Zarqa University

Faculty of Engineering Technology
Department: Electrical Department
Course title: Control Theory

Prerequisite: Signal Analysis-0904454
Instructor: Prof. Mohammad Alia
Lecture's time: 8:00 - 8:50
Semester: Second
Office Hours: Sun. 12:00 – 13:00

Course description:

Open and closed loop(feed back)systems, examples of feedback control systems, review of complex variable, Laplace transforms and transfer function, modeling of electrical , mechanical , hydraulic and pneumatic systems, linearization of nonlinear systems, systems block diagram and signal flow graphs, transfer function , block diagram reduction techniques , Masons formula , sensitivity of open and closed loop control systems. Time response analysis and performance indices of first and second order systems, dominant poles of high order systems. Routh-Hurwitz stability criterion, steady state error coefficient , design and effects of basic control actions: proportional , integral and derivative, stability analysis using root-locus , Bode diagrams and Nyquist stability criterion , gain and phase margins.

Aims of the course:

The course aims at giving the students the following main competences

1. Classify automatic control systems and recognize the merits of closed- loop systems vs. open loops systems through application examples.
2. Use Laplace transforms in order to model linear control systems and to investigate their dynamic performance
3. Use LabVIEW Control Design software tool for control systems modeling including stability investigations and performance studies.
4. Reduce the block diagrams and signal flow graphs to find closed loop system transfer function
5. Understand and implement the PID control algorithm in the laboratory using dedicated software and using of PLCs as On- OFF controllers
6. Understand the basics of frequency analysis and carry out practical activities to find frequency response of high order linear control systems

.
.
.

Intended Learning Outcomes (ILOs):

1- Represent physical control system in a block diagram , form a signal flow graph , and carry out the necessary simplification of the block diagram or the signal flow graph..
2- Evaluate system stability using algebraic criteria and the mathematical models..
3- Using Bode plots or root locus , the student shall be able to modify system stability conditions and system performance in the required direction.
4- Using analog electronics the student shall build P , PI , PID controllers and perform required parameter tuning. response and filters.

Course structures:

Week	C. Hrs	ILOs	Topics	Teaching Procedure	Assessment methods
1		1	Introduction to control systems. Applications of automatic control in power systems. Examples	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
2		2	Review of the basics of complex variable, Laplace forward transform. Properties of Laplace transforms	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
3		2	Laplace transforms of typical standard control test signals. Laplace transforms of periodic and aperiodic signals	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
4		2	Examples on forward Laplace transforms. Inverse Laplace transforms, partial fraction method , convolution method , and method of residies. Practical examples	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
5		3	Transfer function of linear control system. Transfer functions of typical standard dynamic elements	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
6		3	Transfer functions of the first order and second order elements. Their response to a step function input. The damping ration , the damped and un damped frequencies	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
7		4	**Exam I (up to end of week 6)** Blok diagrams and reduction rules of block diagrams . Examples	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
8			Signal flow graph rules ,	Lecturing using power	1st , 2nd and final

			Mason's formula , examples	point + Home assignment+ Lab activities	exams + Home work assessment
9		4	Introduction to system stability, The characteristic equation and system stability. Algebraic stability criteria	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
10		4	Routh- Hurowitz criteria, Examples	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
11		5	Introduction to PID control. ON- Off control , Proportional , integral and derivative control actions	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
12		5	Exam II (up to end of week 11) Electronic Circuits of P , PI , PID controllers	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
13		5	Limitations to PID controller , Differential over run , Integral wind up , mode change from manual to automatic , solution to the given limitations. examples	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
14		6	Distribution of the zeros and roots in the complex plane. The dominant roots. The effect of gain change on the location of the roots in the complex plane.	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
15		6	The frequency response. Magnitude and phase characteristics . Bode characteristics. System stability and frequency response . Compensation of roots to change system performance	Lecturing using power point + Home assignment+ Lab activities	1st , 2nd and final exams + Home work assessment
16			Final Exam		

References:

1. Modern Control Engineering. Katsuhiko Ogata , rth edition, 2002

Pearson Educational Ltd. London. ISBN: 0-13-043245-8

Assessment Methods:

Methods	Grade	Date
First Exam	20%	In accordance with faculty time table
Second exam	20%	In accordance with faculty time table
Final Exam	50%	In accordance with faculty time table
Home work assessment	10%	In accordance with faculty time table