هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	**Quantum Mechanics**
Course Code:	**2024211-3**
Program:	Bachelor in Mathematics
Department:	Mathematics and Statistics Department
College:	**Faculty of Sciences**
Institution:	**Taif University**
Version:	**1**
Last Revision Date:	20/05/2023

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3					
2. Course type					
A.	☐University	☐College	☒ Department	☐ Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: Level 8 / Fourth Year					
4. Course general Description:					
This course provides a historical development of quantum mechanics, understanding the physical phenomena at a microscopic level. The difference between classical and quantum mechanics. Schrödinger equation, the statistical interpretation, probability, normalization, coordinate, momentum, the uncertainty principle. Stationary states, infinite square well. Harmonic oscillator, free particle, delta-function potential, finite square well. Hilbert Space, observables. Eigen-function and eigen-values of a hermitian operator. Generalized statistical interpretation, Dirac notation. Quantum mechanics in three dimensions, Schrödinger equation in spherical coordinates. Hydrogen atom, angular momentum, spin. Eigen-vectors and eigenvalues of Boson and Farmion operators. The wave equation of two level atom.					
5. Pre-requirements for this course (if any):					
Differential equations (2023103-4)					
6. Co--requirements for this course (if any):					
None					
7. Course Main Objective(s):					

- **Introducing the fundamental concepts in quantum mechanics.**
- **Explaining the difference between the quantum and classical mechanics.**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**3Hr /Week**	100%
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
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 discussions	• Quizzes • Assignments
1.2	Memorize the properties of wave function.	K1	• Lectures • Group discussions	• Exams • Assignments
1.3	Describe of the Schrödinger equation.	K2	• Lectures • Group discussions	• Exams • Assignments
2.0	**Skills**			
2.1	Explain physical properties of elementary particles, nucleons, atoms, molecules and solids (band structure) based on quantum mechanics.	S3	• Interactive classes • Group discussions	• Quizzes • Assignments
2.2	Solve the Schrödinger equation for simple one-	S4	• Lectures • Group discussions	• Exams • Quizzes

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	dimensional systems.			
2.3	Calculate the Schrödinger equation of the one-dimensional potential barrier.	S4	• Lectures • Group discussions	• Quizzes • Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively within groups and independently.	V1	• Interactive classes. • Give students tasks of duties	• Assessment of design projects that have elements of interpersonal skills
3.2	Articulate ethical behavior associated with institutional Guidelines in classroom.	V3	• Lectures • Group discussions	• Exams • Quizzes

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.	3
2.	Planck's Hypothesis of Quantization of Energy, Bohr's Model of the Atom.	3
3.	Schrödinger equation, the statistical interpretation, probability,	3
4.	Normalization, coordinate, momentum, the uncertainty principle.	3
5.	Harmonic oscillator.	3
6.	Stationary states, infinite square well.	3
7.	**First Midterm exam**	3
8.	Hilbert Space, observables, eigen-function and eigen-values of a hermitian operator.	3
9.	Generalized statistical interpretation, Dirac notation.	3
10.	Quantum mechanics in three dimensions,	3
11.	Schrödinger equation in spherical coordinates.	3
12	Hydrogen atom, angular momentum, spin.	3
13.	**Second Midterm exam**	3
14.	Eigen-vectors and eigenvalues of Boson and Farmion operators.	3
15	The wave equation of two level atom.	3
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	Continuous Evaluation	10 %
2.	Assignments, report	Continuous Evaluation	10 %
3.	Midterm 1 Exam	8-9	15%
4.	Midterm 2 Exam	12-13	15%
5.	Final Exam	15-16	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	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	https://en.wikipedia.org/wiki/Quantum_mechanics
Other Learning Materials	Mathcad tutorial

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (Projector, smart board, software)	Data show, Blackboard
Other equipment (Depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Program Leader	Direct & Indirect
Effectiveness of students assessment	Faculty, Program Leader	Direct
Quality of learning resources	Students, Faculty	Indirect
The extent to which CLOs have been	Faculty	Direct & Indirect

Assessment Areas/Issues	Assessor	Assessment Methods
achieved		
Other		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Department Council
REFERENCE NO.	4
DATE	October 2023

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