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
INTERDISCIPLINARY INTRODUCTION TO QUANTUM ENGINEERING	ECE 589	FALL	3 + 0	3	10

Prerequisite Courses	None

Type	Selective
Language	English
Coordinator	Assoc. Prof. Dr. Sergey Borisenok
Instructor	Assoc. Prof. Dr. Sergey Borisenok
Adjunt	None
Aim	Interdisciplinary introduction to basic concepts of modern engineering of small scale objects; Learning the social impact of modern engineering; Learning the role of modern engineering in the solution of global challenge problems.
Learning Outcomes	• Learn the basic principles of interdisciplinary approach to modern engineering science; • Learn the basic of quantum approach to modern engineering; • Learn the basic areas of application for quantum engineering; • Learn the methods of quantum engineering in the developing of modern and forthcoming technologies; • Learn the social impact of modern engineering science; • Learn the contribution of quantum engineering to the solution of global challenge problems.
Course Content	• Basic principles of quantum approach to modern engineering; • Concepts of engineering for quantum dots, wires, wells and nanoscale objects; • Concepts of special and energy control of small scale objects; • Basic concepts of quantum computation and quantum communication; • Application of quantum engineering to bio- and medical technologies; • Social impacts of quantum engineering; • Role of quantum engineering in the developing of modern and forthcoming technologies. • Contribution of quantum engineering to solving global challenge problems.

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Quantum natural science as a base for modern engineering. Historical remarks. First steps of quantum engineering. Nano and beyond.	The relevant articles from the literature
2	World of quantum objects. Basic laws and concepts. Coherence and decoherence.	The relevant articles from the literature
3	Effects of low dimension. Quantum dots, wires and wells. Nanoparticles and clusters.	The relevant articles from the literature
4	Graphene, carbon nanotubes and related objects.	The relevant articles from the literature
5	Spatial control of quantum objects. Beam splitters. Traps. Nanofabrication.	The relevant articles from the literature
6	Quantum engineering and photonics.	The relevant articles from the literature
7	Commercial aspect of quantum engineering. Social impact of quantum engineering.	The relevant articles from the literature
8	Midterm Exam.	The relevant articles from the literature
9	Energy control of quantum objects. Cooling. Demons and quantum heat machines.	The relevant articles from the literature
10	Qubits. Quantum gates. Quantum computer.	The relevant articles from the literature
11	Quantum communication. Quantum teleportation. Quantum engineering and security.	The relevant articles from the literature
12	Quantum engineering for bio- and medical technologies. Quantum engineering in neuroscience.	The relevant articles from the literature

13	Quantum engineering and space technologies.	The relevant articles from the literature
14	Geography of quantum engineering. QE in the leading countries. QE in Turkey.	The relevant articles from the literature
15	Perspectives of quantum engineering. QE and global challenges.	The relevant articles from the literature
16	Final Exam.	

SOURCES	
Lecture Notes	Lecture slides
Other Sources	**Texbook:** • P. Zagoskin, A. M. 2011. Quantum Engineering, Theory and Design of Quantum Coherent Structures, Cambridge University Press. ISBN-13: 978-0521736121. • Vijay Kumar Arora. 2015. Nanoelectronics. Quantum Engineering of Low-Dimensional Nanoensembles, CRC Press. ISBN: 9781498705752. **Recommended Books:** • Miller, D. 2008. Quantum Mechanics for Scientists and Engineers, Cambridge. ISBN: 9780521897839. • Scientific articles.

COURSE MATERIALS SHARING	
Documents	Lecture notes and slides
Homeworks	Students will be given 6 homeworks
Exams	1 Midterm and 1 Final Exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
Midterm	1	30
Homework	6	30
Quizzes	2	10
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 Quantum Engineering					**X**
2	Ability to use science and engineering knowledge for development of new methods in Quantum Engineering					**X**
3	To be able to understand and analyze materials by using basic knowledge on Quantum 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 Quantum Engineering					**x**
10	To be able to define, interpret and create new information about the interactions between various discipline of Quantum 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	5	90
Internet search, library work, literature search	16	4	64
Presentation	8	4	32
Homework	6	5	30
Midterm	1	20	20
Final Exam	1	20	20
Total Work Load			304
Total Work Load / 30			304/30
Course ECTS Credit			10