

MM 326E System Dynamics				DEPARTMENT of MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project/Field Study	Homework	Other	Total	Credit	ECTS Credit
6	42	0	6	15	20	42	125	3	5.0
Language	English								
Compulsory / Elective	Compulsory								
Prerequisites	None								
Course Contents	Modelling of physical systems. Energy ports. One-port and two-port elements. Mechanical, electrical, fluid and thermal system elements. Linear graphics. Evaluation of dynamic equations. Modeling of impure elements. Linearization. State variables. Evaluation of system equations in the form of A-matrices. Physical, canonical and phase variables. Time responses of systems.								
Course Objectives	The objective of the course is to give the students the basics of system dynamics.								
Learning Outcomes and Competences	The students will be able to model and analyze mechanical, fluid, electrical, thermal systems or hybrid engineering systems including these by common methods. These methods can be applied to systems different from engineering systems.								
Textbook and /or Reference	Text Book: Ercan, Y., Modeling and Dynamics of Engineering Systems, 2nd Edition, Literatur Yayınevi, Istanbul, 2003 (in Turkish). Reference Books: Rowell, D., Wormley, D.N., System Dynamics, An Introduction, Prentice-Hall, Upper Saddle River, 1997. Ogata, K., System Dynamics, Prentice-Hall, Englewood Cliffs, 1992. Shearer, J.L., Murphy, A.T., Richardson, H.H., Introduction to System Dynamics, Addison-Wesley, Reading, 1967.								
Assessment Criteria						If any, mark as (x)		Percentage (%)	
	Midterm Exams					X		60	
	Quizzes								
	Homeworks								
	Projects								
	Term Paper								
	Laboratory Work								
	Other								
	Final Exam					X		40	
Instructors	Prof. Nizami AKTURK, Assoc.Prof. Metin U. SALAMCI								
Week	Subject								
1	System concept. Introduction to system dynamics, definitions. Modeling of physical systems. Global parameter models. Variable types.								
2	Power and energy. Energy ports. One-port elements. Type-A, type-T, type-D and source elements.								
3	One-port elements of physical systems.								
4	Linear graph representation of system elements. Oriented linear graphs of systems with one-port elements. Evaluation of basic equations from system graphics and dynamic equations for systems with one-port elements.								
5	Obtaining dynamic equations of some example systems with one-port elements.								
6	Incompatibilities in modeling and dependent elements. Impure elements.								
7	Two-port elements. Oriented linear graphs and dynamic equations of systems with one-port and two-port elements.								
8	Obtaining dynamic equations of some example systems with one-port and two-port elements. State variables and equations.								
9	Determination of state variables of systems with one-port elements from their linear graphics and evaluation of state equations.								
10	Determination of state variables of systems with one-port and two-port elements and evaluation of state equations. Linearization of nonlinear systems. Use of Taylor series in linearization.								
11	Linearization around steady and non-steady operating points.								
12	Laplace transforms. Transfer functions. Characteristic equation. Poles and zeros. Test input types and time response.								
13	Response of systems to impulse, step and ramp inputs. Step and ramp responses of first order systems. Step responses of second order systems.								
14	Responses of systems to sinusoidal inputs. Frequency response, amplitude ratio, phase shifting. Graphical representations of frequency response.								