Lahore University of Management Sciences

PHY 104 – Modern Physics

Summer 2024

Instructor	Faheel Ather Hashmi
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Office Hours	TBA
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TA	TBA
TA Office Hours	TBA
Course URL	On 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
four mandatory in-class lectures every week.

Course Basics				
Credit Hours	4			
Lecture(s)	Nbr of Lec(s) Per Week	4	Duration	120 mins
Recitation (per week)	Nbr of Lec(s) Per Week		Duration	
Tutorial (per two weeks)	Nbr of Lec(s) Per Two Weeks		Duration	

Course Distribution	
Core	All SSE majors
Elective	
Open for Student Category	
Closed for Student Category	

COURSE DESCRIPTION
This course is intended to be a first introduction to relativity, and quantum phenomena in nature. Special relativity, introduced by Albert Einstein at the turn of the twentieth century, fundamentally altered our conception of space and time. Quantum Mechanics forms the basis of our description of nature at small scales and a clear understanding of it is required to explain phenomena ranging from atomic structure and chemical bonding to semiconductors and nuclear physics. We will present a concise and comprehensive picture of quantum theory with emphasis on concept building. Numerous applications to real world phenomena will be discussed throughout the course.

COURSE PREREQUISITE(S)
An understanding of basic mechanics and calculus is assumed.

Learning Outcomes (CLOs)	
1	Demonstrate the ability to solve problems in relativistic kinematics

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2	Acquire basic understanding of wave mechanics
3	Apply the Schrodinger wave equation in cases of one dimensional motion
4	Apply the wave particle duality to understand the Heisenberg uncertainty principle, atomic structure and an elementary treatment of light-atom interactions, and condensed matter systems
5	Develop basic understanding of thermodynamics from the perspective of statistical mechanics

Grading break up: Component Details and weightages

Assignments (20%) 3-5: These are problem sets that students must do to understand the material.
Quizzes (20%). 3-5: may or may not be MCQ based
Mid-Term (30%): A mid-term exam covering topics taught in the first seven weeks will be held in week 9. The mid-term will be of 150 minutes duration.
Final Exam (30%): A three hour comprehensive final exam shall be held on the date specified by the RO.

Note: The course instructor reserves the right to readjust the grading policy by upto 5%.

Examination Detail	
Mid Term Exam	Yes
Final Exam	Duration: The exam shall be of 3 hours duration.

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Course Overview			
Week#	Topics	Readings	CLOs
1	Special theory of relativity, Inertial Frames, Lorentz Transformations, Length contraction, time dilation	Ch 1/1	1
1,2	Momentum and energy, collisions, relativistic dynamics	Ch 1/1,2	1
2	A brief introduction to wave mechanics	Ch 16,18	2
2,3	Photoelectric effect, X-rays, Compton effect, pair production, Bragg's law, wave-particle duality	Ch 2/3	3
3	de Broglie hypothesis, Single and Double slit experiment with particles, The uncertainty principle and the Fourier transform	Ch 3/4	3
4	Bohr's atomic model, Light from atoms, Schrodinger's equation in one dimension, free-particle, bound states	Ch 3,4/4,6	3
4,5	Infinite quantum wells, Simple harmonic oscillator, Expectation values, uncertainties, eigenvalues, non-stationary states	Ch 4/6	3
5	Finite barriers, Tunneling, alpha decay	Ch 5/6	3
6	Statistical physics, microcanonical ensemble and entropy, distribution functions in physical systems	Chs 1-6/ 1-6	5

Note: Above mention timelines are tentative and may change. The course outline is also evolving and may incorporate further details. The students enrolled are advised to communicate with the course instructor for status of the course and timely updates.

See Textbook list to understand color coding in the readings.

Textbook(s)/Supplementary Readings	
1	**Nonclassical Physics**, Randy Harris.
2	**Modern Physics**, Paul Tipler.
3	**Concepts of Modern Physics**, Arthur Beiser.
4	**Modern Physics,** Serway and Moses.
5	**Physics for Scientists and Engineers**, 6th edition, Serway
6	**Thermal Physics**, Charles Kittel
7	**Modern Physics for Scientists and Engineers, Andrew F. Rex and Stephen Thornton**

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

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'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)*