ENEE14006 *Embedded Microcontrollers*
Term 1 - 2022

Profile information current as at 10/04/2024 12:17 am

General Information

Overview

This unit will introduce you to microcontroller basics and their real-world applications. Fundamentals of high-level structured language programming, essential for programming a microcontroller, will be taught in this unit. 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. Advance topics of reading analog inputs, implementation of Universal Synchronous Asynchronous Receiver Transmitter connections with the external world, 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 a specific microcontroller and finally design and prototype a real-world application of the embedded system in your project using the same development 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

Prerequisite: (ENEE13020 Digital Electronics AND ENEE13018 Analogue Electronics) OR ENEX12002 Introductory Electronics
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 - 2022

- Bundaberg
- Cairns
- Gladstone
- Mackay
- 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 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. **Written 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 feedback survey.

Feedback
Good resources were provided as an introduction to C language and microcontroller programming

Recommendation
These good resources will be further enhanced.

Feedback from Student feedback survey.

Feedback
The physical use of hardware in this unit gave the opportunity to apply knowledge into practice.

Recommendation
This practice will be continued.

Feedback from Student feedback survey.

Feedback
The code on some lecture slides didn't work when copied and pasted.

Recommendation
Most of the code in lecture slides work straight away however, some code segments have left with errors to force students to debug the code by themselves when copied and pasted. Footnotes can be added to all example code to remind students debugging is required to develop coding skills.

Feedback from Student feedback survey.

Feedback
Further exercises and explanations into some aspects of the hardware programming will be helpful.

Recommendation
New exercises and hardware programming examples will be added.

Unit Learning Outcomes

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

1. Apply fundamental structured programming knowledge to develop software solutions
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 an authentic 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 4N)

1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline. (LO: 4N)

Intermediate

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 4I)

3.6 Effective team membership and team leadership. (LO: 5I 6I)

Advanced

1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline. (LO: 2I 3I 4A)

1.4 Discernment of knowledge development and research directions within the engineering discipline. (LO: 1I 2I 3I 4A)

1.6 Understanding of the scope, principles, norms, accountabilities, and bounds of sustainable engineering practice in the specific discipline. (LO: 3I 4A)

2.1 Application of established engineering methods to complex engineering problem solving. (LO: 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: 4A)

2.4 Application of systematic approaches to the conduct and management of engineering projects. (LO: 4A)

3.1 Ethical conduct and professional accountability. (LO: 3I 4I 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: 3I 4A 5A 6A)

3.4 Professional use and management of information. (LO: 3I 4A 5A 6A)

3.5 Orderly management of self, and professional conduct. (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 information
https://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	6
1 - Written Assessment - 25%	•					
2 - Written Assessment - 25%		•	•	•		•
3 - Portfolio - 50%	•	•	•	•	•	•

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
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						

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)

Referencing Style

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

Teaching Contacts

Narottam Das Unit Coordinator
n.das@cqu.edu.au

Schedule

Week 1 - 07 Mar 2022

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	

Week 2 - 14 Mar 2022

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

Week 3 - 21 Mar 2022

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

Week 4 - 28 Mar 2022

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

Week 5 - 04 Apr 2022

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 (8 Apr 2022) 11:55 pm AEST

Vacation Week - 11 Apr 2022

Module/Topic	Chapter	Events and Submissions/Topic

Week 6 - 18 Apr 2022

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing I - LCD Display units, Timers and Counters	N/A	

Week 7 - 25 Apr 2022

Module/Topic	Chapter	Events and Submissions/Topic
• PIC 18F4321 hardware interfacing II - Sensors (analog and Digital)	N/A	

Week 8 - 02 May 2022

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

Week 9 - 09 May 2022

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

Week 10 - 16 May 2022

Module/Topic	Chapter	Events and Submissions/Topic
• PIC18F4321 communication - RS232, I2C, SPI	N/A	**Assignment 2: Hardware Programming using CQU PIC Development kit** Due: Week 10 Friday (20 May 2022) 11:55 pm AEST

Week 11 - 23 May 2022

Module/Topic	Chapter	Events and Submissions/Topic
• Introduction to Assembly Language Programming	N/A	

Week 12 - 30 May 2022

Module/Topic	Chapter	Events and Submissions/Topic
• Embedded microcontroller future opportunities	N/A	**Portfolio** Due: Week 12 Friday (3 June 2022) 11:55 pm AEST

Review/Exam Week - 06 Jun 2022

Module/Topic	Chapter	Events and Submissions/Topic

Exam Week - 13 Jun 2022

Module/Topic	Chapter	Events and Submissions/Topic

Term Specific Information

The residential school will be held in n Rockhampton with other campuses (Week 3 Wed-Fri 9:00am - 5:00pm) connected via Zoom.

Assessment Tasks

1 Assignment 1 - C language programming

Assessment Type
Written Assessment

Task Description
This assignment is based on C language programming. The essential C language skills needed for embedded microcontroller programming will be tested here and students should develop their own solutions to the given problems. Try to analyse the system first and develop a concept solution, develop a graphical representation of it before start coding. All evidence of your own work including a soft copy of your workbook should be provided as evidence.
This is an individual assessment item and no teamwork or contribution from others are allowed.

Assessment Due Date
Week 5 Friday (8 Apr 2022) 11:55 pm AEST

Return Date to Students
Week 7 Friday (29 Apr 2022)
Marked assignment with feedback. However, there will be no model answers provided.

Weighting
25%

Assessment Criteria
Detailed assessment criteria is 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 evidences. 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 development of it (ex: 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 word file

Learning Outcomes Assessed

- Apply fundamental structured programming knowledge to develop software solutions

2 Assignment 2: Hardware Programming using CQU PIC Development kit

Assessment Type
Written Assessment

Task Description
This assignment is based on essential C language programming skills needed for embedded microcontroller programming. The embedded hardware programming skills will be tested here and students should develop their own solutions to the given problems. Try to analyse the system first and develop a concept solution, develop a graphical representation of solution before start coding. All evidence of your own work including a soft copy of your workbook should be provided as evidence.
This assignment is based on CQU PIC development board provided and all programs must be developed with MPLAB X IDE and in C language. More technical details will be provided with the assignment.
This is an individual assessment item and no teamwork or contribution from others allowed.

Assessment Due Date
Week 10 Friday (20 May 2022) 11:55 pm AEST

Return Date to Students
Week 12 Friday (3 June 2022)
Marked assignment with feedback. However, there will be no model answers provided.

Weighting
25%

Minimum mark or grade
50%

Assessment Criteria
Detailed assessment criteria is in the assignment itself.
To obtain full marks students must provide all in detail problem solving and solution development evidences. Each student must have their unique programms 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 development of it (ex: a soft copy of workbook pages relevant to it or explanation of your code) will receive a maximum of 50% of the allocated marks for that question. No assembly language solutions or sub routines are allowed.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
as a single word file

Learning Outcomes Assessed

- 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 an authentic application
- Work autonomously and as a team member to analyse problems and present solutions.

3 Portfolio

Assessment Type
Portfolio

Task Description
Project Details
This is the major project in this unit and it is an open ended project. Student can decide the project in consultation with the lecturer and tutors and must finalize it by the end of week 3. The main hardware used is the CQU PIC Development kit and the sensor/actuator board provided by CQU. Students are free to use any additional sensors, actuators, and accessories to the project at their own cost. Students will develop a working prototype of an embedded system solution for a real world problem. Project outcome (developed prototype) will be tested towards the end of the term.
This is an individual assessment item and no teamwork or contribution from others allowed.

Portfolio Details
Portfolio is an individual submission based on their individual project. It must contain the following items and **omission of any of them will result in a Fail Grade:**

- Project report containing (but not limited to)

Executive summary
Problem definition
Project scope
Solution development report (concept level to programming level)
Project management report
Project development report (actual physical prototype fabrication)
Results and discussion
Lessons learnt and recommendations for future development

- Programming report (your complete programming listing of the project)
- A copy of peer review of assigned student project (format will be available in Moodle)
- Individual workbook (scanned /electronic copy of your workbook including your hand-written work).

Assessment Due Date
Week 12 Friday (3 June 2022) 11:55 pm AEST

Return Date to Students

Will be returned with feedback after release of grades.

Weighting
50%

Minimum mark or grade
50%

Assessment Criteria
The portfolio marks will be allocated to the project depth, successfulness of each individual element, successfulness of integrating all elements into a complete working prototype, and professional documentation related to 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 usages etc.
Detailed description of portfolio assessment criteria will be available in Moodle.

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
as a single PDF file

Learning Outcomes Assessed

- Apply fundamental structured programming knowledge to develop software solutions
- 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 an authentic 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.

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