INTRODUCTION TO QUANTUM PHYSICS

1	Course Title:	INTRODUCTION TO QUANTUM PHYSICS	
2	Course Code:	EEM3306	
3	Type of Course:	Optional	
4	Level of Course:	First Cycle	
5	Year of Study:	3	
6	Semester:	6	
7	ECTS Credits Allocated:	4.00	
8	Theoretical (hour/week):	3.00	
9	Practice (hour/week):	0.00	
10	Laboratory (hour/week):	0	
11	Prerequisites:	• Having successfully completed General Physics I and II courses • Being proficient in mathematical methods (derivative, integral, differential equations).	
12	Language:	Turkish	
13	Mode of Delivery:	Face to face	
14	Course Coordinator:	Doç. Dr. UMUT AYDEMİR	
15	Course Lecturers:		
16	Contact information of the Course Coordinator:	Doç.Dr. Umut AYDEMİR umutaydemir@uludag.edu.tr	
17	Website:		
18	Objective of the Course:	This course aims to introduce students to the basic principles and concepts of quantum physics. By emphasizing the limitations of classical physics and the necessity of quantum physics, it is aimed to provide students with a new perspective in understanding the microscopic world.	
19	Contribution of the Course to Professional Development:	Fundamental Knowledge and Understanding: Quantum physics is the foundation of modern physics and technology. Those who take this course gain depth in understanding the fundamental behaviors of matter and energy and can apply this knowledge in different areas. Problem-Solving Skills: Quantum physics develops the ability to analyze and solve complex problems. These skills are critical for those working in research, development and innovation. Understanding New Technologies: Quantum physics forms the basis of many modern technologies such as lasers, transistors, and MRIs. Those who take this course can better understand the working principles of these technologies and contribute to their development. Research and Development: Research in the field of quantum physics is constantly leading to new discoveries and technologies. Those who take this course can follow developments in this field and apply them to their own research.	
20	Learning Outcomes:		
		1	They will be able to explain and demonstrate with examples the basic concepts of quantum physics (wave-particle duality, uncertainty principle, superposition, tunneling).
		2	They will be able to understand the Schrödinger equation at a basic level and solve it for simple systems.
		3	They will be able to analyze basic quantum mechanical systems such as the hydrogen atom.

	4	They will be able to give examples of technological applications of quantum physics (lasers, transistors, MRI).
	5	They will be able to follow and understand current developments in quantum physics.
	6	
	7	
	8	
	9	
	10	

21	Course Content:

Course Content:

Week	Theoretical	Practice
1	Introduction to Quantum Physics and Limits of Classical Physics • The birth and importance of quantum physics • Events that classical physics cannot explain: Blackbody radiation, photoelectric effect, Compton scattering	
2	Wave-Particle Duality • Wave and particle properties of light • De Broglie hypothesis • Double slit experiment and wave properties	
3	• Heisenberg uncertainty principle • Interpretation and consequences of the Applications: Energy-time uncertainty, position-momentum uncertainty • Wave function and probability interpretation	
4	• Potential well problem Schrödinger Equation (2)	
5	• Tunneling effect • Harmonic oscillator	
6	Hydrogen Atom Spectrum of the hydrogen atom • Bohr model and its limits • Quantum numbers and orbital concept	

Activites	Number	Duration (hour)	Total Work Load (hour)
Theoretical	14	3.00	42.00
Practicals/Labs	0	0.00	0.00
Self study and preperation	14	2.00	28.00
Homeworks	0	0.00	0.00
Projects	0	0.00	0.00
Field Studies	0	0.00	0.00
Midterm exams	1	25.00	25.00
Others	0	0.00	0.00
Final Exams	1	25.00	25.00
Total Work Load			120.00
Total work load/ 30 hr			4.00
ECTS Credit of the Course			4.00

7	Multi-Electron Atoms • Pauli exclusion principle • Periodic table and properties of elements • Atomic spectra and selection rulesMulti-Electron Atoms • Pauli exclusion principle • Periodic table and properties of elements • Atomic spectra and selection rulesMulti-Electron Atoms • Pauli exclusion principle • Periodic table and properties of elements • Atomic spectra and selection rulesMulti-Electron Atoms • Pauli exclusion principle • Periodic table and properties of elements • Atomic spectra and selection rules	
8	Molecules • Molecular bonds and energy levels • Molecular spectra • Molecular orbital theory	
9	Solids • Crystal structure and lattice • Energy bands and conductivity • Semiconductors and their applications	
10	Quantum Statistics • Bose-Einstein statistics and Fermi-Dirac statistics • Applications: Lasers, Bose-Einstein condensate	
11	Technological Applications of Quantum Physics (1) • Lasers: Working principles and areas of use	
12	Technological Applications of Quantum Physics (2) • Transistors and microelectronics • Nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI)	
13	Quantum Computers and Quantum Cryptography • Quantum bit (qubit) and superposition • Quantum algorithms and applications • Quantum cryptography and secure communication	
14	Current Issues and Discussions in Quantum Physics • Quantum entanglement and the EPR paradox • Quantum measurement problem • Interpretations of quantum physics	

22	Textbooks, References and/or Other Materials:	Textbook: • Serway, R. A., & Jewett, J. W. (2014). Physics for Scientists and Engineers with Modern Physics. Cengage Learning. • Beiser, A. (2015). Concepts of Modern Physics. McGraw-Hill Education. Recommended Resources: • Griffiths, D. J. (2004). Introduction to Quantum Mechanics. Pearson Prentice Hall. • Shankar, R. (1994). Principles of Quantum Mechanics. Springer. • Feynman, R. P., Leighton, R. B., & Sands, M. (2011). The Feynman Lectures on Physics, Vol. III: Quantum Mechanics. Basic Books.
23	Assesment	

TERM LEARNING ACTIVITIES	**NUMBER**	**WEIGHT**
Midterm Exam	1	40.00
Quiz	0	0.00
Home work-project	0	0.00
Final Exam	1	60.00
Total	2	100.00
Contribution of Term (Year) Learning Activities to Success Grade		40.00
Contribution of Final Exam to Success Grade		60.00
Total		100.00
Measurement and Evaluation Techniques Used in the Course		Exams, homework

24 ECTS / WORK LOAD TABLE

25 CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS

	PQ1	**PQ2**	**PQ3**	**PQ4**	**PQ5**	**PQ6**	**PQ7**	**PQ8**	**PQ9**	**PQ10**	**PQ11**	**PQ12**	**PQ13**	**PQ14**	**PQ15**	**PQ16**
ÖK1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
ÖK2	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
ÖK3	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
ÖK4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
ÖK5	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0

LO: Learning Objectives PQ: Program Qualifications

Contribution Level:	**1 very low**	**2 low**	**3 Medium**	**4 High**	**5 Very High**