ELEC240

Signals and Systems

S2 Day 2017

Dept of Engineering

Contents

General Information

Unit convenor and teaching staff
Lecturer (weeks 8-13)
Sam Reisenfeld
sam.reisenfeld@mq.edu.au
Monday 4-5pm

Lecturer (weeks 1-7) and Convenor
Stephen Hanly
stephen.hanly@mq.edu.au
Wednesday 4-5pm

tutor
Ahsan Ali
ahsan.ali1@students.mq.edu.au

Credit points
3

Prerequisites
ENGG150 and (MATH136 or MATH133)

Corequisites
MATH235

Co-badged status

Unit description
The aim of this unit is to give students a comprehensive introduction to the theory of signal processing and analysis that is used in many areas of electronic and telecommunications engineering including: circuit analysis; amplifiers and electronic systems; analogue and digital communications; audio and image processing; and control systems. The unit covers time and frequency analysis for both continuous-time and discrete-time signals. Topics covered in the unit include: linear time-invariant systems; convolution; Fourier series; Fourier transforms; Discrete Fourier transforms; and Z transforms.

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:

Demonstrated use of Matlab to solve problems in Signals and Systems
Be able to solve signal processing problems involving Complex Numbers
Demonstrated understanding of how signals can be scaled in space, time, flipped in time (time-reversal), delayed (right and left shifted), and other signal properties (mean, energy, power, periodicity)
Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
Demonstrated understanding of the relationship between the tools used in discrete-time and continuous-time signal processing, and to be able to find the appropriate signal domain and transform method to find system outputs from system inputs in a variety of applications (eg circuits, filters, communication channels)
Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

General Assessment Information

An overall mark of 50 or more is required to pass the unit (P/CR/D/HD). It is also required that the final exam mark is above 40% (hurdle). Students achieving between 30% and 40% on the final exam are eligible to sit a supplementary hurdle exam with the same 40% hurdle requirement.

Assessment Tasks

Name	Weighting	Hurdle	Due
In class test questions	10%	No	weekly
practicals held each week	15%	No	weekly
test	15%	No	weeks 3,7, and 12

Name	Weighting	Hurdle	Due
Assignment 1	2%	No	4/9/2017
Assignment 2	3%	No	3/10/2016
Assignment 3	3%	No	23/10/2016
Assignment 4	2%	No	10/11/2016
End of Semester Exam	50%	Yes	scheduled in final exam period

In class test questions

Due: **weekly**
Weighting: **10%**

A test question will be given to the class every week (except week 1) during the usual lecture times and graded. The final mark for this assessment (worth 10% of assessment overall) will be taken from the best 6 answers given by the student during the semester.

On successful completion you will be able to:

- Demonstrated understanding of how signals can be scaled in space, time, flipped in time (time-reversal), delayed (right and left shifted), and other signal properties (mean, energy, power, periodicity)
- Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
- Demonstrated understanding of the relationship between the tools used in discrete-time and continuous-time signal processing, and to be able to find the appropriate signal domain and transform method to find system outputs from system inputs in a variety of applications (eg circuits, filters, communication channels)

practicals held each week

Due: **weekly**
Weighting: **15%**

Two test questions during each practical session scheduled in weeks 2-13

On successful completion you will be able to:

- Demonstrated use of Matlab to solve problems in Signals and Systems

test

Due: **weeks 3,7, and 12**
Weighting: **15%**

There will be 3 in-class tests during the unit for a total of 15%. Each test will take 45 minutes, and all will take place in the lecture room on Tuesday at 12pm. We will take your best two test scores: the final result for the "test" will be an average of your best two individual test scores (of the three). The first test will take place on Tuesday August 15 at 12pm . The second test will take place on Tuesday September 12 at 12pm. The third test will take place on Tuesday October 31 at 12pm.

The first test will be on complex numbers and signal properties. The second test will be on continuous time signal processing (not including sampling or aliasing, but on everything up to end of week 6). The third test will be on discrete-time signal processing (not including filtering , but on everything between weeks 8-10 inclusive).

On successful completion you will be able to:

- Be able to solve signal processing problems involving Complex Numbers
- Demonstrated understanding of how signals can be scaled in space, time, flipped in time (time-reversal), delayed (right and left shifted), and other signal properties (mean, energy, power, periodicity)
- Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.

Assignment 1

Due: **4/9/2017**
Weighting: **2%**

Problems on signal properties, linear time-invariant systems, convolution and impulse response

On successful completion you will be able to:

- Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assignment 2

Due: **3/10/2016**
Weighting: **3%**

Problems on Fourier Series, Fourier Transform, and Transfer function of a linear time-invariant system

On successful completion you will be able to:

- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assignment 3

Due: **23/10/2016**
Weighting: **3%**

Problems on sampling, aliasing and Nyquist criterion in time and frequency domain, and discrete time convolution

On successful completion you will be able to:

- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assignment 4

Due: **10/11/2016**
Weighting: **2%**

Problems on Z Transform, Discrete-time Fourier Transform, solving difference equations

On successful completion you will be able to:

- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated understanding of the relationship between the tools used in discrete-time and continuous-time signal processing, and to be able to find the appropriate signal domain and transform method to find system outputs from system inputs in a variety of applications (eg circuits, filters, communication channels)
- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

End of Semester Exam

Due: **scheduled in final exam period**
Weighting: **50%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

Final exam. Students must obtain at least 40% on final exam to pass the unit.

On successful completion you will be able to:

- Demonstrated understanding of how signals can be scaled in space, time, flipped in time (time-reversal), delayed (right and left shifted), and other signal properties (mean, energy, power, periodicity)
- Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
- Demonstrated understanding of the relationship between the tools used in discrete-time and continuous-time signal processing, and to be able to find the appropriate signal domain and transform method to find system outputs from system inputs in a variety of applications (eg circuits, filters, communication channels)

Delivery and Resources

Required and Recommended texts and/or materials

There is no text book. The following books are useful references.

There are many other books in signal processing in the library. Books which cover similar material to ELEC240 include:

“Signals, Systems and Transforms” 4th ed, by Phillips, Parr and Riskin. Pearson publishers. 2008.

“Signals and systems”, M. J. Roberts, McGraw-Hill.2004.

“An Introduction to Signals and Systems”, J. A. Stuller, Thomson publishers, 2008.

“Linear Systems and Signals”, 2nd ed, B. P. Lathi, Oxford University Press, 2005.

“Digital Signal Processing. Principles, Algorithms and Applications”, 4th ed, J. G. Proakis and D. G. Manolakis, Pearson publishers, 2007.

“Signals and systems”, S. Haykin and B. Van Veen, John Wiley &b Sons. 1999.

More advanced books include:

“Discrete-time signal processing”, A. V. Oppenheim and R. W. Schafer with J. R. Buck, Prentice-Hall, 1999.

“Signals & Systems”, A. V. Oppenheim and A. S. Willsky with S. H. Nawab, Prentice-Hall, 1997.

Matlab & Simulink Student Version Software by the MathWorks is highly recommended.

Unit Web Page

Unit lecture notes, resources, assignments and other information about the unit can be accessed through iLearn.

Technology used

Library and internet search engines, word processing software. The primary software tool used in practicals is Matlab.

Practical Sessions

Attendance at laboratory sessions is **compulsory**. Any student who is absent from more than two sessions may not be permitted to sit the examinations.

Experimental work and reports are to be written during the laboratory sessions with reports to be viewed by the tutors. Test questions must be undertaken during the practical sessions and marked by the tutors during those sessions. It is prohibited to use the computers in the laboratory

for any purpose other than as directed.

Practical Session Safety

No student will be permitted to enter the laboratory without proper footwear. THONGS OR SANDALS ARE NOT ACCEPTABLE. NO FOOD OR DRINK may be taken into the laboratory.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, 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.

Student Support

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

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops

- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit 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.

Graduate Capabilities

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Demonstrated use of Matlab to solve problems in Signals and Systems
- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue

knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcome

- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assessment tasks

- In class test questions
- practicals held each week
- test
- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Demonstrated use of Matlab to solve problems in Signals and Systems
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- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from

one representation to another.

- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
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- Assignment 3
- Assignment 4
- End of Semester Exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Demonstrated use of Matlab to solve problems in Signals and Systems
- Demonstrated understanding of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
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and continuous-time signal processing, and to be able to find the appropriate signal domain and transform method to find system outputs from system inputs in a variety of applications (eg circuits, filters, communication channels)

Assessment tasks

- practicals held each week
- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- End of Semester Exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Demonstrated use of Matlab to solve problems in Signals and Systems
- Demonstrated understanding of the concept of signal domains: how the same signal can be represented in different domains (in time or in frequency) and how to transform from one representation to another.
- Demonstrated understanding of the role of sampling and filtering in converting between continuous-time to discrete-time signals, including the Nyquist criterion, and concept of aliasing.
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Assessment tasks

- In class test questions
- practicals held each week
- Assignment 1
- Assignment 2

- Assignment 3
- Assignment 4
- End of Semester Exam

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcome

- Demonstrated ability in the following areas of professional engineering practice: –self motivation and self learning –Production of quality work to meet a given deadline

Assessment tasks

- practicals held each week
- test
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Changes in response to student feedback

There will be less use of powerpoint, and more worked examples in the lectures.

Changes since First Published

Date	Description
10/08/2017	The third 45 minute test has been changed to be in week 12, it is now Tuesday October 31 in week 12.
10/08/2017	The component of assessment based on quiz questions has changed. The final mark is based on the best 6 quiz results during the unit (previously it was the best 8). The dates for the 45 minute tests have changed. These are now taking place on Tuesday August 15, Tuesday September 12, and Tuesday October 31, all in class.

Date	Description
31/07/2017	Updated tutor information
31/07/2017	The test questions in class are weekly in the usual lecture times, starting in week 2. There will be one question per week. The overall score (worth 10% of overall assessment) will be taken from the best 8 answers.