هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Digital Control and Robotics**
Course Code:	**CENX 453**
Program:	**B.S. in Computer Engineering**
Department:	**Department of Computer Engineering**
College:	**College of Computer and Information Sciences**
Institution:	**King Saud University**
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4 hours)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 8)					
4. Course general Description:					
Review of mathematical representation of systems modeling (in the frequency domain and in the time domain) and parameter identification; system analysis in the time domain, system stability, and steady-state error; and compensator design using pole placement. Digital controller using discrete equivalence. State space representation, stability, controllability and observability, stability, and steady-state error. Feedback control and observer, nonlinear system, and linearization. Introduction to robotics; kinematic model, localization, path planning, and control of robotic systems, autonomous navigation.					
5. Pre-requirements for this course (if any)**:**					
CENX 352, Digital Signal Processing MATH 240, Linear Algebra					
6. Co-requirements for this course (if any)**:**					
7. Course Main Objective(s):					
The primary goal of this course is to provide a basic understanding of the concepts and techniques involved in designing control schemes for engineering systems and autonomous mobile robots.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	6 hours per week	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	30
3.	**Field**	
4.	**Tutorial**	15
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Explain the basic concepts of linear systems (control systems and robotics).	**1**	**Lectures and Tutorials and Lab**	**Exams and Homework**
1.2	Model and simulate linear systems in the frequency domain.	**1**	**Lectures and Tutorials and Lab**	**Exams and Homework**
2.0	**Skills**			
2.1	Evaluate the tracking performances and design a controller using pole placement with analog and digital implementation of the controller.	**2**	**Lectures and Tutorials and Lab**	**Exams and Homework**
2.2	Modeling and control in the time domain, state feedback control, and observer.	**2**	**Lectures and Tutorials**	**Exams and Homework**
3.0	**Values, autonomy, and responsibility**			
3.1	Modeling the mobile robot, localization, path planning, and autonomous	**6**	**Lectures and Tutorials and Lab**	**Exam and Homework**

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	navigation of a wheeled mobile robot.			

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to system control and dynamic systems modeling in the frequency domain.	16
2.	System analysis in the frequency and time domain (time response, steady state error, and stability)	16
3.	Compensator design using pole placement technique with analog and digital implementation.	14
4.	Modeling in the state space domain (continuous and discrete cases), stability, observability, and controllability analysis.	16
5.	Design a feedback control system with the observer. linearization of nonlinear systems.	14
6.	Localization, path planning, and Control of robotic systems.	14
Total		90

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Examination (1)	6	15%
2.	Midterm Examination (2)	12	15%
3.	Homework Assignments	Weekly	10%
4.	LAB experiment reports	Bi-weekly	20%
5.	Final Exam (Laboratory + Theory)	End	40% (5+35)%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Control System Engineering, Nise, N. S., John Wiley & Sons, 7th Ed., 2015.
Supportive References	Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems, Gregor Klancar, Andrej Zdesar, Saso Blazic, and Igor Skrjanc, 1st Edition - January 10, Elsevier, 2017

Electronic Materials	https://lms.ksu.edu.sa
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room with a number of seats enough to accommodate enrolled students.
Technology equipment (projector, smart board, software)	Overhead projector with required software to facilitate presentations on smart board.
Other equipment (depending on the nature of the specialty)	Pcs with Windows 10 and Matlab software. Temperature control system. DC motor control system. Water level control system. Robot motion control system.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Department Council	Course reports are evaluated by the Department Council.
Effectiveness of Students assessment	Faculty-Peer Review	Final examination is moderated.
Quality of learning resources	Students	Indirect – Edu-gate survey.
The extent to which CLOs have been achieved	Faculty	Attainment level of every CLO is measured directly.
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	