هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

Course Specifications

Course Title:	**Quantum Physics 2**
Course Code:	**2034204-2**
Program:	**Bachelor in Physics**
Department:	**Physics Department**
College:	**College of Science**
Institution:	**Taif University**

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A. Course Identification

1. Credit hours: 2
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 12th Level / 4th Year
4. Pre-requisites for this course (if any)**: Quantum Physics 1 (2033202-3)**
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**	3	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Distance learning**	0	0%
5	**Other**	0	0%

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	**Lecture**	30
2	**Laboratory/Studio**	0
3	**Tutorial**	0
4	**Others** (specify)	0
	Total	30

B. Course Objectives and Learning Outcomes

1. Course Description

Operators (Review). Matrix formulation of Quantum Physics. The simple harmonic oscillator problem. Time development of a system in terms of operators. Interaction of electrons with electromagnetic field; Zeeman effect. Approximation Methods.

2. Course Main Objective

- To introduce students to operators and their role in Quantum Physics.
- To solve the simple harmonic oscillator problem using operators.
- To point out the importance of Quantum Physics in other disciplines, and in research.
- To draw the attention of students to the special functions that appear in Quantum Physics, and previously in Mathematical Physics 1.
- To study the time evolution of a system.
- To teach the students the interaction of electrons with electromagnetic field, and to relate that to experiments where available, as Zeeman Effect.
- To represent matrix formulation in Quantum Physics.
- To point out the importance of approximation methods in Quantum Physics.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge and Understanding**	
1.1	Define the fundamental concepts of quantum physics theory	K2
1.2	Understanding the quantum physics precisely the approach methods to solve Schrodinger equation.	K3
2	**Skills :**	
2.1	To use mathematical formulation to describe the physical principle or phenomena.	S1
2.2	How to use physical laws and principles to understand the subject	S3
3	**Values:**	
3.1	Show responsibility for working independently and for continuous improvement of personal capabilities.	V1
3.2	Enrich his/here physics understanding of Quantum Physics-2 rather than using it as pure mathematics. Communicate and explain the physics wealth in Quantum Physics-2 with others by speaking and writing.	

C. Course Content

No	List of Topics	Contact Hours
1	Operators-Review: ▪ Definition of an operator ▪ Schrödinger equation ▪ Solutions of the eigenvalue equation ▪ Superposition principle ▪ Commutation relations ▪ Coordinate operators ▪ Linear momentum and angular momentum operators	4
2	Matrix formulation of Quantum Physics: ▪ Basis and Representations ▪ Elementary matrix properties ▪ Matrix representation of harmonic oscillator operators ▪ The energy representation ▪ Matrix representation of angular momentum operators ▪ The Pauli spin matrices	6
3	The simple harmonic oscillator problem: ▪ Definition of the simple harmonic oscillator problem ▪ Ladder operators ▪ Eigenstates and eigenvalues ▪ The interpretation of the wave function as probability amplitude	4
4	Time development of a system in terms of operators: ▪ Time-dependent Schrödinger equation; separation of variables ▪ Time development of a harmonic oscillator ▪ Ehrenfest's principle ▪ Description of a systems by three pictures: Schrödinger,	4

	Heisenberg, and Dirac	
5	Interaction of electrons with electromagnetic field: ▪ Maxwell's equations ▪ Coupling of electrons to vector potential ▪ Schrödinger equation for an electron in a uniform magnetic field ▪ The normal Zeeman effect ▪ The anomalous Zeeman effect	4
6	Approximation Methods: ▪ Time-independent, non-degenerate and degenerate perturbation theory ▪ The Stark effect ▪ Time-dependent perturbation theory ▪ Variational method	6
	General Review	2
Total		30

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	Define the fundamental concepts of quantum physics theory	Lecture	Written exam and Homework reports
1.2	Understanding the quantum physics precisely the approach methods to solve Schrodinger equation.	Lecture and Group discussion	Written exam
2.0	**Skills**		
2.1	To use mathematical formulation to describe the physical principle or phenomena.	Lectures	Written exam and Homework reports
2.2	How to use physical laws and principles to understand the subject	Lecture and Group discussion	Written exam; and summarizing research papers
3.0	**Values**		
3.1	Show responsibility for working independently and for continuous improvement of personal capabilities.	Group discussion	Project and Class performance
3.2	Enrich your physics understanding of Quantum Physics 2 rather than using it as pure mathematics. Communicate and explain the physics wealth in Quantum Physics 2 with others by speaking and writing.	Groups discussion	Homework reports and projects

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Activities	Periodically	10%
2	Midterm exam	6th	30%
3	Short exam	9th	10%
4	Final exam	12th	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 during office hours, in the instructor's office or by appointment.
- Also teaching staff are available for individual student consultations during office hours.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	1) R. L. Liboff; Introductory Quantum Mechanics; Addison-WesleyPublishingCompany, Massachusetts, (1980).
Essential References Materials	2) S. Gasiorowicz, Quantum Physics, John Wiley and Sons, New York (1974).
Electronic Materials	• http://hyperphysics.phy-astr.gsu.edu/
Other Learning Materials	• MATHEMATICA, MATHLAB

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• Lecture room with max 60 seats • Labs
Technology Resources (AV, data show, Smart Board, software, etc.)	• data show, Smart Board, software
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
Student Feedback on Effectiveness of Teaching	Students	Indirect
Evaluation of Teaching	Pear reviewer Program coordinator Departmental council Faculty council	Indirect
Improvement of Teaching	Program coordinator Relevant committee	Direct
Quality of learning resources	Students Instructor Faculty	Indirect
Extent of achievement of course learning outcomes,	Program coordinator Instructor	Direct
Course effectiveness and planning for improvement	Program coordinator Instructor	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 Council / Committee of academic development
Reference No.	
Date	October 2, 2022