

MAE 4310 – Introduction to Automatic Control
Fall Semester 2009
Monday, Wednesday, Friday 11:00-11:50AM
WH 311

Required Course

Course (Catalog) Description: Block diagram algebra, transfer functions, and stability criteria. The use of transient response, frequency response, and root locus techniques in the performance analysis, evaluation, and design of dynamic systems.

Prerequisites: MAE 3319 (also offered as EE 4314) – Dynamic Systems Modeling And Simulation or MAE 3405 – Flight Dynamics

Instructor: Dr. Atilla Dogan
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WH 315 H (office location)

Course Web site: <http://www.uta.edu/webct/>
You should login with your UTA NetID and password.

Textbook and/or other required material:

- Textbook: Ogata, Katsuhiko, Modern Control Engineering 4th ed., Prentice Hall, Inc., Upper Saddle River, NJ, 2002.
- Software: MATLAB Student Edition/Control Toolbox by Mathworks Inc.

Course objectives:

- Analysis: understanding the behavior of systems characterized by linear ordinary differential equations (ODEs).
- Design: use time and frequency domain design techniques based on above analysis to design linear control laws.
- Software: learn to use MATLAB CAD tools for control systems design and the SIMULINK software package for system simulation

Course Content:

- Introduction
 - System, Input, Output
 - Block Diagram
 - Plant, Actuator, Sensor, Controller
 - Scope of the Course
 - Main Control Objectives
- Transfer Function of Systems

- Definition & Construction
- Poles & Zeros
- System Behavior based on Poles
- System Decomposition based on Poles
- System Response Analysis
 - Types of Input Signals
 - Transient & Steady-state Response
 - Impulse Response of Systems
 - Recap of Step Response of 1st and 2nd Order Systems
 - Effect of Poles on the Response
 - Effect of Zeros on the Response
 - Dominant Poles and Zeros
 - Effect of Real Pole on Second Order System
 - System Type
- Control System Design
 - Open Loop versus Feedback Control
 - Stability of Linear Feedback Control System
 - Routh–Hurwitz Stability Criterion
 - Root–Locus Method
 - PI, PD, PID Controllers
 - Internal Model Principle
 - PID Analytical Design
 - Frequency Response Analysis
 - Fundamental Theorem of Harmonic Analysis
 - Bode Plot
 - Bode Design
 - Nyquist Analysis

Class schedule: Three 50-minute sessions per week

Contribution of course to meeting the professional component: 3 hours of Engineering Topics

Relationship of course to program outcomes: A, B, C, D, E, F, G, I, K

Course Requirements:

Attendance - Class attendance required

Midterm Exams - Two One-hour long exams (open notes, open books)

Final Exam - Comprehensive Final Exam (open notes, open books)

Homework - Weekly homeworks will be assigned throughout the semester. Each homework is due at the beginning of lecture in a week after assigned. Only one homework may be legitimately late (no later than three days). Afterwards, there will be 50% penalty on each late homework submission, within 72 hours after the submission deadline. Submission 72 hours later than the deadline will NOT be accepted. Only conceptual discussion among students is allowed; no sharing of equations, results or code. You will need to use MATLAB and/or SIMULINK for numerical computation, simulation and plotting.

Project - The design project will be available on the WebCT site early in the semester. You are required to set up teams of **at least three but not more than four** students. You can start working on as soon as the project is posted. Every team will turn in one project at the beginning of the final exam for final evaluation. You will fill an evaluation form for each of your teammates at the final exam and turn them in along with your final exam. Your evaluation will effect your teammates' grade he/she will get from the project according to the policy provided in the evaluation form.

Library Search You need to (i) identify a subject, from the text book, that is not covered in this course and of interest to you, (ii) conduct a library search to find at least one conference/journal article on the subject, (iii) read the article and summarize, in a one-page report, what you have learned by reading the article and, in addition to the knowledge, what you have gained by working on this assignment. Sometime early semester, the AE subject librarian will give a half-hour presentation for you to understand how you can utilize library resources to complete this assignment. Based on the one-page report, you will get a pass/fail grade. Due date for this assignment is Wednesday November 4th.

Classroom Questions During lectures, I will ask questions to the class to answer immediately on a voluntary base. The first person who chooses to answer orally and gives the right answer will get 5 extra points that will be added to the homework grades.

Key Assignment: This course specifically assesses your ability (i) to function in a multi-disciplinary team (Outcome D), (ii) to identify, formulate and solve engineering problems (Outcome F), (iii) to recognize the need for, and engage in, lifelong learning (Outcome I), and (iv) to use the techniques, skills and modern engineering tools necessary for engineering practice (Outcome K). Therefore, certain related assignments in this course must be passed in order to pass the course. During the semester these assignments will be designated as key assignments. **In order to pass this class you must pass all key assignments.** If any key assignment is not passed by the end of the course, you will not pass the class even if you score perfectly on all the other exams and assignments. Assignments that are key assignments are explained below.

Key Assignment for Outcome D - *“an ability to function on multidisciplinary teams.”* Completing the term project by working in a team is a key assignment. The teams will not be set up by the instructor, instead every student is responsible to set up his/her own team and organize the structure of the team in terms of roles and responsibilities. Every student will need to fill a teammate evaluation form for every teammate in his/her team. In the evaluation form, there are several questions to quantify, with a rating scale of 1 to 5, a students ability to function on a multidisciplinary team. The average of the scales given for a student by his/her teammates will affect his project grade. Since conducting the project in a team is a key assignment, please note that *the project must be passed in*

order to receive a passing grade in the course.

Key Assignment for Outcome E - *“an ability to identify, formulate and solve engineering problems.”*

The second midterm exam is used as the key assignment for assessing the students regarding their ability to identify, formulate and solve engineering problems. The exam questions are designed specifically to determine whether students can formulate and analyze open loop systems, based on the results of the analysis, whether they can formulate objectives of control design and/or whether they can design controllers for the closed loop system to meet the design requirements. Since the second midterm exam is designated as a key assignment for assessment, please note that *the exam must be passed in order to receive a passing grade in the course.*

Key Assignment for Outcome I - *“a recognition of the need for, and the ability to engage in, lifelong learning.”*

Every student will be asked to (i) identify a subject, from the text book, that is of interest to him/her, (ii) conduct a library search to find at least one conference/journal article on the subject, (iii) read the article and summarize, in a one-page report, what he/she has learned by reading the article and, in addition to the knowledge, what he/she has gained by working on this assignment. The instructor will ask AE subject librarian to give a half-hour presentation for students to understand how they can utilize library resources to complete this assignment. Based on the one-page report, students will get a pass/fail grade. Regardless of his/her performance in other parts of the class, *students must pass this assignment as any other key assignment in order to receive a passing grade in the course.*

Key Assignment for Outcome K - *“an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.”*

Term project work requires extensive use of modern engineering tools such as Matlab/Simulink to design controllers, simulate system response, plot and present project results and/or animate system response. The term project is also designated as the key assignment for assessing students ability to use the techniques, skills and modern engineering tools that are necessary for engineering practice.

Grade Allocation: Course grades will be earned based on the following criteria:
A = 85% and above, B = 70% - 84%, C = 55% - 69%, D = 40% - 54%, F = 0% - 39%

Weighting of each assignment on final grade:

Midterms 30%; Final 20%; Homeworks 30%; Project 20%.

University Policies:

Email to/from Faculty - You should use emailing tool provided within WebCT environment to communicate with the instructor. The instructor will only use this tool to send email to the students. Within WebCT, you can set email forwarding to any other email address to receive emails sent to your webCT account. However, you should use WebCT email tool to send email to the instructor.

Student Evaluation of Teaching - You will be asked to complete feedback forms at the end of the semester.

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Absences Based on Religious Beliefs - A student who misses an examination, work assignment, or other project due to the observance of a religious holy day will be given the opportunity to complete the work missed. To be eligible for such a make-up, the student must notify his/her instructor in writing within the first 15 days of class. Failure to follow the rules provided above within the time frames listed will result in the absence being considered unexcused.

Americans with Disabilities Act - The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 93112 – The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans With Disabilities Act - (ADA), pursuant to section 504 of The Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens. As faculty members, we are required by law to provide **“reasonable accommodation”** to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with *informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels*. For more information contact the Office for Students with Disabilities at 917-272-3364.

Academic Dishonesty - It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. Any person involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University. It is your responsibility to know University policies on these matters. “Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.” (Regents’ Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22)

Inclement Weather Policy - In the event that weather or other conditions are such that normal campus operations could be impeded the following policy will apply for this class. If the University is closed this class will not meet. Any assignments due or examinations scheduled will be due or rescheduled to the very next class period that the class meets. Local media should announce any closings. You can also get information by dialing (972) 601- 2049.

Student Success - UTA supports a variety of student success programs to help you connect with the university and achieve academic success. They include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

Notice - The instructors reserve the right to make changes to the course syllabus as necessary. It is the students responsibility to keep up with changes to the syllabus as posted on the class FTP site.

Copyright - Copyright 2007 UTA COE as to this syllabus, all lectures and all materials. Students are prohibited from selling notes taken during this course to (or being paid for

taking by) any person or commercial firm without the express written permission of the professor teaching this course.

Prepared by: Atilla Dogan

Date: 8-18-09

Teammate Evaluation

Name of Teammate:

SA = strongly agree (5);

A = agree (4)

N = neutral (3)

D = disagree (2)

SD = strongly disagree (1)

1. Overall this teammate contributed a lot (circle one)

SA A N D SD

2. This teammate was knowledgeable technically

SA A N D SD

3. This teammate communicated clearly

SA A N D SD

4. This teammate was reliable in commitments

SA A N D SD

5. This teammate was a good team player

SA A N D SD

Your teammate's project grade = teammate rate * Project grade

teammate rate = 1 if evaluation ≥ 3

= 0.7 if $3 > \text{evaluation} \geq 2$

= 0.5 if $2 > \text{evaluation}$