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

EECS 120: Signals and Systems
Fall Semester 1999

Course Organization and Syllabus

Instructor: Professor Joseph M. Kahn, 514 Cory, 3-8848, `jmk@eecs`, `http://www.eecs.berkeley.edu/~jmk`. OH: M 1-2, W 4-5. Assistant: Alev Burton, 558 Cory, 3-6683, `alevb@eecs`.

Teaching Assistants: Weerachai (Jack) Anotaipaiboon, `anotai@eecs`, OH: M 4-6, 297 Cory. Xiaoyi (Michael) Tang, `xiaoyi@eecs`, OH: Tu 10-11, Tu 5-6, 297 Cory.

Class Meetings: M W 2-4 pm, 1 LeConte Hall.

Section Meetings: 101: Tu 4-5, 3109 Etcheverry (Anotaipaiboon), 102: Tu 8-9, 3113 Etcheverry (Anotaipaiboon), 103: W 11-12, 71 Evans (Tang), 104: F 2-3, 241 Cory (Tang). 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*, New York: John Wiley and Sons, 1999. A list of errata (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 5*, 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`.

Official Prerequisites: Math 53 and 54 and EECS 20. EECS 40 may substitute for EECS 20.

Grading: Homework (20%), First Midterm (16%), Second Midterm (16%), Final (48%).

Examinations: *Exam dates given are tentative.* All exams will be open-book and open-note, but no calculators 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.

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 5* 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. To learn about `help`, type `help help` at the MATLAB prompt.

MATLAB is available on EECS instructional Unix and Windows NT computers. The Unix computer facilities in 117 Cory and 199 Cory are available for your use on a walk-in basis. Alternatively, you can access these machines or other Unix servers remotely (e.g., from home) using `ssh` and Exceed (X Windows for a PC). You can obtain `ssh` and Exceed free from `http://www-inst.eecs.berkeley.edu/connecting.html`. Early in the semester, if we find that the Unix facilities are inadequate for our purposes, I will get NT class accounts for the class. If you have been assigned an NT account for another class, you can use that to access the NT systems, e.g., in 111 Cory.

Obtaining a Named Computer Account: If you are not an EECS major or are a new student, you should obtain a new named account on the EECS instructional machines. Go to one of the EECS Unix instructional labs (e.g., 199 Cory or 273 Soda) and log in to one of the computers as "`newacct`". Detailed instructions are posted on the walls of those labs. If the "`newacct`" program rejects you, it is probably because your name is not on the TeleBears enrollment list for EECS 120. In that case, please send e-mail to one of the TAs, who will convey your name to the appropriate person (include your student identification number in the message).

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 (8/23, 8/25, 8/30): 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 (9/1, 9/8, 9/13, 9/15): 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 (9/20, 9/22, 9/27, 9/29, 10/4, 10/6): 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, 10/6, in class, 60 minutes.

Weeks 8-9 (10/11, 10/13, 10/18, 10/20): 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 10-11 (10/25, 10/27, 11/1, 11/3): 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 (11/3, 11/8, 11/10, 11/15, 11/17): 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, 11/10, in class, 60 minutes.

Weeks 14-15 (11/22, 11/24, 11/29, 12/1): 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 15, 5-8 p.m., room to be announced.