



# ELEC8844

## Signal Processing for Software Defined Radio

Session 1, In person-scheduled-weekday, North Ryde 2022

*School of Engineering*

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## General Information

Unit convenor and teaching staff

Convenor

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Lecturer

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Tutor

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Tuesday, 3-5 pm online by appointment

Credit points

10

Prerequisites

Admission to MEngElecEng

Corequisites

20cp at 8000 level

Co-badged status

### 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 from preceding Digital Signal Processing unit and 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

The entire assessment in this Unit is by Assignment 1 Report, Assignment 1 Oral Defense, Assignment 2 Report, Assignment 2 Oral Defense, Project Report, and an Oral Examination on the outcome of the Project. 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.

If assessments are missed due to illness or misadventure, students should apply for Special Consideration. Oral Defenses must be taken at the time indicated in the Unit Guide. Should

these activities be missed due to illness or misadventure, students may apply for Special Consideration.

All report assessments must be submitted by 5:00 pm (Sydney Time) on their due date. Resubmissions will not be allowed.

Should these assessments be missed due to illness or misadventure, students should apply for Special Consideration.

Assessments not submitted by the due date will receive a mark in accordance with the late submission policy as follows:

A 12-hour grace period will be given after which the following deductions will be applied to the awarded assessment mark: 12 to 24 hours late = 10% deduction; for each day thereafter, an additional 10% per day or part thereof will be applied until five days beyond the due date. After this time, a mark of zero (0) will be given. For example, an assessment worth 20% is due 5 pm on 1 January. Student A submits the assessment at 1 pm, 3 January. The assessment received a mark of 15/20. A 20% deduction is then applied to the mark of 15, resulting in the loss of three (3) marks. Student A is then awarded a final mark of 12/20.

## Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignment 1</u>	10%	No	Week 4
<u>Defence 1</u>	15%	No	Week 5
<u>Assignment 2</u>	10%	No	Week 10
<u>Defence 2</u>	20%	No	Week 11
<u>Project Report</u>	15%	No	Week 12
<u>Project Defence and Demonstration</u>	30%	No	Week 13

### Assignment 1

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

Indicative Time on Task <sup>2</sup>: 20 hours

Due: **Week 4**

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: **15%**

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.
- Prepare design documents and reports and communicate and explain design decisions.

## Assignment 2

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

Indicative Time on Task <sup>2</sup>: 20 hours

Due: **Week 10**

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 11**

Weighting: **20%**

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.
- Prepare design documents and reports and communicate and explain design decisions.

## Project Report

Assessment Type **1**: Report

Indicative Time on Task **2**: 25 hours

Due: **Week 12**

Weighting: **15%**

Project Report (2000-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.

## Project Defence and Demonstration

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

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

Due: **Week 13**

Weighting: **30%**

An oral examination of the outcomes of the project

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.

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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

The Unit will be delivered with a two-hour lecture, a one-hour SGTA, and a three-hour laboratory for each week. The unit requires some project work with RTL-SDR devices manufactured by Nooelec. Students are required to purchase their own devices, which are USB plug-in units for either laptop or desktop computers. The software required is MATLAB or Simulink, which may

be downloaded by Macquarie University students from the Mathworks Website. For on-campus laboratory work, RTL-SDR devices will be available for use by students.

Lectures will be delivered online. SGTAs and Practical Classes will be delivered on-campus.

There will be a return to on-campus activities for Semester 1, 2022. If students are unable to get back to campus in time for the start of semester, the students should contact the Unit Convenor as soon as possible.

SGTA and Practical Classes start in Week 1.

## Unit Schedule

Lectures will be delivered online. SGTAs and Practical Classes will be delivered on-campus.

If students have difficulty in attending on-campus SGTAs or Practical Classes because they cannot get back to campus on time, they should contact the Unit Convenor as soon as possible.

SGTA and Practical Classes start in Week 1.

## 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](mailto: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 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.

## Changes from Previous Offering

There are no changes from the previous offering.

## 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.	UL01,UL02,UL03,UL04,
	1.3 In-depth understanding of specialist bodies of knowledge	UL01,UL02,UL03,UL04,
	1.4 Discernment of knowledge development and research directions	UL01,UL02,UL03,UL04,UL05
	1.5 Knowledge of engineering design practice	UL01,UL02,UL03,UL04,UL05
	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.	UL01,UL02,UL03,UL04,
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	UL01,UL02,UL03,UL04,UL05
Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	UL01,UL02,UL03,UL04,UL05
	3.2 Effective oral and written communication in professional and lay domains.	UL01,UL02,UL03,UL04,UL05
	3.3 Creative, innovative and pro-active demeanour.	UL04,UL05
	3.4 Professional use and management of information.	UL01,UL02,UL03,UL04,UL05

	3.5 Orderly management of self, and professional conduct.	UL04,UL05
	3.6 Effective team membership and team leadership	UL01,UL02,UL03,UL04,UL05