EEM 410 – Digital Control Systems

Course Code	Course Name	Semester	
EEE 409	Digital Control Systems	Fall ☒ Spring ☐ Summer ☐	
Hours		**Credit**	**ECTS**
Theory	**Practice** / **Lab**	4	5
3	0 / 0		

Course Details	
Department	Electrical and Electronics Engineering
Course Language	Turkish
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Lecturer(s)	
Course Objectives	The primary challenge in control engineering is designing an appropriate controller for the intended purpose. With today's technology, flexible software tools are available to verify various types of controllers. This lecture aims to equip control engineers with the knowledge and skills needed to identify suitable control structures and determine their coefficients
Course Content	• Ideal Sampler • Shannon's Sampling Theorem • Impulse Transfer Function • Jury Stability Test • Time Domain Performance Criteria • Steady-State Analysis of Discrete-Time Systems • Frequency Domain Criteria and Bilinear Transformation • Implementation of Discrete-Time Controllers with Digital Programming • Discrete PID Controller Design • Generalized Controller Design

Course Method/ Techniques	Lecture ☒ Question & Answer ☐ Presentation ☐ Discussion ☐
Prerequisites/ Corequisites	
Work Placement(s)	

Textbook/References/Materials

Katsuiko Ogata, Discrete-time Control Systems, Second Edition, Prentice Hall

M. Sam Fadali, Digital Control Engineering, Analysis and Design, Elsevier

Course Category				
Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☒
Engineering Design	☒		Health	☐
Social Sciences	☐		Profession	☒

Weekly Schedule

No	Topics	Materials/Notes
1	Ideal Sampler, Shannon Sampling Theorem, Holders	(Textbook, Ch. 2)
2	State Space of Discrete-Time Systems	(Textbook, Ch. 2)
3	Modeling of Digital Control Systems	(Textbook, Ch. 2)
4	Time Domain Performance Criteria	(Other Sources, Ch. 3)
5	Stability Analysis of Digital Control Systems	(Textbook, Ch. 4)
6	Time Domain Analysis of Digital Control Systems	(Textbook, Ch. 4)
7	Practice or Review	
8	Midterm Exam	
9	Frequency Domain Criteria and Bilinear Transformation	(Textbook, Ch. 4)
10	Implementation of Discrete-Time Controllers with Digital Programming	(Textbook, Ch. 4)
11	Implementation of Discrete-Time Controllers with Digital Programming	(Other Sources, Ch. 6)
12	Discrete PID Controller Design	(Other Sources, Ch. 12)
13	Generalized Controller Design	(Textbook, Ch. 7)
14	Generalized Controller	Design (Textbook, Ch. 7)

15	Review	
16	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance		
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework		
Presentation / Seminar		
Project	1	20%
Report		
Seminar		
Midterm Exam	1	20%
Final Exam	1	60%
	Total	**100%**
Contribution of Midterm Studies to Success Grade	1	40%
Contribution of End of Semester Studies to Success Grade	1	60%
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	16	3	48
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time	16	5	80
Quiz/Studio/Criticize			
Homework			
Presentation / Seminar			
Project	1	50	50
Report			
Midterm Exam and Preparation for Midterm	1	23	23
Final Exam and Preparation for Final Exam	1	24	24
Total Workload			**225**
Total Workload / 25			**9**
"1ECTS Credit			**5**

Course Learning Outcomes	
No	**Outcome**
L1	Students will identify digital control problems.
L2	Students will design and implement digital control systems.
L3	Students will analyze the performance of time and frequency domain responses.
L4	Students will design discrete PID controllers.
L5	Students will identify digital control problems.

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	5	5	5	5	5	5	5	5	4	4	4					-
L2	5	5	5	5	5	5	5	5	4	4	4					-
L3	5	5	5	5	5	5	5	5	4	4	4					-
L4	5	5	5	5	5	5	5	5	4	4	4					-
L5	5	5	5	5	5	5	5	5	4	4	4					-
															Total	-

i. Sufficient knowledge in the fields of mathematics, natural sciences, and related engineering disciplines; the ability to apply theoretical and practical knowledge in solving complex engineering problems.

ii. The ability to identify, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.

iii. The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

iv. The ability to select and use modern techniques and tools required for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.

v. The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or discipline-specific research topics.

vi. The ability to work effectively in intra-disciplinary and multidisciplinary teams; the ability to work independently.

vii. The ability to communicate effectively both orally and in writing; proficiency in at least one foreign language; the ability to write effective reports, understand written reports, prepare design and production reports, make effective presentations, and give and receive clear and understandable instructions.

viii. Awareness of the necessity of lifelong learning; the ability to access information, track developments in science and technology, and continuously renew oneself.

ix. Acting in accordance with ethical principles, knowledge of professional and ethical responsibilities, and the standards used in engineering applications.

x. Knowledge of business practices such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge of sustainable development.

xi. Knowledge of the impact of engineering practices on health, environment, and safety at global and societal levels, and awareness of contemporary engineering issues; awareness of the legal consequences of engineering solutions.