ELEC4522 COURSE CATALOG INFO

Course Code : ELEC4522				**Course Name :** Digital Control Engineering			
Semester	**Lecture (Le+T+L)**	**Local Credit**	**ECTS**	**Language**	**Category**	**Instructional Methods**	**Prerequisites**
7 or 8	(3+0+0)	3	5	English	Elective	Lecture	ELEC3521 OR MECH3422
Course Content	Introduction to digital control and discrete time systems. Representation of discrete time systems using difference equations, block diagrams and state-space equations. Solution of discrete time control system using convolution and state-space techniques. The z-transform. Frequency response of discrete time systems. Steady-state error computation for digital control systems. Stability analysis of digital control systems using the Jury test. Digital control system design.						
Course Outcomes	**CO 1.** Describe principles of modeling sampled data systems and discrete time control systems in terms of input-output relations and also in terms of state-space equations. **CO 2.** Identify basic discrete time signals and properties of the discrete-time linear systems. **CO 3.** Apply discrete time convolution to obtain the output of linear discrete time control system. **CO 4.** Apply techniques of z-transformation for the analysis of digital control systems. Obtain inverse z-transform by partial fraction expansion. Apply the Jury test for stability analysis of discrete time systems. **CO 5.** Design digital control systems based on the difference equation describing the system and determine the corresponding block diagram. **CO 6.** Classify digital systems in terms of type and determine the steady-state error to different discrete time inputs.						

COURSE PLAN	
W1	Introduction to Digital Control and modelling of sampled data systems. Some examples of modelling continuous time or analog systems with block diagrams or state space equations and the use of A/D and D/A converters to obtain models for digital systems.
W2	Discretization of continuous time systems. Solution to the state space equations and its zero-order-hold (ZOH) equivalent.
W3	Basic concepts and properties of linear systems. Discrete time signals. Impulse response of discrete time systems and the convolution summation.
W4	The z-transform and its properties. Transfer function models in the z-domain. Stability considerations. The Jury stability criterion.
W5	Inverse z-transformation by partial fraction expansion.
W6	Frequency domain analysis of signals and systems. Continuous and discrete time sinusoidal signals. Sampling of continuous time signals. MIDTERM EXAM No:1

W7	Fourier series and Fourier transforms. Frequency response. Fourier transform of discrete time signals (DTFT). Sampling of analog signals.
W8	Reconstruction of analog signals from samples. Filtering. Pole-zero location based discrete filter design in the z-domain.
W9	Classification of filters: low-pas; band pass, high pass.
W10	Discrete Fourier Transform (DFT).
W11	Control structures: Feed forward controller, one degree and two degrees of freedom feedback controllers; lead-lag controllers.
W12	Proportional, integral, derivative controllers. MIDTERM EXAM No:2
W13	System type. Error performance of control systems of different type under different inputs.
W14	Time domain performance specifications. Small rise time in response, small overshoot in response.

COURSE ASSESMENT AND ECTS WORK LOAD

Type of Work	Count	ECTS WORK LOAD	
		Time (Hour)(Including prep. time)	Work Load
Attendance	14	3	42
Final Exam	1	25	25
Quizzes			0
Term project			0
Reports			0
Final Project			0
Seminar			0
Assignments		8	8
Presentation			0
Midterms		20	20
Project			0

Laboratory		0	0
Tutorial		0	0
Other(Self study, Paper reviews)		30	30
		Total work load	125
		Total work load/25	5
		ECTS Credit	5

PROGRAM OUTCOMES - COURSE OUTCOMES RELATIONS		
PO	**Program Outcomes**	**CO**
1	**1.1.** Adequate knowledge in fundamentals of mathematics (algebra, differential equations, integrals, probability etc), science (physics, chemistry, biology etc.) and computer science (programming and simulation);	
	1.2. ability to use theoretical and applied knowledge in these areas in complex engineering problems.	
2	**2.1.** Ability to identify, formulate, and solve complex engineering problems;	1,..,4
	2.2. ability to select and apply proper analysis and modeling methods for this purpose.	1,..,4
3	**3.1.** Ability to design and integrate components of a complex system or process, as they relate to Electrical and Electronics Engineering discipline, under realistic constraints and conditions, in such a way as to meet desired requirements;	
	3.2. ability to apply modern design methods.	
4	**4.1.** Ability to devise, select, and use techniques and tools needed for analyzing and solving complex problems encountered in engineering practice;	
	4.2. ability to employ information technologies effectively.	
5	**5.1.** Ability to design experiments,	
	5.2. ability to conduct experiments, gather, analyze and interpret data.	
6	**6.1.** Ability to work in intra-disciplinary teams;	
	6.2. ability to work in multi-disciplinary teams;	
	6.3. ability to take individual responsibilities.	

7	**7.1.** Ability to effectively communicate via written and oral means;	
	7.2. knowledge of at least one foreign language;	
	7.3. ability to write effective reports and comprehend written reports;	
	7.4. ability to write design and manufacturing reports	
	7.5. ability to present effectively,	
	7.6. ability to give and follow clear instructions.	
8	**8.1.** Recognition of the need for lifelong learning;	
	8.2. ability to access information, to follow developments in science and technology, and to continue to educate him/herself.	
9	**9.1.** Consciousness to behave according to ethical principles, and about professional and ethical responsibility;	
	9.2. knowledge on standards used in engineering practice.	
10	**10.1.** Knowledge about business life practices such as project management, risk management, and change management;	
	10.2. awareness in entrepreneurship, innovation;	
	10.3. knowledge about sustainable development.	
11	**11.1.** Knowledge about the global and social effects of engineering practices on health, environment, and safety, and contemporary issues of the century reflected into the field of engineering;	
	11.2. awareness of the legal consequences of engineering solutions.	

Revison Date	Prepared by	Approved by
1.9.2019 1.6.2021	Prof. Dr. Yorgo Istefanopulos	Prof.Dr. Ahmet Aksen