Course Name						
HEAT TREATMENT of METALS						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 376E	6	2	3	2	-	-

Department/Program	Metallurgical and Materials Eng.		
Course Type	Elective	**Course Language**	English
Course Prerequisites	None		

Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
	-	50	50	-

Course Description	Fe-C phase diagram, the effect of alloying elements on Fe-C phase diagram, Austenite transformation and TTT and CCT curves, fundamentals of martensitic transformations, quenching and tempering of steel, hardenability, surface hardening, heat treatments of non-ferrous alloys, precipitation hardening, heat treatments defects, heat treatment equipments.
Course Objectives	1. To define the basic principles of heat treatment, 2. To define the effect of alloying elements on heat treatment of steel, 3. To teach the usage of TTT and CCT curves, 4. To explain the relationships between heat treatment and mechanical properties.
Course Learning Outcomes	Students who pass the course will be able to: 1. Interpret the importance of Fe-C phase diagram and the effect of alloying elements on Fe-C phase diagram, 2. Understand the fundamentals of heat treatment 3. Interpret the effect of hardening or non hardening heat treatments on steel, 4. Interpret the relationships between heat treatments and mechanical properties, 5. Use TTT and CCT diagrams, 6. Perform precipitation hardening and its application.
Textbook	• G. E. Totten (Ed.), Steel heat treatment: Metallurgy and Technologies", Boca Raton, FL : Taylor & Francis, 2007.
Other References	• H.E. Boyer, Practical Heat Treating, (Fourth Edn.) A S M. Ohio, 1989. • M.A. Topbaş, Isıl İşlemler, Prestij Basım-Yayın, 1993. • K.Tülbentçi, Metallerin Isıl İşlemi (Fotokopi ile çoğaltılmış ders notu), 1995 • Sinha K. A., Ferrous physical metallurgy, 1989. • Totten E. G., Steel heat treatment handbook, Marcel Dekker Inc., Newyork, 1997.
Homework & Projects	Students will be given a subject and this will be presented in the class. Presentation subjects may be used as a source for exams.
Laboratory Work	**NONE**
Computer Use	
Other Activities	

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	**2**	**40**
	Quizzes		
	Homework		
	Projects		
	Term Paper/Project		
	Laboratory Work		
	Other Activities	**1**	**20**
	Final Exam	**1**	**40**

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Fe-C phase diagram and the effect of alloying elements on Fe-C phase diagram	I
2	Fe-C alloys (Steels)	I
3	Fe-C alloys (Cast irons)	I
4	Fundamentals of heat treatment	II-III
5	Quenching and tempering	III
6	Non hardening heat treatments	III
7	Relationships between heat treatment and mechanical properties	IV
8	Relationships between heat treatment and mechanical properties	IV
9	TTT and CCT diagrams	V
10	Hardenability and factors affecting hardenability	V
11	Surface hardening (Flame and induction hardening)	II-III
12	Surface hardening (Carburization, Nitriding, carbonitrding)	II-III
13	Precipitation hardening	VI
14	Heat treatments faults	IV

Relationship between the Course and METALLURGICAL AND MATERIALS ENGINEERING **Curriculum**

	Program Outcomes	Level of Contribution		
		1	**2**	**3**
1	Ability to apply the knowledge of mathematics, science and engineering principles to solve problems in metallurgical and materials engineering (ABET:a)			**X**
2	Ability to characterize materials using standard and/or self designed experimental methods and to evaluate the results (ABET:b)			
3	Ability to design a system or a process, taking into consideration of the desired specifications, quality, ethics and environment. (ABET:c)			
4	Ability to communicate both orally and in the written form and to take part in, and provide leadership of the teams in the elucidation of engineering problems; (ABET:d, g)			
5	Ability to define, formulate and solve engineering problems in the development, production, processing, protection and usage of engineering materials. (ABET:e)			**X**
6	An understanding of professional and ethical responsibilities(ABET:f)			
7	An understanding of current/contemporary issues and impact of engineering solutions in broad cultural, national and global levels;. (ABET:h, j)		**X**	
8	A comprehension of the nature of engineering progress closely linked with the development of new materials and production processes. An ability to engage in life-long learning and a recognition of its necessity (ABET:i)		**X**	
9	Ability to use essential tools and techniques of modern engineering in the development, production, processing, protecting of the existing and new engineering materials. (ABET:k)			**X**

1: Little, 2. Partial, 3. Full

Course relationships with major elements of the field and material classes

		Level of Contribution		
		1	**2**	**3**
MAJOR ELEMENT OF THE FIELDS	STRUCTURE			**X**
	PROPERTIES		**X**	
	DESIGN EXPERIMENT/ANALYSE DATA			**X**
	PROCESSING		**X**	
	COST/PERFORMANCE		**X**	
	QUALITY/ENVIRONMENT		**X**	
	DESIGN PROCESS OR PRODUCT		**X**	
MATERIAL CLASSES	METAL			**X**
	CERAMICS			
	POLYMERS			
	COMPOSITES			

1: Little, 2. Partial, 3. Full

Prepared by	**Date**	**Signature**
PROF. DR. HÜSEYİN ÇİMENOĞLU PROF. DR. MURAT BAYDOĞAN	December 2020	