)
- A computer with speaker & microphone, Microsoft Windows OS(10 or later) with admin rights to install software, and good internet connectivity

Referencing Style

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

Teaching Contacts

Lasi Piyathilaka Unit Coordinator
l.piyathilaka@cqu.edu.au

Schedule

Week 1 - 10 Mar 2025

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to Mechatronics Systems Design • Introduction to LabView	N/A	

Week 2 - 17 Mar 2025

Module/Topic	Chapter	Events and Submissions/Topic
• Kinematics of robotic systems	N/A	

Week 3 - 24 Mar 2025

Module/Topic	Chapter	Events and Submissions/Topic
• 3-D Design and analysis of robotic systems	N/A	

Week 4 - 31 Mar 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Virtual Instruments	N/A	

Week 5 - 07 Apr 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - MathScripts	N/A	**Assignment 1 - Mechatronics systems Design (Mechanical)** Due: Week 5 Friday (11 Apr 2025) 11:45 pm AEST

Vacation Week - 14 Apr 2025

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 21 Apr 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Editing and Debugging Virtual Instruments	N/A	

Week 7 - 28 Apr 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Programming Structures	N/A	**Assignment 2 - Labview based control system** Due: Week 7 Friday (2 May 2025) 11:45 pm AEST

Week 8 - 05 May 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Sub VIs, Hardware Interfacing	N/A	

Week 9 - 12 May 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Arrays and Clusters	N/A	Residential School at the Mackay Ooralea Campus

Week 10 - 19 May 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Charts and Graphs	N/A	

Week 11 - 26 May 2025

Module/Topic	Chapter	Events and Submissions/Topic
• LabVIEW - Data Acquisition	N/A	

Week 12 - 02 Jun 2025

Module/Topic	Chapter	Events and Submissions/Topic
• Advanced Mechatronics Systems and Future Opportunities	N/A	**Portfolio Assessment** Due: Week 12 Friday (6 June 2025) 11:45 pm AEST

Review/Exam Week - 09 Jun 2025

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 16 Jun 2025

Module/Topic	Chapter	Events and Submissions/Topic

Term Specific Information

Students are required to purchase the necessary embedded microcontroller board, sensors, actuators and accessories for the projects.

Assessment Tasks

1 Assignment 1 - Mechatronics systems Design (Mechanical)

Assessment Type
Written Assessment

Task Description
Students will design mechanical components for a given mechatronics system, ensuring functionality, structural integrity, and manufacturability. Using CAD software, they will create 3D models and perform stress analysis through simulations to evaluate performance under expected loads. Each student will submit technical drawings, stress analysis results, and 3D-printable files (e.g., STL or STEP). Additionally, a brief report will be required, detailing design choices, material selection, and relevant calculations.

Assessment Due Date
Week 5 Friday (11 Apr 2025) 11:45 pm AEST

Return Date to Students

Marked assignment with feedback. However, there will be no model answers provided as this is a design.

Weighting
25%

Minimum mark or grade
50%

Assessment Criteria

- Functionality and Design Accuracy: The mechanical components meet the required functional specifications of the mechatronics system, ensuring proper fit, movement, and integration with other components.
- Structural Integrity: The design demonstrates appropriate consideration of mechanical properties, such as strength, stiffness, and durability. Stress analysis results should show minimal risk of failure under expected loading conditions.
- CAD Modeling and Detailing: The CAD models are detailed, accurate, and represent the design clearly. The technical drawings should be precise and follow standard engineering drawing conventions, including dimensions, tolerances, and assembly details.
- Stress Analysis and Performance Evaluation: The student applies appropriate simulation tools to assess the component's performance under expected loads. The analysis is thorough, and results are used to refine the design where necessary.
- Material Selection: The materials chosen for the components are suitable for the expected mechanical loads, environmental conditions, and manufacturability. Justification for material choice should be provided, considering factors like strength, cost, and availability.
- 3D-Printable Files: The submission includes 3D-printable files (e.g., STL or STEP) that are ready for manufacturing. The files should be optimised for the intended fabrication method.
- Calculations and Justification: Relevant engineering calculations (e.g., stress, strain, factor of safety, and deformation) are provided, with clear explanations of the methods used and results obtained. The Report should also justify any design decisions based on the analysis.
- Report Quality: The report is well-organised, clear, and professional, summarising the design process, analysis, material selection, and calculations. It should include any modifications made to the initial design based on analysis or testing outcomes.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
As a single zipped folder containing everything.

Learning Outcomes Assessed

- Assemble a mechatronics system designed and fabricated from custom components

Graduate Attributes

- Problem Solving
- Critical Thinking

2 Assignment 2 - Labview based control system

Assessment Type
Practical Assessment

Task Description
Students will design virtual instruments (VIs) for various tasks, utilising LabVIEW software to develop interactive and functional solutions for data acquisition, signal processing, control, or automation applications. Each student will independently design and implement their own VI, ensuring that it meets the specified functional requirements and follows best practices in software development, including modularity, efficiency, and user-friendly interface design. The designed virtual instruments should be capable of performing tasks such as data visualization, sensor integration, or control system implementation, depending on the assigned project. Students will test and validate their designs to ensure proper operation and compatibility with LabVIEW. Each student will submit the completed LabVIEW VI file, along with any necessary supporting files, ensuring compatibility for execution within the LabVIEW environment. Additionally, a brief documentation report will be required, detailing the design process, functionality, key features, and any challenges encountered during development.

Assessment Due Date
Week 7 Friday (2 May 2025) 11:45 pm AEST

Return Date to Students

Marked assignment with feedback. However, there will be no model answers provided as this is a design.

Weighting
25%

Minimum mark or grade
50%

Assessment Criteria

- Functionality: The virtual instrument meets the functional requirements of the task, performing all specified operations correctly.
- Design and User Interface: The design is user-friendly, with a clear and organised interface. The layout and controls are intuitive for ease of use.
- Code Structure and Efficiency: The VI follows best practices in terms of modularity, efficiency, and readability of the code. Proper use of loops, structures, and subVIs is demonstrated.
- Testing and Validation: The instrument is tested thoroughly, with all functionality verified to work correctly under different scenarios.
- Documentation: The report is clear, concise, and includes an explanation of the design, functionality, and any modifications or challenges encountered during development.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Pdf report, and LabView code and demostration video

Learning Outcomes Assessed

- Apply skills in industry standard data acquisition and control software to acquire sensor signals and control actuators
- Apply the design process to propose a mechatronics system for a real-world application
- Develop industry-standard control systems and SCADA systems to operate the designed mechatronic system
- Work individually and collaboratively in teams, communicate professionally using mechatronics engineering terminology, symbols and diagrams that conform to Australian and international standards.

Graduate Attributes

- Problem Solving
- Critical Thinking
- Information Technology Competence

3 Portfolio Assessment

Assessment Type
Portfolio

Task Description
This is the main project of the unit, in which you will develop a mobile robotic platform with obstacle avoidance and the

ability to follow a prescribed path. The assembly of the robot will be done as a group, while the testing will be carried out individually. The group will collaborate on testing each type of sensor and actuator in the system, working both independently and together before installing them on the individual robots. Once the sensors and actuators are calibrated, they will be fitted onto the mobile platform. Each student will then load their own program for the given task, and the robots will be tested individually. Your portfolio will consist of two parts: the first part will cover the sensor and actuator calibrations conducted in the group, and the second part will focus on your individual program to control your robot.

Assessment Due Date
Week 12 Friday (6 June 2025) 11:45 pm AEST

Return Date to Students

The portfolio will not be returned until the unit grades are released as there is no final examination for this unit.

Weighting
50%

Minimum mark or grade
50%

Assessment Criteria

To obtain full marks students must;

- Provide all required components of the portfolio (a detailed document is available on Moodle)
- Provide the Labview control program developed by the individual student
- Provide a report discussing the control behaviour of the mechatronics system using their own LabView program
- Provide a report on all laboratory experiments conducted with a detailed discussion
- Provide a demonstration video
- All drawings and writing must be clear and legible.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
As a single zipped folder containing everything.

Learning Outcomes Assessed

- Apply skills in industry standard data acquisition and control software to acquire sensor signals and control actuators
- Apply the design process to propose a mechatronics system for a real-world application
- Assemble a mechatronics system designed and fabricated from custom components
- Develop industry-standard control systems and SCADA systems to operate the designed mechatronic system
- Work individually and collaboratively in teams, communicate professionally using mechatronics engineering terminology, symbols and diagrams that conform to Australian and international standards.

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Information Literacy
- Team Work
- Information Technology Competence
- Ethical practice

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