Lahore University of Management Sciences

PHY 212 – Quantum Mechanics 1
Fall 2023

To understand how to navigate course outlines, consult: How to Use a Course Outline (http://surl.li/gpvuw)

Instructor	Moeez Hassan
Room No.	9-111A
Office Hours	TBA
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Telephone	
Secretary/TA	
TA Office Hours	
Course URL (if any)	LMS
Support Services	LUMS offers a range of academic and other services to support students. These are mentioned below, and you are encouraged to use these in addition to in-class assistance from course staff. For a complete list of campus support services available for you click here (https://advising.lums.edu.pk/#supportservices)

Course Teaching Methodology
• Teaching Methodology: Lectures will be in-person on-campus. All Covid related SOPs are to be strictly followed in the classroom. Unless medically exempted, all students sitting in the class must be fully vaccinated (i.e., they must have received the final dose of their vaccine at least 14 days prior to the start of classes).

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

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Quantum Mechanics is the cornerstone of modern physics. This course aims to show exactly how this weird theory has been formulated to explain the results of various experiments. Once students become familiar with the postulates of the theory and how to apply them, they can (in principle at least) make predictions for any quantum system. Examples and applications will be discussed throughout.

COURSE PREREQUISITE(S)

- PHY 104: Modern Physics AND
- MATH 120: Linear Algebra with Differential Equations OR MATH 220: Linear Algebra I
  OR
- Instructor's Permission

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

CLO-2: Construct the mapping from a physical system to a Hilbert space and vice versa

CLO-3: Should be able to predict the outcomes of a quantum measurement and the probabilistic nature of the outcomes.

CLO-4: Realize selected applications of quantum mechanics.

Grading Breakup and Policy

Component	Weightage	Description
Assignments	20%	- Approximately 1 each week. - N/2 - Late Submissions: 10% penalty per day, upto a maximum of 30% (3 days late). - HW grading scheme (0, 1 or 2 points for each problem): 2 points: Problem solved completely and correctly with margin for a minor error. 1 point: Problem incomplete, multiple minor errors, or a major error.

		○ 0 points: Problem not attempted, multiple major errors, or an incoherent solution.
Quizzes	5% (5%)	• • Quiz-1 ('Prep Quiz') will be of 10% weightage and will cover all the necessary pre-requisite materials for this course including topics in quantum mechanics from Modern Physics, differentiation and integration, and topics from Linear Algebra. • Quiz-2 to Quiz-6 will be of 6% weightage each (30% total), and there will be an N-1 on these (i.e., best 4 out of 5 will count from Quiz-2 to Quiz-6). • Dates: ○ Quiz-1: 21st September ○ Quiz-2: 5th October ○ Quiz-3: 19th October ○ Quiz-4: 2nd November ○ Quiz-5: 16th November ○ Quiz-6: 30th November • All of these will be held live in-class.
Mi9d	30%	•
Final Exam	45%	• Comprehensive final exam

- The instructor reserves the right to vary these grade assignments or add new instruments by upto 10%.
- In the event that the course has to be shifted online, this grading breakup (and the details) may be substantially revised.
- **University policy for cheating/unfair means will be applicable on all grading instruments. You must submit your own work. If any evidence of plagiarism is found, these cases will be forwarded straight to the School DC.**

COURSE POLICIES (READ CAREFULLY):

- All Covid related SOPs are to be strictly followed in the classroom. Unless medically exempted, all students sitting in the class must be fully vaccinated (i.e., they must have received the final dose of their vaccine at least 14 days prior to the start of classes).
- **All emails** sent to the instructor or TAs must have a **subject line** of the following format (examples):

    "PHY 212--subject line"
- **All emails** must be signed with name and **roll-number**.
- If you email me asking me a question that is already answered in the outline, I will not answer your email.
- All announcements will be posted on LMS (with an email notification). **It is your responsibility** to regularly check the LMS site for this course.
- Please come on time. No talking/disturbance during class. No cell-phones, laptops etc. during class.
- **Missed quiz/HW:** A zero will be awarded for a missed quiz/HW. For an approved petition from the OSA, student's own average in the remaining quizzes/HWs will be given for the missed quiz/HW.

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Examination Detail	
Midterm Exam	Yes/No: No Combine Separate: Duration: Preferred Date: Exam Specifications:
Final Exam	Yes/No: Yes Combine Separate: Duration: 3 hours Exam Specifications: Closed book, closed notes.

Tentative list of topics:

Lectures	Topic	Recommended Readings	CLO
1-5	Review of Linear Algebra, Vector spaces, Hilbert spaces, operators		2
6-7	Postulates of Quantum Mechanics, wavefunction, measurement		1,3
8-13	Schrodinger's equation, position and momentum representations, One-dimensional problems		2,3
14-17	The Harmonic oscillator (power series solution, energy basis, ladder operators)		4
18-19	Interpretations of Quantum Mechanics, The Ehrenfest theorem		1
			4

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20-26	[Time permitting] Two particle systems, entanglement, Quantum computation		1,4

Textbook(s)/Supplementary Readings
1. Principles of Quantum Mechanics by Shankar. 2. Introduction to Quantum Mechanics by Griffiths. 3. Quantum Mechanics: Concepts and Applications by Nouredine Zettili. 4. Quantum Mechanics: A Paradigms Approach by David McIntyre.

Campus supports & Key university policies
Campus Supports Students are strongly encouraged to meet course instructors and TA's during office hours for assistance in course-content, understand the course's expectations from enrolled students, etc. Beyond the course, students are also encouraged to use a variety of other resources. (Instructors are also encouraged to refer students to these resources when needed.) These resources include Counseling and Psychological Services/CAPS (for mental health), LUMS Medical Center/LMC (for physical health), Office of Accessibility & Inclusion/ OAI (for long-term disabilities), advising staff dedicated to supporting and guiding students in each school, online resources (https://advising.lums.edu.pk/advising-resources), etc. To view all support services, their specific role as well as contact information click here (https://advising.lums.edu.pk/#supportservices). Academic Honesty/Plagiarism LUMS has zero tolerance for academic dishonesty. Students are responsible for upholding academic integrity. If unsure, refer to the student handbook and consult with instructors/teaching assistants. To check for plagiarism before essay submission, use similarity@lums.edu.pk. Consult the following resources: 1) Academic and Intellectual Integrity (http://surl.li/gpvwb), and 2) Understanding and Avoiding Plagiarism (http://surl.li/gpvwo). LUMS Academic Accommodations/ Petitions policy Long-term medical conditions are accommodated through the Office of Accessibility & Inclusion (OAI). Short-term emergencies that impact studies are either handled by the course instructor or Student Support Services (SSS). For more information, please see Missed Instrument or 'Petition' FAQs for students and faculty (https://rb.gy/8sj1h) **LUMS Sexual Harassment Policy** LUMS and this class are a harassment-free zone. No behavior that makes someone uncomfortable or negatively impacts the class or individual's potential will be tolerated. To report sexual harassment experienced or observed in class, please contact me. For further support or to file a complaint, contact OAI at oai@lums.edu.pk or harassment@lums.edu.pk. You may choose to file an informal or formal complaint to put an end to the offending behavior. You can also call their Anti-Harassment helpline at 042-35608877 for advice or concerns. *For more information: Harassment, Bullying & Other Interpersonal Misconduct: Presentation (http://surl.li/gpvwt)*