هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

T-104
2022

Course Specification

Course Title:	Quantum Mechanics I
Course Code:	352PHYS
Program:	Physics
Department:	Physics
College:	Science
Institution:	Jazan University
Version:	V2022
Last Revision Date:	30/12/2022

Table of Contents:

A. General information about the course:

Course Identification					
1. Credit hours:	3				
2. Course type					
a.	University ☐	College ☐	Department☒	Track☐	Others☐
b.	Required ☒	Elective☐			
3. Level/year at which this course is offered: **Level 9/ Year 3**					
4. Course general 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.					
5. Pre-requirements for this course (if any): **252 PHYS**					
6. Co- requirements for this course (if any):					
7. Course Main Objective(s) ▪ 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 in fields of atomic and nuclear spectroscopy, elementary particle physics and solid-state physics as well as more advanced quantum mechanics.					

1. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	**33**	**100%**
2.	E-learning		
3.	Hybrid ● Traditional classroom ● E-learning		
4.	Distance learning		

2. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	**30**
2.	Laboratory/Studio	**--**
3.	Field	--
4.	Tutorial	3
5.	Others (specify)	--
	Total	**33**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	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 require the development of a quantum theory of matter and light.	**PLO 1.2**	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	**PLO 1.1**	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	**PLO2.1**	Lectures, discussion	**Direct** (formative and summative): In class interactive questioning,

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	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			quizzes, written exams. **Indirect:** student survey
2.2	**Analyze** the Schrödinger equation in one dimension within different experimental phenomena (potentials)	**PLO2.2**	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	**PLO2.2**	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)	**PLO2.2**	Lectures, Discussion, Tutorial	**Direct** (formative and summative): In class interactive questioning, quizzes, written exams. **Indirect:** student survey
2.5	**Develop** communication and critical thinking competencies during interactive discussion, group assignments, essays or web-based activities	**PLO2.4**		
3.0	Values, autonomy, and responsibility			
3.1	**Develop** skills of working in groups in group assignments and discussion and bear individual responsibility in the assigned tasks	**PLO 3.1**	Discussion, question and answer	**Direct** In class interactive questioning, quizzes, written exams.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
				Indirect: student survey
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**1- The Wave Function** • The Schrodinger Equation • The Statistical Interpretation • Probability • Normalization • Momentum The Uncertainty Principle	**6**
2.	**2- 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	**10.5**
3	**3- Formalism (Mathematics of Quantum Mechanics)** • Linear Algebra The Uncertainty Principle,	**4.5**
4	**4- Quantum Mechanics in 3D** • Schrodinger Equations in Spherical Coordinates • The Hydrogen Atom • Angular Momentum • Spin	**12**
Total		33

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Assignment 1**	2	**5** (5%)
2.	**Assignment 2**	6	**5** (5%)
3.	**Quiz I**	4	**5** (5 %)
4.	**Mid-term exam**	7	**20** (20%)

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
5.	**Assignment 3**	9	**5** (5%)
6.	**Assignment 4**	11	**5** (5%)
7.	**Quiz II**	10	**5** (5%)
8.	**Final Exam**	12	**50** (50%)

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Introduction to Quantum Mechanics; David J. Griffiths, CAMBRIDGE UNIVERSITY PRESS, 2017.
Supportive References	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. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	Smart board
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	DEPARTMENT BOARD
REFERENCE NO.	PHYS2304
DATE	**28/02/2023**