Department of physics
Faculty of Science
Al alBayt university

Course description of:
Atomic and molecular physics (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 for seniors (4th year level). The main topics to be covered are: Schrodinger mechanics in and in spherical coordinates, the quantum solution for the hydrogen atom system, the angular momentum (orbital, spin 1/2 and total angular momentum), identical particles, Atoms, solids, and quantum statistical mechanics.

3 Courtse Information

Course No.:402464)	Course Title: Atomic and molecular physics
Level: Bachelor 4^{th} Yr.	Course Type: Theoretical
Prerequisite: Quantum Mechanics I	Class Time: .
Class days: .	Academic Year:2020-2021
Semester: First	Study hours:

4 Course Objectives CO

CO1.	Acquire the knowledge of quantum mechanics in spherical coordinates
CO2.	Apply quantum mechanics in spherical coordinates to hydrogen atome
CO3.	Acquire the knowledge of quantum mechanics in angular momentum and spin.
CO4.	Acquire the knowledge of distinguishable, identical bosons, and identical fermions particles.
CO5.	Acquire the knowledge of the electrons configuration in atoms.
CO6.	Acquire the knowledge of the electron gas in solids.
CO7.	Acquire the knowledge of the quantum statistical 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.	Write Schrodinger equation in spherical coordinates and solve for the angular part and write the radial part.
LO2.	Apply Schrodinger equation in spherical coordinates to the hydrogen atom and solve for energy states, degenerate states and its associated wavefunctions
LO3.	Define the operators associated with the orbital and spin angular momentum with their eignstates and eigenvalues.
LO4.	Defined the properties of the distinguishable, identical boson, and identical fermion particles.
LO5.	Apply atomic quantum levels to study the electron configuration of the periodic table atoms.
LO6.	Apply quantum theory to study the electron free gas in solids.
LO7.	Apply quantum theory with statistical mechanics to study the many particles (distinguishable, bosons, and fermions) systems.

6 Course Content

Week	Topic	Comments	LO
1	General introduction		LO1
2	**ch.4** Schrodinger equation in spherical coordinate.		LO1
3+4	The Hydrogen atome		LO2
5	Angular momentum.		LO3
6	Spin.		LO3
7	Addition of angular momentum.		LO3
8+9	**ch.5** Two particle system.		LO4
9+10	Helium atom.		LO4
11	Periodic table.		LO5
12	Solid.		LO6
13+14	Quantum statistical mechanics.		LO6

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%
Homeworks		20
Mid. Exam	Twelfth week	30%
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	2nd 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, 2nd Edition, 2000.