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, 12th ed., Prentice-Hall, 2010.

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. 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]
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]
7. Apply flow graph representation with Mason Gain rule to determine the transfer function of a control system. [1,2]

8. Determine the stability and Performance of a control system using the Nyquist criterion. [1,2]
9. Analyze the performance of PI and PID controllers for simple control systems. [1,2]
10. Setup the state-space equations for simple systems. [1,2]
11. Utilize engineering literature such as technical manuals and product datasheets to select components to meet experimental or prototype requirements. [1,2]
12. Analyze transient performance of control systems using advanced simulation software. [4]
13. 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; [12,13]
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. [10,11]

[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:		Hours

Prepared By:	Ron Pieper	Date:	02/07/2016
	Ron Pieper		01/07/2020
			Revised

EENG 4308 Automatic Controls Spring, 2020

Class Time: **9:05 – 10:00 MWF**
Location: **RBN 2011**

Instructor: Ron Pieper
Email: rpieper@uttyler.edu

Office Hours Tentative plan 8:30 to 10AM Tuesday (**not first week**)
Will confirm via canvas when determined -EE conference room expected location
:

Catalog EENG 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) and MATH 3305, Special prerequisites ME (EENG 3304 and MENG 3301)

Disclaimer elements of this course EENG 4308 make use of matrices. Having taken the BSEE requirement "matrix methods for engineers" scheduled to be taken in Fall semester before EENG 4308 will be very helpful in following thread of logic in one or more chapters.

Textbook: Richard Dorf and Robert Bishop, **Modern Control Systems,12th ,ed.**, Prentice-Hall,
Additional: Instructor's Notes to be placed on Canvas
Materials Software:**MatlaB®**

Important dates (you are highly encouraged to double check dates if they are critical to decisions you need to make. based on academic calendar Spring 2020 found on internet)

- no class holiday Monday Jan 20 (Martin Luther King Jr holiday)
- Census date (deadline for Schedule changes) Jan 27
- Spring break, Mar 9-14
- last day to withdraw from one or more classes, Mar 30
- Final exam Study day Monday April 20

- final exam week April 28-May 2
- Final exam (EENG 4308) Not yet posted

Tentative schedule :

Ch1 topic Introduction to automatic control systems, great overview read chapter,
Ch2 Differential Equation Laplace Block diagrams, signal flow graphs, Mason Gain rule for signal flow graphs Reading assignment includes sections 2.2,2.3,2.4, 2.5. 2.6, 2.7
Ch6 Seciton 6.1, 6.2 Routh Hurwitz criterion

Exam 1 (in February)

Ch5 Test input signals, Performance second order system, s-plane root location and transient response, steady state error, section 5.3, 5.5 and 5.6
Ch4 Open and closed loop systems, Sensitivity to parameter variation, 2nd order system, steady state error
state error of feedback control systems
March 12-17 Spring Break
Ch3 State Variable representations
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)

Final Exam (End of April , early May)

Current plan: Waiting for a grader to be assigned. (No more later and will update when established)

Tentative Grading:

assignments /quiz/Project	10%
Matlab® simulation projects	10%
Exam 1 (in February)	20%
Exam 2 (in March	20%
Final Exam (not comprehensive *)	40%

- **If prior topics covered prior to Exam 2 or Exam 1 are included in final exam material "covered" then those specific topics will be identified in the final exam guide available prior to Final Exam.**

  FYI if A grader is being assigned it will impact decision to go with collection of HW Or quiz

Chapter 1, great overview of topic not no very mathematical recommended reading entire chapter

1st week, RE: notes, By time you read this. Chapter 1 class lecture notes, based on pages 1-9, will be on Canvas (or should be), Also reading assignment by Monday Chapter 2 sections 2.1-2.4,

General observations

Disclaimer There are two primary channels for communication in the class. In class. One channel is thru class attendance and the second channel is Canvas. These channels are intended to be complementary and not redundant. Students should consider it a requirement to attend class and to review materials on canvas on as need basis on canvas. To avoid any misunderstanding or confusion on class requirements make sure you make use of both channels.

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:

Students who have registered with the Office of Student Accessibility and Resources and deemed eligible for accommodated testing may take their exams in the Testing Center. https://www.uttyler.edu/disabilityservices/accommodatedtesting.php

There is a Grade Replacement Policy:

If you are repeating this course for a grade replacement, you must file an intent to receive grade forgiveness with the registrar by the 12th day of class. Failure to file an intent to use grade forgiveness 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 student) or two (graduate student) course repeats during his/her career at UT Tyler. (2006-08 Catalog, p. 35) your responsibility to check if details have changed)

Background on grading and study habits

Typical ranges for grades in this class run as follows, 91-100% A, 80-90% B, 65% to 79% C. The class examples and HW problems provide a basis for gauging you comfort level with the material. The amount of time a student should study can not always be easily quantified due to differences between students. If after reviewing notes, book and HWs if you are having trouble digesting the concept or procedure involved you are highly encouraged to come to an office hour or make an appointment with me.

ClassRoom Etiquette

Please remember to turn off cell phones before coming to class. Working on class assignments or surfing the web while class is going on is not acceptable. If these activities are important for you on a particular day it would be better you did them outside the class environment. You can claim you are looking at class notes and if that is the case I request you take a seat at the back or on far left so as not to distract students.

That being said attendance is important and will taken periodically during the semester. If you know you have an emergency schedule conflict that comes up please inform me (email OK). Although I do not plan to integrate attendance data in with student evaluation it can and will provide additional information if a student is experiencing problems keeping up.

Use of lap top to review notes related to class or in special cases an e-file of text is available would not be ruled out. However other uses such as checking email, checking your HW for another class, other activity not related to class including autonomous web surfing should be considered inappropriate. Primary reason is such activity is not related to the class (you don't need to be sitting in class for that function) and might be distracting to someone sitting next to you. .

Advance Information on notes, exams, quizzes

Not open book, limited equation reference allowed and provided. General policy is: you should get your questions answered before the day of exams. On exam day I will typically be involved with other activities including getting your exam ready. "needs of many outweigh needs of one " Materials placed in advance on Canvas for early reference/printing. Department policy prevents me from duplicating notes for students on regular basis.