ABDULLAH GÜL UNIVERSITY
GRADUATE SCHOOL OF ENGINEERING & SCIENCE
MATERIALS SCIENCE AND MECHANICAL ENGINEERING PROGRAM
COURSE DESCRIPTION AND SYLLABUS

Course Title	Code	Semester	T+L Hours	Credit	ECTS
Microstructure Engineering	MSME 683	SPRING	3 + 0	3	10

Prerequisite Courses	Basic knowledge on material science

Type	Elective
Language	English
Coordinator	Burak Bal
Instructor	Burak Bal
Adjunt	none
Aim	To learn the relationship between mechanical properties of materials and microstructure and obtain a good knowledge on crystal plasticity and multi-scale modeling.
Learning Outcomes	• Learning the relationship between mechanical properties of materials and microstructure • Learning the defects in materials and their effects • Learning the elastic deformation & plastic deformation at both micro and macro scales. • Learning the fracture mechanisms in materials. • Learning the effects of hydrogen interstitial on the microstructure of materials. Learning the diffusion and localization of atomic hydrogen both close and far away from dislocations. • Learning the stacking faults in materials. • Learning the effects of dynamic strain aging and the corresponding strain rate sensitivity. • Learning the fatigue at both micro and macro scales. • Learning the crystal plasticity modeling. • Learning to multi-scale modeling approach.
Course Content	• Introduction to microstructure the relationship between mechanical properties of materials and microstructure • Material defects • Elasticity-Plasticity • Ductile and brittle fracture • Investigation of hydrogen embrittlement • Dislocation-hydrogen atom interactions • The effect of dynamic strain aging on material response • Fatigue • Crystal plasticity modeling • Multi-scale modeling

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Introduction to Material Science and Microstructure	The relevant articles from the literature
2	Dislocations, Inclusion, Stacking faults	The relevant articles from the literature
3	Elasticity	The relevant articles from the literature
4	Plasticity	The relevant articles from the literature
5	Fracture	The relevant articles from the literature
6	Hydrogen Embrittlement	The relevant articles from the literature
7	Midterm I	
8	Dislocation – Interstitials atom interactions	The relevant articles from

		the literature
9	Dynamic Strain Aging	The relevant articles from the literature
10	Microstructure under Low-cycle fatigue	The relevant articles from the literature
11	Microstructure under High-cycle fatigue	The relevant articles from the literature
12	Crystal Plasticity Modeling	The relevant articles from the literature
13	Crystal Plasticity Modeling	The relevant articles from the literature
14	Multiscale Modeling considering microstructural changes	The relevant articles from the literature
15	Multiscale Modeling considering microstructural changes	The relevant articles from the literature
16	Final Exam	

SOURCES	
Lecture Notes	Lecture notes and presentations
Other Sources	1: "Mechanical Behavior of Materials," by William F. Hosford; Cambridge; ISBN-10: 0521846706 2: Mechanical Behavior of Materials, Thomas H. Courtney, McGraw Hill 3: Introduction to Dislocations, D Hull & DJ Bacon, Butterworth-Heinemann 4: Theory of Dislocations, Hirth & Lothe, Krieger 5: Crystals, Defects, and Microstructure, Rob Phillips, Cambridge

COURSE MATERIALS SHARING	
Documents	Lectures notes will be shared on the internet
Homeworks	There will be 4 homework
Exams	1 midterm and 1 final exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
Project	1	%50
Midterm	1	%15
Homework	4	%15
Final	1	%20
SUB-TOTAL	6	100
Contribution of Semester Study	5	%80
Contribution of Final Exam	1	%20
TOTAL	6	100

Course Category	
Sciences and Mathematics	
Engineering	100%
Social Sciences	

RELATIONSHIPS BETWEEN LEARNING OUTCOMES AND PROGRAM QUALIFICATIONS							
No	Program Qualifications	Contribution Level				
		1	2	3	4	5
1	Accessing knowledge, evaluating and interpreting information by doing scientific research in the field of Materials Science and Mechanical Engineering					x
2	Ability to use science and engineering knowledge for development of new methods in Materials Science and Mechanical Engineering					x
3	To be able to understand and analyze materials by using basic knowledge on Materials Science and Mechanical Engineering					x

4	Design and implement analytical, modeling and experimental research					x
5	Solve and interpret the problems encountered in experimental research				x	
6	Considering scientific and ethical values during the collection and interpretation of data	x				
7	Integrating knowledge of different disciplines with the help of scientific methods, and completion and implementation of scientific knowledge using data					X
8	To gain leadership ability and responsibility in disciplinary and interdisciplinary team works				x	
9	To be able to contribute to the solution of social, scientific and ethical problems encountered in the field of Materials Science and Mechanical Engineering					x
10	To be able to define, interpret and create new information about the interactions between various discipline of Materials Science and Mechanical Engineering					x

*Increasing from 1 to 5.

ECTS / WORK LOAD TABLE			
Activities	Number	Duration (Hours)	Total Work Load
Course Length (includes exam weeks: 16x total course hours)	16 weeks	3	48
Out-of-class Study Time (Pre-study, practice)	16 weeks	2	32
Reading	16 weeks	1	16
Internet search, library work, literature search	16 weeks	2	32
Report Preparation	2	48	96
Presentation Preparation	2	24	48
Presentation	1	2	2
Homework	4	5	20
Midterm	1	3	3
Final Exam	1	3	3
Total Work Load			300
Total Work Load / 30			300/30
Course ECTS Credit			10