The University of Texas at San Antonio — ECE Department

EE 3413 — Analysis and Design of Control Systems

Spring 2016

Instructor:	Ahmad F. Taha	**Time:**	TR 2:30 – 3:45
Email:	ahmad.taha@utsa.edu	**Place:**	Engineering Building 2.04.04

Course Pages:

- UTSA Blackboard: http://utsa.blackboard.com
- My Webpage: http://engineering.utsa.edu/~taha

Office Hours:

- Tuesdays & Thursdays, 11:00 – 12:00
- Or by appointment

Recitation and TA Info:

- Mondays and Thursdays, 12:00 – 12:50, Engineering Building 2.04.23
- Teaching assistant — Name: Halid Kaplan
- Office hours: Mondays, 1–2pm Wednesdays, 4:30–6pm, Location: EB 2.04.30

Catalog Description: 3 hours credit. Modeling, analysis, and design of linear automatic control systems; time and frequency domain techniques; stability analysis, state variable techniques, and other topics. Control systems analysis and design software will be used. One hour of problem recitation per week.

Prerequisites:

- EGR 2323 or MAT 3253; EE 3423

Main Reference: Lecture notes will be provided as handouts or presentation slides (all posted on Blackboard). However, you may need to refer to the following textbook:

- Richard C. Dorf, and Robert H. Bishop, *Modern Control Systems*, 11th Edition, Addison-Wesley 2008.
- K. Ogata, *Modern Control Engineering*, Prentice Hall, Upper Saddle River, New Jersey, Fifth Edition, 2011 [Not Mandatory].

Course Objectives & Expected Outcomes:

1. Introduce to students some real systems, which use automatic control. [k]
2. Introduce to students mathematical modeling of physical systems. [a, b, e]
3. Introduce students to analysis of automatic control systems. [a, c, e]
4. Introduce students to design of linear automatic control systems. [a, c, k]

5. Learning to apply course material to improve thinking, problem solving, and making. [b, e]

Major prerequisites by topic:

1. Application of mathematical principals to the analysis of engineering problems.
2. Linear algebra and ordinary differential equations.
3. Frequency response and complex variables.
4. Mathematical modeling of systems.

Grading Policy

- Homework assignments (5%) and drop quizzes (15%)
- Two midterm exams (40%)
- Final exam (25%)
- Course project and instructor's evaluation (15%)

Course Grade Cutoffs:

- A-, A, A+: 85–100
- B-, B, B+: 70–84
- C-, C, C+: 55–69
- D: 50–54
- F: $\leq$ 49

Homework and Exams Policy:

- **Homework assignments** will be assigned, but will not be graded. Do not think of homework assignments as punishment: we're all here to learn. A significant part of learning is to struggle through experiences, and homeworks can only make you better.
- While homeworks will not be graded, they'll be collected. You'll get credit for simply trying.
- **Drop quizzes:** the quizzes will contain questions that are very similar to the homework problems or in-class examples. Performing poorly on quizzes means that (a) you're not doing your homework and/or (b) you are not attending class or not focusing.
- **Exams:** midterm and final exams **will only** reflect what we learned together in class. I will stay loyal to that promise, and if you feel that I betrayed this, you should immediately voice your concerns.

Programming Tools:

MATLAB will be required for homework assignments and course projects. Students can obtain the discounted student version of MATLAB online or through the university bookstore. Also, students are encouraged to use LaTeX for their course projects.

Class Policy:

- **Regular attendance** is essential and expected. The course instructor will occasionally take attendance and this will be counted towards the overall course grade. Students are allowed to miss one class when the attendance is recorded.

- **Emailing the instructor**: we all receive tons of emails every day. Students are required to write exactly the following in the subject line of the email: [EE 3413] – ABC, where ABC is the usual subject of the email. Your email might be ignored if you do not include that in the subject line of your email.
- Students are expected to show up few minutes **before** the start of the class. It is the student's responsibility to plan ahead of time and inform the course instructor of any emergencies. In case the student anticipates that they will be late for class, he/she should email the instructor before the class starts. Late arrival to class will negatively influence the attendance and instructor's evaluation grade. And that **will not** be tolerated. :)
- The **aim of the project** is to help students understand research control theory applications and encourage them to learn more about relevant research challenges related to feedback and control. Hence, students should think of the course project as a learning, beneficial research exercise rather than a bland assignment that has to be done for grade credit. Students who produce excellent project reports and demonstrate high competence will be given substantial grade bonuses.
- **Late submission policy:** besides medical and family emergencies (a written verification is required), there will be no extensions granted for project submissions. Late submissions will be scaled according to lateness, removing 10% from your project grade per day late, up to a maximum of 50%. Submissions more than 5 days late will be assigned a score of 0.
- **Changes to the syllabus:** students will be regularly informed about any changes for the course syllabus.
- **Smartphone breaks:** let's face it—we're all addicted to our smartphones, and as a result, we all have shorter attention spans. Consequently, there will be regular *smartphone breaks* every 20–30 minutes (twice for each class) for 1–2 minutes. Students have found that to be helpful, and I hope it proves to be so this semester.

Tentative Course Outline*:

Part I — EE 3413 Introduction .....
Course introduction & syllabus, prerequisites, major policies, course overview
Part II — Mathematical Modeling & Background .....
Mathematical modeling of systems, Laplace transforms, differential equations
Part III —Block Diagrams .....
High-level representations of control systems, feedback loops, transfer functions
Part IV — Closed-Loop System Characteristics .....
1st and 2nd order systems, time and frequency domain analysis, RH criterion
Part V — Root-Locus .....
Design of systems with root-locus construction and stability analysis
Part VI — Frequency Response Plots .....
Bode plots, gain and phase margins
Part VII — Compensator Design .....
Design and analysis of PID controllers
Part VIII — Modern Control 1: State-Space and Beyond .....
State-space construction, time-domain response, matrix exponential
Part IX — Modern Control 2: MIMO System Properties .....
Controllability, observability, detectability, stabilizability, stability

Collaboration Policy and Academic Honor Code:

*This might change.

You are responsible for your own work in this course. You may consult with classmates but copying from another student's work is considered CHEATING and will have severe consequences. Ask yourself whether you are compromising your integrity. If in doubt, ask first.

A. Preamble

The University of Texas at San Antonio community of past, present and future students, faculty, staff, and administrators share a commitment to integrity and the ethical pursuit of knowledge. We honor the traditions of our university by conducting ourselves with a steadfast duty to honor, courage, and virtue in all matters both public and private. By choosing integrity and responsibility we promote personal growth, success, and lifelong learning for the advancement of ourselves, our university, and our community.

B. Honor Pledge

In support of the ideals of integrity, the students of The University of Texas at San Antonio pledge: *As a UTSA Roadrunner, I live with honor and integrity.*

C. Shared responsibility

The University of Texas at San Antonio community shares a commitment to integrity, the ethical pursuit of knowledge, and adheres to the UTSA Honor Code. http://utsa.edu/about/honorcode/

D. Academic Dishonesty:

As an entity of The University of Texas at San Antonio, ECE Department is committed to the development of its students and to the promotion of personal integrity and self responsibility.

The assumption that a student's work is a fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as 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 designated to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Office of Student Judicial Affairs who will investigate the charge and set a preliminary meeting with the student to discuss disposition. Consequences of academic dishonesty may be as severe as dismissal from the University.

E. Road Runner Creed

The University of Texas at San Antonio is a community of scholars where integrity, excellence, inclusiveness, respect, collaboration, and innovation are fostered. As a Roadrunner, I will:

- Uphold the highest standards of academic and personal integrity by practicing and expecting fair and ethical conduct;
- Respect and accept individual differences, recognizing the inherent dignity of each person;
- Contribute to campus life and the larger community through my active engagement; and
- Support the fearless exploration of dreams and ideas in the advancement of ingenuity, creativity, and discovery.

Guided by these principles now and forever, *I am a Roadrunner!*

F. UTSA policies

Students are expected to follow the student code of conduct as explained in http://catalog.utsa.edu/informationbulletin/appendices/studentcodeofconduct/ and scholastic dishonesty under Section 203.