UNIVERSITY OF CALIFORNIA, SANTA CRUZ
BOARD OF STUDIES IN COMPUTER ENGINEERING

CMPE-242:
APPLIED FEEDBACK CONTROL

WINTER 2015 SYLLABUS

FPE: FRANKLIN, POWELL, EMAMI - **FEEDBACK CONTROL OF DYNAMIC SYSTEMS, 6TH**
FPW: FRANKLIN, POWELL, WORKMAN - **DIGITAL CONTROL OF DYNAMIC SYSTEMS, 3RD**
SHAUM'S: STUBBERUD, WILLIAMS, DISTEFANO - **SCHAUM'S OUTLINE OF FEEDBACK AND CONTROL SYSTEMS**

WEEK	DATES	TOPIC	ASSIGNMENTS
1	06/08-JAN	Course Mechanics, Syllabus, LCCDE, Free and Forced Dynamic Response, Laplace Transform, Convolution, Transfer Function, Impulse Response, Partial Fractions, Residues, FVT, Evan's Form	Read FPE Ch. 1-3, Appendix A. <u>Homework #1 out</u>
2	13/15-JAN	Root Locus vs. Bode, Stability, Control Design Spec's, Transient Spec's, Tracking Spec's, Robustness Spec's, Evan's Form, Root Locus	Read FPE Ch. 4 & 5, Review RL techniques from Schaum's and CMPE-241 notes. <u>Homework #2 out</u> *Homework #1 due 15-Jan*
3	20/22-JAN	Root Locus review, Analysis vs. Synthesis, Lead and Lag compensators, Pole Zero Cancellations, PID Control, Bode	Read FPE Ch. 6, Review Bode techniques from Schaum's and CMPE-241 notes. <u>Homework #3 out</u> *Homework #2 due 22-Jan*
4	27/29-JAN	Bode Plots, Non-minimum phase systems, Frequency Domain Specs, Bode design examples	Re-read FPE Ch. 6 (not kidding), Schaum's and CMPE-241 notes on Nyquist. <u>Homework #4 out</u> *Homework #3 due 29-Jan*
5	03/05-FEB	Bode Plots, Non-minimum phase systems, Frequency Domain Specs, Bode design examples	Read FPE Ch. 8 and FPW Ch. 1-5 <u>Homework #5 out</u> *Homework #4 due 05-Feb*
6	10/12-FEB	Performance vs. Robustness tradeoffs, Nyquist, Phase and Gain Margins, Introduction to Digital Control, Sample and Hold, CCO∆E, ZOH, half-sample time delay, numerical differentiation, Padé Approximation, numerical integration	Re-Read FPE Ch. 8 and FPW Ch. 4-7 <u>Homework #6 out</u> *Homework #5 due 12-Feb*
7	17/19-FEB	Z-transform, Euler Integration, Backward Euler, Trapezoidal Integration, Discrete Equivalent, z-plane, Aliasing, Unit Pulse Response, z-domain stability, Unit Circle, z-grid, digital control design, ZOH-equivalent, z-plane design, Inverse Z-	Re-read FPE Ch. 8 (so not kidding) and FPW Ch. 7-8 <u>Homework #7 out</u> *Homework #6 due 19-Feb* **MIDTERM** in CLASS 19-FEB

		transform, FVT, DC gain	
8	24/26-FEB	Anti-Aliasing Filters, Continuous to Discrete Equivalent (ZOH), Direct Digital design, Pade approximations	Read FPE Ch. 7, and FPW Ch. 9-11. *Homework #7(a) due 26-Feb*
9	03/05-MAR	Bode and Nyquist in z-plane, Tustin, Pre-warping, Introduction to State Space, State Space to Transfer Function, Eigenvalues, Characteristic Equation, Controller Canonical Form	Re-read Ch. 7, review notes on State Space from CMPE-240. <u>Homework #8 out</u> *Homework #7(b) due 5-Mar*
10	10/12-MAR	Similarity Transforms, Uniqueness of State, Pole Placement, Ackerman's Formula, Controllability Matrix, Controllability condition number equivalent to pole zero cancellation, Regulator, Estimator, Observability, Separation Principle, LQR, LQE, LQG control. Optimal Control, Bryson's Rule, LQY, Symmetric Root locus, Kalman Filter, BLUE, Integral Control (State Augmentation), Tracking commands, Digital State Space, Deadbeat Controller, Reduced Order Estimator, Pincher Control, Implicit Model Following	Re-read FPE Ch. 1-8, Review for Final Exam. <u>Homework #9 out</u> *Homework #8 due 12-Mar* *Homework #9 (Practice Final) due 17-Mar (before Final Review Session)*
FINAL	18-MAR	Covers everything in the class	Location TBD @ 4-7PM

Note: this syllabus is tentative, and subject to revisions. Depending on how much review is required, there might be some make-up or supplementary lectures during the quarter, and depending on student availability, the midterm might be scheduled outside of normal class hours.