



ÇANKAYA UNIVERSITY

MSE 426 - Thermal Processing Of Materials



(2016-2017 Spring)

Methods of Instruction	Theor.	Appl.	Lab.	Total	Credit	ECTS Credit
	42	-	-	42	(3 0 3)	5
Semester	Spring 2016 – 2017					
Instructor	Assoc. Prof. Dr. Ziya Esen, Materials Science and Engineering Dept. Room: NB-16, e-mail: ziyaesen@cankaya.edu.tr					
Assistant(s)	Expert Ezgi Bütev Materials Science and Engineering Dept. Room: NC-09, e-mail: ebutev@cankaya.edu.tr					
Schedule	Lecture Hours Tuesday 09:20-12:10					

Course Description

Property changes due to heat treatment. Iron-carbon system. Solubility. Austenitizing, transformation of austenite, Microstructure development. Microstructure-property relationship. I-T and C-T diagrams, annealing, normalizing, hardening, CCR (critical cooling rate). Actual cooling rate, quenching media, size and mass effect. Hardenability and applications of hardenability data in plain carbon and alloy steels. Tempering. Secondary hardening, temper embrittlement, austempering. Case hardening (flame&induction hardening, carburizing, nitriding, etc.). Formation and effect of residual stresses, application of martempering.

Course Objective

The aim of this course is to provide a conceptual framework for understanding the behavior of metallic materials (steels, cast irons and non-ferrous alloys) by emphasizing important relations between internal structure and properties. Explain principles of heat treatment procedures for metals and alloys; explain the effect of heat treatment parameters on microstructure and on mechanical properties. Perform a heat treatment procedure to obtain desired properties considering the microstructure. Provide information about techniques and effect of surface processing techniques.

Textbook(s)				
Author(s)	Title	Publisher	Publication Year	ISBN
Avner, S. H	Introduction to Physical Metallurgy, 2nd Edition.	<i>McGraw-Hill, New York</i>	1974	0070024995
Romesh C. Sarma	Principles of Heat Treatment of Steels	<i>New Age International Ltd.</i>	1996	81-224-0869-9

Reference Books				
Author(s)	Title	Publisher	Publication Year	ISBN
Brandt D. A., Warner J. C.,	Metallurgy Fundamentals, 4th edition	<i>The Goodheart-Willcox Company, Inc. Illionis</i>	2009	1605250791
Shackelford J. F.,	Introduction to Materials Science for Engineers, 7th Edition	<i>Macmillan Publishing Company</i>	2009	0136081681
Roberts G. A., Cary R. A.,	Tool Steels, 5th edition	<i>American Society for Metals</i>	1998	0-87170-599-0

Attendance

70% attendance of all lecture hours is required by the university's regulations. Absence from a quiz or an examination will result in zero grade

Grading Policy

Quiz..... 5%
 Project.....15%
 Midterms (I&II).....50%
 Final.....30%

Tentative Course Outline

2016-2017 Week	Topics covered
1 (13-17 Feb)	Classification of Engineering Materials
2 (20-24 Feb)	Classification of Ferrous Alloys , Iron-iron carbide metastable equilibrium phase diagram (Invariant reactions; Properties of phases)
3 (27 Feb - 3 Mar)	Iron-iron carbide metastable equilibrium phase diagram - Microstructural investigation of equilibrium cooled steels - Determination of phases present during equilibrium cooling (Lever rule) - Solubility limit and solubility of carbon in iron
4 (6-10 Mar)	Heat treatment of steels - Characteristics of phases formed upon heat treatment - TTT (Temperature-time-transformation) diagrams - Annealing (types of annealing) and normalizing, Use of IT and CCT diagrams
5 (13-17 Mar)	Heat treatment of steels - Hardening (CCT diagrams) - Hardening (important characteristics of martensite transformation, - Hardenability (determination of hardenability, use of hardenability data) - Conventional quenching and tempering, Martempering and austempering
6 (20-24 Mar)	Midterm I
7 (27-31 Mar)	Alloy Steels - Types of alloying elements - Effect of alloying on the mechanical properties and heat treatment response of steels - Standard Designation of steels
8 (3-7 Apr.)	Tool and Die Steels - Classification and properties of tool and die steels, Application fields
9 (10-14 Apr)	Surface Hardening Methods for Steels - Carburizing, Nitriding, Cyaniding and Carbonitriding - Flame and induction hardening
10 (17-21 Apr)	Stainless Steels - Corrosion and degradation - Classification and properties of stainless steels
11 (24-28 Apr)	Cast Irons - Classification and properties of cast irons - Microstructural characterization of equilibrium cooled cast irons - Modification of microstructures
12 (1-5 May)	Midterm II
13 (8-12 May)	Heat treatment procedures applied to common non-ferrous alloys

14 (15-19 May)

Non-ferrous metals and alloys
- Properties and applications of Al, Cu, Mg and Ti-alloys, Precipitation hardening