هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	Quantum Mechanics I
Course Code:	**352PHYS**
Program:	**Physics**
Department:	**Physics**
College:	**Science**
Institution:	**Jazan University**

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 6/ Year 3
4. Pre-requisites for this course (if any)**:252 PHYS**
5. Co-requisites for this course (if any)**: NIL**

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**38**	**84%**
2	**Blended**	**7**	**16%**
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	**42**
2	**Laboratory/Studio**	**--**
3	**Tutorial**	**3**
4	**Others** (specify)	
	Total	**45**

B. Course Objectives and Learning Outcomes

1. Course Description

This course covers fundamental concepts of quantum mechanics: wave properties, uncertainty principles, Schrödinger equation, and operator and matrix methods. Basic applications of the following are discussed: one-dimensional potentials (harmonic oscillator), three-dimensional central potentials (hydrogen atom), and angular momentum and spin.

2. Course Main Objective

The course is designed to provide students with
Justification of the failure of classical physics to explain many phenomena.

- An introduction to the conceptual and mathematical foundations of quantum mechanics.
- Analytical methods commonly used in quantum mechanics.
- The foundations for further studies infields of atomic and nuclear spectroscopy, elementary particle physics and solid state physics as well as more advanced quantum mechanics.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	**Describe** the kinds of experimental results which are incompatible with classical physics and which required the development of a quantum theory of matter and light.	**PLO 1.2**
1.2	**Write the** general time Schrödinger equation within different potentials and different coordinates, Hilbert space and Hermitian operators and their vital use in quantum mechanics	**PLO 1.1**
2	**Skills :**	
2.1	**Apply** the basic postulates of quantum mechanics, the role of uncertainty in quantum physics to a particle's physical properties such as position, momentum and energy, and use the commutation relations of operators to determine whether or not two physical properties can be simultaneously measured	**PLO2.1**
2.2	**Analyze** the Schrödinger equation in one dimension within different experimental phenomena (different potentials)	**PLO2.2**
2.2	**Formulate** the Schrödinger equation in three dimensions using spherical coordinates and	**PLO2.2**
2.3	**Derive** analytical results for spherically symmetric potentials (Hydrogen atom)	**PLO2.2**
3	**Values:**	
3.1	**Develop** skills of working in groups in group assignments and discussion and bear individual responsibility in the assigned tasks	**PLO 3.1**

C. Course Content

No	List of Topics	Contact Hours
1	**1- Introduction to Quantum Mechanics**	**3**
2	**2- The Postulates Quantum Mechanics**	**6**
3	**3- The Wave Function** • The Schrodinger Equation • The Statistical Interpretation • Probability • Normalization • Momentum • The Uncertainty Principle	**6**
4	**4- Formalism (Mathematics of Quantum Mechanics)** • Linear Algebra • The Uncertainty Principle,	**6**
5	**5- The time-independent Schrodinger equation.** • Stationary States • The Infinite Square Well • The Harmonic Oscillator • The Free Particle • The Delta-Function Potential • The Finite Square Well	**9**

6	**6- <u>Quantum Mechanics in 3D</u>** • Schrodinger Equations in Spherical Coordinates • The Hydrogen Atom • Angular Momentum • Spin	12
7	**Review**	3
Total		**45**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
1.1	**Describe** the kinds of experimental results which are incompatible with classical physics and which required the development of a quantum theory of matter and light.	Lectures, discussion comparisons	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
1.2	**Write the** general time Schrödinger equation within different potentials and different coordinates, Hilbert space and Hermitian operators and their vital use in quantum mechanics	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.0	**Skills**		
2.1	**Apply** the basic postulates of quantum mechanics, the role of uncertainty in quantum physics to a particle's physical properties such as position, momentum and energy, and use the commutation relations of operators to determine whether or not two physical properties can be simultaneously measured	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.2	**Analyze** the Schrödinger equation in one dimension within different experimental phenomena (different potentials)	Lectures, discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.3	**Formulate** the Schrödinger equation in three dimensions using spherical coordinates and	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
2.4	**Derive** analytical results for spherically symmetric potentials (Hydrogen atom)	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams **Indirect:** student survey
3.0	**Values**		

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
3.1	**Develop** skills of working in groups in group assignments and discussion and bear individual responsibility in the assigned tasks	Discussion, question and answer	**Direct** In class interactive questioning, quizzes, written exams **Indirect:** student survey

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Assignment 1**	**3**	**2.5** (2.5%)
2	**Assignment 2**	**6**	**2.5** (2.5%)
3	**Quiz I**	**7**	**5** (5 %)
4	**First Mid-term exam**	**8**	**15** (15%)
5	**Assignment 3**	**11**	**2.5** (2.5%)
6	**Assignment 4**	**13**	**2.5** (2.5%)
7	**Quiz II**	**14**	**5** (5%)
8	**Second mid-term exam**	**14**	**15** (15%)
9	**Final Exam**	**16**	**50** (50%)

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

Each group of students is assigned to a staff member who will be available for help and academic guidance office hours at specific 2hr on daily basis.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Introduction to Quantum Mechanics; David J. Griffiths, CAMBRIDGE UNIVERSITY PRESS, 2017.
Essential References Materials	1. -Introductory Quantum Mechanics; R. Liboff, 4th Edition, Addison-Wesley, 2002. 2. Quantum Mechanics; Sara M. Mc Murry, Addison-Wesley, 1994
Electronic Materials	• *e-Learning* in the School of *Physics* and Astronomy *(www.ph.ed.ac.uk/elearning)* • Physical Sciences Resource Center (PSRC) (www.psrc-online.org) • The Physics Homepage (*www.physics.ox.ac.uk)*
Other Learning Materials	• Mathematical packages: *Mathematica*, Math Lab, and Maple. • Software: Virtual Physics

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Class room
Technology Resources (AV, data show, Smart Board, software, etc.)	Data show- smart boar
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Assessment	Students, Program assessment committee	Direct/ Indirect
Extent of achievement of course learning outcomes	Instructor	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	**Department council**
Reference No.	**8**
Date	**16/4/1442**