Introductory Signal Processing - Course Outline

ECEN 320: 2011 Trimester 1

This document sets out the workload and assessment requirements for ECEN 320. It also provides contact information for staff involved in the course. If the contents of this document are altered during the course, you will be advised of the change by an announcement in lectures and/or on the course web site. A printed copy of this document is held in the School Office.

Course Description

The course studies continuous and discrete time signal processing, with applications to electronics and communications. Topics include Fourier, Laplace and z-transforms, filter design and spectral analysis.

Prerequisites

Prerequisites: ECEN 220 (or ENGR 201) or MATH 243 or MATH 244 (or MATH 206)

Restrictions: ECSE 420, ELEN 303, PHYS 420, TECH 420

Objectives

At the completion of this course, students will be able to

- apply the principle of orthogonality of vectors and functions to approximation problems, and be able to derive decompositions based on various orthogonal function sets. 3(a) .
- calculate and apply Fourier transforms for functions that are periodic or nonperiodic and that are discrete or continuous in time, both analytically and numerically. 3(a) .
- calculate power spectral density via the Fourier transform, and via the autocorrelation function. 3(a) .
- apply windowing to spectral estimation. 3(a) .
- compute the response of a linear time invariant system (continuous or discrete time) to arbitrary input. 3(a) .
- design both analogue and digital filters to meet a given frequency specification, and be able to implement digital filters in software. 3(c) .

Objectives 1--5 are assessed primarily by written assignments and the examination. Objective 6 are assessed primarily by programming and laboratory assignments.

Course Material and Textbooks

Course notes will be provided, but students are advised to also take down their own notes in class. These should then be combined with further reading from the recommended reading for the course. There are many introductory signal processing texts that cover the material.

The textbook, focusing mainly on the discrete-time signal processing, is

Alan V. Oppenheim, Ronald W. Schafer, *Discrete-Time Signal Processing (3rd Edition)*, Prentice Hall 978-0131988422

and is available at the university bookstore.

The following texts are avilable on 3-day loan or closed reserve from the library:

- B.P. Lathi, *Linear Systems and Signals* , TK5102.5 L352L.
- P.A. Lynn, *An Introduction to the Analysis and Processing of Signals,* TK51092.5 L989I 3rd edn.

Additional references are:

- D.C. Champeney, *Fourier Transforms and their Applications,* QA403.5 C451.
- R.M. Bracewell, *The Fourier transform and its Application,* QA403 B796.
- A. Papoulis, *The Fourier Integral and its Applications,* QA403 P218.
- C.D. McGillem & GR Cooper, *Continuous and Discrete Signals and System Analysis* TK5102.5 M145 C 3rd edn.
- J.N. Rayner, *An Introduction to Spectral Analysis,* QA403 R275.
- W.H. Press et al., *Numerical Recipes for Scientific Computing,* QA76.73 P2 N971.

Lectures, Tutorials, Laboratories, and Practical work

A schedule of lecture topics, readings, and assignment due dates is available online

Lectures are timetabled for Mondays, Wednesdays and Thursdays 1-2pm. Note that some of the Thursday time slots will be used for tutorials rather than lectures.

Labs will be held on Mondays 2-5pm in CO249 beginning Wed, 7 March.

Assignments and Projects

Description of assignment/project work, including submission, and how the assigned work relates to the course objectives

Workload

Students are expected to commit approximately 10 hours per week to this course, including lecture and laboratory time. A plausible and approximate breakdown for these hours would be:

- Lectures and tutorials: 3
- Labs/Project: 3
- Readings: 2
- Assignments: 2

School of Engineering and Computer Science

The School office is located on level three of the Cotton Building (Cotton 358).

The notice board for ECEN 320 is located on the second floor of the Cotton Building.

Staff

The course coordinator is Dr Pawel Dmochowski. The lecturers are Dr Pawel Dmochowski and A/Prof Paul Teal

Contact details:

- Pawel Dmochowski
- AM 227
- 463 5948
- Pawel.Dmochowski@ecs.vuw etc

Contact details:

- Paul Teal
- AM 228
- 463 5966
- Paul.Teal@ecs.vuw etc

The tutor for this course is Brett Ryan

The class representative is Joshua O'sullivan [joshosullivan # gmail.com]

Announcements and Communication

This course uses Blackboard. Course materials and other information will be posted on Blackboard. Students should check Blackboard regularly. Email will also be used for communication, so please ensure that your email address is correct in the VUW system.

Assessment

Your grade for ECEN 320 will be determined based on the following assessment weightings:

Item	Weight	Objectives Assessed

assignments	15%	1-6
labs + project	25%	1-5
2 tests	10 %	1- 6
Final Examination	50%	1-6

Bachelor of Engineering students should be aware that copies of their assessed work may be retained for inspection by accreditation panel.

Tests and Exams

The timetable for final examinations will be available from the University web site and will be posted on a notice board outside the faculty office. The final examination will be three hours long. No computers, electronic calculators or similar device will be allowed in the final examination. Paper non-English to English dictionaries will be permitted. The examination period for trimester 1 is 10 - 29 June.

Homework and Lab Assignments

The four assignments will include written solutions to problems, as well as occasional (small) Matlab exercises. The approximate due dates for the assignments are: 24 March, 28 April, 19 May, 7 June

The 10 Laboratory assignments will be Matlab based. The printed results of a Matlab ``publish'' of a file constructed during each laboratory session is to be handed in no later than one week following the laboratory session. Assignments and labs not collected in lectures can be collected from the SECS school office at hours to be announced.

All work is due in on the due date. Work submitted after the due date will incur a penalty. Marks will be deducted at a rate of 10% of the full mark for each working day late. Work will not be marked if more than 1 week late. Any work handed in after the model solutions have been made available will not be graded at all. Extensions will be given only in exceptional circumstances, and if agreed before the due date. In the event of an aegrotat application, regular submission and performance in assignments and laboratories will contribute substantially to the outcome.

Course Content

The following is a preliminary outline of the topics covered in the lectures.

- Signals Overview / Orthogonality
- Fourier Series, Generalised FS
- Fourier Transform and properties (review)
- Sampling / Quantisation (review)
- Discrete Time signals, Discrete Time systems
- The Discrete Time Fourier transform
- The DFT and FFT (including overlap save, overlap add)
- Windowing

- Difference equations and the z transform, first order systems
- Analogue Filters: high/low/band pass, band stop, causality, stability, phase linearity
- Filter design: Butterworth
- Discrete Time Systems II: allpass systems, minimum phase
- Discrete time filters FIR/IIR: continuous/discrete equivalence - impulse response invariance, bilinear transformation
- Digital filter design
- Modulation, quadrature multiplexing, single sidebands, Hilbert transform

Plagiarism

Working Together and Plagiarism

We encourage you to discuss the principles of the course and assignments with other students, to help and seek help with programming details, problems involving the lab machines. However, any work you hand in must be your own work.

The School policy on Plagiarism (claiming other people's work as your own) is available from the course home page. Please read it. We will penalise anyone we find plagiarising, whether from students currently doing the course, or from other sources. Students who knowingly allow other students to copy their work may also be penalised. If you have had help from someone else (other than a tutor), it is always safe to state the help that you got. For example, if you had help from someone else in writing a component of your code, it is not plagiarism as long as you state (eg, as a comment in the code) who helped you in writing the method.

Mandatory Requirements

In order to pass this course it is necessary to

- obtain and overall pass grade of C
- hand in at least 90% of assignments and labs by the due dates, and
- attend at least 80% of the lectures.

Passing ECEN 320

To pass ECEN 320, a student must satisfy mandatory requirements and gain at least a **C** grade overall.

Withdrawal

The last date for withdrawal from ECEN 320 with entitlement to a refund of tuition fees is Fri 11 March 2011. The last date for withdrawal without being regarded as having failed the course is Fri 13 May 2011 -- though later withdrawals may be approved by the Dean in special circumstances.

Rules & Policies

Find key dates, explanations of grades and other useful information at http://www.victoria.ac.nz/home/study.

Find out about academic progress and restricted enrolment at http://www.victoria.ac.nz/home/study/academic-progress.

The University's statutes and policies are available at http://www.victoria.ac.nz/home/about/policy, except qualification statutes, which are available via the Calendar webpage at http://www.victoria.ac.nz/home/study/calendar (See Section C).

Further information about the University's academic processes can be found on the website of the Assistant Vice-Chancellor (Academic) at http://www.victoria.ac.nz/home/about/avcacademic

All students are expected to be familiar with the following regulations and policies, which are available from the school web site:

Grievances
Student and Staff Conduct
Meeting the Needs of Students with Disabilities
Student Support
Academic Integrity and Plagiarism
Dates and Deadlines including Withdrawal dates
School Laboratory Hours and Rules
Printing Allocations
Expectations of Students in ECS courses

The School of Engineering and Computer Science strives to anticipate all problems associated with its courses, laboratories and equipment. We hope you will find that your courses meet your expectations of a quality learning experience.

If you think we have overlooked something or would like to make a suggestion feel free to talk to your course organiser or lecturer.