Lahore University of Management Sciences

PHY 212 – Quantum Mechanics 1

Fall 2019-20

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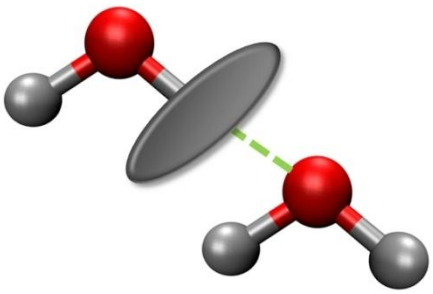
Course URL (if any)	

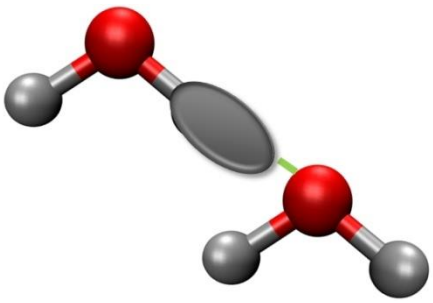
Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	1 hour 15 minutes
Recitation/Lab (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per week)	Nbr of Lec(s) Per Week		Duration	

Course Distribution	
Core	Physics Core
Elective	
Open for Student Category	All
Close for Student Category	None

COURSE DESCRIPTION

Quantum Mechanics is the cornerstone of physics. This introductory course for undergraduates is meant to motivate the students about quantum states and their dynamics and present mathematically consistent, useful, pertinent and accurate descriptions of low energy systems. The ordering we will follow in this course is unusual because we will start with simpler, two dimensional systems (spins) and describe their time evolution. Later, we move on to continuous variable systems (particle in a box, hydrogen atom, harmonic oscillator). We will present examples and applications throughout.





COURSE PREREQUISITE(S)

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• • •	PHY 104: Modern Physics OR Calculus-I.

COURSE OBJECTIVES	
• • •	To introduce the students to the basic ideas of Quantum Mechanics. To introduce the basic mathematical framework on which quantum mechanics is built To describe the fundamental examples of quantum systems

Learning Outcomes (CLO)	
	At the conclusion of this course, students should be able to:
CLO 1	Identify the difference between classical and quantum systems
CLO2	Identify similarities between physically disparate physical systems, and should be able to present a unified picture of states based on state vectors and density matrices and dynamics based on unitary operators.
CLO3	Should be able to predict the outcomes of a quantum measurement and the probabilistic nature of the outcomes.
CLO4	Realize selected applications of quantum mechanics.

Grading Breakup and Policy

Quizzes 20% (4 to 5)

Homeworks: 20% (8 to 10)

Mid-Term 25%

Final Exam 35%

There will be no n-1 policy. Attendance is mandatory and the instructor can assign a 5% grade to a new instruments (such as attendance, project).

Examination Detail	
Midterm Exam	Yes/No: Yes Combine Separate: NA Duration: class time Preferred Date: None

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	Exam Specifications:
Final Exam	Yes/No: Yes Combine Separate: NA Duration: 3 hours Exam Specifications:

Week	Topic	Some Particular Applications	CLO
1A	**Spin 1/2 systems:** The Stern-Gerlach experiment, spin states, commutation relations		
1B	**Quantum States:** Description of pure quantum states, orthogonality, measurement and analogies with classical states of polarized light		
2-3	**Operators and quantum measurement:** Hermitian operators, projection operators, unitary and rotation operators, Schrodinger equation, meaning of quantum measurement, complementarity and indeterminacy of quantum states	Zeno effect, quantum logic gates and quantum circuits	
4-5	**Schrodinger's Equation:** Time evolution operator, the Schrodinger equation	Spin-1/2 inside a magnetic field, magnetic resonance, neutrino oscillations	
7, 8A	**Two particle systems:** States of two-particle systems, Entanglement, Bell's inequalities, local realism, density matrices	Applications of symmetrization postulate in spin isomers, teleportation or tests of local realism	
8B	**Mid-Term**		
9-10	**Wave Mechanics:** Position and momentum operators, representations, wave packets	Infinite, finite square wells, tunneling, some applications of tunneling in electronic devices, slow and fast light (dispersion)	

11	**The Harmonic oscillator:** creation and annihilation operators, energy spectrum and wave functions, Fock states and photons, coherent states	Squeezed light	
12-13	**Three-dimensional wave mechanics:** central potential, hydrogen atom, quantum numbers, multi-electron atoms	Origin of paramagnetism	
14	**Review and Final Exam**		

Textbook(s)/Supplementary Readings

1. A Modern Approach to Quantum Mechanics by Townsend
2. Quantum Mechanics by McIntyre