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
MACROMOLECULAR CHEMISTRY AND PHYSICS	MSME-603	FALL-SPRING	3 + 0	3	10

Prerequisite Courses	None

Type	Selective
Language	English
Coordinator	Assoc. Prof. Hakan Usta
Instructor	Assoc. Prof. Hakan Usta
Adjunt	none
Aim	Teaching the general chemical structures, types, synthesis methods, chemical and physical properties of polymers in detail, and detailed examination of industrial and daily life applications of polymers.
Learning Outcomes	• Learning the bases of organic chemistry, functional groups, hybridization, bond theories • Learning general chemical structures and types of polymers • Learning chain size determination theory of polymers and experimental methods • Learning working principles, mechanisms and types of polymerization reactions • Learning step polymerization reaction mechanisms and working principles • Learning insertion polymerization reaction mechanisms and working principles • Learning industrial applications of polymers • Learning radicalic polymerization reactions and examining the configuration properties of polymers • Learning mechanical and physical properties of polymers and, chemical and external factors affecting these properties
Course Content	• Definition of Organic Chemistry and Classification of Organic Compounds • Bond Theories and Isomers • Chemical Structures and Types of Polymers • Polymer Size Properties and Determination • Principles and Types of Polymerization Reactions • Step Polymerization Reactions • Addition Polymerization Reactions • Industrial Applications • Radicalic Polymerization Reactions • Molecular Configurations of Polymers • Mechanical and Physical Properties of Polymers • Factors Determining the Mechanical Properties of Polymers

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Introduction to Organic Chemistry-I: Orbitals, Carbon hybridization, covalent bond types, single and multiple bonds.	The relevant articles from the literature
2	Introduction to Organic Chemistry-II: Isomers, bond rotations, dipole moment, intermolecular bonds.	The relevant articles from the literature
3	Chemical Structures of Polymers: Definition of polymer, general chemical structures, types and, properties of Nylon, polyurethane, polystyrene, polyethylene polymers.	The relevant articles from the literature
4	Polymer Types: Thermoplastics, Elastomers, Thermosets, Homopolymers and Copolymers.	The relevant articles from the literature
5	Polymer Size Properties and Determination: Molecular weight types, calculations, determination methods.	The relevant articles from the literature
6	Fundamentals of Polymerization Reactions: Polymerization reaction principles, types, step polymerization, chain polymerization.	The relevant articles from the literature
7	Step Polymerization Reactions: Linear step polymerization, poly-condensation, polyester, polyamide, polyether, polysiloxane reactions	The relevant articles from the literature
8	Addition Polymerization Reactions: Linear polyurethane synthesis, Polyurea synthesis, ladder type polymer synthesis, Carother theorem.	The relevant articles from the literature
9	Industrial Applications: Industrial applications of Step and Addition polymerization reactions and gel point determination.	The relevant articles from the literature

10	Midterm	The relevant articles from the literature
11	Radicalic Polymerization Reactions: Steps and working principles of free radical polymerization reactions.	The relevant articles from the literature
12	Radicalic Reaction Initiators: Types and chemical properties of initiators in radical reactions	The relevant articles from the literature
13	Molecular Configurations of Polymers: Stereoisomers, isotactic, syndiotactic, atactic configurations	The relevant articles from the literature
14	Mechanical and Physical Properties of Polymers: Elasticity, stress-strain curves, elastic and plastic deformation, heat dependence, hardness, impact resistance, fatigue, tear strength.	The relevant articles from the literature
15	Factors Determining the Mechanical Properties of Polymers: Chain Interactions, Molecular Weight, Crystallization Degree, Heat Application, Elastomer Deformation, Vulcanization, Glass Transition Range, Crystallization and Melting	The relevant articles from the literature
16	Final Exam	

SOURCES	
Lecture Notes	Lecture slides and notes
Other Sources	**Course Textbook:** "Introduction to Polymers, Third Edition", Robert J. Young, Peter A. Lovell, 3rd Edition, 2011, CRC Press. **Additional Materials:** 1. "Polymer Chemistry", Paul C. Hiemenz, Timothy P. Lodge, 2nd Edition, 2007, CRC Press 2. "Polymer Physics", M. Rubinstein, Ralph H. Colby, 1st Edition, 2003, Oxford University Press.

COURSE MATERIALS SHARING	
Documents	Lecture notes, slides and molecular model set
Homeworks	Students will be given one homework each week
Exams	1 Midterm and 1 Final Exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
Midterm	1	20
Homework	14	25
Quiz	14	25
SUB-TOTAL		70
Contribution of Semester Study		70
Contribution of Final Exam	1	30
TOTAL		100

Course Category	
Sciences and Mathematics	60%
Engineering	40%
Social Sciences	0%

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	3	48
Out-of-class Study Time (Pre-study, practice)	16	6	96
Internet search, library work, literature search	16	4	64
Presentation	6	3	18
Homework	16	3	48
Midterm	1	20	20
Final Exam	1	20	20
Total Work Load			314
Total Work Load / 30			314/30
Course ECTS Credit			10