# Tennessee Tech University, Department of Electrical and Computer Engineering

ECE 3210-001: Control Systems Analysis  
Fall Semester, 2020  
Tuesday/Thursday, 12:00 pm-01:20 pm  
Brown 320

## Course instructor and contact information

[Joseph C. Slater, PhD, PE](https://josephcslater.github.io/josephcslater/)  
[website](https://josephcslater.github.io/josephcslater/): https://josephcslater.github.io/josephcslater/  
[email](mailto:jslater@tntech.edu): jslater@tntech.edu (less reliable)  
phone: 931-372-3172 (less reliable)  
iLearn: (most reliable)  
MSTeams: Please don’t use this for communication outside of class time and office hours. **Do** use this for communication during class and office hours.  
Office Hours: Thursday 11-12. Will be updated based on student availability (via iLearn communication)

## Materials/References

Textbook: Modern Control Systems, R. C. Dorf, 13th Edition, Pearson, 2017.  
Supplemental materials: [GitHub](https://github.com/josephcslater/Tennessee_Tech_ECE_3210), [Anaconda Python](https://www.anaconda.com/products/individual), Matlab, [Octave](https://www.gnu.org/software/octave/) with [Controls Toolbox](https://wiki.octave.org/Category:Octave_Forge)

## Course description

Modern and classical methods of control system analysis of continuous-time systems. Introduction to design tools.

## Prerequisites

PHYS 2110 and C or better in either ECE 3010 or ME 2330.

## Major Teaching Method

Flipped classroom. Online lectures/video with in-class/home problem solving.

## Course instructional outcomes

* Model dynamical systems using transfer function and state space representation.
* Analyze the stability of linear invariant systems using Routh-Hurwitz stability.
* Identify the parameters that characterize the transient and steady-state performance of LTI systems.
* Determine analytically the performance parameters for prototype second order systems.

## Course topics

1. Mathematical background: Laplace transform and applications (5%)
2. Transfer functions and signal-glow graphs: impulse response, transfer function, block diagram, signal flow graph (5%)
3. Frequency domain modeling of physical systems-Transfer Function: electric networks, mechanical systems, systems with delays (30%)
4. Time domain modeling of physical systems-State Space Model: State variable state variable, state equation, output equation, transition matrix, characteristic equation (10%)
5. Stability of linear systems: BIBO stability, Routh-Hurwitz stability (10%)
6. Time Domain analysis of linear systems (15%)
7. Root-locus technique (15%)
8. Tests (10%)

## Course Policies

### Exams (80%)

There will be two tests and a final exam graded on a straight scale (≥ 90 = A, ≥ 80 = B, ≥ 70 = C, ≥ 60 = D, < 59 = F). The final exam will count for two test grades. The lowest exam grade of the four will be dropped. Solutions will be discussed during the lecture following the exam if time permits. All grading discrepancies must be brought up in writing no later than one week after the exam is returned. A simple note describing your contentions will do. Exams must be conducted without external assistance of any form unless explicitely allowed by the instructor.

### Homework (10%)

Homework is intended to challenge you to ensure that you are aware of whether you are on track or not. There is no restriction on working with others in the class, but obtaining solutions from others is plagiarism. Homework will be of a variety of formats depending on the objective.

### Attendance

The first day of class will be online.

Attendance is not required except for examinations. Given the style of the class, all lectures will be received at “home” (where ever you want to watch them) with in-class work focusing on practicing skills learned online.

Given the current situation with COVID-19, only half of the class will be allowed in the classroom at any time. You will be assigned to a cohort; Tuesday or Thursday. We will certainly have to be flexible as the semester progresses. I will have limited ability to accommodate requests. Not all requests will be fulfilled.

### Class Participation

Participation is optional, but my availability to help you is predicated on regular attendance (online or in person) and consistent participation.

### Disability Accommodation

Students with a disability requiring academic adjustments and accommodations must contact the Accessible Education Center (AEC). AEC is located in the Roaden University Center, Room 112; phone 372-6119. For more information see Tennessee Tech Policy 340 (Services for Students with Disabilities) at <www.tntech.edu/policies>.

### Professionalism (10% of grade)

Professionalism is a measure of your behavior regarding expected practice as an engineer. This includes aspects such as attendance, note taking, consistency of performance, tenacity in problem solution, leadership, **legibility** and organization of problem solutions, clarity of communication, etc. For details on expected behavior, please consult *The Unwritten Rules of Engineering* by W.J. King, with revision by J.G. Skakoon. For your own professional development, I highly recommend that you [own a personal copy](https://www.amazon.com/Unwritten-Laws-Engineering-James-Skakoon-dp-0791861961/dp/0791861961/ref=mt_other?_encoding=UTF8&me=&qid=). If you read an older edition of the book (prior to Skakoon), please be attentive to the fact that some of the comments, for example those regarding polishing shoes, are considered rather quaint today.

**Two points (of the 10) will be automatically be deducted from your professionalism score** each time you receive less than a 70% on an exam *and* do not interact with me synchronously within one week after receiving the exam grade to clear up confusion.

## COVID – 19

1. Students must take personal responsibility in following the recommended CDC COVID-19 guidelines. Students are expected follow all COVID-19 directives published by Tennessee Tech including, but not limited to, notices on Tennessee Tech’s webpage, building and facilities signage, and similar publications. The university’s Return to Campus Student Handbook can be found at https://www.tntech.edu/return/index.php.
2. According to Tennessee Tech University’s protocols, face coverings must be worn (covering the mouth and nose) by students in the classroom at all times.
3. Students must abide by predetermined social distancing guidelines and seating arrangements. Movement during class sessions should be limited as to not endanger other students or faculty. Students should be conscious and respectful of others and their health concerns.
4. Students who refuse to comply with university protocols on these matters will be reported to the Tennessee Tech Dean of Students.
5. Students should direct all requests for excused class absences related to COVID-19, regardless of where the COVID-19 testing is performed, to Tennessee Tech’s Health Services. The Office of Student Affairs will provide notifications to faculty members of student absences and the expected length of the absence.