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
MOLECULAR PHOTOCHEMISTRY	MSME-679	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	Learning fundamentals and working principles of photochemical and photophysical processes at the molecular level and detailed study of these processes in materials science and nanotechnology fields.
Learning Outcomes	• Learning the fundamentals of organic molecules, functional groups, hybridization and bond theories • Learning general chemical structures and types of molecules • Learning molecular orbital theory and its application to π-conjugated systems • Learning π-Conjugate systems and working principles • Learning Molecular Photochemical Processes and Electromagnetic Spectrum • Comparison of photon and wave characteristics of light and photoelectric effect experiment, learning quantum concepts • Study of photochemistry and photophysical phenomena using quantum concepts • Learning basics of fluorescence and phosphorescence processes • Learning the structures of organic aromatic compounds and chromophore structures
Course Content	• Introduction to Molecular Chemistry-I: orbitals, carbon hybridization, covalent bond types, single and multiple bonds. • Introduction to Molecular Chemistry-II: Isomers, bond rotations, dipole moment, intermolecular bonds. • Molecular Orbital Theory. • π-conjugated systems and orbital symmetry, UV-vis Absorption Spectroscopy. • Molecular Photochemical Processes and Electromagnetic Spectrum. • Photon and Wave Properties of Light, Photoelectric Effect Experiment, Quantum Concepts. • Electronic Energy Levels and Fluorescence/Phosphorescence Processes. • Franck-Condon Principle and Kasha's Rule in Absorption and Radiation Processes. • Born-Oppenheimer Approximation in Photochemistry. • Schrödinger Equation and Wave Functions in Molecules, Vibrational Wave Function and Molecular Vibrations. • Organic Chromophoric Structures and Light Interactions • Organic Aromatic Compounds and Dye Materials

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Introduction to Molecular Chemistry-I: Orbitals, Carbon hybridization, covalent bond types, single and multiple bonds.	The relevant articles from the literature
2	Introduction to Molecular Chemistry-II: Isomers, bond rotations, dipole moment, intermolecular bonds.	The relevant articles from the literature
3	Molecular Orbital Theory: Comparison with valance-bond theory and investigation of orbitals of π-conjugated systems.	The relevant articles from the literature
4	π-conjugated systems and orbital symmetry.	The relevant articles from the literature
5	UV-vis Absorption Spectroscopy.	The relevant articles from the literature
6	Molecular Photochemical Processes and Electromagnetic Spectrum.	The relevant articles from the literature
7	Photon and Wave Properties of Light, Photoelectric Effect Experiment, Quantum Concepts.	The relevant articles from the literature

8	Electronic Energy Levels and Fluorescence / Phosphorescence Processes.	The relevant articles from the literature
9	Franck-Condon Principle and Kasha's Rule in Absorption and Radiation Processes.	The relevant articles from the literature
10	Midterm	The relevant articles from the literature
11	Born-Oppenheimer Approximation in Photochemistry.	The relevant articles from the literature
12	Schrödinger Equation and Wave Approach in Molecules.	The relevant articles from the literature
13	Vibrational Wave Function and Molecular Vibrations.	The relevant articles from the literature
14	Organic Chromophore Structures and Light Interactions.	The relevant articles from the literature
15	Organic Aromatic Compounds and Dye Materials.	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	70%
Engineering	30%
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	3	48
Presentation	7	3	21
Homework	16	4	64
Midterm	1	15	15
Final Exam	1	20	20
Total Work Load			312
Total Work Load / 30			312/30
Course ECTS Credit			10