Department of Mathematical & Physical Sciences
EAST WEST UNIVERSITY
Aftabnagar, Dhaka 1212, Bangladesh

Course Outline of Course PHY 209 (Engineering Physics-II); Sec 1 and 2; Fall 2024 Semester; Course Instructor: Ruhul Amin (MRA)

Course Information

Course Code	:	PHY 209
Course Title	:	Engineering Physics – II (Introductory Quantum Physics)
Pre-requisite	:	MAT 205
Credit Hours	:	3

Class Time :

Section	Day	Time	Room No
1	ST	10:50am –12:05pm	FUB801
2	MW	10:50am –12:05pm	FUB801

Make-up Schedule : Makeup classes will be suitably arranged.

Instructor Information

Course Instructor	:	M. Ruhul Amin (MRA)
Tel. No.	:	09666775577 (Ext. 125)
E-mail	:	ramin@ewubd.edu
Office	:	MPS Department, Room # 906, 8th Floor

Office Hours :

Day	Time
ST	09:25am-10:40am; 12:15pm-01:30pm
MW	09:25am-10:40am
R	08:00am-09:15am, 10:50am-12:05pm

TA1 (GTA)	:	Will be announced soon.
TA2 (UTA)	:	X

Course Objective

The principal objectives for this course are for you to learn the fundamental concepts, principles, and theories of foundations of quantum physics and to develop the ability to solve problems. Lectures are structured to help you understand the conceptual basis of modern quantum physics and examples are designed to re-enforce those concepts. This course will give the students the necessary insights and skills required to understand the physics behind the electronic and optoelectronic properties of solid-state materials in general and of semiconductor structures in particular. The students will be prepared for courses concerning electronic components, lasers, optical materials, (opto-) electronic systems, non-linear and quantum optics, Quantum computing, etc.

Learning Outcomes

After completing the course, the students will be able to:

- Explain qualitatively and quantitatively, the role of photons in understanding phenomena such as the photoelectric effect, X-rays and Compton Effect.
- Gain an understanding to discuss and interpret experiments displaying wavelike behavior of matter, and how this motivates the need to replace classical mechanics by a wave equation of motion for matter (the Schrödinger equation).
- Understand the central concepts and principles of quantum mechanics: the Schrödinger equation, the wave function and its physical interpretation, stationary and non-stationary states, time evolution and expectation values.
- Demonstrate an understanding of the significance of operators and eigenvalue problems in quantum mechanics.
- Independently solve the Schrödinger equation for simple one-dimensional systems – the square well, harmonic oscillator, potential barrier etc.
- Solve simple problems in two- and three-dimensions in various coordinate systems, e.g. by using separation of variables in the Schrödinger equation.
- Develop a knowledge and understanding of the concept that quantum states live in a vector space.

Course Contents/Descriptions

1. **Emergence of Quantum Mechanics (4 Lectures)**
   Black body radiation, photoelectric effect, Compton Effect; de Broglie hypothesis and wave particle duality.

2. **Wave Mechanics (5 Lectures)**
   Wave packets and the Uncertainty relations; the Schrödinger equation; Axioms of wave mechanics; the probability interpretation; Stationary states; eigenfunctions and eigenvalues; quantum probability; equation of motion in Schrödinger picture; Ehrenfest's theorem; the parity operator; the uncertainty relation.

3. **One-Dimensional Potentials (6 Lectures)**
   The free particle; the infinite square well; potential barriers and scattering states; the single step potential barrier; Simple harmonic oscillator.

4. **Three Dimensional Potentials (4 Lectures)**
   Three-dimensional infinite potential well; Schrödinger equation in spherical polar coordinates; separation into angular and radial components; the rotor; the hydrogen atom.

5. **Formulation of Quamtum Theory (5 Lectures)**
   Hilbert space and linear operators; Dirac notation; eigenstates and eigenvalues; Hermitian operators and observables; matrix representation of operators; unitary transformation; commuting operators; postulates of quantum mechanics.

6. **Quantum Computing (6 Lectures)**
   Introduction to quantum computer; quantum bit (qubit); single qubits; the state space of a single qubit; multiple qubit systems; quantum state transformation – quantum logic gates; simple search algorithms.

Course Materials

Text Book:

1. David Griffiths. Introduction to Quantum Mechanics, PEARSON Education, 2nd Edition, 2009. ISBN: 978-81-7758-230-7.

In addition to the above textbook, some lecture notes will be provided, particularly for chapters 5 & 6.

Reference Book:

1. Gasiorowicz, Stephen. Quantum Physics. 3rd ed. Hoboken, NJ: Wiley, 2003. ISBN: 9780471057000.

Assessment Tools

Assessment tools include **Class Attendance/Performance, Class Tests** (**Short Quizzes**)**, Presentations/Viva, and Exams**. The Class Tests are about 20 minutes in class and the Mid Term Exam and Final Exam are 70 minutes duration in class. Class Test dates will be announced in the Class and the Exam dates are as follows:

Mid Term Exam Date	**Sec. 1**	**15/12/2024; Sunday**
	Sec. 2	**18/12/2024; Wednesday**
Final Exam Date	**Sec. 1**	**09/02/2025; Sunday**
	Sec. 2	**12/02/2025; Wednesday**

Assessment/Evaluation/Grading Policy

The relative contributions of class tests, presentations and exams are as follows:

Test/Exam	% of Marks
Class Tests	20
Class Performance/Viva	20
Mid Term Exam; Chapters 1, 2, & 3	30
Final Exam; Chapters 4, 5, & 6	30

The University Grading Scheme is the following

Range of Marks (%)	Letter Grade	Grade Point	Range of Marks (%)	Letter Grade	Grade Point	Range of Marks (%)	Letter Grade	Grade Point
80 – 100	A+	4.00	65 – 69	B+	3.25	50 – 54	C+	2.50
75 – 79	A	3.75	60 – 64	B	3.00	45 – 49	C	2.25
70 – 74	A-	3.50	55 – 59	B-	2.75	40 – 44	D	2.00
						Less than 40	F	0.00

Essential Policy Information

1. There is zero tolerance for cheating at EWU. Students caught with cheat sheets in their possession, whether used or not used, &/or copying from cheat sheets, writings on the palm of hand, back of calculators, chairs or nearby walls, etc. would be treated as cheating in the exam hall. The only penalty for cheating is expulsion from EWU.
2. Regular Class attendance will be taken. The students are advised to attend classes regularly. The number of lectures shown may slightly vary.
3. Makeup exam for mid terms and final may be arranged for compelling reasons. For the makeup exam, the student must apply with supporting documents.
4. A student may be forced to drop/withdraw the course if her/his attendance falls below 80%.

20/10/2024

(M. Ruhul Amin)
Course Instructor