ELEC240

Signals and Systems

S2 Day 2015

Dept of Engineering

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General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
12cp including (MATH136(P) or MATH133)

Corequisites

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:

1. Be able to write programs in Matlab to study signal processing problems.
2. Be able to solve review problems in complex numbers and solve linear constant coefficient differential equations (1st and 2nd order)
3. Demonstrated understanding (via calculations using Matlab or pen and paper) of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
4. Demonstrated understanding (via calculations using Matlab or pen and paper) 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.
5. 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 or communication channels)
6. Demonstrated understanding of the relationship between the tools used in discrete and continuous signal processing, and the role of sampling and filtering in converting between continuous and discrete signals, including the Nyquist criterion
7. 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

Name	Weighting	Due
End-of-semester examination	50%	Final exam period
Practical work	20%	Throughout semester
Assignment 1	3%	10/08/15
Assignment 2	3%	24/8/15
Assignment 3	3%	7/9/15
Assignment 4	3%	28/9/15
Assignment 5	4%	12/10/15
Assignment 6	4%	16/10/15

Name	Weighting	Due
Midsemester Test	10%	11/9/15

End-of-semester examination

Due: **Final exam period**
Weighting: **50%**

Exam will test learning outcomes 3,4,5, and 6.

On successful completion you will be able to:

- 3. Demonstrated understanding (via calculations using Matlab or pen and paper) of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- 4. Demonstrated understanding (via calculations using Matlab or pen and paper) 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.
- 5. 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 or communication channels)
- 6. Demonstrated understanding of the relationship between the tools used in discrete and continuous signal processing, and the role of sampling and filtering in converting between continuous and discrete signals, including the Nyquist criterion

Practical work

Due: **Throughout semester**
Weighting: **20%**

Weekly practical sessions that consist of Matlab exercises and/or tutorial style problems. Each week there will be two test questions set that will test particular learning outcomes. All 7 learning outcomes will be tested over the 12 practical sessions. Each test question will be marked, and there will be a mark for the quality of the work done during the entire prac.

On successful completion you will be able to:

- 1. Be able to write programs in Matlab to study signal processing problems.
- 7. 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 1

Due: **10/08/15**

Weighting: **3%**

Assignment to test learning outcomes 2 and 7

On successful completion you will be able to:

- 2. Be able to solve review problems in complex numbers and solve linear constant coefficient differential equations (1st and 2nd order)
- 7. 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: **24/8/15**
Weighting: **3%**

Assignment to test learning outcome 3

On successful completion you will be able to:

- 3. Demonstrated understanding (via calculations using Matlab or pen and paper) of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.

Assignment 3

Due: **7/9/15**
Weighting: **3%**

Assignment to test learning outcome 4

On successful completion you will be able to:

- 4. Demonstrated understanding (via calculations using Matlab or pen and paper) 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.

Assignment 4

Due: **28/9/15**
Weighting: **3%**

Assignment to test learning outcome 5

On successful completion you will be able to:

- 5. 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 or communication

channels)

Assignment 5

Due: **12/10/15**
Weighting: **4%**

Assignment to test learning outcome 6

On successful completion you will be able to:

- 6. Demonstrated understanding of the relationship between the tools used in discrete and continuous signal processing, and the role of sampling and filtering in converting between continuous and discrete signals, including the Nyquist criterion

Assignment 6

Due: **16/10/15**
Weighting: **4%**

Assignment to test learning outcome 5

On successful completion you will be able to:

- 5. 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 or communication channels)

Midsemester Test

Due: **11/9/15**
Weighting: **10%**

Test in Friday lecture slot testing learning outcomes 3 and 4. There will be 5 minutes reading time, and then 40 minutes to work on test in class.

On successful completion you will be able to:

- 3. Demonstrated understanding (via calculations using Matlab or pen and paper) of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
- 4. Demonstrated understanding (via calculations using Matlab or pen and paper) 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.

Delivery and Resources

Required and Recommended texts and/or materials

The textbook used is "**Signals, Systems and Transforms**" 4th ed, by Phillips, Parr and Riskin. Pearson publishers. 2008.

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

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

"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.

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.

Laboratory 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 submitted at the end of sessions for marking. It is prohibited to use the computers in the laboratory for any purpose other than as directed.

Laboratory 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.

Unit Schedule

Week	Topics
1	Continuous time signals
2	Special signals, systems
3	Differential equations
4	Laplace transforms, Impulse response, convolution
5	LTI systems, Fourier series
6	Fourier transforms
7	Sampling
8	Discrete time signals
9	Discrete time LTI systems
10	Discrete time Fourier transforms (DTFT) and Discrete Fourier transform (DFT)
11	z-transforms
12	Digital filters
13	Digital filter design

Learning and Teaching Activities

Lectures

There is a one-hour and a two-hour lecture each week devoted to theory and concepts. Part of the two-hour lecture will be used for tutorial problems.

Practicals

Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

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.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

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

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

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.

Late tutorial problems will receive a 10% mark penalty for every day late. Exceptions to this may be made for individuals with the appropriate medical certificate.

Late Practical Reports will receive a 10% mark penalty for every day late. Exceptions to this may be made for individuals with the appropriate medical certificate.

Assignments will receive a 10% mark penalty for every day late. Exceptions to this may be made for individuals with the appropriate medical certificate.

Applications for extension of time to submit Tutorial Problems, Practical Reports, or Assignments must be lodged on:

http://ask.mq.edu.au

The request must include a copy of the medical certificate.

No extensions of time for Tutorial Problems, Practical Reports, or Assignaments wil be granted without the appropriate medical certificate.

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://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- 1. Be able to write programs in Matlab to study signal processing problems.
- 5. 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 or communication channels)

Assessment tasks

- End-of-semester examination
- Practical work
- Assignment 4
- Assignment 5
- Assignment 6

Learning and teaching activities

- Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

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

- 5. 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 or communication channels)
- 7. 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

- Practical work
- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- Assignment 5
- Assignment 6

Learning and teaching activities

- Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

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

- 7. 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

- Practical work
- Assignment 1
- Assignment 2
- Assignment 3

Learning and teaching activities

- There is a one-hour and a two-hour lecture each week devoted to theory and concepts. Part of the two-hour lecture will be used for tutorial problems.
- Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

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

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- 6. Demonstrated understanding of the relationship between the tools used in discrete and continuous signal processing, and the role of sampling and filtering in converting between continuous and discrete signals, including the Nyquist criterion

Assessment tasks

- End-of-semester examination
- Practical work
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- Assignment 4
- Assignment 5
- Assignment 6
- Midsemester Test

Learning and teaching activities

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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 outcome

- 5. 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 or communication channels)

Assessment tasks

- End-of-semester examination
- Assignment 4
- Assignment 5

- Assignment 6
- Midsemester Test

Learning and teaching activities

- There is a one-hour and a two-hour lecture each week devoted to theory and concepts. Part of the two-hour lecture will be used for tutorial problems.
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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

- 2. Be able to solve review problems in complex numbers and solve linear constant coefficient differential equations (1st and 2nd order)
- 3. Demonstrated understanding (via calculations using Matlab or pen and paper) of the concept of a linear time-invariant system and its use in modeling the input-output relationship for signals in many applications.
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- Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

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

- 7. 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

- Practical work
- Assignment 1
- Assignment 2
- Assignment 3
- Assignment 4
- Assignment 5
- Assignment 6

Learning and teaching activities

- Practical sessions will be on the use of Matlab to solve signal processing problems and for doing tutorial work. Tutorial work and practicals are assessed weekly.

Changes from Previous Offering

The unit is similar to the previous offering. The main change is that there are new practicals for the first half of the semester. Minor changes have been made to lecture content (mainly

differential equations).

Satisfactory completion

A satisfactory performance in ALL aspects of the unit is required to pass.