Işık University
Faculty of Arts and Sciences
Department of Physics

PHYS 333 - Quantum Mechanics I

COURSE SYLLABUS

Course Name	Code	Semester	Theory (hour/week)	Application (hour/week)	Laboratory (hour/week)	Local Credits	ECTS
Quantum Mechanics I	PHYS 333	Fall	3	0	2	4	8

Prerequisities	None

Course Language	English
Course Type	Required
Course Level	First Cycle
Course Coordinator	-
Course Lecturer(s)	-
Course Assistants	-
Course Objectives	This is the first part of a two-semester long course that covers the basic principles of quantum mechanics leading to the formalized solution of the hydrogen atom problem. By the end of the course, students should • recognize the basic characteristics of quantum systems. • visualize the nature of the quantum mechanical wave function and its basic properties. • demonstrate a knowledge of how to calculate the expectation values of simple physical quantities like position and momentum. • explain the concepts of eigenstates and operators. • apply the Schrödinger equation to simple quantum mechanical problems in one dimension. • solve the Schrödinger equation for three dimensional problems with a central potential.
Course Learning Outcomes	On successful completion of this course students will be able to • demonstrate knowledge of fundamental concepts in quantum mechanics. • recognize the nature of quantum mechanical wave function and its Born interpretation. • normalize wave functions. • apply the Schrödinger equation to simple quantum mechanical systems in one dimension. • develop an understanding of eigenstates and eigenvalues of operators. • calculate expectation values of observables using the associated operators. • use the Dirac notation for inner products. • articulate how quantum mechanics can be used to describe the hydrogen atom.
Course Content	Wave packets and uncertainty, postulates of quantum mechanics, eigenfunctions and eigenvalues, simple problems in one dimension, general structure of wave mechanics, harmonic oscillator, hydrogen atom.

WEEKLY SUBJECTS AND RELATED PREPARATION STUDIES

Week	Subject
1	Why quantum mechanics?, Blackbody radiation, photoelectric effect, Compton effect, the wave function
2	Probabilistic interpretation, expectation values and momentum, operators, Heisenberg uncertainty relation
3	Operators, Heisenberg uncertainty relation
4	Plane waves and wave packets
5	Time independent Schrödinger equation , eigenvalues, eigenfunctions
6	Simple eigenvalue problems: One dimensional potentials
7	One dimensional potentials
8	Expansion postulate and its physical interpretation, degeneracy, parity
9	Operator methods in quantum mechanics, time dependence of operators
10	Harmonic oscillator
11	Postulates of quantum mechanics
12	The Schrödinger equation in three dimensions, the central potential
13	Hydrogen atom
14	Hydrogen atom , matrix representation of operators
15	Matrix representation of operators

TEXTBOOKS

Required Textbook(s)	• David J. Griffiths, *Introduction to Quantum Mechanics, 2nd ed.* Prentice-Hall, 2005 • Gasiorowicz, S. *Quantum Physics, 3rd edition*, Wiley, 2003.
Recommended Readings	• Shankar, R. *Principles of Quantum Mechanics, 2nd ed.* New York: Plenum, 1994. • Feynman, R.P., Leighton, R.B., Sands, M. *The Feynman Lectures on Physics, Volume III*, Addison Wesley, 1966.

EVALUATION SYSTEM

Semester Requirements	**Number**	**Percentage of Grade**
Attendance/Participation	-	-
Laboratory	-	-
Application	-	-
Field Work	-	-
Special Course Internship (Work Placement)	-	-
Quizzes/Studio Critics	5	10
Homework Assignments	10	15
Presentation/Jury	-	-
Project	-	-
Seminar/Workshop	-	-
Midterms/Oral Exams	2	50
Final/Oral Exam	1	25
Total	16	100

Percentage of Semester Work	15	75
Percentage of Final Work	1	25
Total	16	100

COURSE CATEGORY

ISCED GENERAL FIELD CODE	GENERAL FIELDS	ISCED MAIN AREA CODE	MAIN EDUCATIONAL AREAS	%
1	Eğitim	14	Öğretmen Yetiştirme ve Eğitim Bilimleri	0
2	Beşeri Bilimler ve Sanat	21	Sanat	0
2	Beşeri Bilimler ve Sanat	22	Beşeri Bilimler	0
3	Sosyal Bilimler, İşletme ve Hukuk	31	Sosyal ve Davranış Bilimleri	0
3	Sosyal Bilimler, İşletme ve Hukuk	32	Gazetecilik ve Enformasyon	0
3	Sosyal Bilimler, İşletme ve Hukuk	38	Hukuk	0
4	Bilim	42	Yaşam Bilimleri	0
4	**Bilim**	**44**	**Doğa Bilimleri**	**80**
4	**Bilim**	**46**	**Matematik ve İstatistik**	**20**
4	Bilim	48	Bilgisayar	0
5	Mühendislik, Üretim ve İnşaat	52	Mühendislik	0
5	Mühendislik, Üretim ve İnşaat	54	Üretim ve İşleme	0
5	Mühendislik, Üretim ve İnşaat	58	Mimarlık ve Yapı	0
6	Tarım	62	Tarım, Ormancılık, Hayvancılık ve Su Ürünleri	0
6	Tarım	64	Veterinerlik	0
7	Sağlık ve Refah	72	Sağlık	0
7	Sağlık ve Refah	76	Sosyal Hizmetler	0
8	Hizmet	81	Kişisel Hizmetler	0
8	Hizmet	84	Ulaştırma Hizmetleri	0
8	Hizmet	85	Çevre Koruma	0
8	Hizmet	86	Güvenlik Hizmetleri	0

THE RELATIONSHIP BETWEEN COURSE LEARNING OUTCOMES AND PROGRAM OUTCOMES

Number	Program Outcomes	Level of Contribution*				
		1	2	3	4	5
1	To have a comprehension of the core areas of physics, including classical and quantum mechanics, electromagnetism, statistical and thermal physics.					X
2	To have a comprehension of basic mathematics, including differential and integral calculus, linear algebra, differential equations and complex analysis.					X
3	To have a comprehension of computer programming and chemistry.					
4	To have a comprehension of the importance and practice of good ethical standards.	X				
5	To have a recognition of contemporary issues in science and its applications.					X
6	To have an ability to construct theoretical models, solve problems, design and conduct experiments, as well as to analyze and interpret data.					X
7	To have an ability to demonstrate their understanding of at least one advanced topic in theoretical or experimental physics.					X
8	To have an ability to function on multi-disciplinary teams					
9	To have an ability to effectively communicate information in both written and verbal form		X			
10	To have a recognition of the need for and an ability to engage in life-long learning.				X	
11	To have an ability to use modern physics techniques, skills, and computing tools necessary for physics practice (use laboratory and workshop equipment to generate data, prepare technical drawings, prepare technical reports, give technical presentations, take notes effectively, write computer programs, use mathematics and/or computational tools and packages to make models) .					

*1 Lowest, 2 Low, 3 Average, 4 High, 5 Highest

Contribution of Course Learning Outcomes to Program Outcomes	The class contributes to the student development in terms of building a sound foundation of quantum mechanics for further study in physics. Students should develop problem solving abilities and enhance critical thinking and improve their written communication skills.

ECTS / WORKLOAD TABLE

Activities	**Number**	**Duration (Hour)**	**Workload (Hour)**
Course Hours (Including Exam Week: 16 x Total Hours)	15	3	45
Laboratory	-	-	-
Application	-	-	-
Special Course Internship (Work Placement)	-	-	-
Field Work	-	-	-
Study Hours Out of Class	15	4	60
Presentations / Seminar	-	-	-
Project	-	-	-
Homework Assignments	10	5	50
Quizzes	5	2	10
Midterms / Oral Exams	2	10	20
Final / Oral Exam	1	15	15
		Total Workload	**200**
		Total Workload/25	**8**