Course Specification

1- Basic Information

Code	Course Title				Bylaw
EEC 161	**Digital Control Systems**				2011
Program	Electrical Engineering and Computers Engineering BSc.			**Category**	Mandatory (Compulsory) Course
Delivered by	Electrical Engineering and Computers Engineering Dept.			**Prerequisite**	-
Course Units	**Lectures**	2	**hr.**	**Stage**	Diploma
	Tutorials	-	**hr.**	**Level**	02 Elec.
	Practical	-	**hr.**	**Semester**	2nd. Semester
	Total Units	2	**Cr.h.**	**Academic Year**	2022/2023
Approval Date	**Program**	**Academic council**		No. (46) 19/9/2022	
		Dept. council		5/9/2022	
	Course	**Academic council**		No. (50) 16/1/2023	
		Dept. council		2/1/2023	

2- Course Aims

The aim of this course to

- Understand the basics of Z-Transform, the stability analysis of digital control system and basic knowledge of digital process control design.
- Understand PID controller, state feedback and observers.
- Know introduction to state variables.

3- Course Subject Area

A	B	C	D	E	F	G	Total
Humanities and Social Sciences	**Mathematics and Basic Sciences**	**Basic Engineering Sciences**	**Applied Engineering and Design**	**Computer Applications and ICT**	**Projects and Practice**	**Discretionary Subjects**	
-	-	100 %	-	-	-	-	**100 %**

4- Competencies of Learning Outcomes from the Course

Program competencies that the course contributes in achieving it		Course competencies in detail	
A8	Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools.	a8.1	Cooperate with engineering community and industry via exchange knowledge and skills related to stability and PID controller.
		a8.2	Compile proper technical reports and present them orally or in written forms to illustrate information related to digital control systems and time domain analysis.
B2	Design, model and analyze an electrical/electronic/digital system or component for a specific application; and identify the tools required to optimize this design.	b2.1	Devise specialized engineering designs and/or re-design a process, component or system using Z-transform, block diagram, signal flow graph, gain formula, and bilinear transformation.
		b2.2	Use numerical modeling methods and/or appropriate computational techniques to solve problems related to digital control systems, steady state error, root locus, state feedback and observers.
		b2.3	Utilize appropriate computer programming for the design and diagnostics of different digital control systems and PID controller.
B4	Estimate and measure the performance of an electrical/electronic/digital system and circuit under specific input excitation, and evaluate its suitability for a specific application.	b4.1	Use relevant laboratory equipment and analyze the results correctly to verify system stability and state variables.
		b4.2	Employ the appropriate specifications for digital control systems and controllers.
C1	Basics of design and analyzing electrical and computer engineering systems, while considering the constraints of applying inappropriate technology and the needs of commercial risk evaluation.	c1.1	Evaluate the performance of digital control systems and controllers.
		c1.2	Evaluate, organize and utilize information and knowledge from different sources to construct a proper design or solution for digital control system and controller.
		c1.3	Identify principles of analyzing and designing of digital control systems and controllers, while considering the constraints of applying inappropriate technology and the needs of commercial risk evaluation.
C2	Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems using new information technologies.	c2.1	Integrate electrical, electronic and mechanical components and equipment with transducers, actuators and controllers in creatively computer controlled systems to develop a digital control system.
		c2.2	Design and implement digital control systems that is based on advanced technologies.
C3	Proposing various computer-based solutions to business system problems. Cost-benefit analysis should be performed especially in sensitive domains where direct and indirect costs are involved.	c3.1	Adopt creative and innovative thinking based on computer controlled system in solving problems, and designing products related to digital control systems.

5- Course Content

Z transform, block diagram, signal flow graph, gain formula, stability, bilinear transformation, time domain analysis, steady state error, root locus, PID controller, state feedback and observers, introduction to state variables.

6- Course Topics/Timeline

Topic		No. of Weeks
Topic (1)	Z-transform.	Week (1)
Topic (2)	Inverse Z transform and difference equation.	Week (2)
Topic (3)	Block diagram.	Week (3)
Topic (4)	Signal flow graph.	Week (4)
Topic (5)	Gain formula.	Week (5)
Topic (6)	Stability.	Week (6)
Topic (7)	Bilinear transformation.	Week (7)
Topic (8)	Time domain analysis.	Week (8)
Topic (9)	Digital PID controller.	Week (9)
Topic (10)	State feedback.	Week (10)
Topic (11)	Observers.	
Topic (12)	Introduction to state variables.	

7- Course Topics / Competencies

Competencies	Course Topics											
	Topic (1)	Topic (2)	Topic (3)	Topic (4)	Topic (5)	Topic (6)	Topic (7)	Topic (8)	Topic (9)	Topic (10)	Topic (11)	Topic (12)
a8.1					X	X			X	X		
a8.2												X
b2.1					X							X
b2.2						X						X
b2.3								X				
b4.1		X	X	X								
b4.2	X				X		X				X	
c1.1			X	X								X
c1.2								X				
c1.3		X	X	X								
c2.1	X				X		X				X	
c2.2			X	X								X
c3.1										X	X	X

8- Teaching and Learning Methods

Competencies	Teaching and Learning Methods												
	Lecture	Presentations	Discussions	Tutorials	Lab experiments	Problem solving	Brain storming	Projects	Site visits and scientific trips	Reporting	Group working	Self-reading	Distance Learning
a8.1	X	X	X			X	X			X	X	X	X
a8.2	X	X	X			X	X			X	X	X	X
b2.1	X	X				X				X			X
b2.2	X	X				X				X			X
b2.3	X	X				X				X			X
b4.1	X		X							X	X	X	X
b4.2	X		X							X	X	X	X
c1.1	X	X	X							X	X	X	X
c1.2	X	X	X							X	X	X	X
c1.3	X	X	X							X	X	X	X
c2.1	X		X			X				X	X	X	X
c2.2	X		X			X				X	X	X	X
c3.1	X	X	X			X				X	X	X	X

9- Assessment Methods

Competencies	Assessment Methods									
	Written Exams	Oral Exam	Projects	Report	Quiz	Presentation	Practical Test	Observations	Dissertation	Online quiz
a8.1		X		X		X		X		
a8.2		X		X		X		X		
b2.1	X			X		X				
b2.2	X			X		X				
b2.3	X			X		X				
b4.1	X	X		X		X		X		
b4.2	X	X		X		X		X		
c1.1	X	X		X		X				
c1.2	X	X		X		X				
c1.3	X	X		X		X				
c2.1				X		X		X		
c2.2				X		X		X		
c3.1		X		X	X	X		X		

10- Assessment Methods Weight

Assessment Method	Percentage
Final Exam	40 %
Mid-term Exam	40 %
Semester Work	20 %
Total	100 %

11- List of References

Course Notes	handouts prepared by the instructor
Essential Books	1- "Digital Control Engineering - Analysis and Design", M. Sami Fadali & A. Visioli, 3rd edition, 2019, Published by Elsevier. 2- "Modern control systems", Richard C. Drof & Robert H. Bishop, 12th edition, 2011, by Pearson Education, Inc., New Jersey. 3- "Modern Control Engineering", by Katsuhiko Ogata, 5th edition, 2009, Published by Prentice Hall.
Recommended Books	"Automatic Control Systems", by Farid Golnaraghi and Benjamin C. Kuo, 16th edition, 2018, Published by Wiley.
Periodicals, Websites, etc.	IEEE.xplore.ieee.org

We certify that all of the information required to deliver this course is contained in the above specification and will be implemented.

Course Coordinator

Name: Dr. Mohammed Morad Salama

Signature: Dr. Mohammed Morad salama **Date:** 1/1/2023

Head of Electrical Engineering and Computers Engineering Department

Name: Dr. Omar Makram Kamel

Signature: O. M. Kamel **Date:** 1/1/2023