2023
TPG-153

Course Specification
(Postgraduate)

Course Title:	**Quantum Mechanics**
Course Code:	**Math 619**
Program:	**Mathematics**
Department:	**Mathematics**
College:	**College of Science and Humanities, Alkharj**
Institution:	**Prince Sattam Bin Abdulaziz University**
Version: :	**1/2024**
Last Revision Date:	*Pick Revision Date.*

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (2 hours)				
2. Course type				
A.	☐University	☐College	☒ Department	☐Track
B.	☒ Required		☐Elective	
3. Level/year at which this course is offered: (: 2 (2,2,0))				
4. Course General Description:				
This course aims to give students a solid grounding in modern quantum theory. This will involve being able to confidently solve the Schroedinger equation in a variety of physical situations, and calculate measurement probabilities. You will learn the language of quantum mechanics, namely Dirac notation and the use of matrices. You will learn the basics of quantum angular momentum and spin. The course will be summarized in a skills-based lecture.				
5. Pre-requirements for this course (if any): None				
6. Pre-requirements for this course (if any): None				
7. Course Main Objective(s):				
Gain an understanding of the fundamental concepts within quantum mechanics. **Develop the mathematical skills required to appreciate high-level physics.** **Apply knowledge of quantum mechanics to predict and explain physical phenomena.** **Be able to grasp famous quantum mechanical paradoxes such as Schrodinger's cat and tunnelling.** **Understand the role of the wave function in quantum phenomena and calculations.** **Gain the necessary foundations to study further topics such as quantum computation and particle physics.**				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	4 hours a week	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning	**E-learning**: In case of suspension of regular classes due to any unforeseen eventualities	Not applicable
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**32**
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	**32**
5.	**Others (specify)……**	
	Total	**64**

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	understanding of the fundamental concepts within quantum mechanics.	K1	1. Class Room Lectures 2.Interactive sessions 3.Exclusive Office Hours for clearing doubts in small groups	1. Two Internal Exams 2.At least two Quiz 3.End Semester Exam
1.2	Understand the role of the wave function in quantum phenomena and calculations.	K2		
2.0	**Skills**			
2.1	• Be able to grasp famous quantum mechanical paradoxes such as Schrodinger's cat and tunnelling.	S1	Application oriented exercises during tutorial session	1.Homework 2.Assignments 3.Quiz 4.Mid Term and Final Exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	Gain the necessary foundations to study further topics such as quantum computation and particle physics	S2		
3.0	**Values, autonomy, and responsibility**			
3.1	Conduct with researchers on a high international level in quantum mechanics and its applications	V2	Group Discussion during lectures and Interactive Session and Exercises during Lecture and Tutorials	1. Presentation 2. Continuous assessment 3. Workshop attendance 4. Report evaluation
3.2	Work independently and in groups	**V1**		

C. Course Content:

No	List of Topics	Contact Hours
1.	The concept of a photon, and evidence for it. Bohr model of the atom, and evidence for it.	**10**
2.	The concept of matterwaves, calculation of the de Broglie wavelength, and interpretation of the result. Separation of variables and the derivation of the time-independent Schroedinger equation	**10**
3.	Using the Schroedinger equation to calculate the energies of a particle in an infinite square well. Familiarity with the techniques to solve the finite square well and harmonic potential problems	**10**
4.	Calculation of quantum tunnelling fractions. How to calculate probability from a wavefunction. How to calculate averages / expectation values using a wavefunction.	**10**
5.	Wavefunction expansion, its interpretation, and calculation of expansion coefficients. The meaning of eigenfunctions, eigenvalues, operators and observables, and their manipulation Raising and lowering operators for the harmonic oscillator.	**10**

6.	Vector representation of wavefunctions. Matrix representation of operators. Dirac notation and manipulation of bra-kets. Hermitian operators: what they represent and how to prove an operator is Hermitian.	**10**
7.	Commutation relations and their physical interpretation. Familiarity with angular momentum commutation relations	**4**
Total		**64**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid Term Exam I	6	15%
2.	Quiz (At least 2 quiz)	4 & 10	10%
3.	Mid Term Exam II	13	15%
4.	Continuous Assessment – Homework, Assignment, Attendance etc.	--	10%
5.	End Semester Exam	17	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	▪ PR Berman, Introductory Quantum Mechanics, (2010). ▪ NA Rudra, A Course in Quantum Mechanics. CRC Press; (2019). ▪ E Fermi, Notes on quantum mechanics. University of Chicago Press; (1995).
Supportive References	
Electronic Materials	
Other Learning Materials	

G. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms with Smartboards with seating facilities for at least 30 students
Technology equipment (Projector, smart board, software)	• Smartboard, Internet Connection for Blackboard

Items	Resources
	• Computer Lab with 40 terminals • Visual Studio software.
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 Review/Classroom Observation	Indirect
Effectiveness of students assessment	Independent member teaching staff	Check marking by an independent member teaching staff of samples of student work.
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	Faculty Member Quality Unit of College and department	Direct Learning outcomes assessment.
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	**OCT 2023**