ENEX20001 *Embedded System Design*
Term 1 - 2024

Profile information current as at 28/04/2024 03:38 pm

General Information

Overview

This unit will introduce you to microcontroller basics and their real world applications. You will learn about different microcontroller families and their similarities and differences from an application point of view. You will also learn about microcontroller architecture, memory maps, addressing modes, interrupts, timers, counters, and hardware interfacing of a chosen microcontroller. You will learn how to program a microcontroller in a high level language using an integrated development environment. Advanced topics of reading analog inputs, implementation of USART (Universal Synchronous Asynchronous Receiver Transmitter) connections with external world, PWM (Pulse Width Modulation), will also be covered in this unit. After learning the fundamentals of hardware interfacing you will practice them in a laboratory using a microcontroller development system based on this specific microcontroller and finally design and prototype an authentic application of embedded system in your project using the same development system. Online education students are required to attend the residential school.

Details

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

Pre-requisites or Co-requisites

ENEE14006 Embedded Microcontrollers is an Anti-Requisite 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 - 2024

- Melbourne
- Mixed Mode
- 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. **Online Quiz(zes)**
Weighting: Pass/Fail
2. **Written Assessment**
Weighting: 20%
3. **Practical Assessment**
Weighting: 20%
4. **Practical Assessment**
Weighting: 20%
5. **Portfolio**
Weighting: 40%

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 In-class student feedback

Feedback

The use of Microsoft Teams is a more efficient way to resolve hardware and software problems encountered by students in their assessments.

Recommendation

Microsoft Teams should be employed alongside emails and forums when addressing student queries related to software and hardware issues.

Feedback from Student unit evaluation responses

Feedback

More sample codes and reading materials are needed to improve learning resources.

Recommendation

Additional sample codes and reading materials should be provided to enhance learning resources.

Feedback from Unit Coordinator's refelction

Feedback

The use of authentic assessment practices with individualised assessment items has resulted in a decrease in academic misconduct cases.

Recommendation

Authentic assessment practices with individualised assessment items should be employed to mitigate academic misconduct cases.

Unit Learning Outcomes

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

1. Apply fundamental structured programming knowledge to perform software tasks
2. Program a microcontroller to interface with external devices such as analog and digital sensors, actuators and computers
3. Analyse and design microcontroller based real-time applications using a given industry-standard development system and software tools
4. Prototype an embedded microcontroller system for a real-world application
5. Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document design and prototyped solutions
6. Work autonomously and as a team member to analyse problems and present solutions.

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

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 Postgraduate Units Moodle site for further information on the Engineers Australia's Stage 1 Competency Standard for Professional Engineers and course level mapping information
https://moodle.cqu.edu.au/course/view.php?id=11382

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

Assessment Tasks	Learning Outcomes					
	1	2	3	4	5	6
1 - Online Quiz(zes) - 0%	•					
2 - Written Assessment - 20%	•					
3 - Practical Assessment - 20%		•				
4 - Practical Assessment - 20%			•	•	•	•
5 - Portfolio - 40%	•	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
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 - Online Quiz(zes) - 0%	○							
2 - Written Assessment - 20%	○	○	○		○	○		
3 - Practical Assessment - 20%	○	○	○	○	○	○		
4 - Practical Assessment - 20%	○	○	○	○	○	○		
5 - Portfolio - 40%	○	○	○	○	○	○	○	

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
- Access to a computer with Windows 10 with authoity to install software required for the unit
- Downlaod and Install Visual Studio Code

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 - 04 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to C language programming environment	N/A	

Week 2 - 11 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to Embedded Systems and Microcontrollers	N/A	**Assignment 1- Diagnostic test** Due: Week 2 Friday (15 Mar 2024) 11:59 am AEST

Week 3 - 18 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
• AVR Programming basics • Digital Inputs /Outputs	N/A	

Week 4 - 25 Mar 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Programming in C language - Motor Control	N/A	

Week 5 - 01 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
• ATMEGA328P Serial Communication	N/A	**Assignment 2 - C language programming** Due: Week 5 Friday (5 Apr 2024) 11:45 pm AEST

Vacation Week - 08 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 15 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Analog to Digital Conversion	N/A	Project Proposal and plan due

Week 7 - 22 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Timers, Interrupts and PWM	N/A	**Assignment 3 - Laboratory Exercises** Due: Week 7 Friday (26 Apr 2024) 11:45 pm AEST

Week 8 - 29 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Servo Motor Control	N/A	

Week 9 - 06 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Ultrasound Sensor Interfacing	N/A	**Assignment 4 : Hardware Programming Task** Due: Week 9 Friday (10 May 2024) 11:45 pm AEST

Week 10 - 13 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Project Progress Review	N/A	

Week 11 - 20 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Project Help	N/A	Project progress review

Week 12 - 27 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
• Final Project Progress Update	N/A	

Review/Exam Week - 03 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
		Assignment 5 - Portfolio Due: Review/Exam Week Thursday (6 June 2024) 11:45 pm AEST

Exam Week - 10 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic

Term Specific Information

Students are required to purchase the sensors, actuators, and a microcontroller board to complete the hardware programming assignments and the project. It is expected that students purchase all these necessary components by week 3, and the list of the required components can be found on the Week 1 Moodle site.

Assessment Tasks

1 Assignment 1- Diagnostic test

Assessment Type
Online Quiz(zes)

Task Description
This is a diagnostic test (which carry no marks towards your grade) to identify students' level of understanding of computer programming and electronics basics to support them more effectively.

Number of Quizzes

Frequency of Quizzes
Other

Assessment Due Date
Week 2 Friday (15 Mar 2024) 11:59 am AEST

Return Date to Students

Students will know the test outcome soon after completing the test.

Weighting
Pass/Fail

Assessment Criteria
This will be assessed to identify the need for extra support for individual students and indentify the knowledge gaps. This online quiz will have equal weight to all questions.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Online Quiz

Learning Outcomes Assessed

- Apply fundamental structured programming knowledge to perform software tasks

Graduate Attributes

- Knowledge

2 Assignment 2 - C language programming

Assessment Type
Written Assessment

Task Description
The purpose of this assignment is to evaluate your understanding of AVR C language programming and configuring control registers to accomplish specific tasks on a microcontroller. The assignment aims to assess your ability to analyze a system, develop a conceptual solution, create a visual representation, and write code to solve the given challenges. It is essential to note that this assignment is an individual task, and collaborating or seeking help from others is strictly prohibited. You must demonstrate proof of your independent efforts as outlined in the assignment submission requirements. In this assignment, you will have to program simulated hardware to achieve a specific goal. The objective is intended to demonstrate your C programming skills within the context of solving a real-world problem.

Assessment Due Date
Week 5 Friday (5 Apr 2024) 11:45 pm AEST

Return Date to Students

Marked assignment with feedback will be returned to students usually within 2 weeks after submission. However, there will be no model answers provided.

Weighting
20%

Minimum mark or grade
30%

Assessment Criteria
This assessment will be based on the achievement of specified tasks in the assessment document, and marks will be allocated for each task according to the following assessment criteria.
1. Task Achievement:

- Demonstrates the ability to understand the goals and requirements of the simulated robot program.

- Develops a comprehensive and correct solution for each task.
- Achieves the desired outcomes as specified in the assignment.
- Provide evidence of the program successfully accomplishing the tasks, such as video recordings or screenshots.

2. Problem-Solving and Solution Development:

- Presents a clear and logical approach to solving the problems.
- Breaks down complex problems into smaller, manageable tasks.
- Uses appropriate algorithms, data structures, and programming constructs to implement the solution.
- Provides a detailed explanation of the problem-solving process, including any iterations or revisions made during development.
- Includes flowcharts, or other graphical representations to illustrate the solution.

3. Code Quality and Documentation:

- Follows standard programming conventions and naming conventions.
- Includes appropriate comments throughout the code to explain the purpose of each section, key variables, and logic.
- Provides an explanation of the code's functionality, highlighting any important algorithms or techniques used.
- Writes clean and well-structured C language code.

5. Individuality and Originality:

- Ensures that each student develops their own unique programs independently.
- Avoids copying code or solutions from external sources without proper attribution.
- Demonstrates creativity and original thinking in solving programming problems.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
A single PDF file , software codes and video files need to be uploaded to moodle

Learning Outcomes Assessed

- Apply fundamental structured programming knowledge to perform software tasks

Graduate Attributes

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

3 Assignment 3 - Laboratory Exercises

Assessment Type
Practical Assessment

Task Description
This assessment is designed to incorporate hands-on learning experiences through laboratory exercises, utilizing the simulated and actual Microcontroller board along with sensors and actuators. These practical exercises will be conducted over four weeks, specifically weeks 2 to 6 of the unit, allowing students ample time to explore and master the concepts. Throughout this period, students will engage in a series of workshops that involve working with the Microcontroller board, sensors, and actuators. The exercises are carefully crafted to cover various aspects of the unit material and provide a comprehensive understanding of microcontroller-based systems.
Each week, students are expected to complete a set of laboratory exercises using a simulated environment. These weekly exercises ensure that students remain actively engaged and stay on track with their progress. It also allows instructors to monitor individual performance and provide timely feedback.
It is important to note that this is an individual assessment, and no collaboration or contribution from others is permitted.

Assessment Due Date
Week 7 Friday (26 Apr 2024) 11:45 pm AEST

These laboratory exercises should be completed weekly. The final report and codes are due by Week 7.

Return Date to Students

Marked lab report with feedback will be returned to students usually within 2 weeks after submission.

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
Assessment Criteria (each question)

- Graphical representation of the program using a flowchart or a block diagram
- A fully working program producing expected outcomes, which will be assessed based on the video demonstration, codes, and the report submitted to the Moodle site.
- Explanation of the code, including all functions and configuration parameters, with appropriate comments on all code sections. Screenshots from the code should be used when explaining each section, and this should be included in the report.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Report as a Pdf File, Video demos, software codes need to be uploded to Moodle

Learning Outcomes Assessed

- Analyse and design microcontroller based real-time applications using a given industry-standard development system and software tools
- Prototype an embedded microcontroller system for a real-world application
- Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document design and prototyped solutions
- Work autonomously and as a team member to analyse problems and present solutions.

Graduate Attributes

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

4 Assignment 4 : Hardware Programming Task

Assessment Type
Practical Assessment

Task Description
This assignment evaluates your essential C language programming skills for embedded microcontroller programming. You will be tested on your ability to develop solutions for given problems and implement them on the embedded microcontroller board.
Before starting the coding, it's crucial to analyze the system, create a conceptual solution, and develop a graphical representation. All your work, including software codes and demonstration videos, must be submitted as evidence of your individual efforts. Technical details regarding the assignment will be provided upon receiving the task.
It is important to note that this is an individual assessment, and no collaboration or contribution from others is permitted.

Assessment Due Date
Week 9 Friday (10 May 2024) 11:45 pm AEST

Return Date to Students

Marked assignment with feedback will be returned to students usually within 2 weeks after submission. However, there

will be no model answers provided.

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
Assessment Criteria (each question)

- Graphical representation of the program using a flowchart or a block diagram.
- A fully working program producing expected outcomes, which will be assessed based on the video demonstration, codes, and the report submitted to the Moodle site. Failure to provide a demonstration video and codes will result in a zero mark.
- Explanation of the code, including all functions and configuration parameters, with appropriate comments on all code sections. Screenshots from the code should be used when explaining each section, and this should be included in the report.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Report as a Pdf File, Video demos, software codes need to be uploded to Moodle

Learning Outcomes Assessed

- Program a microcontroller to interface with external devices such as analog and digital sensors, actuators and computers

Graduate Attributes

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

5 Assignment 5 - Portfolio

Assessment Type
Portfolio

Task Description
This project is a vital part of the unit, offering students both guided and open-ended opportunities to showcase their abilities. The primary objective is to develop a functional prototype of an embedded system solution for a real-world problem by using a microcontroller board and any additional components. At the end of the term, the prototype's performance will be assessed. Collaboration or assistance from others is not permitted, ensuring that students' work demonstrates their unique skills and creativity. The project allows students to demonstrate their expertise in designing and implementing embedded systems while gaining practical experience in solving real-world challenges.

Assessment Due Date
Review/Exam Week Thursday (6 June 2024) 11:45 pm AEST

Return Date to Students

Marked portfolio will be returned with feedback after the release of grades.

Weighting
40%

Minimum mark or grade
50%

Assessment Criteria
1. Project progress Reviews (Week 11)

- Each student will get an Individual Zoom interview with the unit coordinator. Students need to show substantial

progress towards the timely completion of the project. Need to provide evidence for the progress such as video, codes, sensor and actuator testing, and design sketches

2. Goal Achievement:

- Demonstrates the ability to understand the goals and requirements of the simulated robot program.
- Develops a comprehensive and correct solution for each goal.
- Achieves the desired outcomes as specified in the assignment.
- Provides evidence of the program successfully accomplishing the goals, such as video recordings or screenshots.

3. Report

- Need to complete a report according to the given structure that demonstrates the following problem-solving skills
- Presents a clear and logical approach to solving the problems.
- Breaks down complex problems into smaller, manageable tasks.
- Uses appropriate algorithms, data structures, and programming constructs to implement the solution.
- Provides a detailed explanation of the problem-solving process, including any iterations or revisions made during development.
- Includes flowcharts, or other graphical representations to illustrate the solution.

4. Software Codes

- Follows standard programming conventions and naming conventions.
- Includes appropriate comments throughout the code to explain the purpose of each section, key variables, and logic.
- Writes clean and well-structured C language code using functions.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Report as a single PDF file, sofware codes, demostration video

Learning Outcomes Assessed

- Apply fundamental structured programming knowledge to perform software tasks
- Program a microcontroller to interface with external devices such as analog and digital sensors, actuators and computers
- Analyse and design microcontroller based real-time applications using a given industry-standard development system and software tools
- Prototype an embedded microcontroller system for a real-world application
- Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document design and prototyped solutions
- Work autonomously and as a team member to analyse problems and present solutions.

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