Lahore University of Management Sciences

PHY 5313 - Atomic and Laser Physics

Spring 2024

Instructor	TBA
Room No.	
Office Hours	
Email	
Telephone	
Secretary/TA	
TA Office Hours	
Course URL (if any)	
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 Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	75 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	No
Elective	Yes
Open for Student Category	BS and Grad
Close for Student Category	None

COURSE DESCRIPTION
Atomic and laser physics is one of the most actively researched field in Physics currently. This course provides a modern introduction to the physics of atoms and atom-light interaction. This course will deal mainly with the spectra of single-electron atoms in the presence of external electromagnetic fields. Multi-electron atoms and the tools for their approximate treatment will also be dealt with. The course will end an introduction to the basics of laser physics.

COURSE PREREQUISITE(S)	
•	PHY221 Quantum Mechanics I
•	
•	Or PHY517 Quantum Mechanics III

Learning Outcomes (CLO)	
	At the end of the course, the student will be able to: CLO1: Understand how a one-electron atom interact with electromagnetic radiation and understand the basic theoretical models used to explain this interaction

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	CLO2: Understand the spectra of one-electron atom in the presence of external fields CLO3: Understand the basics of two-electron atom's spectra and their interaction with external fields CLO4: Understand the approximate treatment of many-electron atoms and the calculation of approximate properties

Grading Breakup and Policy

Assignment(s):
Home Works: 40%
Quiz(s): 20% (Quizes will be impromptu without any prior notice)
Midterm Project without Presentation: 20% (Will be individual big problem due in 9th week)
Final Project with Presentation: 20% (will be individual topic for explanation in 15th week)

Examination Detail

Midterm Exams	Yes/No: No
Final Exam	Yes/No: No

COURSE OVERVIEW

Week	Topics	Recommended Readings	CLO
1-2	Review of one-electron atoms, several-particle system, Hydrogen atom, hydrogen atom in external fields		
3-5	Variation method, Perturbation Theory, Helium atom ground state		
6-7	Electron spin, spin-statistics, Lithium atom		
8-9	Many-electron atoms, identical particles, exchange interaction, central field approximation, Hartee—Fock model		
10-11	Molecular Symmetry, Diatomic Molecules, Molecular orbitals, Valence bands, Theorems of Molecular quantum mechanics		
12-14	Introduction to computational technique for electronic structures of many atoms		

Textbook(s)/Supplementary Readings

The main textbook to be followed is

[Ira N. Levine] Quantum Chemistry, Seventh Edition. This will be the main text but the following will also be helpful in finding the rigorous treatment.

[Donald McQuarrie] Quantum Chemistry, almost similar treatment of topics as Levine.

[Brasnden,Joachain] Physics of Atoms and Molecules by Bransden and Joachain, 2nd Edition. This is a very comprehensive book that covers just about everything in atomic and molecular physics at an undergraduate level.

You can review your quantum mechanics from the following:

[Griffiths] "Introduction to Quantum Mechanics" by Griffiths, 2nd Edition. This should enable you to brush up on your quantum mechanics. Also has good discussions of fine structure and the Zeeman effect.

Course Policies

Late/Missed Assignment	Late Assignments will be accepted with 10% deduction for each late day, with a maximum penalty of 50%.
Missed Class Activity	Missed Activity will not be replaced.
Disability/Sickness/Internet Access	Any disability, sickness, are chronic internet issues should be brought to instructor immediately, as soon as possible. Also, help can be sought from the office of student affairs (OSA) and office accessibility and inclusion (OAI). We will follow the policy of university and decisions made by the OSA accordingly.
Plagiarism/Cheating	Any discussion with and help from anybody else including from people remotely that directly solves the problems in assignments, quizzes, and exams is prohibited. However, students are allowed to take help from any notes/books. A violation of this policy in exams and assignments will result in referral to university's disciplinary committee.

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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)*