Carleton University

Department of Systems and Computer Engineering

SYSC 3500 A ***Signals and Systems*** **Fall 2011/12**

Course Outline

Instructor:

Prof. Ian Marsland, Office: 7030 MC, 613-520-2600 ext. 2052, email: ianm@sce.carleton.ca
Office Hours: Wednesdays 1:00-2:30pm.

Calendar Description:

Signals: energy and power signals, discrete-time and continuous. Linear systems and convolution. Fourier Transform; complex Fourier series; signal spectral properties and bandwidth. Laplace transform and transient analysis. Transfer functions, block diagrams. Baseband and passband signals, with applications to communications systems.
Precludes additional credit for SYSC 3600 or SYSC 2500.
Prerequisite: MATH 2004.
Lectures three hours a week, problem analysis/laboratory three hours alternate weeks.

Course Overview:

This course provides an introduction to the fundamental concepts of signals and systems. The definition and characteristics of signals, both analogue and digital, will be presented, with a focus on deterministic signals. Both time and frequency domain analysis of signals will be studied, and a thorough understanding of Fourier series and Fourier transforms will be developed. Systems that manipulate signals will be discussed, with an emphasis on linear time-invariant systems. Time domain analysis of systems, including impulse response and convolution will be examined, as will frequency domain analysis and system frequency response. Particular emphasis will be on applications relating to communication signals and systems.

Learning Objectives:

By the end of this course, students will be familiar with the fundamental terminology and theory behind signal and system analysis. Students will develop the mathematical tools to model and analyze signals and systems, including convolution and Fourier transforms, along with the related elements of calculus. Students will acquire the necessary background for further study in fields such as communication theory, signal processing, and control systems

Instructional Resources:

Lectures: Tuesdays and Thursdays, 4:05-5:25, in Room 3328ME.

Web Site: http://www.sce.carleton.ca/courses/sysc-3500/f11 – Please check the website regularly, as important announcements will be posted there as the course progresses.

TA: The TA, Jason Rhinelander (jasonr@sce.carleton.ca) is responsible for marking the assignments and labs, and lab supervision, and will hold regular tutorials.

Instructor: I will be available for discussion during my scheduled office hours (Wednesdays 1:00-2:30pm), but feel free to drop by my office at any time (I'm usually available most afternoons). Appointments at other times can be arranged if you have trouble finding me. I can also be reached by email, but for help with difficult problems it is usually more productive to meet in person.

Textbook: E. Kamen and B. Heck, *Fundamentals of Signals and Systems using the Web and MATLAB, 3rd Ed.*, Pearson Prentice Hall, 2007. The book, *Signals and Systems*, by Oppenheim and Willsky is also an excellent reference.

Tutorials: The dates, times, and locations of the tutorials will be posted on the course website.

Assignments:

A total of 5 assignments will be posted on the web site as the course progresses. Assignments are due at 4pm on the following days:

Assignment #1	Thursday,September 29th
Assignment #2	Thursday, October 13th
Assignment #3	Thursday, October 27th
Assignment #4	Thursday, November 10th
Assignment #5	Thursday, December 1st

Assignments are to be submitted in the assignment box in the 4400 block of the Mackenzie Building. Late assignments will be accepted until 4pm on the following Tuesday (except for the last assignment), but will be subject to a 20% late penalty.

Laboratories:

There will be five software laboratories throughout the term, according to this schedule:

	Room	Lab Date	Time
Lab #1	6045 MC	September 21st	2:30-5:30 PM
Lab #2	6045 MC	October 5th	2:30-5:30 PM
Lab #3	6045 MC	November 2nd	2:30-5:30 PM
Lab #4	6045 MC	November 16th	2:30-5:30 PM
Lab #5	6045 MC	November 30th	2:30-5:30 PM

Lab manuals will be posted on the course website a few days before each lab.

Lab reports are due at the time specified by the TA for each lab. Late lab reports will be penalized by 20%. Reports more than one week late will not be accepted.

Lab exemptions will not be granted for this course, and attendance at the scheduled laboratory periods is mandatory. If you are unable to attend a lab due to medical reasons, you must provide a medical note within two days of returning to campus.

Prerequisites:

MATH 2004.

Students who have not satisfied the prerequisites for this course must either:

a) withdraw from the course, or

b) submit a prerequisite waiver form online at http://www.sce.carleton.ca/ughelp.

Students without the prerequisites or a prerequisite waiver may be deregistered from the course after the last day to register for courses in the Fall 2011 term.

Examinations:

There will be a written mid-term exam and a written final exam. Both exams will be closed-book, but students will be allowed to bring one 8.5×11" sheet of notes (double-sided), and a calculator.

The mid-term exams will be held during the lab period on Wednesday, October 19th. The final exam will be held during the University's examination period in December. The precise date should be announced by the end of October. The final exam is for evaluation purposes only and will not be returned to students.

The *Academic Regulations of the University* permit instructors to specify requirements that must be satisfied for students to be eligible to write the final examination or, where circumstances warrant, apply to the Registrar's Office for deferral of the final examination.

- All students are encouraged to write the final examination.
- Students who miss the final exam due to a valid medical reason, but attended all labs and attempted all assignments and the midterm exam, will receive the grade ABS. These students are eligible to apply for deferral of the final examination. For more information, see the current Undergraduate Calendar, *Academic Regulations of the University*, Section 2.2, The Course Outline; Section 2.3, Standing in Courses/Grading System; and Section 2.5, Deferred Final Examinations.
- Students who miss the final exam, and did not complete all labs and assignments or missed the midterm exam, will receive the grade FND. These students are ineligible to write the deferred final exam.

Grading Scheme:

To pass the course, students must pass the final examination (50% or better), and complete all the labs. For these students, the final grade will be calculated by weighting the course components according to whichever of the following schemes yields the highest grade:

	Scheme #1	Scheme #2
Assignments:	10%	10%
Lab Exercises:	10%	10%
Mid-term Exam:	20%	0%
Final Exam:	60%	80%

Attendance:

Students are expected to attend all lecture and lab periods. The Faculty of Engineering and Design requires its students to have a conflict-free timetable, so requests to accommodate missed exams, assignment due dates, etc., because of conflicts with other courses, jobs or vacation plans will not be considered.

Early Feedback

At least one assignment and one lab report will be evaluated and returned prior to the 25th teaching day of the term. Informal in-class quizzes will provide additional feedback.

Students with Disabilities:

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities for a formal evaluation of disability-related needs. Registered PMC students are required to contact the Centre, 613-520-6608, every term to ensure that I receive your Letter of Accommodation, no later than two weeks before the first assignment is due or the first midterm requiring accommodations. If you require accommodation for your formally scheduled final exam in this course, please submit your request for accommodation to PMC by November 11th 2011.

Academic Accommodation for Religious Obligations

Students who require accommodations due to religious obligations must follow the procedures described in Section 2.10 of the *Academic Regulations of the University*.

Health and Safety:

Every student should have a copy of our Health and Safety Manual. An electronic version of the manual can be found at http://www.sce.carleton.ca/courses/health-and-safety.pdf

Plagiarism:

Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated. All suspected cases of plagiarism and other instructional offenses, will be forwarded to the Associate Dean of Engineering for investigation. Please refer to the section on instructional offenses in the Undergraduate Calendar for additional information.

Week-by-week Outline:

The following week-by-week outline is a preliminary guideline only and is subject to change:

Weeks 1-2 – September 12th-23rd:

Introduction to signals: Classifications of signals: continuous-time vs. discrete-time, continuous amplitude vs. discrete amplitude, energy vs. power, deterministic vs. random, periodic vs. aperiodic. Unit step function, rectangular pulses, triangular pulses, ramp functions, the Dirac delta (impulse function), complex sinusoids. Time shifted signals.

Introduction to systems: Classification of systems: Linear vs. nonlinear, time invariant vs. time-variant, realizable vs. non-realizable, memoryless vs. with memory.

Weeks 3-4 – September 26th-October 7th:

Linear time-invariant systems: Transmission of signals through linear time-invariant systems. Impulse response. Convolution sum and convolution integral. Difference equations and differential equations.

Weeks 5-8 – October 10th-November 4th:

Frequency domain representation of continuous-time signals: Complex Fourier series. Line spectra. Fourier transforms and inverse Fourier transforms. Fourier transforms of common signals. Energy/power spectrum. Bandwidth. Parseval's Theorem. Properties of the Fourier transform and transform pairs. Applications to modulation and demodulation.

Frequency domain representation of discrete-time signals: Discrete-time Fourier transforms. Discrete Fourier transforms. Properties. Spectrum of discrete-time signals.

Week 9 November 7th-11th:

Fourier Analysis of Systems: Continuous-time signals – frequency response. Discrete-time signals. Analysis of ideal filters. Lowpass, bandpass, highpass filters.

Week 10 – November 14th- 18th:

Sampling and Quantization: Nyquist's sampling theorem. Sampling frequency. Signal reconstruction. Aliasing. Uniform quantization and quantization error.

Week 11 – November 21st- 27th:

Amplitude Modulation: Lowpass and bandpass signals. Modulation & demodulation. Quadrature amplitude modulation.

Week 12 – November 28th-December 2nd:

Laplace Transforms: Laplace transform of a signal. Transfer function.