AYDIN ADNAN MENDERES UNIVERSITY
COURSE INFORMATION FORM

Course Title	Introduction to Quantum Computation and Quantum Information								
Course Code	FİZ431		Couse Level	First Cycle (Bachelor's Degree)					
ECTS Credit	7	Workload	175 *(Hours)*	Theory	3	Practice	0	Laboratory	0
Objectives of the Course	In Quantum computation(QC) and quantum information(QI), some fundamental concepts are investigated in introductory level.								
Course Content	Qubits, matrices, QMT, Quantum Algorithms.								
Work Placement	N/A								
Planned Learning Activities and Teaching Methods	Explanation (Presentation), Discussion								
Name of Lecturer(s)									

Assessment Methods and Criteria		
Method	Quantity	Percentage (%)
Midterm Examination	1	30
Final Examination	1	70
Quiz	2	10

Recommended or Required Reading	
1	Quantum Computation ad Quantum Information, Michael A. Nielsen, Isaac L. Chuang, 2011.
2	Principles of Quantum Computation and Information Vol.I (Basic Concepts), Giuliano Benenti, Giulio Casati, and Giuliano Strini, 2004.
3	Classical and Quantum Computing, Yorick Hardy and Willi-Hans Steeb,2002.
4	The Physics of Quntum Information, Dirk Bouwmeester, Artur Ekert, and Anton Zeilinger, 2000.

Week	Weekly Detailed Course Contents	
1	Theoretical	Qubits and quantum states
2	Theoretical	Matrices and operators
3	Theoretical	Tensor Product
4	Theoretical	Density Operators
5	Theoretical	Quantum Measurement Theory
6	Theoretical	EPR paradox and Bell inequality
7	Theoretical	Entanglement
8	Intermediate Exam	MIDTERM EXAM
9	Theoretical	Quantum Gates and Circuits
10	Theoretical	Quantum Algorithms
11	Theoretical	Teleportation and Super-Dense coding
12	Theoretical	Super-Dense coding
13	Theoretical	Entanglement swapping
14	Theoretical	Tools of Quantum Information theory
15	Theoretical	Adiabatic Quantum Computation

Workload Calculation				
Activity	Quantity	Preparation	Duration	Total Workload
Lecture - Theory	14	4	3	98
Quiz	2	2.5	0.5	6
Midterm Examination	1	30	2	32
Final Examination	1	37	2	39
			Total Workload (Hours)	175
			[Total Workload (Hours) / 25*] = **ECTS**	7
**25 hour workload is accepted as 1 ECTS*				

Learning Outcomes	
1	The students should be able to define a qubit and express a qubit in different basis.
2	The students should be able to establish the relationship between the quantum logic gates and operators and matrix representation of operators should be able to written.
3	The students should be able to write the tensor product of quantum states.
4	The students should be able to define entanglement and give some examples.
5	The student should be able to write the process of quantum gates on quantum states and to analyze the quantum circuit diagrams.
6	The students should be able to express the difference of quantum algorithms than the classical ones.
7	The students should be able to express teleportation and super dense coding as the applications of entanglement
8	The students should be able to express the relationship between quantum information theory and entropy.

Programme Outcomes *(Physics)*	
1	To understand the importance of physics by understanding the general concepts of physics, matter and energy
2	To be able to define the movements of matter and to distinguish the characteristics of movements under different force (potential)
3	Be able to say the meaning of Lagrange and Hamiltonian formulations of the movement and apply them to simple problems,
4	To be able to express the fundamental concepts such as time, space, force, momentum and energy in the movements of matter close to the speed of light and be able to solve and interpret the simple problems related to
5	To be able to establish the relationship between electric and magnetic forces and to be able to illustrate their applications to technology and solve problems related to the movement of particles in electric and magnetic fields
6	Be able to say the basic laws of electromagnetics and apply them to problems, illustrate their applications to simple technology
7	To be able to tell the reasons of the differences between the classical cases and the quantum scale and explain the reasons
8	Explain the concepts of discontinuity, uncertainty, matter-antimatter, indecisiveness of quantum physics with examples and explain simple problems related to the subject.
9	To be able to solve the problems of micro-particles under different simple potentials and be able to say their meanings
10	To be able to establish the relationship between the movements and properties of multi-particle systems and the laws of probability and solve simple problems
11	To be able to illustrate the laws, meanings and applications of thermodynamics and use them
12	Be able to use their knowledge about quantum physics and mechanics in explaining some properties of atoms and nuclei
13	To be able to show the meanings of some theoretical concepts by experimenting, and develop a strong relationship between thought and the real world, develop analytical thinking
14	To be able to apply the meanings of the basic laws of physics, their comprehension of universality and the relations between them and the unity of the laws of nature.
15	Use computer to solve physics problems
16	To be able to understand the problems by using their analytical knowledge skills and to propose solutions by dealing with the laws of physics
17	Be able to use the knowledge of physics to understand new technologies
18	To be able to tell the relations between symmetry and conservation laws in laws of physics

Contribution of Learning Outcomes to Programme Outcomes *1:Very Low, 2:Low, 3:Medium, 4:High, 5:Very High*

	L1	L2	L3	L4	L5	L6	L7	L8
P1	1	1	1	1	1	1	1	1
P2	1	1	1	1	1	1	1	1
P3	1	1	1	1	1	1	1	1
P4		1	1	2	1	1	1	1
P5	1	1	1	1	1	5	1	1
P6	1	1	1	1	1	1	1	1
P7	5	2	4	5	3	5	5	5
P8	3	1	2	2	1	1	1	1
P9	1	1	1	2	1	1	1	1
P10	4	2	3	4	2	1	3	3
P11	1	1	1	4	1	1	4	4
P12	3	2	2	3	2	1	4	1
P13	1	1	1	1	1	2	1	1
P14	1	2	1	2	1	1	1	3
P15	2	1	1	1	1	3	1	1

P16	3	1	1	1	2	3	5	5
P17	5	2	1	5	2	4	3	3
P18	2	3	2	1	1	1	1	1