Material Science for Mechanical Engineers

Course Code:

ME 264

Course Period:

Spring

Course Type:

Core

Credits:

3

Theoric:

3

Practice:

0

Laboratory Hour:

0

ECTS:

4

Prerequisite Courses:

General Chemistry [1]
Course Language:

English

Course Objectives:

To introduce the structures and properties of metals, ceramics, polymers and composites as engineering materials, To introduce the relationships between the structural properties of materials and their mechanical, physical and chemical properties, To emphasize the importance of material selection in design process.

Course Content:

Introduction to engineering materials. Structural and physical properties of materials. Crystal structure and imperfections in materials. Solid-state diffusion. Mechanical properties of engineering materials. Phase equilibrium and binary phase diagrams. Kinetics of phase transformation. Heat treatment of metals and alloys. Engineering materials. Corrosion of metals and prevention methods.

Course Methodology:

1: Lecture, 2: Question-Answer, 3: Lab, 4: Case-study

Course Evaluation Methods:

A: Testing, B: Experiment, C: Homework, D: Project

Course Learning Outcomes At the end of this course, students should be able to:	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Predict the physical properties of materials by considering their chemical compositions and atomic bonding characteristics,	1	1,2	A,C
2)Know crystalline defects and appreciate their probable effects on properties of materials,	1,3	1,2	A,C
3) Understand the concept of phase and determine the existing phases, percentages and chemical compositions by using binary phase diagrams,	1,2	1,2	A,C
4) Understand mechanical properties of materials and their measurement techniques, Know and make comments on microstructure-property relations of metals, ceramics, polymers and composite materials,	2,3	1,2	A,C

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to engineering materials. Atomic structure and bonding	Textbook
2	Crystalline structure. Structure of metals, polymers and ceramics.	Textbook
3	Crystal defects, point defects, solid-state diffusion	Textbook

4	Linear defects, dislocations and plastic deformation of crystals, planar defects	Textbook
5	Mechanical properties of materials, tensile properties	Textbook
6	Hardness, fracture, fatigue and creep properties	Textbook
7	Phase equilibrium, solid solutions, binary phase diagrams (Midterm Exam-1)	Textbook
8	Kinetics of phase transformations. Eutectic, eutectoid and peritectic phase transformations	Textbook
9	Fe-C phase diagram and other important binary diagrams	Textbook
10	Kinetics of phase transformations, TTT diagrams, heat treatment of metals and alloys	Textbook
11	Ferrous and nonferrous metals and alloys (Midterm Exam-2)	Textbook
12	Ceramics, polymeric materials and their properties	Textbook
13	Composite materials and their properties	Textbook
14	Wear, corrosion and prevention methods, magnetic, electrical and thermal properties	Textbook

RECOMMENDED SOURCES	
Textbook	*Materials Science and Engineering-An Introduction*, W. D. Callister Jr., John Wiley & Sons,
Additional Resources	*Introduction to Materials Science for Engineers,* J.F. Shackelford, McMillan Pub. Co., *The Science and Engineering of Materials*, D.R. Askeland, PWS Pub. Co.,

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	2	50
Assignment	5	8
Quizes	5	42
Total		**100**

CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE'S CONTRIBUTION TO PROGRAM								
No	Program Learning Outcomes		Contribution					
		NA	1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied knowledge in these areas in complex engineering problems.	**X**						
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.	**X**						
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	**X**						
4	Ability to devise, select, and use modern techniques and tools needed for analyzing and solving complex problems encountered in engineering practice; ability to employ information technologies effectively.	**X**						
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating complex engineering problems or discipline specific research questions.	**X**						
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.	**X**						
7	Ability to communicate effectively in Turkish, both orally and in writing; knowledge of a minimum of one foreign language; ability to write effective reports and comprehend written reports, prepare design and production reports, make effective presentations, and give and receive clear and intelligible instructions.	**X**						
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.	**X**						

9	Consciousness to behave according to ethical principles and professional and ethical responsibility; knowledge on standards used in engineering practice.	**X**						
10	Knowledge about business life practices such as project management, risk management, and change management; awareness in entrepreneurship, innovation; knowledge about sustainable development.	**X**						
11	Knowledge about the global and social effects of engineering practices on health, environment, and safety, and contemporary issues of the century reflected into the field of engineering; awareness of the legal consequences of engineering solutions.	**X**						
12	Ability to work professionally in both thermal and mechanical systems areas, including design and realization.	**X**						
13	Ability to verify and validate numerical solutions to engineering problems.	**X**						

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 12x Total course hours)	12	3	36
Hours for off-the-classroom study (Pre-study, practice)	12	3	36
Midterm examination	2	3	6
Homework	5	4	20
Final examination	1	3	3
Total Work Load			101
Total Work Load / 25 (h)			4.0
ECTS Credit of the Course			4