Course: Automatic Control – 0908353 (3 Cr. – Core Course)

Instructor: Dr. Zaer S. Abo-Hammour
Office: CH203, Telephone: 5355000 Ext: 23026, Email: zaer@ju.edu.jo
Office Hours: (Sum, Tus, thru:11.00-12.00.), (Mon, Wed: 09.30-11.00)

Course Website: http://elearning.ju.edu.jo


Prerequisites by Course: System Dynamics (0908351).

Prerequisites By Topic:
1. Signals and Systems
2. Elementary Matrix Theory and Algebra.
3. Laplace transform.
4. Modeling and Simulation of Physical systems.
5. Programming with MATLAB.
6. Ordinary Differential Equations


References:
- Modern Control Engineering, Katsuhiko Ogata, 5th Edition n, Prentice Hall

Schedule & Duration: 15 Weeks, 45 lectures (50 minutes each) plus exams. (Sun, Tus, Thru: 9.00 – 10.00)

Minimum Student Material: Text book, class handouts, and an access to Personal Computer with MATLAB

Instructional Methods
1. Lecture/Problem solving sessions.
2. Case studies using MATLAB.

Minimum College Facilities: Classroom with whiteboard and projection display facilities, library, computational facilities with MATLAB and Simulink.

Course Objectives:
1. To teach students the techniques by which the stability of control systems is analyzed in both time and frequency domains.
2. To teach students the techniques by which control systems are designed to meet certain design specifications in both time and frequency domains.
3. To let students use the Matlab control toolbox in the analysis and design of control systems.
Course Learning Outcomes and Relation to ABET Student Outcomes:
Upon successful completion of this course, a student should:
1. Understand the basic definitions related to Control Systems, classifications of control systems, and their objectives. [a]
2. Know the basic components of control systems, and the advantages of closed loop control systems over open loop control systems. [a]
3. Understand the definition of stability of control systems. [a, e]
4. Differentiate between the absolute and relative stability concepts. [a, e]
5. Study the absolute stability of control systems using the Routh-Hurwitz criteria. [a, e, k]
6. Use the Routh-Hurwitz criteria for the analysis and design of control systems. [a, e, k]
7. Find the steady state errors of stable unity feedback control systems. [a, e, k]
8. Determine the error constants and the steady state error for certain input. [a, e, k]
9. Understand the basic steps of drawing the root locus of control systems. [a, c, e, k]
10. Understand the effect of addition of poles and/or zeros to the control systems. [a, c, e, k]
11. Design Lead and Lag Compensators using Root locus method to achieve desired transient and steady state performance in time domain. [a, c, e, k]
12. Analyze control systems in frequency domain. [a, c, e, k]
13. Construct the Bode plots of control systems. [a, c, e, k]
14. Design Lead and/or Lag Compensators using Bode diagram to achieve desired performance in frequency domain. [a, c, e, k]
15. Know and apply different configurations of PID controllers. [a, c, e, k]
16. Design of PID controller using Open loop tuning methods. [a, c, e, k]
17. Design of PID controller using closed loop tuning methods. [a, c, e, k]
18. Use MATLAB in the analysis and design of control systems. [c, e, k]

ABET SO:
a) Applying the mathematical, scientific and engineering principles in solving engineering problems.

c) Design, construct (or supervise the construction of) a system or part of a system that fulfills a certain requirement.

e) Identify, formulate and solve mechatronics engineering problems.
k) Use the techniques, skills, and modern engineering tools for engineering practice.

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<tr>
<th>ABET SO</th>
<th>c</th>
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<td>Will be measured</td>
<td>Yes</td>
<td>Yes</td>
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Course Topics:

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<tr>
<th>Topic Description</th>
<th>Hrs</th>
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<tr>
<td>1. Introduction to control systems: Define a Control system and introduce types of control systems</td>
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<td>Explain why controls systems are important, Introduce the basic components of control system, Give some examples of control system applications</td>
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<td>2. Stability of Linear Control Systems: Study the stability of control system, Apply th Routh-Hurwitsc criterion to check the stability of linear system.</td>
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<td>3. Steady State Error Analyses: Steady state error of linear system for three basic input function,</td>
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<td>constant error</td>
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<td>4. Root-Locus Technique: Define the root locus, Procedure to construct the root locus, Effect of adding poles and zeros, Desing Lead, Lag, and Lead-lag compensators using root locus method.</td>
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<td>5. Frequency-Domain Analysis and Design: The Definition of Bode plot, Procedure to construct the Bode plot, Desing Lead, Lag, and Lead-Lag compensators using bode plot method.</td>
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<td>6. Design of PID Controller: Determine the controller or compensator configuration, Determine the parameter values of the controller using Open Loop and Closed Loop Methods.</td>
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<td>7. MATLAB Programming</td>
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• **Attendance:**
  Students are expected to attend EVERY CLASS SESSION and they are responsible for all material, announcements, schedule changes, etc., discussed in class. The university policy regarding the attendance will be strictly adhered to.

• **Make up Examinations**
  There will be no make up exams for any exam that will be taken during the course. exceptions to this rule is restricted only to the following cases:-
  1. death of only first order relatives (father, mother, sister, or brother).
  2. hospital entry (in-patient) during thr time of the examination.
  Any other cases will be given the zero mark in the corresponding exam.

• **Special Notes**
  1. Seating plan will be as given in the attendance sheet.
  2. Students creativity is welcomed and will receive additional marks

**Assessments:**
Exams, Quizzes, Projects, and Assignments.

**Grading policy:**

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<th>Assessment</th>
<th>Percentage</th>
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<tr>
<td>MATLAB Programming Exam</td>
<td>20 %</td>
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<tr>
<td>Midterm Exam</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>50%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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**Last Updated:** February, 2017