Zarqa University
Faculty Science
Department: Physics
Course title: Quantum Physics I
(0302360)

Instructor: Dr. Riad S. Masharfe
Lecture's time: 9:00-10:00
Semester: Second 2018/2018
Office Hours: Sunday, Tuesday, and Thursday: 9:00-10:00

Course description:

The course will start with a brief review of the experiments (blackbody radiation, photoelectric effect, Compton effect, etc.) that cannot be explained by classical physics, thereby providing the necessity for quantum mechanics. This will be followed by a discussion of the wave function and its properties, leading to Schrödinger's equation. Next will be various applications of the 1-D Schrödinger equation (Infinite and finite square wells, free particle, harmonic oscillator, δ-function potential, potential barriers). This will be followed by a treatment of the mathematical formalism of quantum mechanics (Hilbert space, observables and Hermitian operators, eigenvalues and eigenfunctions, uncertainty principle, and Dirac bra and ket notation).

Learning Outcomes

The successful student will obtain a thorough introduction to the Quantum Mechanics including:

- Quantum mechanical solution of simple systems such as the harmonic oscillator and a particle in a potential well.
- Improved mathematical skills necessary to solve differential equations and eigenvalue problems.
- Experience in computer simulation and modeling.

Aims of the course:

1) Learning the fundamental concepts of quantum mechanics
2) Application of quantum theory to the study of atoms/molecules through spectroscopy
3) Describing molecular structure and bonding from a quantum mechanical basis
4) Examining basic approximation methods.
5)To prepare students for courses in quantum field theory.

Intended Learning Outcomes: (ILOs)

A. Knowledge and Understanding

A1. Concepts and Theories:

Provide a systematic introduction to some of the core concepts including: one dimensional time independent Schrödinger equation, harmonic oscillator, free particle, delta function potential, function spaces.

A2. Contemporary Trends, Problems and Research:

Analytical and numerical models of quantum mechanics; finite square well , harmonic oscillator.

A3. Professional Responsibility:

To treat students with understanding, dignity and respect, to guide classroom discussion and set reasonable limits on the manner in which students express opinions.

B. Subject-specific skills

B1. Problem solving skills:

Finding the wave function and energies for different quantum problems. Solving commutations relations and give an interpretation, find eigenvalues (energy, spin,..).

B2. Modeling and Design:

Writing the Hamiltonian operator for different systems.

B3. Application of Methods and Tools:

Apply the rising and lowering operators to solve specific quantum mechanical systems. Normalizing wave functions by integration.

C. Critical-Thinking Skills

C1. Analytic skills: Assess

Analyzing problem and set the suitable quantum mechanical tool.

C2. Strategic Thinking:

Thinking in different ways the student can look to quantum mechanical system.

C3. Creative thinking and innovation:

Thinking quantum mechanically about some reviewed problems in different courses.

D. General and Transferable Skills (other skills relevant to employability and personal development)

D1. Communication:

-Apply different quantum physical principles in different disciplines of science and medicine.
- Enhance the observation of individual to the natural phenomena.
- Assist the student to participate in life science studies

D2. Teamwork and Leadership:

- Increase the cooperative behavior between the different research groups of different applications.
- To work in stressful environment and within constraints.
- To Communicate effectively.
- Use the efficient IT capabilities.
- Management the tasks efficiently.
- To Acquire entrepreneurial skills.
- Refer to relevant literature effectively.
- Searching for the information and going to self learning a new topic.

Course structures:

Week	Credit Hours	ILOs	Topics	Teaching Procedure	Assessment methods
1,2	3	A1, A2, B3	The Wave Function	Lecture, Oral inquiry	Class participation problems(1, 3, 5, 9, 17)pages 12,14,20,22
3,4,5,6, 7,8,9	3	A2,B3,C1, C2, D1	TIM-INDEPENDENT SCHRODINGER EQUATION	Lecturing discussion	Homework: text problems(2, 3, 10, 11, 17, 21, 27, 37, 41, 51)pages 30, 38, 40, 57,77 ,86
10,11, 12,13	3	A3, C2,C3	FORMALIZEM	Lecture, Class discussion, Problem solving or case studies	Oral, Homework: text problems(2, 4, 6, 12, 21, 26)page 96, 98,100, 109, 124 Short-answer questions