

Handout 1: Syllabus/Course Overview

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This is the first handout and syllabus for EE235, Fall 2006 (SLN 12206). We will begin a study of signals, linear systems, and transforms, focusing on continuous time signals. This will include basic signals including impulses, unit steps, periodic signals, convolution of signals, and Fourier series and transforms in continuous time. There will be a problem set due every week, and there will be 5 computer laboratories. In this latter case, we will use computer simulation to illustrate time and frequency domain signal processing operations. Part of the responsibility of this course is to learn MATLAB since you will need use it in later courses here at UW and beyond.

Instructor: Professor Jeff A. Bilmes, office: EE1-418. <bilmes@ee.washington.edu>

Office Hours:, Tuesdays: 4:35pm-6:30pm and Wednesdays 3:35-4:30pm.

Lectures: MTWF 2:30-3:20 in SIG-134

Course Units: 4

Prerequisites: Either 1.0 in MATH 136 or 1.0 in MATH 307 either of which maybe taken concurrently, 1.0 in PHYS 122; 1.0 in PHYS 132.

TAs:

Evan M. Hanusa <hanusaem@ee.washington.edu>, Office Hours: Wednesdays 10am-12pm, Thursdays 10am-11am, Sieg 126/128.

Eric Rombokas <erombokas@ee.washington.edu> Office Hours: Mondays, 10:30-12:00, Thursdays 1:30-2:30, Sieg 126/128.

Grader: we will have a grader or two in this class. The grader will grade all homework due in the class. If you have a question about homework grading, the first person to go to is the grader(s). If after speaking with the grader, you still have a question about grading, see the TAs. If you still have a question about the grading, then see me. (we should know the grader(s) by the 2nd week of class I am told). **Grader(s):** TBA tba@ee.washington.edu,

Discussion Sessions/Laboratories: Sessions/Labs will both be held in the rooms listed below. See the class outline below to find out when labs are due (listed as Lab 1, Lab 2, etc.). Description of the labs is below, but note that labs are due in the discussion sessions (you get a grade right there) so you do need to attend at least one of them per week (if you miss your assigned one, it is ok to attend another one, but make sure you let **both** of the TAs know this). It is your responsibility to make sure the TAs have recorded grades for your completed labs.

- **Computer/Problem Session AA/SLN12207:** Monday, 9:30-10:20, SIG-232, TA Evan Hanusa
- **Computer/Problem Session AB/SLN12208:** Tuesday, 8:30-9:20, SIG-232, TA Eric Rombokas
- **Computer/Problem Session AC/SLN12209:** Wednesday, 3:30-4:20, SIG-232, TA Eric Rombokas
- **Computer/Problem Session AD/SLN12210:** Thursday, 11:30-12:20, SIG-232, TA Evan Hanusa

Photos: We need to get a digital photo of you that identifies you with your name and student id (SID). The photo should be recent and **must look like you look in class**. You can either email your name, photo, & SID to <mailto:ee235picture@ssli.ee.washington.edu>, or we can take your photo in class. Turning in a photo is a real assignment, last day to turn in photos is Wed, Oct 4th.

Course web page: <http://ssli.ee.washington.edu/courses/EE235.html> or can be accessed from the Classes list on the Electrical Engineering Department homepage. On it are announcements about the class, a list of our office hours, and all handouts from the class. In addition, there are links to MATLAB and convolution web pages.

Course Text: Charles L. Phillips, John M. Parr, and Eve A. Riskin *Signals, Systems, and Transforms*, Prentice Hall (Third Edition), 2003. We will cover most of Chapters 1-7 in this class. The textbook is on reserve in the Engineering Library. There are also lecture notes available for purchase at the communications building basement copy center (see <http://www.washington.edu/home/maps/?CMU> for the building location).

Homework: There will be nine (9) weekly problem sets due. They will either be due on Fridays (before the midterm) or on Wednesdays (thereafter). Each problem set will be graded separately on a points basis, 100 points maximum (900 points total for problem sets).

Laboratory exercises: There will also be 5 computer laboratories (MATLAB + interactive exercises) throughout the quarter due in the discussion sections. In other words, the laboratory exercises are due while you are sitting in discussion section, and the TA running the discussion section will give you a grade based on what you've done during that hour. The laboratories are all listed online and are given here: <http://www.cnx.org/content/coll10374/latest/>. Each laboratory will be graded based on a pass/no-pass grade (for a total of 500 points for the laboratory exercises, 100 points if you pass, 0 if not). The laboratory exercises will be graded by the TAs in the discussion session in which you complete the lab.

Homework late policy: Homeworks are due **in class before the beginning of lecture**. This means that they are due no later than 2:30pm on each homework due date. Homeworks turned in after 2:30pm will be considered late. Points will be deducted from homework and laboratories depending on how late they are. The late policy is as follows: 1st 24 hours after due date, 10 point deduction (so max score 90). Next 24 hours after due date 20 *additional* points (max score 70). Next 24 hours after due date, 30 *additional points* (max score 40). Next 24 hours, zero. Note that these 24-hour increments don't count weekends (so Monday is the day after Friday). Laboratories are due in the discussion section itself — you must complete the lab during the week in which it is held in at least one of the discussion sections to receive credit (it is your responsibility to ensure that the TAs have an accurate account of you doing the lab if you switch sections).

Grading: Grades will be based on a combination of the homework (15%), computer laboratories (15%), the midterm exam (30%) and the final exam (40%). Grading will be on a curve (so absolute scores on midterms and finals, which will be on a 100 point scale, are meaningful only when seen along with a score histogram, the histogram for each exam will be made available as soon as the exam is graded).

Academic Calender: (info about deadlines for adding/dropping courses, late fees, etc.) A few of these dates are given below. <http://www.washington.edu/students/reg/0607cal.html>

Last day for free drop: October 3th, 2006.(no fee)

Last day for unrestricted drop: October 10th, 2006. (\$20 fee, but it will not appear on your transcript)

Last day for annual drop: November 12th, 2006. (also the last day to convert to S/NS grade option). (\$20 fee)

Midterm Exam: 2:30-3:20 p.m. Wednesday, November 1st (including all material up to lecture 18). There will be **no early exams or makeups**. The exam is closed-book, closed notes. You will be allowed one side of one 8.5×11 sheet of original, self-written (you need to write them by hand yourself, and they must be *handwritten*) notes (no photocopies, scans, computer printouts, laptops, PDAs, or cell-phones allowed).

Holidays: Friday Nov 10th, 2006 (Veterans Day), Thur/Fri Nov 23/24, 2006 (Thanksgiving).

Last Day Of Class: Friday Dec 8th, 2006.

Finals Week: Dec 11th-15th, 2006.

Our Final Exam: Tuesday, December 12, 2006, 2:30-4:20, MGH 389. *No early exams or makeups*. The exam is closed-book, closed notes. The exam will cover any material in the course, with 65% weight on the material since the midterm. You will be allowed two sides of one 8.5×11 sheet of original, self-written and *handwritten* notes (again, no photocopies or computer printouts allowed). You can use your 1-page handwritten midterm notes for the first half.

Email: You should have a computer account and can use email to communicate with your TAs and me. You will be receiving files that are necessary to run the Matlab exercises by email or on the web page. You will also find the latest version of all these matlab .m files on the course web page.

Useful Other Texts:

- Signals and Systems: Second Edition, Oppenheim and Willsky w. Nawab, 1997, Prentice Hall.
- B.P. Lathi, *Signal Processing and Linear Systems*, Oxford, 1998.

Class outline 40 total lectures.

- **Week 1, 9/27-9/29:** Introduction, continuous time signals and operations.
Homework: HW 0 on complex numbers (see web page) **due Friday 9/29** (optional, not graded)
Laboratories: no lab this week
Readings: All of Chapter 1, Section 2.1
 - *Day 1, Wednesday 9/27:* chapter 1 (nts: 1–4): Class overview, links, matlab demo, applications, basic definitions of signals and systems.
 - *Day 2, Friday 9/29:* Section 2.1 (nts: 5–12): Time domain operations (time reversal, scaling, shifting) **HW 0 optionally due.**
- **Week 2, 10/2-10/6:** Continuous time system properties.
Homework: HW 1 (2.1(b), 2.3, 2.9, 2.10(c,d), 2.12, 2.14(a), 2.15(b),) **due Friday, 10/6.**
Laboratories: Lab 1 at <http://www.cnx.org/content/col110374/latest/>
Readings: Sections 2.1 – 2.7 inclusive.
 - *Day 3, Monday 10/2:* Section 2.1,2.2 (nts: 13–16). amplitude operations, even/odd functions, periodic functions.
 - *Day 4, Tuesday 10/3:* Section 2.3 (nts: 17–23): more on periodic functions, exponential signals, Euler’s identity, complex functions, amplitude & phase.
 - *Day 5, Wednesday 10/4:* Section 2.4,2.5 (nts: 24–30): Singularity functions, unit step, unit impulse, properties, sifting property,
 - *Day 6, Friday 10/6:* Sections 2.6,2.7 (nts: 31–36): Continuous-time systems, properties, memory, inversion, causality. OEA in-class survey I. **HW1 due.**
- **Week 3, 10/9-10/13:** Continuous time convolution.
Homework: HW 2 (2.16, 2.17, 2.20(b,c-iii,c-iv), 2.26, 2.27, 2.28, 2.29(a,b,c)) **due Friday, 10/13.**
Laboratories: Lab 2 at <http://www.cnx.org/content/col110374/latest/>
Readings: Sections 2.7, 3.1, 3.2
 - *Day 7, Monday 10/9:* Section 2.7 (nts: 37–44): stability, time-invariance, begin linearity
 - *Day 8, Tuesday 10/10:* Section 2.7 (nts: 44–50): Linearity, Superposition, LTI
 - *Day 9, Wednesday 10/11:* Section 3.1, 3.2 (nts: 50–54): Impulse reps, Convolution (time view).
 - *Day 10, Friday 10/13:* Section 3.2 (nts: 55–60,63): Convolution examples, LTI **HW2 due.**
- **Week 4, 10/16-10/20:** Linear time-invariant (LTI) constant-coefficient (LTIC) systems.
Homework: HW 3 (3.1(ai,aii,aiv),3.3, 3.7, 3.8,3.10, 3.20) **due Friday, 10/20.**
Laboratories: Lab 3 at <http://www.cnx.org/content/col110374/latest/>
Readings: Sections 3.2 – 3.5
 - *Day 11, Monday 10/16:* Section 3.2 (nts: same as last time): More convolution, Convolution Demo.
 - *Day 12, Tuesday 10/17:* Section 3.2 (nts: 62,64,65): Impulse & Step response, superposition, examples.
 - *Day 13, Wednesday 10/18:* Section 3.3,3.4 (nts: 66–73): More superposition, eigenfunctions of LTI, properties of convolution, continuous-time LTI systems (invertibility, causality).
 - *Day 14, Friday 10/20:* Sections 3.4,3.5 (nts: 74–79): natural responses, stability, differential-equation models. **HW3 due**
- **Week 5, 10/23-10/27:** Finish LTI systems .
Homework: HW 4 (3.17, 3.22, 3.26(ii,v), 3.27, 3.28, 3.31, 4.1) **due Friday 10/27.**
Laboratories: No lab this week (start midterm studying)
Reading: Read Secs. 3.5-3.7, and 4.1 (skip sec. 3.8).
 - *Day 15, Monday 10/23:* Sections 3.5,3.6: (nts: 80–84): diff-eq models, stability.
 - *Day 16, Tuesday 10/24:* Section 3.7: (nts: 85–88): Diff-eq models and exponential inputs, intro to transfer function $H(s)$.
 - *Day 17, Wednesday 10/25:* Sections 3.7, 4.1 (nts: 89 – 96) Example LTI responses to signals, Intro Orthogonal Expansion, Fourier Series.

- *Day 18, Friday 10/27*: Section 4.1 (nts: 90–96): More on orthogonal expansion, Fourier Series, Eigenfaces. **HW4 due. No lates accepted.**
- **Week 6, 10/30-11/3**: Midterm/Fourier Series (FS).
Midterm Exam Week: (midterm on Wednesday)
Homework: No homework this week (**but study for midterm**)
Laboratories: No lab this week
Reading: Sections 1.1 – 4.2 (excluding sec. 3.8)
 - *Day 19, Monday 10/30*: Section 4.1, 4.2 (nts: 97–99): More on ortho-expansions, Fourier Series
 - *Day 20, Tuesday 10/21*: Midterm exam review (Days 1-18)
 - *Day 21, Wednesday 11/1*: **Midterm Exam** in class (material up to and including Day 18).
 - *Day 22, Friday 11/3*: Sections 4.3 – 4.5 (nts: 100,102-105): Fourier series, frequency spectra, properties, convergence
- **Week 7, 11/6-11/10**: Fourier Series and Start Fourier Transform (FT).
**** HOMEWORKS NOW DUE EVERY WEDNESDAY ****
Homework: HW 5 (4.2(iii,vi), 4.4, 4.5, 4.6(c), 4.9(e,f), 4.18, 4.28) **due *Wednesday*, 11/8.**
Laboratories: No lab this week
Reading: Sections 4.6, 5.1
 - *Day 23, Monday 11/6*: Section 4.6 (nts: 106,107,101): Fourier Series Amplitude and Time Transformations
 - *Day 24, Tuesday 11/7*: Section 5.1 (nts: 108,109): Fourier Transform, analysis/synthesis
 - *Day 25, Wednesday 11/8*: Sections 5.1 (nts: 110-115): more Fourier Transform, sinc function. **HW 5 due.**
 - *Day XX, Friday 11/10*: (HOLIDAY, Veterans Day, no class)
- **Week 8, 11/13-11/17**: Fourier Transform, Sampling.
Homework: HW6 (5.2(a,d), 5.3, 5.4(c,d,f), 5.10, 5.17(a,b), 5.20, 5.24) **due Wednesday, 11/15.**
Laboratories: Lab 4 at <http://www.cnx.org/content/col110374/latest/>
Reading: Sections 5.1 – 5.4 (+ glance at 1st 2 pgs of 6.1)
 - *Day 26, Monday 11/13*: Sections 5.1, 5.2 (nts: 116-121): FT properties, (linearity, duality, convolution, time-shifting), multiplication, frequency shifting (modulation)
 - *Day 27, Tuesday 11/14*: Section 5.2 (nts: 122–125,143,144): FT, ideal filters, multiplication of signals, frequency shifting/modulation,
 - *Day 28, Wednesday 11/15*: Section 5.2, 5.3 (nts: 126–131): FT other properties, time shifting, periodic signals. **HW6 Due.**
 - *Day 29, Friday 11/17*: Section 5.4 (nts: 132–136): pulsed cosine, sampling continuous time signals, periodic signals.
- **Week 9, 11/20-11/24**: Sampling, Aliasing, Applications.
Homework: HW7 (5.19, 5.23, 5.26, 5.27) **due Wednesday, 11/22.**
Laboratories: No lab this week
Reading: Sections 5.5, 5.6, 6.1-6.3
 - *Day 30, Monday 11/20*: Sections 5.5, 5.6 (nts: 137–143): more sampling, aliasing, energy/power density spectra, FT applications
 - *Day 31, Tuesday 11/21*: Sections 6.1, 6.2 (nts: 143–147): Ideal filters, real filters
 - *Day 32, Wednesday 11/22*: Section 6.3 (nts: 148–150): Bandwidth relationships, bandpass filters, amplitude modulation **HW7 Due.**
 - *Happy Thanksgiving!!!*
- **Week 10, 11/27-12/1**: Laplace Transform
Homework: HW 8 (6.13,6.14,6.19,6.23,6.26 (optional extra credit 20 pts, 6.38)) **due Wednesday, 11/29.**
Laboratories: Lab 5 at <http://www.cnx.org/content/col110374/latest/>
Reading: Laplace Transform (LT) Handout (from Oppenheim & Wilsky text), AM Handout, Chapter 7
 - *Day 33, Monday 11/27*: AM Handout: FT and FS, AM Frequency Division Multiplexing, more AM, QAM. OEA in-class Survey II

- *Day 34, Tuesday 11/28*: Section 6.1 (nts: 151–154): Laplace Transform, unilateral, bi-lateral, relationship to FT.
- *Day 35, Wednesday 11/29*: Section 6.1 (nts: 155–159): Laplace transform examples, region of convergence (ROC), LT pairs. **HW8 Due.**
- *Day 36, Friday 12/1*: Section 6.2 (nts: 160–163): Laplace Transform properties (time shifting)

- **Week 11, 12/4-12/8**: Laplace Transform: region of convergence, inverse LT, LT for system analysis, Review.

Homework: HW 9 (9.1(a,c,e), 9.3, 9.5, 9.7, 9.9) from Laplace Transform (LT) handout **due Wednesday, 12/6, no lates.**

Laboratories: No lab this week

Reading: LT Handout and Chapter 7.

- *Day 37, Monday 12/4*: Section 6.2 (nts: 164–170): LT properties (differentiation, integration, multiplication by t , conjugation, transformations, initial/final values, inversion)
- *Day 38, Tuesday 12/5*: Sections 6.1, 6.2, handout: (nts: 171,172): Inverse Laplace transforms
- *Day 39, Wednesday 12/6*: Sections 6.2, handout (nts: 167,173-182): Response of LTI systems using Laplace analysis. causality, stability, invertibility, pole-zero plots. **HW9, no lates accepted.**
- *Day 40, Friday 12/8*: Final exam **review.**

- **Week 12, 12/11-12/15**: Finals week

Homework: none

Laboratories: none

Reading: review all

- *Monday 12/11*: Extra 4 open office hours (11:30am-3:30pm, EE1-418)
- *Day 41, Tuesday 12/12*: **Final Exam**, 2:30-4:20pm, EE1-125
- *Wednesday 12/13*: \emptyset
- *Friday 12/15*: \emptyset