2023
TPG-153

Course Specification
(Postgraduate)

Course Title:	**Quantum Mechanics**
Course Code:	**202620-3**
Program:	**Master of Pure Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Taif university**
Version:	1
Last Revision Date:	**20/10/2023**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☒ Required		☐ Elective	
3. Level/year at which this course is offered: Level 2/First Year				
4. Course general Description:				
Classical mechanics and the quantum theory of light and a comparison between them - The discovery of the electron - Classical quantum theory - Hypothesis of Bohr - The basics of quantum mechanics to wilson and applications on the oscillating harmonic- Time-dependent and time independent Schrödinger equation - Wave function and boundary conditions - Schrodinger equation in one dimension - The representation of dynamic change by moving the differential - Applications of the Schrodinger equation - Potential Barrer- Linear harmonic oscillator - Quantum mechanics by operators - The angular momentum in the quantum mechanics –Hydrogen atom- Eigen-vectors and eigenvalues of Boson and Farmion operators.-Annihilation and creation operators- quantum computer.				
5. Pre-requirements for this course (if any)**:**				
None				
6. Pre-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				
The student will be taught as follows: **1. Introduce the fundamental concepts in quantum mechanics.** **2. Explain the difference between the quantum and classical mechanics.** **3. Study time-dependent and time independent Schrödinger equation** **4. Study wave function and boundary conditions** **5. Study the applications of the Schrodinger equation such as Potential Barrer** **6. Study Linear harmonic oscillator** **7. Study Quantum mechanics by operators** **8. Study the angular momentum in the quantum mechanics** **9. Study the Hydrogen atom** **10. Study the eigen-vectors and eigenvalues of Boson and Farmion operators.** **11. Study the annihilation and creation operators.**				

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	√	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

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

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	NA
3.	**Field**	NA
4.	**Tutorial**	NA
5.	**Others (specify)……**	NA
	Total	**45**

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	Recognize the basic conceptions of the quantum mechanics.	K1	Lectures, group discussion `	Exams, Quizzes, Assignments
1.2	Describe the properties of wave function and the Schrödinger equation.	K2	Lectures, group discussion	Exams, Quizzes, Assignments
2.0	**Skills**			
2.1	Explain physical properties of elementary particles, nucleons, atoms, molecules and solids (band structure) based on quantum	S3	Lectures, group discussion	Exams, Quizzes, Assignments, report

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	mechanics.			
2.2	Apply the Schrödinger equation for simple one-dimensional systems.	S1	Lectures, group discussion	Exams, Quizzes, Assignments, report
2.3	Use the superposition principle to predict experimental outcomes for measurement of observables on simple quantum systems.	S4	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.0	**Values, autonomy, and responsibility**			
3.1	Participate effectively within groups and independently.	V1	Lectures, group discussion	Exams, Quizzes, Assignments, report
3.2	Accept critical thinking, communication skills and mathematical techniques in solving many problems in other disciplines	V3	Lectures, group discussion	Exams, Quizzes, Assignments, report

C. Course Content:

No	List of Topics	Contact Hours
1.	Historical development of quantum mechanics, understanding the physical phenomena at a microscopic level, the difference between classical and quantum mechanics	6
2.	Planck's Hypothesis of Quantization of Energy, Bohr's Model of the Atom.	3
3.	Schrödinger equation, the statistical interpretation, probability, normalization, coordinate, momentum, the uncertainty principle.	6
4.	Stationary states, infinite square well.	6
5.	Free particle, delta-function potential, finite square well.	3
6.	Harmonic oscillator, Hydrogen atom	3
7.	Quantum mechanics in three dimensions	3
8.	The angular momentum in the quantum mechanics	6
9.	Eigen-vectors and eigenvalues of Boson and Farmion operators.	3
10.	Annihilation and creation operators	6
Total		**45**

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes and HomeWorks	Continues	10 %
2.	Midterm exam	8^{th} -9^{th}	20 %
3.	Final exam	16^{th}	70%

*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	Mathematical Methods of Classical Mechanics, v. I. Arnold 1978 D. J. Griffiths, Introduction to Quantum Mechanics, 2nd edition, Pearson Prentice Hall, NJ, USA, 2004.
Supportive References	R. L. Liboff, Introductory Quantum Mechanics, Addison Wesley, 2002.
Electronic Materials	Publisher's website at https://en.wikipedia.org/wiki/Quantum_mechanics
Other Learning Materials	Calculus programming (Mathematica, Mathcad, Mathlab)

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (Projector, smart board, software)	Data show, Blackboard, Maple and MATLAB software
Other equipment (Depending on the nature of the specialty)	Wi-Fi internet connections

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect
Effectiveness of students assessment	Students	Indirect
Quality of learning resources	Students	Indirect
The extent to which CLOs have been achieved	Peer reviewer	Direct
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	**Department of Mathematics and Statistics**
REFERENCE NO.	
DATE	**20/10/2023**

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