1. **Course number and name:** 055:060 – Control Systems

2. **Credit and contact hours:** 3

3. **Coordinator:** Mark Andersland

4. **Textbook:** Control Systems Engineering, Nise, 2011
   a. Other materials: lab manual

5. **Specific course information**
   a. Brief course description. Fundamental concepts of linear feedback control, mathematical modeling, transfer functions, system response, feedback effects, stability, root locus and frequency response analysis and design, compensation, lab arranged.
   b. Prerequisite: 055:040
   c. Required for electrical track

6. **Specific goals for the course – see next page**

7. **Brief list of topics to be covered**
   a. Review
   b. System modeling
   c. Time-response
   d. Block diagrams
   e. Stability and Error Type
   f. Root locus analysis
   g. Root locus compensator design
   h. Freq. response analysis
   i. Freq. response compensator design
   j. Exams
   k. Laboratory Projects:
      i) Inverted Pendulum Demo: Observe, first-hand, the benefits of using feedback control to balance a self-erecting, cart-mounted, inverted pendulum.
      ii) Seesaw Balancer Experiment: Design, simulate, evaluate and tune a controller to maintain seesaw balance by moving a motorized cart back and forth on the seesaw.
      iii) Hanging Crain Experiment: Design, simulate, evaluate and tune a controller to move a cart-mounted hanging pendulum to a prescribed position while minimizing pendulum swing.
Specific goals for the course and mapping onto outcomes

<table>
<thead>
<tr>
<th>Course Goal</th>
<th>Basis For Goal Assessment</th>
<th>Supports ABET Outcomes</th>
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</thead>
<tbody>
<tr>
<td>1. The student will be able to write the system of differential equations governing the dynamics of simple linear, time invariant electrical, mechanical and electromechanical systems.</td>
<td>HW, exams, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<tr>
<td>2. The student will be able to use Laplace transforms and their properties to analyze linear, time invariant system behavior and solve systems of differential equations.</td>
<td>HW, exams, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>3. The student will have an understanding of the concept of system type and can use it to assess, and design controllers to improve a system’s steady-state tracking and disturbance rejection capabilities.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>4. The student will have an understanding of what bounded input bounded output stability is and how to check for it in both the time and frequency domains.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>5. The student will be able to construct and interpret Routh arrays, and will use them to check system stability and design simple controllers.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<tr>
<td>6. The student will be able to construct and interpret Root-locus plots and use them to check system stability and design simple controllers.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>7. The student will be able to construct and interpret Bode plots and use them to check system stability and design simple controllers.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>8. The student will be able to construct and interpret Nyquist plots and use them to check system stability and design simple controllers.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<tr>
<td>9. The student will be able to determine and interpret a system’s gain and phase margins and use them to check system stability and design simple controllers.</td>
<td>HW, exams, lab reports, instructor evaluation</td>
<td>a(●), c(●), k(●)</td>
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<td>10. The student will had opportunities to further his/her professional development through team projects, practicing written, oral and graphical communication skills, and using modern computer tools.</td>
<td>Lab reports, instructor evaluation</td>
<td>b(○), c(●), d(○), g(●), k(●)</td>
</tr>
</tbody>
</table>

○ denote moderate contribution to the outcome; ● denote substantial contribution to the outcome

Performance Criteria:
Instructor completes a Course Outcome Rating (COR) that quantitatively evaluates student performance for each course goal-related outcome using a standard scale (4.0 = outstanding ability; 3.0 = good ability; 2.0 = adequate ability; 1.0 = poor ability; 0.0 = no ability). Instructor chooses appropriate graded course artifacts (homework questions, exam questions, etc) for each outcome rating. COR scores below 2.5 are indicative of problems with meeting course goals/outcomes and COR scores below 2.0 indicate failure to adequately meet course goals/outcomes.
Prepared By:
Mark Andersland (May, 2013)