



# ELEC8844

## Signal Processing for Software Defined Radio

Session 1, In person-scheduled-weekday, North Ryde 2024

*School of Engineering*

### Contents

---

<a href="#"><u>General Information</u></a>	2
<a href="#"><u>Learning Outcomes</u></a>	2
<a href="#"><u>General Assessment Information</u></a>	3
<a href="#"><u>Assessment Tasks</u></a>	4
<a href="#"><u>Delivery and Resources</u></a>	7
<a href="#"><u>Policies and Procedures</u></a>	8
<a href="#"><u>Engineers Australia Competency Mapping</u></a>	10

---

#### **Disclaimer**

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Convenor

Yiqing Lu

[yiqing.lu@mq.edu.au](mailto:yiqing.lu@mq.edu.au)

3MD 137

Fridays 3-5 pm

Credit points

10

Prerequisites

Admission to MEngElecEng

Corequisites

20cp at 8000 level

Co-badged status

ELEC4844

Unit description

This unit aims to provide students with the theory and hands-on experience in designing and implementing digital signal processing algorithms using software defined radio technology. The unit builds on previous knowledge and skills in signals and systems, and provides an additional foundation in digital signal processing. The unit introduces the software defined radio concept along with various software defined radio architectures and platforms. Topics covered include: sampling and quantisation, low-pass representation of bandpass systems, quadrature-signal representation, frequency translation, sample rate conversion, decimation and interpolation, direct and polyphase interpolator and decimator architectures, half-band FIR filters, digital up and down converters, matched filters and the software defined radio architectures and platforms. The unit culminates in a project where students develop a software defined radio technology-based solution from high-level functional specifications through to design, implementation and testing on real hardware.

## 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:** Describe what a software defined radio platform is and its constituent functional components.

**ULO2:** Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.

**ULO3:** Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.

**ULO4:** Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.

**ULO5:** Prepare design documents and reports and communicate and explain design decisions.

## General Assessment Information

### Requirements to Pass this Unit

The entire assessment in this Unit consists of 10 weekly submissions during practical classes, Assignment 1 Report, Assignment 1 Oral Defense, Assignment 2 Report, Assignment 2 Oral Defense, and Semester Project report and oral presentation. Passing this Unit requires an **overall Mark of 50 out of 100**. There is no Final Examination, and therefore there is no Supplemental Examination. There are no hurdle requirements.

### 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 7<sup>th</sup> day (including weekends). After the 7<sup>th</sup> 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 Sydney Time**. 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](#).

Resubmission of work is not allowed.

### Assessments where Late Submissions will be accepted

Assignment/Project Reports - Yes, Standard Late Penalty applies

Defences - No, unless Special Consideration is Granted

If assessments are missed due to illness or misadventure, students should apply for Special Consideration.

### 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](http://ask.mq.edu.au).

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#">Practical Tasks</a>	20%	No	weekly, till Week 12
<a href="#">Assignment 1</a>	10%	No	Week 5
<a href="#">Defence 1</a>	10%	No	Week 5
<a href="#">Assignment 2</a>	10%	No	Week 9
<a href="#">Defence 2</a>	15%	No	Week 9
<a href="#">Semester Project</a>	35%	No	Week 13

### Practical Tasks

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

Indicative Time on Task <sup>2</sup>: 10 hours

Due: **weekly, till Week 12**

Weighting: **20%**

Tasks carried out during the practical classes

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.
- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.

## Assignment 1

Assessment Type <sup>1</sup>: Report

Indicative Time on Task <sup>2</sup>: 15 hours

Due: **Week 5**

Weighting: **10%**

Assignment 1 Report (1000-word equivalent)

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.
- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.
- Prepare design documents and reports and communicate and explain design decisions.

## Defence 1

Assessment Type <sup>1</sup>: Viva/oral examination

Indicative Time on Task <sup>2</sup>: 5 hours

Due: **Week 5**

Weighting: **10%**

An oral examination on the first part of the unit

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.

- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.

## Assignment 2

Assessment Type **1**: Report

Indicative Time on Task **2**: 15 hours

Due: **Week 9**

Weighting: **10%**

Assignment 2 Report (1000-word equivalent)

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.
- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.
- Prepare design documents and reports and communicate and explain design decisions.

## Defence 2

Assessment Type **1**: Viva/oral examination

Indicative Time on Task **2**: 5 hours

Due: **Week 9**

Weighting: **15%**

An oral examination on the second part of the unit

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.

- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.
- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.

## Semester Project

Assessment Type <sup>1</sup>: Project

Indicative Time on Task <sup>2</sup>: 35 hours

Due: **Week 13**

Weighting: **35%**

Project report (2000-word equivalent) and oral examination of the outcomes

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Comprehensively convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations on software defined radio platforms.
- Design, implement and test digital signal processing algorithms on real software defined radio hardware platforms.
- Prepare design documents and reports and communicate and explain design decisions.

---

<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

The Unit will be delivered with a two-hour lecture and a three-hour practical for each week, both on-campus and starting in Week 1. If students have difficulty in attending on-campus classes, they should contact the Unit Convenor as soon as possible.

The unit requires some project work with RTL-SDR devices manufactured by Nooelec, which are USB plugins for computers. **Students are required to purchase their own RTL-SDR devices.**

The software required is MATLAB and Simulink, which can be downloaded by Macquarie University students from the Mathworks Website for free.

### **Methods of Communication**

We will communicate with you via your university email or through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion forum or sent to [yiqing.lu@mq.edu.au](mailto:yiqing.lu@mq.edu.au) from your **university email** address.

## **Policies and Procedures**

Macquarie University policies and procedures are accessible from [Policy Central \(https://policies.mq.edu.au\)](https://policies.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](https://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/](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.

## Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	UL01, UL02, UL03, UL04, UL05
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	UL02, UL03, UL04
	1.3 In-depth understanding of specialist bodies of knowledge	UL01, UL02, UL03
	1.4 Discernment of knowledge development and research directions	UL01, UL02, UL03
	1.5 Knowledge of engineering design practice	UL01, UL02
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	UL01, UL02, UL03, UL04, UL05
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	UL01, UL02, UL03, UL04, UL05
	2.2 Fluent application of engineering techniques, tools and resources.	UL01, UL02, UL03, UL04, UL05
	2.3 Application of systematic engineering synthesis and design processes.	UL02, UL03, UL04
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	UL03, UL04, UL05
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	UL05
	3.2 Effective oral and written communication in professional and lay domains.	UL05
	3.3 Creative, innovative and pro-active demeanour.	UL02, UL05
	3.4 Professional use and management of information.	UL02, UL05
	3.5 Orderly management of self, and professional conduct.	UL04, UL05
	3.6 Effective team membership and team leadership	UL05

Unit information based on version 2024.02 of the [Handbook](#)

