

MM 486 Introduction to Failure Analysis				DEPARTMENT of MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project /Field Study	Homework	Other	Total	Credit	ECTS Credit
8	42	0	5	0	5	23	75	3	3.0
Language	Turkish								
Compulsory / Elective	Elective								
Prerequisites	MM 207 E								
Course Contents	Introduction. Mechanical behavior of materials. Causes of failures. Micro fracture mechanisms. Types of wear and wear mechanisms. Oxidation and corrosion. Case studies.								
Course Objectives	The objective of this course is to introduce the types of failures and their mechanisms and to teach methods of analysis of failed engineering components and to recommend solutions to the problems.								
Learning Outcomes and Competences	Students who take this course will gain the knowledge about the types and mechanisms of material failures and they get an ability of solving failure problems.								
Textbook and /or Reference	1) Eryürek I.B. "Hasar Analizi", 1 basım, İTÜ Makine Fakültesi, Birsen yayınevi, İstanbul, 1993. 2) Gürleyik M.Y. "Hasar Bilgisi", KTÜ yayın no 3, Trabzon, 1976. 3) Charlie R.B. Cloudhury A., "Failure Analysis of Engineering Materials", McGraw-Hill NY, 2002. 4) Norman Eç Dowling, "Mechanical Behaviour of Materials" (Engineering Methods for Deformation, Fracture and Fatigue), 2nd ed., Prentice Hall NJ, 1999. 5) Lipson, C. "Basic Course in Failure Analysis", Machine Design, pp.154, 1970. 6) Metals Handbook, "Fractography and Atlas of Fractographs", ASM vol.9, 1974. 7) Metals Handbook, "Failure Analysis and Prevention", ASM vol.10, 1975. 8) Metals Handbook, "Failure Analysis and Prevention", ASM vol.11, 1986. 9) Askeland, D.R., "The Science and Engineering of Materials", 4th ed., Thomson/Brooks/Cole, USA, 2003. 10) Pat L. Mangonon, "The Principles pf Materials Selection for Engineering Design", Prentice Hall NJ, 1999. 11) Ashby, M.F., "Materials Selection in Mechanical Design", Pergamon Pres, 1992. 12) Flinn, R.A., "Engineering Materials and Their Application", 4th ed., Houghton Mifflin Co., Boston, 1994. 13) Onaran, K., "Malzeme Bilimi", 4. Basım, Bilim Teknik yayınevi, İstanbul, 1193. 14) Doruk, M., "Korozyon ve Önlenmesi", ODTÜ yayın no 70, 1982. 15) Oğuz, B., "Ark Kaynağı", Murat Matbaası, İstanbul, 1975. 16) Oğuz, B., "Dökme Demir Kaynağı", Murat Matbaası, İstanbul, 1974. 17) Erdoğan, T., "Metalik Malzemelerin Uygulamalı Optik Metalografisi", Segem yayın no 98, Ankara, 1982. 18) Erdoğan, T., "Mühendisler için Malzeme Seçimi", TMMOB yayın no 119, Ankara, 1986.								
Assessment Criteria					If any, mark as (x)		Percentage (%)		
	Midterm Exams				X		40		
	Quizzes								
	Homeworks				X		10		
	Projects								
	Term Paper								
	Laboratory Work				X		10		
	Other								
Final Exam				X		40			
Instructors									
Week	Subject								
1	Introduction: definition, classification of failure of materials, procedures for determining failures.								
2	Mechanical behavior of materials: overload fracture behavior of tensile, torsion, bending and fatigue samples, state of stresses: principle stresses, stress distribution, triaxial stress and constraints.								
3	Plane stress-plane strain conditions, stress concentration, types of fracture, crack propagation, ductile and brittle fracture.								
4	Identification of crack origins on fracture surfaces, effect of temperature and strain rate on the material behavior, thermal expansion and thermal stresses.								
5	Causes of failures: defective material, faulty design, inappropriate material selection, faulty manufacturing, construction and assembly.								
6	Weld defects, wrong heat treatment, residual stresses, hot and cold tearing.								
7	Wearing of components, overload or unforeseen loading conditions, inadequate maintenance pr improper repairing, abnormal operating temperatures, severe vibration, impact or collisions, thermal shock.								
8	MIDTERM I								
9	Micro fracture mechanisms: slip, cleavage, twinning, mixed mechanism of fracture, tearing, intergranular separation, fatigue fracture.								
10	Environmentally assisted fracture, comparison of fractographs, and correlation of micro and macrofractographic features.								
11	Types of wear and wear mechanisms, analysis of wear failures. Oxidation and corrosion: types of corrosion.								
12	Prevention of corrosion, analysis of corrosion failures, decreasing of zinc, Hydrogen embrittlement, graphitization of cast iron.								
13	Case studies: pressure vessels and pipings, turbine blades, steel punches, welded components, broken automobile components, analyses of welded components.								
14	MIDTERM II								