University of California at Berkeley
College of Engineering
Department of Electrical Engineering and Computer Sciences

EECS 120: Signals and Systems
Fall Semester 2002

**Course Organization and Syllabus (Revised on September 3)**

**Instructor:** Professor Joseph M. Kahn, 514 Cory, 3-8848, `jmk@eecs`, `http://www.eecs.berkeley.edu/~jmk`. OH: M 4-5, W 11-12. Assistant: Rosita Alvarez-Croft, 558 Cory, 3-6683, `rosita@eecs`.

**Teaching Assistants:**

Lenny Grokop, `lgrokop@eecs`, OH: M 1-2, Tu 1-2, 297 Cory.

Ryan White, `ryanw@eecs`, OH: Tu 11-12, W 10-11, 297 Cory.

**Class Meetings:** M W 2-4 pm, 277 Cory Hall.

**Section Meetings:**

101: Tu 10-11, 293 Cory (White)

102: Tu 2-3, 534 Davis (Grokop)

103: W 9-10, 293 Cory (White)

104: F 10-11, 293 Cory (Grokop).

Regardless of which section you are officially enrolled in, feel free to attend any section(s) you wish to.

**Required Text:** S. Haykin and B. Van Veen, *Signals and Systems*, First Edition, New York: John Wiley and Sons, 1999. A Second Edition is scheduled to be published in September 2002. As I have not yet seen it, I cannot comment on how much it differs from the First Edition. A list of errata for the First Edition (known to date) is attached. This list is posted at the class web page, and will be updated periodically.

**Optional Supplementary Text:** D. Hanselman and B. Littlefield, *Mastering Matlab 6*, Upper Saddle River: Prentice Hall, 1998. Before buying this book, read the section on MATLAB Assignments below.

**WWW Site:** announcements, handouts, and homework assignments (but not solutions) will be posted at `http://www-inst.eecs.berkeley.edu/~ee120`. As of Monday, August 26, the class home page could be accessed using Microsoft Internet Explorer, but not with Netscape Navigator. This problem should be corrected soon.

**News Group:** the class news group is `ucb.class.ee120`.

**Official Prerequisites:** Math 53 and 54 and EECS 20. The relevant concepts from EECS 20 are given a reasonably self-contained introduction in EECS 120. Hence, if you are not an EECS undergraduate and are not required to take EECS 20, you may consider skipping the EECS 20 prerequisite.

**Grading:** Homework (25%), First Midterm (15%), Second Midterm (15%), Final (45%).

**Examinations:** *Exam dates given are tentative.* All exams will be open-book and open-note, but no calculators, computing or communication devices will be permitted. As the exams will provide space in which to

work the problems and write the answers, no blue books will be required. A lecture will be given after the first midterm, but probably not after the second.

**Homework:** There will be about twelve homework assignments during the semester. In most cases, assignments will be handed out on Mondays, and will be due at the *beginning* of class on the Wednesday nine days later. No homework will be due during midterm weeks. *Late HW will not be accepted.* A group of up to three students may work together and turn in a single homework assignment bearing all their names, for which they will earn a common grade.

**MATLAB Assignments:** About 25% of the homework will involve numerical exercises using MATLAB. Please turn in any graphs you are asked to plot, along with listings of your MATLAB scripts. It is strongly recommended that you not do the MATLAB exercises at the last minute, so that you will not be at the mercy of circumstances beyond your control (e.g., a printer breakdown).

The optional supplementary text *Mastering Matlab 6* is a good general tutorial and reference on MATLAB, and you will find it especially useful if you have never used MATLAB before. If you have used MATLAB previously, you probably do not need to buy this book. This book does not discuss in detail a few of the specialized MATLAB functions used in class, but you can find out all you need to know about these by using MATLAB's built in `help` function.

The assigned exercises can be done on any computer running MATLAB 6 with the Control and Signal Processing Toolboxes. No multimedia capability is required. Three options are available for running MATLAB.

1. Run MATLAB on the EECS instructional Unix systems. You can log in to the Unix systems using the terminals in 199 Cory. Alternatively, you can access these Unix systems from any computer at home or on Campus using `'ssh'` over the Internet. About two thirds of the students in the class already have Unix accounts. Students who do not have Unix accounts can request them by logging in as `'newacct'` (password `'newacct'`) in 199 Cory or via `'ssh'` to `cory.eecs.berkeley.edu`. Your Unix account will not expire at the end of the semester. For information, refer to: `http://inst.eecs.berkeley.edu/connecting.html`.

2. Run MATLAB on the EECS instructional Windows 2000 systems. By the end of the first week of classes, the EECS Instructional and Electronics Support Group will set up Windows 2000 accounts for all students in the class (including those on the waiting list). A list of user names will be posted at the class news group, `ucb.class.ee120`. The initial password will be your student identification number. Your Windows account will expire at the end of the semester. You can use any of the Windows 2000 systems listed at: `http://inst.eecs.berkeley.edu/~iesg/iesglabs.html`.

3. Buy the Student Version of MATLAB 6, along with the Control and Signal Processing Toolboxes.

**Syllabus:** This is a tentative weekly schedule of material to be covered. You are responsible for reading the required text. It is important that you don't fall behind the class. The pace of the course is rapid, and the material is cumulative.

**Weeks 1-2 (8/26, 8/28, 9/4): Introduction to Signals and Systems**
Continuous-time and discrete-time (CT and DT) signals and systems. Classification of signals. Energy and power signals. Operating on signals to produce new signals. Sinusoids, complex exponentials, step and

impulse functions. Classification of systems (linearity, time-invariance, causality, memory, invertibility).
*Reading: HV Sect. 1.1-1.8.*

**Weeks 2-4 (9/4, 9/9, 9/11, 9/16, 9/18): Time-Domain Properties of Linear, Time-Invariant Systems**
Convolution. Impulse response and superposition integral or sum for linear, time-invariant (LTI) systems. Frequency response of LTI systems. LTI systems characterized by differential or difference equations. LTI systems characterized by block diagrams.
*Reading: HV Sect. 2.1-2.5 (skip Sect. 2.6 on state variables).*

**Weeks 5-7 (9/23, 9/25, 9/30, 10/2, 10/7, 10/9): Fourier Representations of CT and DT Signals**
Complex exponentials as eigenfunctions of LTI systems. Fourier series representation of periodic signals. Fourier transform representation of aperiodic signals. Properties of Fourier representations (symmetry, time/frequency shift, differentiation/integration, sum/difference, convolution/modulation, Parseval's identity).
*Reading: HV Sect. 3.1-3.6.*

**Midterm 1: tentatively Wednesday, 10/9, in class, 60 minutes. The material covered by the midterm will be announced in class. A lecture will probably be given after the exam.**

**Weeks 8-9 (10/14, 10/16, 10/21, 10/23): Applications of Fourier Representations**
Frequency response of LTI systems. Conditions for distortionless transmission. Filtering by simple LTI systems. Fourier transform representation of periodic signals and relation to Fourier series representation. Convolution and modulation of mixed signal classes. CT representation of DT signals. Sampling of CT signals. Reconstruction of CT signals from samples. Conditions for perfect reconstruction.
*Reading: HV Sect. 4.1, 4.2 (skip state variable sect.), 4.3-4.5, 4.6 (skip subsampling sect.), 4.7, 4.9, 8.2, 8.3. You may wish to read Sect. 4.8, 4.10, 4.11.*

**Weeks 9-11 (10/23, 10/28, 10/30, 11/4): Communication Systems**
Applications of modulation. Double-sideband amplitude modulation with carrier and its asynchronous demodulation. Double-sideband amplitude modulation with suppressed carrier and its synchronous demodulation. Quadrature-amplitude modulation and its demodulation. Single-sideband amplitude modulation and its demodulation. Hilbert transformers. Pulse-amplitude modulation. Phase and frequency modulations.
*Reading: HV Sect. 5.1-5.10.*

**Weeks 11-13 (11/4, 11/6, 11/18, 11/20): Laplace Transforms for CT Signals and Systems**
Bilateral and unilateral Laplace transforms. Region of convergence. Inversion of Laplace transforms. Partial fraction expansion. Solving linear differential equations with initial conditions using unilateral Laplace transform. Transfer function of LTI CT systems. Relation between transfer function and frequency response.
*Reading: HV Sect. 6.1-6.6, 6.7 (skip state variable sect.), 8.5 (read sect. on Butterworth filters only), 9.1-9.2, B.1.*

**Midterm 2: tentatively Wednesday, 11/13, in class, 60 minutes. The material covered by the midterm will be announced in class. A lecture will probably not be given after the exam.**

**Weeks 14-15 (11/25, 11/27, 12/2, 12/4): Z Transforms for DT Signals and Systems**
Bilateral and unilateral Z transforms. Region of convergence. Inversion of Z transforms. Partial fraction expansion. Solving linear difference equations with initial conditions using unilateral Z transforms. Transfer function of LTI DT systems. Relation between transfer function and frequency response.
*Reading: HV Sect. 7.1-7.8, B.2.*

**Final Exam: Group 20, Wednesday, December 18, 5-8 p.m., room to be announced.**