ENEX20001 *Embedded System Design*
Term 1 - 2023

Profile information current as at 27/04/2024 07:26 pm

All details in this unit profile for ENEX20001 have been officially approved by CQUniversity and represent a learning partnership between the University and you (our student). The information will not be changed unless absolutely necessary and any change will be clearly indicated by an approved correction included in the profile.

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 - 2023

- 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.

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 Coordinator's reflection

Feedback

The use of physical hardware in this unit gave opportunities to apply knowledge into practical problems.

Recommendation

Continue to engage students with practical uses of physical hardware and have exercises and assessments that require students to use physical hardware

Feedback from Unit Coordinator's reflection

Feedback

Further exercises and explanation into some aspects of hardware programming would be useful.

Recommendation

Incorporating and highlighting hardware programming examples in lectures and tutorials and providing more detailed explanation of codes.

Feedback from Unit Survey's Feedback

Feedback

Be more responsive to student emails

Recommendation

Encourage students to exchange questions and ideas on the unit's learning forum as this is beneficial to the entire learning cohort. Educating students that questions that are previously answered in the forum will not be re-answered through personal emails.

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)
- A computer with 9 pin serial port or USB to serial converter, speaker & microphone, Microsoft Windows OS(7 or later) with admin rights to install software, and good internet connectivity
- Code::Blocks IDE for C programming (freeware from www.codeblocks.org)
- MPLAB IDE: MPALB X (provided by CQU on lab computers) or later and MCC18 C compiler(free download from Microchip website)
- Access to a document scanner and a software that can create pdf documents

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 - 06 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to Embedded Systems and Microcontrollers • Introduction to programming languages • Introduction to C language programming environment	N/A	**Diagnostic test** Due: Week 1 Friday (10 Mar 2023) 11:45 pm AEST

Week 2 - 13 Mar 2023

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

Week 3 - 20 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC Microcontroller and MPLAB X - Introduction • Programming in C language - Essentials I	N/A	

Week 4 - 27 Mar 2023

Module/Topic	Chapter	Events and Submissions/Topic

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 memory, input and output • Programming in C language - Essentials II	N/A	

Week 5 - 03 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC18F4321 architecture and addressing modes • Programming in C language - Intermediate level	N/A	**Assignment 1 - C language programming** Due: Week 5 Friday (7 Apr 2023) 11:45 pm AEST

Vacation Week - 10 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 17 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing I - LCD display units, SSD	N/A	Project Proposal due

Week 7 - 24 Apr 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing II - sensors (analog and digital)	N/A	**Laboratory Practicals** Due: Week 7 Monday (24 Apr 2023) 11:45 pm AEST

Week 8 - 01 May 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing III - motors and actuators	N/A	

Week 9 - 08 May 2023

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing IV - keypads,timers ultrasound sensors, and advanced sensors	N/A	

Week 10 - 15 May 2023

Module/Topic	Chapter	Events and Submissions/Topic
		Project Progress update 1
• PIC18F4321 communication - RS232	N/A	**Assignment 2: Hardware Programming using CQU PIC Development kit** Due: Week 10 Monday (15 May 2023) 11:45 pm AEST

Week 11 - 22 May 2023

Module/Topic	Chapter	Events and Submissions/Topic
Embedded microcontroller future opportunities Project Help	N/A	Project progress update 2

Week 12 - 29 May 2023

Module/Topic	Chapter	Events and Submissions/Topic
Project Help	N/A	Project progress update 3

Review/Exam Week - 05 Jun 2023

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 12 Jun 2023

Module/Topic	Chapter	Events and Submissions/Topic

Term Specific Information

This unit includes intensive laboratory classes. Please check the timetable for the location and dates

Assessment Tasks

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 1 Friday (10 Mar 2023) 11:45 pm 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 of extra support for individual student. 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 1 - C language programming

Assessment Type
Written Assessment

Task Description
The aim of this assignment is to assess your skills in C language programming for embedded microcontroller use. You are required to demonstrate your ability to analyze the system, develop a conceptual solution, create a visual representation, and write code to solve the given problems.
It is important to note that this is an individual assignment and no collaboration or assistance from others is permitted. You must provide evidence of your own efforts as specified in the assignment submission requirements. The assignment will test your essential C language programming abilities for use in embedded microcontroller systems.

Assessment Due Date
Week 5 Friday (7 Apr 2023) 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%

Assessment Criteria
Detailed assessment criteria are in the assignment itself.
This assignment is based on C language programming skills. To obtain full marks students must provide all in detail problem solving and solution development evidence. Each student must have their unique programs developed by themselves. Answer to every problem should include a flowchart / NS-diagram or other similar graphical representation of the solution. Students should submit the complete working C language code for each question. A clean working program as the answer to a question without evidence of the development of it (e.g. without a soft copy of workbook pages relevant to it) will receive a maximum of 50% of the allocated marks for that question.

Referencing Style

- [Harvard (author-date)](#)

Submission
Online

Submission Instructions
as a single PDF file and software codes

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 2: Hardware Programming using CQU PIC Development kit

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 CQU PIC development board using MPLAB X IDE and C language.
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 10 Monday (15 May 2023) 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
Detailed assessment criteria are in the assignment itself.
To obtain full marks students must provide all in detail problem solving and solution development evidence. Each student must have their unique programs developed by themselves. Answer to every problem should include a flowchart/ NS-diagram or other similar graphical representation of the solution. Students should submit the complete working C language code for each question. A clean working program as the answer to a question without evidence of the development of it (ex: a soft copy of workbook pages relevant to it or an explanation of your code) will receive a maximum of 50% of the allocated marks for that question. No assembly language solutions or subroutines are allowed.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
as a single PDF file, software codes must be included

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

4 Laboratory Practicals

Assessment Type
Practical Assessment

Task Description
This assessment is based on laboratory placticals which can be carried out at CQU labs at home using the provided CQU PIC Development kit. Detailed description of the practicals will be available on Moodle.

Assessment Due Date
Week 7 Monday (24 Apr 2023) 11:45 pm AEST

Return Date to Students

Marked lab report 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
Detailed assessment criteria are in the assignment itself.
To obtain full marks students must provide all in detail problem solving and solution development evidence. Each student must have their unique programs developed by themselves. Answer to every problem should include a flowchart/ NS-diagram or other similar graphical representation of the solution. Students should submit the complete working C language code for each question. A clean working program as the answer to a question without evidence of the development of it (e.g. a soft copy of workbook pages relevant to it or an explanation of your code) will receive a maximum of 50% of the allocated marks for that question. No assembly language solutions or subroutines are allowed.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
as a single PDF file

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

5 Portfolio

Assessment Type
Portfolio

Task Description
This project is a key component of the unit, providing both guided and open-ended opportunities for students to demonstrate their abilities. The main hardware used for the project is the CQU PIC Development Kit and the sensor/actuator board provided by CQU. You have the freedom to utilize additional sensors, actuators, and accessories at your own cost. The main objective is to create a working prototype of an embedded system solution for a real-world issue. Your prototype's performance will be assessed at the end of the term.
Please keep in mind that this is an individual assessment and no collaboration or assistance from others is permitted.

Assessment Due Date
Exam Week Thursday (15 June 2023) 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
The portfolio marks will be allocated to the project depth, the successfulness of each individual element, the successfulness of integrating all elements into a complete working prototype, and professional documentation related to the project.
The portfolio marks will also be allocated to the level of the project, the level of successful completion, the level of programming techniques and effective memory usage, etc.
A detailed description of portfolio assessment criteria will be available in Moodle.

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