

MM 403E Control Systems				DEPARTMENT of MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project / Field Study	Homework	Other	Total	Credit	ECTS Credit
7	42		6		20	7	75	3	3.0
Language	English								
Compulsory / Elective	Compulsory								
Prerequisites	MM 326 E								
Course Contents	Transfer functions and block diagrams. Basic concepts of automatic control. Control actions. Time response. Stability and Routh-Hurwitz criterion. Root locus. Frequency response methods and Bode diagrams.								
Course Objectives	The objective of the course is to give the students the basics of classical control systems.								
Learning Outcomes and Competences	The students will be able to analyze, design and apply a classical control system. mechanical, fluid, electrical, thermal or hybrid engineering systems by using unified methods. The course gives the students the background necessary for advanced control courses.								
Textbook and /or Reference	Ogata, K., Modern Control Engineering, 4 th Edition, Prentice Hall, Upper Saddle River, New Jersey, 2002. Reference Books: Ercan, Y., Modeling and Dynamics of Engineering Systems, 2 nd Edition, Literatur Yayinevi, Istanbul, 2003 (in Turkish). Nise, N., Control Systems Engineering, 2 nd edition, Addison-Wesley, Menlo Park, CA, 1995. Kuo, B., Automatic Control Systems, Prentice-Hall, 7 th Edition, Englewood Cliffs, 1995. Dorf, R.C., Bishop, R.H., Modern Control System, 9 th Edition, Prentice Hall, Upper Saddle River, New Jersey, 2001. Phillips, C.L., Harbor, R.D., Feedback Control Systems, 3 rd Edition, Prentice Hall, Upper Saddle River, New Jersey, 1996. Franklin, G.F., Powell, J.D., Emami-Naeini, A., Feedback Control of Dynamic Systems, Prentice Hall, Upper Saddle River, New Jersey, 2002.								
Assessment Criteria						If any, mark as (x)		Percentage (%)	
	Midterm Exams					X		45	
	Quizzes								
	Homeworks					X		15	
	Projects								
	Term Paper								
	Laboratory Work								
	Other								
	Final Exam					X		40	
Instructors	Assoc.Prof. Dr. Metin U. SALAMCI, Dr. Bulent OZKAN								
Week	Subject								
1	Introduction to control systems and definitions. Open-loop and closed-loop systems.								
2	Transfer functions. Transfer functions of multiple input and multiple output systems. Transfer functions of cascaded systems. Block diagrams.								
3	Obtaining transfer functions from block diagrams: Analytical method, block diagram algebra.								
4	Mason's rule. Drawing detailed block diagrams from basic equations.								
5	Structure of feedback control systems Desired characteristics of control systems. Sensitivity of control systems to parameter variations.								
6	Controller and control actions. Proportional, integral, derivative control actions. Proportional, integral, proportional-plus-derivative, proportional-plus-integral-plus-derivative control.								
7	Two-position control and its applications. Servo and regulator characteristics of control systems. Examples on applications of different control actions.								
8	Examples on applications of different control actions. Ziegler-Nichols PID control parameter settings.								
9	Transient response. Review of transient responses of first and second order systems. Transient response specifications and their use in analysis and design of second order systems.								
10	Transient responses of higher order systems. Stability of control systems. Stability and system poles. Routh-Hurwitz stability criterion.								
11	Special cases of Routh-Hurwitz stability criterion. Selection of parameter values for stability. Relative stability and stability margin.								
12	Steady state response. Classification of control systems by type. Steady state error and error constants. Root locus method.								
13	Rules of drawing root locus diagrams. Examples of root locus diagrams. Frequency response. Graphical representations of frequency response. Bode diagrams.								
14	Examples of Bode diagrams. System identification by Bode diagrams. Bode diagrams and stability, gain margin, phase margin.								