Department of physics
Faculty of Science
Al alBayt university

Course description of:
Quantum M. II (402468)
Instructor: Dr. M Alshudifat

1 Instructor's Information

Instructor's / Coordinator's Name:	Dr. Mohammad Faleh Alshudifat
Office Hours:	TBA
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Research and Teaching Assistant / Supervisor / Technical (if any):	NA

2 Course Description

This course is the second part of quantum mechanics for seniors (4th year level). The main topics to be covered are: Schrodinger mechanics in three Cartesian coordinates and in spherical coordinates, the quantum solution for the hydrogen atom system, the angular momentum (orbital, spin 1/2 and total angular momentum), perturbation theory for non-degenerate and degenerate quantum systems, and brief introduction to variational principle and WKB approximation methods.

3 Courtse Information

Course No.:402468)	Course Title: Quantum Mechanics II
Level: Bachelor 4^{th} Yr.	Course Type: Theoretical
Prerequisite: Quantum Mechanics I	Class Time: 10:00-11:00.
Class days: Sun. Tu. Th.	Academic Year:2019-2020
Semester: Fall	Study hours:

4 Course Objectives CO

CO1.	Acquire the knowledge of quantum mechanics in Cartesian three-dimensions and apply it to infinite potential well.
CO2.	Acquire the knowledge of quantum mechanics in spherical coordinates
CO3.	Apply quantum mechanics in spherical coordinates to hydrogen atome
CO4.	Acquire the knowledge of quantum mechanics in angular momentum and spin.
CO5.	Apply perturbation theory to perturbed quantum systems and hydrogen atom
CO6.	Acquire Variational principle and WKB approximation methods in quantum mechanics

5 Learning Outcomes (LO)

(Knowledge, Skills, and Competencies)(K,S,C)
Upon successful completion of the course, the students will be able to:

LO1.	Apply quantum operators and Schrodinger equation in Cartesian 3-D to Solve infinite potential well problem in 2 and 3-dimensions and defined the energy degeneracy.
LO2.	Write Schrodinger equation in spherical coordinates and solve for the angular part and write the radial part.
LO3.	Apply Schrodinger equation in spherical coordinates to the hydrogen atom and solve for energy states, degenerate states and its associated wavefunctions
LO4.	Define the operators associated with the orbital and spin angular momentum with their eignstates and eigenvalues.
LO5.	Apply perturbation theory to solve for fine structure and hyperfine splitting in the hydrogen atom.
LO6.	Recognize when Variational principle and WKB approximation methods used.

6 Course Content

Week	Topic	Comments	LO
1	Quantum mechanics I review		
2	**Ch.4** Introduction to 3-D Schrodinger equation		LO1
3	2-D & 3-D infinite potential well		LO2
4-5	Hydrogen atom solution	Use spherical coordinates	LO3+LO4
6	Angular Momentum	Orbital angular momentum	LO5
	First exam		
7	Spin		LO5
8	spin 1/2 particle in magnetic field		LO5
9	**Ch.6** Addition of angular momentum.		LO5
10	Non-degenerate perturbation Theory.		LO6
11	Degenerate perturbation Theory.		LO6
	Second Exam		
12	Fine structure and hyperfine splitting of Hydrogen atom.		LO6
13	**Ch.7** Variational principle and the Helium ground state. WKB approximation	Brief introduction	LO7
14	**Ch.7** WKB approximation	Brief introduction	LO7
–	Final Exam		

7 Teaching and Learning Strategies and Evaluation Methods

No.	LO	Teaching Strategies	Learning Activities	Evaluation /Measurement Method (Exam/ presentations/ discussion/ assignments)
1	LO1-LO6	trad. lect.	Discussion & Problem Solving	HW & Mid-exam & Final Exam

8 Assessment

Methods Used	Assessment Time	Distribution of grades
Semester work (report, assignments, attendance)	During semester	0%
First Exam	Seventh week	25%
Second Exam	Twelfth week	25%
Final Exam	Week of the final exams	50%

9 Textbook

Main Reference	Introduction to quantum mechanics.
Author	David J. Griffiths.
Publisher	Pearson Education Inc.
Year	2005.
Edition	2^{nd} edition.
Textbook Website	`https://doi.org/10.1017/9781316995433`

10 Extra References (books and research published in periodicals or websites)

1	B. Bransden & C. Joachain, Quantum Mechanics, Publisher: Prentice Hall-Pearson, Harlow, EnglandISBN: ISBN 0582-35691-1, 2^{nd} Edition, 2000.