COURSE TITLE	CODE /NO	ARABIC CODE/NO	Contact Hours / Week			CH
			Th.	Pr.	Tr.	
Control Systems	**ECE 331**	**331 هـ كح**	**2**	**3**	**-**	**3**
Prerequisites	**MATH 204, ECE 304**					
Introduction to feedback control systems with examples from different fields. Transfer functions and block diagram algebra. Stability analysis (Routh-Hurwitz and Nyquist). Design of control systems using Bode diagrams and root locus techniques.						

Faculties and departments requiring this course: Electrical and Computer Engineering Department.

Textbook

R. Dorf and R. Bishop, *Modern Control Systems*, Prentice Hall, 2011.

Supplementary references

1. B. Kuo and F. Golnaraghi, *Automatic Control Systems*, Prentice-Hall, 2002.
2. K. Ogata, *Modern Control Engineering*, Prentice Hall, 2009.

Class Schedule

Lectures: 2 sessions/week, 1 hour/session.
Lab.: 1 session/week, 3 hours/session.

Objectives

By completion of the course, the students should be able to:

1. describe some practical examples and draw the corresponding block diagram.
2. explain the difference between the open and closed loop control system.
3. apply the MATLAB in solving mathematical problems.
4. develop mathematical models (differential equations, state-variables, transfer functions) for a variety of dynamic physical systems.
5. apply the theory of Signal Flow Graph in finding the transfer function of the systems.
6. analyze the control system using the state - variables approach.
7. analyze the control system in the time domain (steady state error and transient response).
8. analyze the stability of linear control system using (direct method, Routh - Hurwitz Test, and the Root Locus plot).
9. designing feedback control systems.
10. Carry out experiments using MATLAB and Simulink.
11. gain experience in technical writing, and improve communication skills.

Contents

1. Mathematical Background.
2. Mathematical Modeling of Physical Systems.
3. Transfer Functions of Linear systems - Block Diagram Models.
4. State Variables Models.
5. Performance of Feedback Control Systems.
6. Stability of Linear Feedback Control Systems.
7. Root Locus Techniques.
8. Frequency Response Methods.
9. Stability in the Frequency Domain.
10. Design of Feedback Control Systems.

Course Outcomes

A. Knowledge

1. Recognize definitions and terminologies used in classical linear automatic control systems.
2. Identify modeling techniques for electrical and/or mechanical systems.
3. Define specifications of time and frequency responses of systems.
4. Define methods of stability analysis of systems.
5. Identify relative stability indices.

B. Cognitive Skills

1. Assess the steady-state and transient performance of linear systems.
2. Assess the adequacy of systems based on their performance and stability.
3. Evaluate performance and stability of electromechanical systems.

C. Interpersonal Skills and Responsibilities

1. Suggest solutions to improve the performance and stability of systems.
2. Practice implementation of solutions.
3. Design controllers and/or compensators for systems.

D. Communication, IT, and Numerical Skills

1. Work in a team.
2. Develop and share ideas with others.
3. Collaborate and innovate in problem solving.
4. Overcome the practical problems.

Assessment methods for the above elements

1. Midterm and Final Exams to assess understanding and scientific knowledge.
2. Homework and Quizzes to assess ability to solve problems and analyze results independently.
3. Class and Lab reports to assess practical, and presentation skills.

Weekly Calendar of Lectures		
Week	**Topics**	**Remarks**
1	Mathematical Background	
2, 3	Mathematical Modeling of Physical Systems	
4, 5	Transfer Functions of Linear systems - Block Diagram Models	
6, 7	State Variables Models	
8, 9	Performance of Feedback Control Systems	
10	Stability of Linear Feedback Systems	
11, 12	Root Locus Techniques	
13	Stability in the Frequency Domain	
14, 15	Design of Feedback Control Systems	
	Final Exam	

Weekly Calendar of Laboratory Experiments		
Week	**Experiment**	**Remarks**
1	Analysis and Simulation of Control Systems Using MATLAB	
2	Introduction to Simulink and Simulation of a Simple Speed Control System	
3	Identification of DC Motor and Tachometer Constants	
4	Servo Motor Speed Control Using a Proportional Controller	
5	Simulation of a Prototype Second Order System	
6	Servo Motor Position Control Using a Proportional Controller	
7	Analysis of Error Performance Indices	
8	Speed Control with a Proportional plus Integral Controller	
9	Magnetic Levitation System	
10	Cascade Compensation via Frequency Domain Techniques	