The University of Texas at Tyler
Department of Electrical Engineering

Course: EENG 4308 – Automatic Control (Required)

Syllabus

Catalog Description:

Introduction to automatic control systems; mathematical models of physical systems; block diagrams and signal flow graphs; transient and steady state responses; PID controllers; stability of linear feedback systems; root-locus and Routh's criteria; frequency response methods: polar, Nyquist and Bode plots; stability margins; state-variable formulation. **Prerequisites:** EENG 3305 (or EENG 3304 for non-EE) and MATH 3305 or permission of the instructor.

Prerequisites: EENG 3305 and MATH 3305

Credits: 3 (3 hours lecture, 0 hours laboratory per week)

Text(s): Richard Dorf and Robert Bishop, Modern Control Systems, 13th ed., Pearson, 2017.

Additional Material: Matlab®
Instructor's Lecture Notes

Course Coordinator: Hassan El-Kishky

Topics Covered: (paragraph of topics separated by semicolons)

Introduction to automatic control systems; mathematical models of physical systems; block diagrams and signal flow graphs; transient and steady state responses; PID controllers; stability of linear feedback systems; root-locus and Routh's criteria; frequency response methods: polar, Nyquist and Bode plots; stability margins; introduction to state-space systems.

Evaluation Methods: (only items in dark print apply):

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Objectives[1]: By the end of this course students will be able to:

1. Develop mathematical models of engineering systems. [1,2]
2. Determine the transfer function of linear time-invariant control systems. [1,2]
3. Obtain the transient response of a second-order system. [1,2,4]
4. Determine the sensitivity, steady-state error, rise-time, time to-peak, settling-time, percentage peak overshoot, and transient response to step, impulse, and ramp input signals. [1,2,4]
5. Determine the absolute stability of a control system using the Routh-Hurwitz criterion. [1,2]
6. Determine the stability of a control system using the Root-Locus method. [1,2,4]
7. Construct Bode Plots and determine stability of control systems. [1,2,4]
8. Determine the stability and Performance of a control system using the Nyquist criterion.

[1,2,4]
9. Analyze the performance of P, PI and PID controllers for simple control systems. [4]
10. Setup the state-space equations for simple systems. [1,2]
11. Analyze transient performance of control systems using advanced simulation software. [4]
12. Analyze control system stability using advanced simulation software. [4]

[1] *Numbers in brackets refer to method(s) used to evaluate the course objective.*

Relationship to Program Outcomes (only items in dark print apply)[2]: This course supports the following Electrical Engineering Program Outcomes, which state that our students will:

1. have the ability to apply mathematics, science, and engineering principles in the practice of electrical engineering; [3]
2. have the ability to use modern engineering tools and techniques in the practice of electrical engineering; [11,12]
3. have the ability to analyze electrical circuits, devices, and systems; [4,7,8,9]
4. have the ability to design electrical circuits, devices, and systems to meet application requirements; [5,6]
5. have the ability to design and conduct experiments, and analyze and draw conclusions from experimental results;
6. have the ability to identify, formulate, and solve problems in the practice of electrical engineering using appropriate theoretical and experimental methods; [1,2]
7. have effective written, visual, and oral communication skills; [4,5,6]
8. possess an educational background to understand the broader context in which engineering is practiced, including:
   a. knowledge of contemporary issues related to science and engineering;
   b. the impact of engineering on society;
   c. the role of ethics in the practice of engineering;
9. have the ability to contribute effectively to multi-disciplinary engineering teams; [1,4]
10. have a recognition of the need for and ability to pursue continued learning throughout their professional careers. [10]

[2] *Numbers in brackets refer to course objective(s) that address the Program Outcome.*

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:	0.5	Hours
Engineering Sciences and Design:	2.5	Hours
General Education Component:	0	Hours

Prepared By: Hassan El-Kishky Date: 01/15/2019 (revised)

EENG 4308 Automatic Controls
Spring, 2018

Class Time: **9:30-10:50AM T/Th.**
Location: RBN 2012

Coordinator: Hassan El-Kishky
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Tel: 903-565-5580
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Catalog EEGR 4308: Automatic Controls
Introduction to automatic control systems; mathematical models of physical systems; block diagrams and signal flow graphs; transient and steady state responses; PID controllers; stability of linear feedback systems; root-locus and Routh's criteria; frequency response methods: polar, Nyquist and Bode plots; stability margins; state-variable formulation. **Prerequisites:** (EENG 2101 and EENG 3305) or (EENG 3304, MENG 3301 and MATH 3305).

Textbook: Richard Dorf and Robert Bishop, Modern Control Systems, 13th ed., Pearson, 2013.

Additional: Instructor's handouts
Materials

Software: **MATLAB®-**Please check with IT on how or if MATLAB® would be available for students to download on their personal laptops

Contents:
Ch1 topic Introduction to automatic control systems
Ch2 Differential Equation Laplace Block diagrams, signal flow graphs, Mason Gain rule for signal flow graphs
Ch3 signal flow graphs
Exam 1 (in February)

Ch4 Open and closed loop systems, Sensitivity to parameter variation, 2nd order system, steady state error
Ch5 Test input signals, Performance second order system, s-plane root location and transient response, steady state error of feedback control systems
Ch6 Concept stability, Routh Hurwitz Stability Criterion

Exam 2 (In March)

Ch7 Root Locus concept, Root Locus procedure, parameter design root locus, sensitivity and root locus, three term PID controller
Ch8 Frequency Response Plots, Bode diagrams, Frequency response measurements, Performance specifications Frequency domain, Log magnitude and phase diagrams
Ch9 Mapping contours in the S plane, Nyquist criterion, Relative stability and Nyquist Criterion (gain and phase margins)
Ch3 State-pace Formalism

Ch6 stability using state variable
Special topic time permitting, discrete time nonlinear systems with feedback and introduction to bifurcation theory and chaos.
Final Exam

Grading:	**Quizzes and select homework assignments**	**10%**
	MATLAB® simulation assignments	**10%**
	Exam 1 (in February TBD)	**25%**
	Exam 2 (in March TBD)	**25%**
	Final Exam (comprehensive)	**30%**

Repeat exam (for exams 1 and 2 only) would be only considered for those who would miss an exam with a strong and valid excuse (with proof) such as been sick or been in accident

1st week-MATLAB® warm up

1st week, RE: notes, by time you read this. Chapter 1 class lecture notes, based on pages 1-11, will be on Blackboard (or should be), Also reading assignment, Chapter 2 sections 2.1-2.4, HW practice Problems identified by Thursday.

Academic Integrity:

Students should be aware that absolute academic integrity is expected of every student in all undertakings at The University of Texas at Tyler. Failure to comply can result in strong university-imposed penalties.

Note:

Disabilities: If you have a disability, including a learning disability, for which you request disability support services/accommodation, please contact the Disability Support Services office so that the appropriate arrangements may be made. In accordance with federal law, a student requesting disability support services/accommodation must provide documentation of his/her disability to the Disability Support Services counselor. For more information, call or visit the Student Services Office located in the University Center, Room 282. The telephone number is 566-7079 (TDD 565-5579).

Grade Replacement Policy:
If you are repeating this course for a grade replacement, you must file intent to receive grade replacement with the Registrar by the 12th day of class. Failure to file intent to use grade replacement will result in both the original and repeated grade being used to calculate your overall grade point average. A student will receive grade forgiveness (grade replacement) for only three (undergraduate) courses or two (graduate) courses repeats during his/her career at UT Tyler. (please check your applicable catalog)