UNIVERSITY OF CALIFORNIA, SANTA CRUZ
BOARD OF STUDIES IN COMPUTER ENGINEERING
CMPE-242:
APPLIED FEEDBACK CONTROL
WINTER 2017 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, DI STEFANO - SCHAUM’S OUTLINE OF FEEDBACK AND CONTROL SYSTEMS

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATES</th>
<th>TOPIC</th>
<th>ASSIGNMENTS</th>
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<tr>
<td>1</td>
<td>10/12-JAN</td>
<td>Course Mechanics, Syllabus, LCCDE, Free and Forced Dynamic Response, Laplace Transform, Convolution, Transfer Function, Impulse Response, Partial Fractions, Residues, FVT, Evan’s Form</td>
<td>Read FPE Ch. 1-3, Appendix A. Homework #1 out</td>
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<td>2</td>
<td>17/19-JAN</td>
<td>Root Locus vs. Bode, Stability, Control Design Spec’s, Transient Spec’s, Tracking Spec’s, Robustness Spec’s, Evan’s Form, Root Locus</td>
<td>Read FPE Ch. 4 &amp; 5, Review RL techniques from Schaum’s and CMPE-241 notes. Homework #2 out Homework #1 due 17-Jan</td>
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<td>3</td>
<td>24/26-JAN</td>
<td>Root Locus review, Analysis vs. Synthesis, Lead and Lag compensators, Pole Zero Cancellations, PID Control, Bode</td>
<td>Read FPE Ch. 6, Review Bode techniques from Schaum’s and CMPE-241 notes. Homework #3 out Homework #2 due 24-Jan</td>
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<td>4</td>
<td>31-JAN/02-FEB</td>
<td>Bode Plots, Non-minimum phase systems, Frequency Domain Specs, Bode design examples</td>
<td>Re-read FPE Ch. 6 (not kidding), Schaum’s and CMPE-241 notes on Nyquist. Homework #4 out Homework #3 due 31-Jan</td>
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<td>5</td>
<td>07/09-FEB</td>
<td>Bode Plots, Non-minimum phase systems, Frequency Domain Specs, Bode design examples</td>
<td>Read FPE Ch. 8 and FPW Ch. 1-5 Homework #5 out Homework #4 due 07-Feb</td>
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<td>6</td>
<td>14/16-FEB</td>
<td>Performance vs. Robustness tradeoffs, Nyquist, Phase and Gain Margins, Introduction to Digital Control, Sample and Hold, CCOΔE, ZOH, half-sample time delay, numerical differentiation, Padé Approximation, numerical integration</td>
<td>Re-Read FPE Ch. 8 and FPW Ch. 4-7 Homework #6 out Homework #5 due 14-Feb</td>
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<td>7</td>
<td>21/23-FEB</td>
<td>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-</td>
<td>Re-read FPE Ch. 8 (so not kidding) and FPW Ch. 7-8 Homework #7 out Homework #6 due 21-Feb MIDTERM in CLASS 23-FEB</td>
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<td>Week</td>
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<td>Reading/Assignments</td>
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| 8    | 28-Feb/02-Mar | 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 28-Feb* |
| 9    | 07/09-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.  
*Homework #8 out*  
*Homework #7(b) due 7-Mar* |
| 10   | 14/16-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.  
*Homework #9 out*  
*Homework #8 due 10-Mar*  
*Homework #9 (Practice Final) due 14-Mar (before Final Review Session)* |
| FINAL| 21-Mar      | Covers everything in the class                                      | In classroom @ noon-3PM |