ECTS COURSE INFORMATION FORM

Faculty	**Faculty of Engineering**	
Program	**B.Sc. in Civil Engineering**	**Elective**
	B.Sc. in Computer Engineering	**Elective**
	B.Sc. in Electrical-Electronics Engineering	**Elective**
	B.Sc. in Industrial Engineering	**Elective**
	B.Sc. in Mechanical Engineering	**Required**

Course Code	ME 303			
Course Title in English	System Dynamics and Control			
Course Title in Turkish	Sistem Dinamiği ve Kontrol			
Language of Instruction	English			
Type of Course	Flipped Classroom			
Level of Course	Undergraduate. Advanced			
Course Category (by % of Content)	Basic Science	Basic Engineering	Engineering Design	General Education
		60	40	
Semester Offered	Spring			
Contact Hours per Week	Lecture: 3 hours	Recitation:	Lab:	Other:
Estimated Student Workload	146 hours			
Number of Credits	6 ECTS			
Grading Mode	Standard Letter Grade			
Pre-requisites	DYN201, MATH213, EE 212			
Expected Prior Knowledge	Knowledge of electric and electronic circuits.			
Co-requisites	None			
Registration Restrictions	Only Undergraduate Students			
Overall Educational Objective	To learn the principles of analog control engineering such as system modeling in time and frequency domains, time response, stability, root locus, frequency and state space design.			
Course Description	This course provides the fundamental aspects of control engineering, covering such topics as: System modeling and analysis of linear time-invariant systems in time, Laplace, and frequency domain methods, as well as with the State-space Method; linearization; time response; block diagram reduction; stability analysis using the Routh-Hurwitz and Root Locus techniques; system model conversions; system analysis with initial conditions and general form inputs; state variable feedback controller design. Computer-aided tools will also be used throughout the course.			
Course Description in Turkish	Bu ders kontrol mühendisliğinin temel kavramlarını içermektedir ve şu konuları kapsamaktadır: Sistem modellemesi ve zaman içinde doğrusal zamanla değişmeyen sistemlerin analizi, Laplace, frekans alanı yöntemleri ile Durum-Alan Yöntemi; doğrusallaştırma; Zaman tepkisi; Blok diyagram indirgemesi; Routh-Hurwitz ve Root Locus teknikleri kullanılarak stabilite analizi; Sistem modeli dönüşümleri; Başlangıç koşulları ve genel form girdileri ile sistem analizi; Durum değişken geri bildirim kontrolör tasarımı. Bilgisayar destekli araçlar da ders boyunca kullanılacaktır.			
Course Learning Outcomes and Competences	Upon successful completion of the course, the learner is expected to: 1. identify, analyze, formulate and solve problems on block diagram modeling and setting their mathematical model as ordinary differential equations, Laplace transform, frequency domain and state-space representations; 2. identify, analyze, formulate and solve problems applying the mesh analysis for linear, time-invariant mechanical systems of multiple degrees of freedom to obtain the state-space model;			

	3. identify, analyze, formulate and solve problems on time response behavior of second order systems, apply stability analysis, and design PID controllers using MATLAB Control Systems Toolbox and Simulink; 4. design and implement a PID control system for a real-life application; 5. communicate and collaborate on a project team, setting goals, accomplishing tasks, and meeting deadlines, professionally write its final report, and defend it orally; 6. self-learn and apply new knowledge by his/her own means as a valuable life-long learning skill.

Relationship of the Course with the Student Outcomes	Level	Learning Outcomes	Assessed by
Student Outcomes	N=None S=Supportive H=High		Exam, Project (advances & assignments), HW, Experiment, Report
(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	H	1-3	Exams, tests, Flip. Class. Practice
(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	S	4	Project report
(3) an ability to communicate effectively with a range of audiences			
(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts			
(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	S	5	Project report, project advances
(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	S	6	Project report (self-learning section)

Prepared by and Date	Prof. Dr. Dante Dorantes / January 13, 2020	
Semester	Spring 2019-2020	
Name of Instructor	Prof. Dr. Dante Dorantes	
Course Contents	Week	Topic
	1.	Introduction. Block Diagram Modelling of Physical Systems
	2.	System Modeling Techniques: ODE, TF, FD & SS. Solving ODE's by Laplace Transform and by the use of MATLAB Symbolic Objects
	3.	MISO DC motor model. Transfer functions & Bode plots. Modeling with OpAmps
	4.	Motor constants. Equivalent moment/moment of inertia/viscous damping. Linearization
	5.	The Mesh Analysis Technique
	6.	The Mesh Analysis Technique. MATLAB Plotting, transfer functions, and State Space.
	7.	Arithmetic operations, vectors, solving polynomials in MATLAB. Time response concepts.
	8.	Time Response of system elements. Performance Criteria. System identification
	9.	The PID controller analysis and controller tuning
	10.	LTI Viewer. Reduction of Block Diagrams. TF-SS & SS-TF conversions. Initial Conditions
	11.	PID Tuning in MATLAB. Simulink model of PID controller & plant

	12.	Stability Analysis via Routh-Hurwitz
	13.	Stability Analysis via Root Locus. Signal Flow Graphs and the State-Variable Feedback Design Method (Pole Placement), Controllability
	14.	The State-Variable Feedback Design Method
	15.	Final Exam/Project/Presentation Period
	16.	Final Exam/Project/Presentation Period

Required/Recommended Readings

- Control Systems Engineering, International Student Version, Norman S. Nise, 6th Edition, Wiley, 2011 (textbook) ISBN: 978-0-470-64612-0

Other reference:

- Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Pearson, 2009

Teaching Methods: Flipped classroom

Homework and Projects: Practical implementation of a PID controller. Analysis & design with MATLAB Control Toolbox & Simulink.

Laboratory Work:

Computer Use: Compulsory computer-aided problem-solving using MATLAB Control Toolbox and Simulink.

Other Activities:

Assessment Methods

Assessment	Number	Share (%)
Midterm Exams	2	25
Flipped Classroom Practice	12	10 (participation levels: 0, 1, 2)
After-video tests	10	5
Assignments	4	15
Project advances	6	20
Project report & defense	1	25 (5 Report + 20 Defense)
Total		100

Course Administration

Instructor's office and phone number: 5th Floor, 0212 395 36 40
office hours: Tuesday 13:00-15:00
email address: dante.dorantes@mef.edu.tr

Rules for attendance: attendance is taken during Flipped Classroom Practice. A minimum of 70% of attendance is mandatory.

Rules for Flipped Classroom Practice: Missed Flipped Classroom Practice will be given a zero grade. Participation quizzes with flaws or lack of individual collaboration attitude during team work will be given a grade of one. Successful flipped classroom participation will be given a grade of two.

Rules for late submission of the project: It will be discounted 20/100 by each delayed day.

Rules for missing a midterm: Provided that a valid justification is approved by the university and presented, a make-up exam will be granted one week after the regular midterm date.

Minimum grade to be allowed to pass the course: Satisfactory Project, Laboratory reports, and at least 70% attendance are mandatory to be allowed to pass the course.

A reminder of proper classroom behavior, code of student conduct: YÖK Regulations

Statement on plagiarism: YÖK Regulations http://www.mef.edu.tr/Yonetmelikler

ECTS Student Workload Estimation

Activity	No/Weeks	Hours			Calculation	Explanation
	No/Weeks per Semester (A)	Preparing for the Activity (B)	Spent in the Activity Itself (C)	Completing the Activity Requirements (D)		
Lecture/Flipped Classroom	12		2	1	36	A*(B+C+D)
After-video online test	10		0.5	0.5	10	A*(B+C+D)
Midterms	2	18	4		44	A*(B+C+D)
Project, assignments	1	14	18		32	A*(B+C+D)
Project report and defense	1	22	2		24	A*(B+C+D)
Total Workload					146	
Total Workload/25					5.84	
ECTS					**6**	