ENGINEERING 312: AUTOMATIC CONTROL SYSTEMS

Spring 2022, Trinity College

Instructor:	Dr. Taikang Ning, Professor of Engineering (ning@trincoll.edu)
Office hours:	TH 11:00 – 11:50 a.m. MCEC-343
Lectures and Labs:	MWF 11:00—11:50, @MC 213
Course outline:	Automatic control systems with sensors and feedback loops are ubiquitous in modern designs. The emergence of powerful microcontrollers in recent decades makes control system implementation much easier and encourages more innovation. This course provides a broad coverage of control system theory for engineering majors. Essential mathematical tools to study control systems are reviewed. Course topics include mathematical modeling, solutions to system design specifics, performance analysis, state variable and transition matrix, compensator design using root-locus, and PID controller design. Analysis is focused on linear control systems and broad applications. Linear system modeling is broadly applied to a variety of engineering systems. MATLAB and Simulink are used in assignments and team projects.
Text Book:	*Automatic Control Systems* – Benjamin C. Kuo & Farid Golnaraghi, John Wiley & Sons, Inc.
Grading Policy:	Midterm exam-35 %, Final exam-35%, Assignments-15%, Design Project-15%

WEEK	**TOPICS**
1	Introduction of control systems with examples, differences between open-loop and close-loop systems, i.e., feedback and its effects. *Ch.1*
2	Understanding the mathematic tools required to study control systems: complex variables, differential equations, Laplace and Fourier transform. *Ch.2*
3	Use of Laplace transform in solving linear systems equations *Ch.2*
4	Using MATLAB/Simulink in solving engineering problems
5	System representation through impulse response, transfer function, block diagram, signal-flow graph (SFG) *Ch.3.1-3.4*
6	Properties and algebra of SFG, Gain formula of SFG and application to signal block diagram *Ch.3.5-3.9*

7	Mathematic modeling of physical systems *Ch.4.*
	Midterm Exam: 3/16
8	State variables, state transition, characteristic equation, eigen values and eigen vectors. *Ch.5.1-5.7*
9	Controllability and observability of linear systems *Ch.5.8-5.11*
10	Determining stability of linear control systems through Routh-Hurwitz criterion, BIBO stability, zero-stability *Ch.6.1-6.6*
11	Time domain analysis of 1st and 2nd order linear systems, steady state error and transient response, damping ratio *Ch.7.1-7.6*
12	Effects of adding poles and zeros to system transfer functions *Ch.7.7-7.8*
13	Proportional, integral and derivative (PID) controller design *Ch.10*

Students with Academic Accommodations

Trinity College is committed to creating an inclusive and accessible learning environment consistent with the Americans with Disabilities Act. If you have approval for academic accommodations, please provide notification electronically using SARC Online during the first two weeks of the semester or a minimum of 10 days prior to utilizing your accommodations. Following notification, students are required to meet with faculty to further discuss implementation of accommodations. If you do not have approved accommodations, but have a disability requiring accommodations, or have questions about applying, please contact Jody Goodman or Sheila Njau at jody.goodman@trincoll.edu, sheila.njau@trincoll.edu, or sarc@trincoll.edu, 860-297-5251 or refer to the Student Accessibility Resources (SARC) website: https://www.trincoll.edu/SARC**.**