هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

Course Specifications

Course Title:	**Quantum Mechanics**
Course Code:	**2024211-3**
Program:	**Bachelor in Mathematics.**
Department:	**Mathematics and Statistics Department**
College:	**Faculty of Sciences**
Institution:	**Taif university**

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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: 11th level / 4th year
4. Pre-requisites for this course (if any)**:** Differential equations (2023103-4)
5. Co-requisites for this course (if any)**:** None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	**5Hr /Week**	100
2	**Blended**		
3	**E-learning**		
4	**Distance learning**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	50
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	50

B. Course Objectives and Learning Outcomes

1. Course 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.

2. Course Main Objective

The student will be taught as follows:

1. Introducing the fundamental concepts in quantum mechanics.

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2. Explaining the difference between the quantum and classical mechanics.

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding:**	
1.1	Recognize the basic conceptions of the quantum mechanics.	K1
1.2	Memorize the properties of wave function.	K1
1.3	Describe of the Schrödinger equation.	K2
2	**Skills:**	
2.1	Explain physical properties of elementary particles, nucleons, atoms, molecules and solids (band structure) based on quantum mechanics.	S3
2.2	Solve the Schrödinger equation for simple one-dimensional systems.	S4
2.3	Calculate the Schrödinger equation of the one-dimensional potential barrier.	S4
3	**Values:**	
3.1	Work effectively within groups and independently.	V1
3.2	Articulate ethical behavior associated with institutional Guidelines in classroom.	V3

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.	5
2	Planck's Hypothesis of Quantization of Energy, Bohr's Model of the Atom.	5
3	Schrödinger equation, the statistical interpretation, probability, normalization, coordinate, momentum, the uncertainty principle.	5
4	Harmonic oscillator, Stationary states, infinite square well.	5
5	Hilbert Space, observables, eigen-function and eigen-values of a hermitian operator.	5
6	**Midterm exam,** Generalized statistical interpretation, Dirac notation.	5
7	Quantum mechanics in three dimensions, Schrödinger equation in spherical coordinates.	5
8	Hydrogen atom, angular momentum, spin.	5
9	Eigen-vectors and eigenvalues of Boson and Farmion operators.	5
10	The wave equation of two-level atom.	5
Total		50

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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	Recognize the basic conceptions of the quantum mechanics.	• Lectures • Group discussions	• Quizzes • Assignments
1.2	Memorize the properties of wave function.	• Lectures • Group discussions	• Exams • Assignments
1.3	Describe of the Schrödinger equation.	• 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.	• Interactive classes • Group discussions	• Quizzes • Assignments
2.2	Solve the Schrödinger equation for simple one-dimensional systems.	• Lectures • Group discussions	• Exams • Quizzes
2.3	Calculate the Schrödinger equation of the one-dimensional potential barrier.	• Lectures • Group discussions	• Quizzes • Assignments
3.0	**Values:**		
3.1	Work effectively within groups and independently.	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.	• Lectures • Group discussions	• Exams • Quizzes

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	**Quizzes + Home works**	**Continues**	**10 %**
2	**Midterm exam**	**5th-6th**	**30 %**
3	**Class Work (Homework- report- class test….)**	**8th**	**10 %**
4	**Final exam**	**11th**	**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:
6 hours per week (as defined in the teaching schedule of the faculty member) for academic advice and consultations.
Teaching staff is also available using Blackboard web site and Taif University "Edugate" System.

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F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	**D. J. Griffiths, Introduction to Quantum Mechanics, 2nd edition, Pearson Prentice Hall, NJ, USA, 2004.**
Essential References Materials	**R. L. Liboff, Introductory Quantum Mechanics, Addison Wesley, 2002.**
Electronic Materials	https://en.wikipedia.org/wiki/Quantum_mechanics
Other Learning Materials	**Mathcad tutorial**

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	**Classrooms**
Technology Resources (AV, data show, Smart Board, software, etc.)	**data show**
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 and assessment	Students	Indirect
Quality of learning resources	Peer Reviewer Students	Direct Indirect
Extent of achieving the course learning outcomes	Peer Reviewer Students	Direct 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 of Mathematics and Statistics
Reference No.	11
Date	12-7-1443 H

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