

## Syllabus

### Instructors:

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**Lecture:** Tue, Thur 3:30-4:45pm Phelps 1440  
**Lab Group 1:** Tue 7-9:50pm Harold Frank Hall 3120a  
**Lab Group 2:** Wed 7-9:50pm Harold Frank Hall 3120a

**Website:** [http://www.ece.ucsb.edu/courses/ECE147/147B\\_w12Byl/index.html](http://www.ece.ucsb.edu/courses/ECE147/147B_w12Byl/index.html)

### Required Text:

(FPW) Franklin, Powell, and Workman, "Digital Control of Dynamic Systems, 3rd edition". See website for information on purchasing a discounted reprint of the book.

**Grading:** Homework (25%), Lab (25%), Mid-Term (20%), Final (30%).

- **Homework (including Computer Modules):** There will be 8 homework assignments. Only the best 7 out of 8 of these assignments will count toward your term grade.
- **Laboratories:** Due to TA and student scheduling conflicts, we have replaced the Friday section with a Tuesday evening time slot. Group 1 meets Tue, 7-9:50pm. Group 2 meets Wed, 7-9:50pm. **Tentative assignments will be handed out during the first lecture.** You must contact the instructors if you need to switch lab groups. Lab begins the first week of class with an (optional) introductory mini-session ("Lab 0") for which no write-up is due. (*Those who have taken ECE147A may find "Lab 0" unnecessary... It is intended to provide familiarity the basics of the Quanser controls lab set-ups.*) See the link to the lab website for future pre-lab assignments and post-lab reports.
- **Mid-Term Exam:** The mid-term is (*tentatively!*) scheduled for Tuesday, February 8 during lecture (3:30-4:45pm in Phelps 1440) and will cover material (in lecture and/or lab) from the first 5 weeks of class (i.e., through February 6). You are allowed one (1) single-sided 8½ x 11 sheet of notes for the mid-term exam. Your "cheat sheet" must be self-prepared and will also be submitted with your exam; it will then be returned (unmarked) along with your graded exam.
- **Final Exam:** A 3-hour final exam will cover class material (from lecture and lab) from all 10 weeks of class. Time (Thursday, March 22, 4-7pm) and location (TBA) are determined by the registrar. You are allowed two (2) single-sided 8½ x 11 self-prepared sheets of notes for the final exam. Both of these "cheat sheets" will also be submitted with your exam; they will then be returned (unmarked) along with your graded exam.

## Tentative Lecture Schedule

This schedule may be revised somewhat throughout the term. (FPW refers to Franklin, Powell and Workman. RS refers to Roy Smith's lecture notes for ECE 147b, available on website.)

Week	Topics	Reading
1	Jan.10 Review of CT dynamics and control. Bode and Nyquist. Jan.12 Difference equations. Sampling. Tustin (bilinear) approx.	FPW (Ch.1), 2.1-2.5; RS-1,2 FPW 3.1-3.2, 4.1; RS-3
2	Jan.17 Tustin w/ pre-warp. Discrete-time (DT) transfer fns (TFs). Jan.19 Sampled-data systems. ZOH. Properties of z-transform.	FPW 4.2, 6.1 (pp.189-195); RS-4 FPW 4.3.1, 4.6; RS-5
3	Jan.24 <i>Guest lecture:</i> Petar Kokotovic (usual classroom and time). Jan.26 Time response. S-plane vs Z-plane.	--- N/A --- FPW 4.4, 7.3.1; [RS-3]
4	Jan.31 Freq. response. Direct control design: deadbeat control. Feb.2 Intro to state space (SS).	FPW 4.5, 7.5; RS-7 FPW 4.3.3; RS-8
5	Feb.7 State space, continued. Discrete equivalents to CT SS. Feb.9 Review for midterm.	FPW 6.1 (pp.197-200); RS-9,10 <i>Review material through Feb.7.</i>
6	<b>Feb.14 ** Midterm [material through week 5] **</b> Feb.16 Controller design: emulation vs pole placement.	<b>1 single-sided sheet of notes</b> FPW 7.2, 8.1; RS-11
7	Feb.21 Estimator design via pole placement. Feb.23 Reduced-order estimator. Separation principle.	FPW 8.2.1-8.2.4; RS-12 FPW 8.2.5, 8.3; RS-13
8	Feb.28 Frequency response methods. Mar.1 Reference tracking.	FPW 7.4 FPW 8.4.1; RS-14
9	Mar.6 Integral control via state augmentation. Mar.8 Intro to LQR. Least-squares estimation.	FPW 8.5.1; RS-15 9.3.5, 9.4.1; RS-16
10	Mar.13 Recursive least-squares. Kalman filtering. Mar.15 Review for final.	FPW 9.4.1-9.4.2 (pp.387-394) <i>Review all material to date.</i>

**Supplemental Text:** A good reference on “Sampling” is Chapter 7 of “Signals and Systems,” by Oppenheim and Willsky. This material is entirely optional, but may be worth reviewing, if you already own the book.

**Due dates.** The schedule below is a general guideline. *There may be some variation during the course of the term.*

- **Homework:** Due by **FRIDAY at 5:00pm**. There will be 8 assigned homeworks, but only your top 7 scores will be counted. (No HW is due Week 1 or Week 6 (midterm week).)
- **Pre-lab:** Due on **MONDAY at noon**, in the drop box outside HFH 3120. There are 7 required pre-labs (no pre-lab for weeks 1, 6, or 10.), and 1 extra credit pre-lab.
- **Lab reports:** Due in Lab, **the next time your group meets after a lab is performed**. (Usually, this means one week later, except for midterm week.)

**Lecture Videos:** Tentatively, we hope to post video of lectures on-line. Details coming soon...