The University of Jordan
School of Engineering

Department	Course Name	Course Number	Semester
Mechanical Engineering	System Dynamics and Control	0904418	

2019 Course Catalog Description

Review of complex variables and Laplace transform .Poles and element transfer function and block diagram. Modelling of physical systems, electrical, mechanical, hydraulic and pneumatic systems. Linearization of nonlinear systems. System representations. Thermal, System block diagrams and signal flow graphs. Overall transfer function, block diagrams reduction techniques and Mason's gain formula. Time response analysis and performance indices of first and second order systems. Dominate poles of high order systems. Routh - Hurwitz stability criterion. Stability analysis using root locus. Bode diagrams and Nyquist stability criterion. Introduction to analysis using state-space equations.

Instructors

Name	E-mail	Sec	Office Hours		Lecture Time	

Text Books

	Text book 1	Text book 2
Title	Modern Control Engineering,	(Handouts)
Author(s)	K. Ogata	-
Publisher, Year, Edition	Prentice-Hall, latest Edition	

References

Books	1. R. Dorf and Bishop, Modern Control System, Prentice Hall
	2. B. Kuo, Automatic Control System, Wiley
Journals	
Internet links	The UoJ ELearning: elearning.ju.edu.jo

Prerequisites

Prerequisites by topic	ODEs, Laplace transforms, statics/dynamics, vibrations, thermodynamics, fluid, heat, circuits
Prerequisites by course	0934411
Co-requisites by course	-
Prerequisite for	0904419 Control Lab., 0904422 Engineering Measurements, 0904521 Robotics, 0904537 Design of Hydraulic and Pneumatic Systems, 0904580 Modern Control Systems., 0904583 Autotronics

Topics Covered

Week	Topics	Chapter in Text	Sections
1	Introduction: What is system dynamics? What is control? Terminologies, objectives of for using controllers. Open and closed loop concepts	Chapter1	
2	Dynamical System Modeling: First Order system, System Response Applications: Tank Level, Laplace Transform overview	Chapter 1	
3-4	Transfer Functions, System Response Analytically and using Matlab. Laplace Inverse using PFD. Input Testing Signals, Applications: RCL circuits	Chapter 2	
5	Poles and Zeroes Concepts and their relation to response, S-Plane, Applications: Cruise	Chapter 2	

6-7	First Order System Performance Measures, 2nd Order Systems Performance	Chapter 3	
8	Thermal Systems Modeling and Applications	Chapter 4	
9-10	Dynamical Systems Stability. Stability theorems Applications	Chapter5	
11-12	Root Locus Analysis and Matlab based design, Introduction to P-Controllers Design	Chapter 7	
13	PID Controller Design	Chapter8	
14	Introduction to Frequency Domain	Chapter 9	
15	Frequency Domain Analysis and Controllers Design	Chapter11	

Mapping of Course Outcomes to ABET Student Outcomes

SOs	Course Outcomes
1	1. Master block diagram manipulation techniques 2. Use design approach to model, analyze and control real dynamical systems 3. Analyze first, second and higher order systems and time response 4. Analyze the stability, performance, and disturbance rejection characteristics of closed loop feedback systems 5. Utilize the graphical methods of Root locus/Bode plots for analysis and design of feedback loops
2	6. Ability to model and write differential equations and transfer functions to model system dynamics using Laplace transform. 7. Introduction to controller design to alter system behavior using PID controllers 8. Mechanical (thermal and applied) system design 9. Use of Matlab to simulate a control system's performance

Evaluation

Assessment Tools	Expected Due Date	Weight
Homework		5%
Quizzes		10%
Midterm Exam		25%
Project		10%
Final Exam + Project		50%

Contribution of Course to Meet the Professional Components

The course contributes to build the fundamental basic concepts of design and analysis of dynamical systems.

Relationship to Student Outcomes

SOs	1	2	3	4	5	6	7
Availability	X	X					

Relationship to Mechanical Engineering Program Objectives (MEPOs)

MEPO1	MEPO2	MEPO3	MEPO4	MEPO5

ABET Student Outcomes (SOs)

1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3	An ability to communicate effectively with a range of audiences

4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Updated by ABET Committee, 2021