

COURSE INFORMATION					
Course Title	Code	Semester	L+P Hour	Credits	ECTS
<b>MODERN CONTROL ENGINEERING</b>	<b>ESYE552</b>		<b>3+0</b>	<b>3</b>	<b>10</b>

<b>Prerequisites</b>	
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<b>Language of Instruction</b>	English
<b>Course Level</b>	M. S.
<b>Course Type</b>	Compulsory
<b>Course Coordinator</b>	
<b>Instructors</b>	Assist. Prof. Uğur Yıldırım
<b>Assistants</b>	
<b>Goals</b>	Teaching modern control techniques based on state space models and optimal control theory
<b>Content</b>	State space models, analysis of systems in state space representation, controllability, observability, state feedback controller synthesis, calculus of variations, optimal control, Linear Quadratic Regulator (LQR)

Course Learning Outcomes	Program Learning Outcomes	Teaching Methods	Assessment Methods
Ability to perform analysis of linear system models in state space form	5	1	A, C
Ability to perform controllability and observability analysis of linear system models in state space form	1	1	A, C
Ability to synthesize state feedback controllers for linear systems	12	1	A, C
Ability to use calculus of variations for finding open-loop optimal control	2	1	A, C
Ability to design optimal state feedback controllers based on LQR principle	4	1	A, C

<b>Teaching Methods:</b>	1: Lecture, 2: Paper Discussion, 3: Lab, 4: Case-Study
<b>Assessment Methods:</b>	A: Testing, B: Paper Summary, C: Homework, D: Project

<b>COURSE CONTENT</b>		
<b>Week</b>	<b>Topics</b>	<b>Study Materials</b>
1	INTRODUCTION	Textbook
2	STATE SPACE MODELS	Textbook
3	SOLUTION OF STATE SPACE EQUATIONS	Textbook
4	CONTROLLABILITY	Textbook
5	OBSERVABILITY	Textbook
6	STATE FEEDBACK CONTROLLER SYNTHESIS	Textbook
7	OBSERVER SYNTHESIS	Textbook
8-9	REVIEW OF FINITE DIMENSIONAL OPTIMIZATION PROBLEMS	Textbook
10	CALCULUS OF VARIATIONS	Textbook
11-12	SOLUTION OF OPTIMAL CONTROL PROBLEMS USING CALCULUS OF VARIATIONS	Textbook
13-14	LINEAR QUADRATIC REGULATOR	Textbook

<b>RECOMMENDED SOURCES</b>	
<b>Textbook</b>	Donald E. Kirk, "Optimal Control Theory: An Introduction", Dover Publications
<b>Additional Resources</b>	

<b>MATERIAL SHARING</b>	
<b>Documents</b>	
<b>Assignments</b>	Homework questions on state space theory, controllability, observability, state feedback controller synthesis and observer synthesis, calculus of variations and optimal control
<b>Exams</b>	Midterm exams, final exam

<b>ASSESSMENT</b>			
	<b>IN-TERM STUDIES</b>	<b>NUMBER</b>	<b>PERCENTAGE</b>
Mid-terms		2	83
Assignment		6	17
	<b>Total</b>		<b>100</b>
<b>CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE</b>			40
<b>CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE</b>			60
	<b>Total</b>		<b>100</b>

<b>COURSE CATEGORY</b>	Expertise/Field Courses
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<b>COURSE'S CONTRIBUTION TO PROGRAM</b>						
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Ability to reach knowledge in breadth and depth through scientific research in Systems Engineering field; to have extensive knowledge about current techniques and procedures together with their constraints.					x
2	Ability to complement and apply knowledge by scientific methods utilizing limited or missing data; to use knowledge in different disciplines effectively by blending them.				x	
3	Ability to formulate Systems Engineering problems; to develop novel and original ideas and procedures for their solutions and to use innovative procedures in solutions.					
4	Awareness of new and developing applications in Systems Engineering; ability to investigate and learn these applications when required.				x	
5	Ability to design and apply analytical, and modeling and experimental based research; to solve and interpret complex situations encountered in this process.					x
6	Ability to lead multi-disciplinary teams; to develop solution approaches in complicated situations and to take responsibility.					
7	Ability to develop novel and/or original ideas and methods; to develop innovative solutions for the design of systems, parts or the processes.					

8	Ability to communicate orally or in writing the process and the results of Systems Engineering studies systematically and openly in national or international platforms.						
9	Ability to master a foreign language (English) at the European Language Portfolio B2 General Level to communicate orally or in writing.						
10	Ability to recognize social, scientific and ethical values in the process of collection, interpretation and publishing of data, and in all professional activities.						
11	Ability to visualize social and environmental dimensions of Systems Engineering applications and to observe these dimensions in professional practice.						
12	Ability to develop appropriate methodology and procedures for the modeling, improvement, control and design of complex systems for a specified target.						x

<b>ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION</b>			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding exam hours: 13x Total course hours)	13	3	39
Hours for off-the-classroom study (midterms)	2	20	40
Hours for off-the-classroom study (final)	1	30	30
Midterm examination	2	2	4
Homework	6	24	144
Final examination	1	3	3
<b>Total Work Load</b>			260
<b>Total Work Load / 25 (h)</b>			10,4
<b>ECTS Credit of the Course</b>			10