Course Specification
— (Bachelor)

Course Title: Digital Control	
Course Code: CEN 1408	
Program: Bachelor in Computer Engineering	
Department: Computer Engineering	
College: Faculty of Computers and Information Technology	
Institution: University of Tabuk	
Version: 1.0	
Last Revision Date: 27 July 2022	

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)

2. Course type

A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required			☐Elective	

3. Level/year at which this course is offered: 8th Level / 4th Year

4. Course general Description:

This course covers the following topics, Introduction to Control Systems, Mathematical representation of systems. Continuous Systems, transfer functions, system analysis in time domains (time response, steady state error, and stability), system stability, Root-Locus analysis and compensator design (PID). Discrete Systems: System Modeling and representation, effect of sampling, discrete models of sampled data systems; Difference equations; Z transform; Time response and stability analysis in discrete domain, Design of discrete-time control systems

5. Pre-requirements for this course (if any):

CEN 1401

6. Co-requisites for this course (if any):

N/A

7. Course Main Objective(s):

1. Analyze control systems using transfer functions _ and block diagrams
2. Mathematically represent different kind of dynamic systems
3. Represent sampled-data systems using difference equations, transfer functions, all-delay block diagrams and state-space models.
4. Model dynamic systems that contain a time-delay.
5. Analyze, design, and synthesize digital control systems using transform techniques (root locus and frequency response) and state-space methods (pole-assignment and state estimation).
6. Effectively use MATLAB and SIMULINK in the analysis, design, simulation, and real-time implementation of discrete-time control systems

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
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**	
5.	**Others (specify)**	
Total		

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

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Describe sampled-data systems using difference equations, transfer functions, all-delay block diagrams and state-space models.**	**K1**	·Lectures ·Lab Sessions ·Class Discussions	● **Exams** ● **Quizzes** ● **HomeWork** ● **Labwork**
1.2	**Define dynamic systems that contain a time-delay.**	**K1**		
1.3	**Recognize and synthesize digital control systems using transform techniques (root locus and frequency response) and state-space methods (pole-assignment and state estimation).**	**K3**		
1.4	**State the use of MATLAB and SIMULINK in the analysis, design, simulation, and real-time**	**K4, K5**		

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	implementation of discrete-time control systems.			
2.0	**Skills**			
2.1	Analyze control systems using transfer functions _ and block diagrams	S2	· Lectures · Lab Sessions · Class Discussions	● Exams ● Quizzes ● HomeWork ● Labwork
2.2	Explain the digital system using difference equation	S3		
2.3	Design of discrete-time control systems and digital controller from a continuous controller using pole placement and polynomial equations	S3,S4		
2.4	Develop knowledge of stability concepts of digital systems using state space	S3,S4		
2.5	Design and simulation of continuous control systems using MATLAB	S2,S4		
3.0	**Values, autonomy, and responsibility**			
3.1				
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	● **Introduction to Control Systems** ● **Lab: Introduction to (MATLAB/SIMULINK) software**	5
2.	● **Mathematical representation of systems** ● **Lab: Mathematical representation of systems using MATLAB software** ● **(MATLAB/SIMULINK) software**	5
3.	● **Continuous Systems** ● **Lab: Continuous system modeling using MATLAB software**	5
4.	● **Transfer functions** ● **Lab: Open loop and closed loop Transfer function implementation using (MATLAB/SIMULINK) software**	5
5.	● **System analysis in time domains (part 1)** ● **Lab: System analysis in time domains using MATLAB**	5
6.	● **System analysis in time domains (time response and steady state error) (part 2)** ● **Lab: Time response and steady state error of system using MATLAB software**	5
7.	● **System stability** ● **Lab: Implementation of System stability using MATLAB software**	5

8.	● Root-Locus analysis and compensator design (PID) ● Lab: Implementation of continuous PID compensator using (MATLAB/SIMULINK) software	5
9.	● Discrete Systems: System Modeling and representation, effect of sampling, discrete models of sampled data systems ● Lab: Discrete system implementation using MATLAB software	5
10.	● Difference equations ● Lab: Difference equations implementation using MATLAB software	5
11.	● Z transform ● Z transform implementation using (MATLAB/SIMULINK) software	5
12.	● Discrete Transfer function ● Lab: Discrete Transfer function analysis for first order & second order system	5
13.	● Time response and stability analysis in discrete domain ● Lab: Time response and stability analysis in discrete domain using (MATLAB/SIMULINK) software	5
14.	● Design of discrete-time control systems (part 1) ● Lab: implementation of digital control (P)	5
15.	● Design of discrete-time control systems (part 2) ● Lab: implementation of digital control (PID)	5
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HomeWork , Quizzes	2-15	10%
2.	LabWork	2-15	20%
3.	Mid-Exam 1	6 or 7	15%
4.	Mid-Exam 2	11 or 12	15%
5.	Final Exam	16	40%
...			

*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	● M. Sami Fadali, Antonio Visioli , Digital Control Engineering, Analysis and Design,2nd Edition - August 21, 2012 ● Norman S. Nise , Control Systems Engineering, 6e, , Wiley, (December 14, 2010)
Supportive References	
Electronic Materials	● **Faculty members websites**

	● **www.free-ebooks.net**
Other Learning Materials	**MATLAB and SIMULINK**

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classroom, Laboratory**
Technology equipment (projector, smart board, software)	**projector**
Other equipment (depending on the nature of the specialty)	**MATLAB and SIMULINK**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of Teaching	Faculty, Program Leaders, and Advisory Board	Both Direct and Indirect
	Students	Indirect
Effectiveness of Students Assessment	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Both Direct and Indirect
Quality of Learning Resources	Faculty, Students, and Advisory Board	Indirect
The Extent to which CLOs have been Achieved	Faculty, Program Leaders, Advisory Board, and Independent Opinion	Direct (as in section B) and Indirect/Surveys
	Students	Indirect
Other	-	-

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	