



# COMP8294

## Embedded IoT Hardware System and Devices

Session 2, In person-scheduled-weekday, North Ryde 2024

*School of Computing*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Convenor

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4RPD, 313

Wednesday, 11 AM - 12 PM

Lecturer

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4RPD, 313

Wednesday, 11 AM - 12 PM

Credit points

10

Prerequisites

COMP6291

Corequisites

Co-badged status

Unit description

Unlike traditional computer-based systems, IoT devices are “embedded” within other devices to provide enhanced functionality without exposing the user to the complexities of a device.

This unit investigates the hardware components of IoT-based Embedded System devices such as microcontrollers, Input/Output interfaces, display and memory, power supply and communication ports. This unit will also examine the architecture, design methodology, and trade-offs of architectures in IoT-based embedded devices.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

## Learning Outcomes

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

**ULO1:** Apply knowledge of major components of embedded systems to design real-time embedded system hardware and low-powered IoT devices and sensors.

**ULO2:** Evaluate, performance-test, and debug IoT-based embedded system hardware architectures and devices using various simulation tools.

**ULO3:** Demonstrate knowledge of, and program, microcontroller architecture.

**ULO4:** Analyse and evaluate different embedded hardware architectures and algorithms.

**ULO5:** Learn and apply knowledge of trusted embedded hardware architecture to secure embedded hardware.

## General Assessment Information

In this unit, students are encouraged to engage actively in their learning through a multifaceted approach. Attending lectures consistently, taking comprehensive notes, and actively participating in discussions are vital components of this active participation. Regular attendance at workshops and practical sessions is emphasized, and students are advised to seek instructor feedback to enhance their understanding of assignments. Pursuing excellence in assignments is a fundamental expectation, requiring thorough preparation to showcase a firm grasp of the content and meet prescribed standards. Additionally, students are urged to engage actively with assigned readings, supplementing their notes and formulating thoughtful questions for further clarification during discussions with lecturers. Thoughtful responses to workshop questions, demonstrating a deep understanding of the material, and contributing meaningfully to discussions are also highlighted. Furthermore, timely completion of assigned tasks or simulation projects within given timeframes is essential for successfully and punctually fulfilling unit requirements. Overall, this holistic approach aims to ensure students actively contribute to and excel in various aspects of their learning experience in the unit.

## Participation Guidelines:

- **Active Engagement:** Attending most classes is strongly recommended, actively participating in discussions by asking and answering questions and contributing perspectives from personal backgrounds and workplaces.
- **Utilization of Supplementary Resources:** Supplementary resources, including lecture materials and digital recordings available through Echo360 via iLearn login, are accessible for review purposes and in case of missed lectures. However, it is essential to note that these recordings should not be solely relied upon, and copyrighted material may be excluded.
- **Effective Out-of-Class Communication:** iLearn is the primary platform for effective out-of-class communication and engaging in discussions on various topics. Accessible at <http://learn.mq.edu.au>, iLearn provides forums for active participation and is a valuable resource for information dissemination. Regularly reviewing iLearn and conducting background reading before each class is highly encouraged to enhance your overall learning experience.

## Assignment Submission

Your assignment is to be submitted online using iLearn.

## Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is **11:55 pm**. A 1-hour grace period will be provided to students who experience a technical concern. For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for [Special Consideration](#).

For example, if the assignment is worth 8 marks (of the entire unit) and your submission is late by 19 hours (or 23 hours 59 minutes 59 seconds), 0.4 marks (5% of 8 marks) will be deducted. If your submission is late by 24 hours (or 47 hours 59 minutes 59 seconds), 0.8 marks (10% of 8 marks) will be deducted, and so on.

## Assessments where Late Submissions will be accepted

- Assignment 1 - YES, Standard Late Penalty applies
- Assignment 2 - YES, Standard Late Penalty applies
- Quizzes - YES, Standard Late Penalty applies

## Supplementary Exam

If you receive [Special Consideration](#) for the final exam, a supplementary exam will be scheduled after the normal exam period, following the release of marks. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

## Requirements to Pass this Unit

In this unit, the final mark will be calculated by combining the marks for all assessment tasks according to the percentage weightings shown in the assessment summary. Concretely, in order to pass the unit, you must obtain an overall total mark of 50% or higher. Students obtaining a higher grade than a pass in this unit will (in addition to the above): have a total mark of 85% or higher to obtain High Distinction; have a total mark of 75% or higher to obtain Distinction; have a total mark of 65% or higher to obtain Credit. This unit does not have hurdle assessments.

## Special Consideration

The [Special Consideration Policy](#) aims to support students who have been impacted by short-

term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through [ask.mq.edu.au](https://ask.mq.edu.au).

### Methods of Communication

Our primary means of communication will be through your university email and announcements on iLearn. It is crucial to consistently check your university email for important updates and information related to the course. Additionally, significant announcements will be posted on iLearn, a centralized platform for accessing vital details about the course. Should you have any queries or require assistance from the teaching staff, including the unit convenor, you have two communication channels. Firstly, you can post your queries on the iLearn discussion board, providing an interactive space for instructors and peers to engage in discussions. Alternatively, you may send emails to the corresponding addresses of the teaching staff using your university email address for official communication. Through these communication methods, we aim to ensure effective and timely dissemination of information and provide the necessary support throughout the course.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Assignment 1</a>	40%	No	11:55 PM on Sunday ending Week 7
<a href="#">Quizzes</a>	30%	No	During lectures in week 6 and 12. Weekly workshop quiz.
<a href="#">Assignment 2</a>	30%	No	11:55 PM on Sunday ending Week 11

### Assignment 1

Assessment Type <sup>1</sup>: Practice-based task

Indicative Time on Task <sup>2</sup>: 40 hours

Due: **11:55 PM on Sunday ending Week 7**

Weighting: **40%**

Design, development and simulation: Design, develop and simulate an embedded system to control an external device.

On successful completion you will be able to:

- Apply knowledge of major components of embedded systems to design real-time

embedded system hardware and low-powered IoT devices and sensors.

- Evaluate, performance-test, and debug IoT-based embedded system hardware architectures and devices using various simulation tools.

## Quizzes

Assessment Type <sup>1</sup>: Quiz/Test

Indicative Time on Task <sup>2</sup>: 30 hours

Due: **During lectures in week 6 and 12. Weekly workshop quiz.**

Weighting: **30%**

The Quiz is an in-class test. It is a formative assessment that can be used to measure students' knowledge and comprehension of unit materials. Quiz Question types include multiple choice, matching items, true/false, short answer and many more. Quizzes allow for formative assessment feedback on basic conceptual competence and therefore usually span multiple learning outcomes.

On successful completion you will be able to:

- Apply knowledge of major components of embedded systems to design real-time embedded system hardware and low-powered IoT devices and sensors.
- Demonstrate knowledge of, and program, microcontroller architecture.
- Analyse and evaluate different embedded hardware architectures and algorithms.
- Learn and apply knowledge of trusted embedded hardware architecture to secure embedded hardware.

## Assignment 2

Assessment Type <sup>1</sup>: Practice-based task

Indicative Time on Task <sup>2</sup>: 28 hours

Due: **11:55 PM on Sunday ending Week 11**

Weighting: **30%**

Analysis and Problem solving: Issues pertaining to Embedded system hardware/soc/noc design and implementation

The purpose of the problem solving assignment is to help the students to get accustomed to dealing with real world problem situations/issues. It is designed to help students analyse a particular problem and find its best solution.

On successful completion you will be able to:

- Apply knowledge of major components of embedded systems to design real-time embedded system hardware and low-powered IoT devices and sensors.
- Evaluate, performance-test, and debug IoT-based embedded system hardware architectures and devices using various simulation tools.
- Demonstrate knowledge of, and program, microcontroller architecture.
- Analyse and evaluate different embedded hardware architectures and algorithms.
- Learn and apply knowledge of trusted embedded hardware architecture to secure embedded hardware.

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<sup>1</sup> If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

<sup>2</sup> Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

## Delivery and Resources

COMP8294 is structured to include both lectures and workshop sessions. Lecture classes are conducted onsite every Wednesday from 9 to 11 AM. Also, workshop classes occur onsite on Wednesdays from 12 to 2 PM. Lecture classes will begin in week 1, and workshops will start in week 2.

### Lectures

COMP8294 lecture sessions explore embedded IoT hardware systems in-depth, blending theoretical concepts, embedded design, mobile programming, and hands-on applications. The focus extends to practical implementation, particularly embedded IoT simulator software and embedded IoT hardware based on NodeMCU8266 microcontroller, intelligent sensors, and IoT platform, to provide students with a comprehensive understanding of conceptual and design principles. The unit emphasizes applying this knowledge in designing embedded IoT systems across various real-world scenarios. The IoT-embedded simulation software tools, including Wokwi, ThingSpeak, and ThingsBoard, will support the learning process. Lecture sessions are the foundation for grasping conceptual knowledge, with practical application during workshops involving tasks such as intelligent sensors, mobile programming, and IoT platforms.

While weekly lecture notes will be provided, students are urged to view them as a guide rather than a substitute for personal notes or the recommended reading list. Active engagement with the material is encouraged, supplementing understanding through provided lecture notes,

personal notes, and suggested readings. This proactive approach is crucial for a robust comprehension of the syllabus topics and contributes to an enriched learning experience in real-time operating systems.

## **Assignments**

The predominant weightage in this class is allocated to Assignment 1 collectively, amounting to 40%, and Assignment 2 to 30%. These assignments are strategically designed to gauge students' proficiency in conceptualizing and implementing embedded IoT hardware systems across diverse applications. Students are granted a substantial four-week period to complete each assignment, with Assignment 1 due by 11:55 PM on Sunday, ending week 7, and Assignment 2 by 11:55 PM on Sunday, ending week 11.

The assessment percentage breakdown for these assignments is as follows: For Assignment 1, which constitutes 40% of the total grade, 20% is attributed to the design and implementation of a programming application, evaluating students' practical skills. An additional 10% is allocated for answering assignment-specific questions, emphasizing theoretical comprehension. The project report holds a weightage of 5%, assessing students' ability to articulate their project details effectively. The remaining 5% is dedicated to presentations and discussions, reinforcing the importance of communication skills and ensuring students comprehend the intricacies of the program they have developed. For Assignment 2, which constitutes 30% of the total grade, 15% is attributed to designing and implementing a programming application evaluating students' practical skills. An additional 5% is allocated for answering assignment-specific questions, emphasizing theoretical comprehension. The project report holds a weightage of 5%, assessing students' ability to articulate their project details effectively. The remaining 5% is dedicated to presentations and discussions, reinforcing the importance of communication skills and ensuring students comprehend the intricacies of the program they have developed. This comprehensive assessment structure aims to foster a holistic understanding of IoT programming and embedded design applications among students.

**Quizzes** The quizzes will be divided into two parts. Part 1 will consist of quizzes given during lectures, held twice on weeks 6 and 11, each contributing 5% to the overall score. Part 2 will consist of weekly quizzes held during workshops. Each workshop module includes tasks that must be completed and submitted to iLearn. The workshops will be conducted onsite over 12 meetings from Week 2 to Week 13. During weeks 2 to 11, students will focus on practical modules, while weeks 12 and 13 will be reserved for make-up sessions for students who missed previous workshops. Each student is allowed to attend a maximum of two make-up classes. This component will contribute 20% to the overall score, with each workshop quiz worth 2 marks, totaling a maximum of 20 marks for the entire workshop.

Students are strongly encouraged to attend all sessions to fully understand how to implement embedded IoT hardware in experiments with experimental tools. Full participation ensures a thorough grasp of the practical aspects of IoT and Networking applications in real-world scenarios.

## **TEXT**

Course Reading Material Information - COMP8294



Please be aware that there isn't a single textbook covering all the content for this unit. However, your lecturer will provide comprehensive reading materials and detailed notes corresponding to each week's lecture topics. These resources will be provided every week for your convenience. It's essential to note that purchasing these books is not obligatory; their inclusion is based on individual preferences and needs. Students are encouraged to evaluate their requirements and determine whether acquiring these supplementary resources aligns with their learning preferences and objectives.

1. Oner, Vedat Ozan, "Developing IoT Projects with ESP32 : Unlock the Full Potential of ESP32 in IoT Development to Create Production-Grade Smart Devices," 2nd ed. Birmingham : Packt Publishing, Limited 2023.
2. Zulfiqar, Asim, "Hands-On ESP32 with Arduino IDE : Unleash the Power of IoT with ESP32 and Build Exciting Projects with This Practical Guide," First edition. Birmingham, UK : Packt Publishing Ltd. 2024.

**Methods of Communication:** Our primary means of communication will be through your university email and announcements on iLearn. It is crucial to consistently check your university email for important updates and information related to the course. Additionally, significant announcements will be posted on iLearn, a centralized platform for accessing vital details about the course. Should you have any queries or require assistance from the teaching staff, including the unit convenor, you have two communication channels. Firstly, you can post your queries on the iLearn discussion board, providing an interactive space for instructors and peers to engage in discussions. Alternatively, you may send emails to the corresponding addresses of the teaching staff using your university email address for official communication. Through these communication methods, we aim to ensure effective and timely dissemination of information and provide the necessary support throughout the course.

## COVID Information

For the latest information on the University's response to COVID-19, please refer to the Coronavirus infection page on the Macquarie website: <https://www.mq.edu.au/about/coronavirus-faqs>. Remember to check this page regularly in case the information and requirements change during semester. If there are any changes to this unit in relation to COVID, these will be communicated via iLearn.

## Unit Schedule

Week	Topic	Outcome
1	Introduction to Embedded Systems and IoT	ULO1
2	Microcontroller Architecture and Programming Part I	ULO3, ULO4

Week	Topic	Outcome
3	Microcontroller Architecture and Programming Part II	ULO2, ULO3, ULO4
4	Embedded Systems Programming Part I	ULO1, ULO2
5	Embedded Systems Programming Part II	ULO1, ULO2
6	Sensors and Actuators for IoT Part I	ULO1, ULO2, ULO3
7	Sensors and Actuators for IoT Part II	ULO1, ULO2, ULO3
8	Embedded IoT Hardware Platforms	ULO1, ULO2
9	Advanced Topics in Embedded Systems Part I: Distributed Embedded Systems	ULO4, ULO5
10	Advanced Topics in Embedded Systems Part II: System-on-Chip (SoC)	ULO4, ULO5
11	Embedded System Design and Implementation Part I	ULO1, ULO5
12	Embedded System Design and Implementation Part II	ULO1, ULO5
13	Unit review	ULO3, ULO5

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.s.mq.edu.au\)](https://policies.s.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Assessment Procedure](#)
- [Complaints Resolution Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#)

Students seeking more policy resources can visit [Student Policies \(https://students.mq.edu.au/support/study/policies\)](https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit [Policy Central \(https://policies.mq.edu.au\)](https://policies.mq.edu.au) and use the [search tool](#).

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/admin/other-resources/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit [ask.mq.edu.au](http://ask.mq.edu.au) or if you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@mq.edu.au)

## Academic Integrity

At Macquarie, we believe [academic integrity](#) – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free [online writing and maths support](#), [academic skills development](#) and [wellbeing consultations](#).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

## The Writing Centre

[The Writing Centre](#) provides resources to develop your English language proficiency, academic writing, and communication skills.

- [Workshops](#)
- [Chat with a WriteWISE peer writing leader](#)
- [Access StudyWISE](#)
- [Upload an assignment to Studiosity](#)
- [Complete the Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

## Student Services and Support

Macquarie University offers a range of [Student Support Services](#) including:

- [IT Support](#)
- [Accessibility and disability support](#) with study

- Mental health [support](#)
- [Safety support](#) to respond to bullying, harassment, sexual harassment and sexual assault
- [Social support including information about finances, tenancy and legal issues](#)
- [Student Advocacy](#) provides independent advice on MQ policies, procedures, and processes

## Student Enquiries

Got a question? Ask us via [AskMQ](#), or contact [Service Connect](#).

## IT Help

For help with University computer systems and technology, visit [http://www.mq.edu.au/about\\_us/offices\\_and\\_units/information\\_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

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Unit information based on version 2024.03 of the [Handbook](#)