Information Technology University
Department of Electrical Engineering

EE361: Control Systems			
Course Code	EE361	**Semester**	Spring 2017
Credit Hours	3+1	**Pre-reqs**	Electrical Network Analysis
Instructor	Usama Bin Sikandar	**E-mail**	usama.sikandar@itu.edu.pk
Office	06-06	**Instructor Office Hours**	Wed 12-2PM, otherwise just walk in
Department	Electrical Engineering	**Discipline**	Engineering
Teaching Assistants	Muhammad Awais, Amna Maqbool	**Google Classroom**	
Lab Instructors	Yasir Manzoor, Sanan Ahmad	**Lab Timings**	Monday 1-4pm

Course Description

This course explores the modeling, analysis and design of linear control systems through feedback, reference tracking and disturbance rejection while considering stability criterion. Students will also get a thorough exposure of graphical design techniques in the second half of the course. The lectures will be complemented by labs to provide the students with a hands-on experience of the design techniques in software and hardware.

Course Outcomes/Objectives

On the completion of the course, the student will be able to demonstrate the following:

Model different real-world mechanisms using control systems conventions and terminology
Understand the stability criterion and design specification for control systems
Use algebraic and graphical techniques to design controllers for LTI systems

Books

Text Book:	*Feedback Control of Dynamic Systems,* 6th edition, by Franklin, Powell and Emami-Naeini
Reference Books:	*Modern Control Systems,* 12th edition, by Dorf and Bishop *Modern Control Engineering,* 4th edition, by Ogata

Course Assessment Distribution

Quizzes:	15 % (7 quizzes + 3 lab quizzes)
Assignments:	10 % (7 homework assignments + 3 project assignments)
Mid-term Exam:	20 %
Final Exam:	30 %
Lab Performance	25 % (Project 10%, Labs 15%)

Weekly Lecture Breakdown

Week 1:	Mathematical modeling and ODEs	Week 10:	Fundamentals of controller design
Week 2:	Input-output and state-space	Week 11:	Modeling and design case-study
Week 3:	Laplace transform	Week 12:	Root locus intro
Week 4:	Transfer function and modeling	Week 13:	Root locus examples
Week 5:	Dynamic Response	Week 14:	Frequency domain design intro
Week 6:	Stability	Week 15:	Bode plots and stability margins
Week 7:	Feedback	Week 16:	Compensation
Week 8:	PID control	Week 17:	Nyquist stability criterion
Week 9:	**Mid-term exam**	Week 18:	**Final exam**

Chapter	Lecture Topics	No. of Lectures
Franklin 2.1, 2.2, 2.3, 7.1, 7.2	**Introduction to Modeling and ODEs** ▪ Electrical circuits, mechanical systems, heat and fluid-flow systems ▪ Analytical and numerical solutions of linear ODEs ▪ Input-output modeling ▪ State-space representation	4
Franklin 3.1, 3.2, 3.4	**Laplace Transform and Dynamic Response** ▪ Meaning of Laplace transform ▪ Solutions of ODEs; Impulse and step response ▪ Convolution ▪ Transfer functions ▪ Systems modeling and block diagrams ▪ Dynamic Response	4
Franklin 3.3, 3.5, 3.7	**Stability** ▪ Internal and BIBO stability ▪ Poles and zeros ▪ Routh-Hurwitz criterion	2
Franklin 1.1-1.2	**Introduction to Control** ▪ Conventions and terminology (plant, controller, actuator, sensor etc.) ▪ Open-loop and closed loop ▪ Examples: temperature control, cruise control etc.	2
Franklin 4.1-4.3	**Feedback Control** ▪ Effects of feedback ▪ Unity feedback ▪ Reference tracking, steady state error and system types ▪ PID control	4
Mid Term Exam		
Dorf Pg. 244-286	**Fundamentals of Control Systems Design** ▪ Setting up control goals ▪ Performance criterion ▪ Pole-placement ▪ Reference tracking ▪ Disturbance rejection ▪ Sensitivity reduction	5
Franklin Ch. 5	**Root Locus Design** ▪ Plotting root locus ▪ Desired pole region ▪ Dynamic compensation ▪ Design examples	4
Franklin Ch. 6	**Frequency Response Design** ▪ Nyquist stability criterion and argument principle ▪ Bode-plots and gain and phase margins for stability ▪ Dynamic compensation ▪ Design examples	7
Final Exam		

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Lab#	Lab Topics	Date
1	Differential Equations Modeling in Simulink	30th Jan, 2017
2	Numerical Solutions of ODEs using Matlab	6th Feb, 2017
3	Transfer Function and State Space Representation of Systems	13th Feb, 2017
4	Step and Impulse response of Systems	20th Feb, 2017
5		
6	Performance Specifications of 2nd order systems	6th Mar, 2017
7	Steady-state error analysis	13th Mar, 2017
8	Effect of Controller on System Parameters	20th Mar, 2017
Mid Term Exam		
9	PID Controller Designing and Implementation	3rd Apr, 2017
10	DC Motor Speed Control	10th Apr, 2017
11	Levitating a Ping-pong Ball Using a Propeller 1	17th Apr, 2017
12	Levitating a Ping-pong Ball Using a Propeller 2	24th Apr, 2017
13	Holiday	1st May, 2017
14	Anti-windup control, Root Locus	8th May, 2017
15		
16		
Final Exam		

Grading Policy:	
Quiz Policy	The quizzes will take place in the lecture right after the submission of a homework assignment and will be totally based on one of the problems in that assignment. So, in order to score well in quizzes, students must spend sufficient time solving the assignment problems individually. Grading for quizzes will generally be on a scale of 0 to 10. The assessment quiz in the first lecture would not be counted towards final grade.
Assignment Policy	In order to develop comprehensive understanding of the subject, homework assignments will be given. Assignments late by one day will be penalized by 20%. After that nothing will be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment individually. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams. Most of the problems in the exams will also be based on the assignments, hence, to pass this course, it cannot be emphasized enough that students need to spend sufficient time on the assignment problems individually.
Plagiarism	ITU maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the ITU plagiarism policy will lead to strict penalties including a failing grade in the course and referral to the Disciplinary Committee for a strict action, which may possibly lead to failing grades in all the courses of the semester.
Grading	Final grading will not be relative. The exact policy will be decided at the end of the course.