

PHY 104

Modern Physics

Instructor: Muhammad Sabieh Anwar

Year: 2023-2024

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Semester: Spring

Office Hours:

Category: Undergrad/Grad

Course Code PHY 104

Course Title: Modern Physics

Credit hours: 4

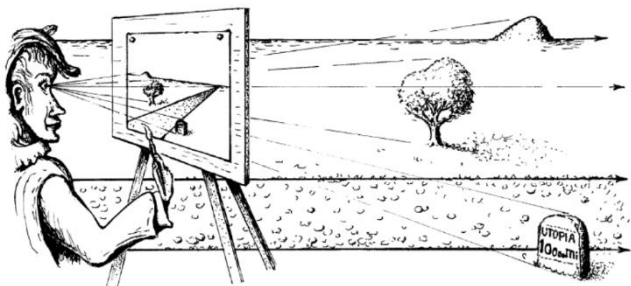
Website: <https://physlab.org/modern-physics-2024>

Lecture format: Check the RO portal or Zambeel.

For Harassment policy and honor code, see the last sections of this outline.

Course Description:

This course is intended to be a first introduction to quantum phenomena in nature. Quantum Mechanics forms the basis of our description of nature at small scales and a clear understanding of it is required to understand phenomena ranging from atoms and chemical bonding to semiconductors and nuclear



physics. We will present a concise and comprehensive picture of quantum theory with emphasis on concept building. The concepts will be organized around the ideas of wave particle duality, uncertainty, superposition, entanglement, and their

physical and conceptual consequences. Numerous applications to real world phenomena will be discussed throughout the course. The course also has a component that discusses the application of statistical ideas in physics and this leads to concepts of irreversibility, entropy and the energy flow inside the universe.

Pre-requisites: None.

Text books: There is no set textbook. For further reading and references, visit the course website.

Grading scheme:

- Quizzes: 30%
- Midterm Exam 30%
- Final Exam 40%
- The instructor has the liberty of varying these grade assignments by 10%.

Tentative Course Schedule & Topics:

Weeks	Topic	Some Particular Physics Ideas
1-4	Waves, particles and uncertainty: nature of quantum objects, waves, particles, the wavefunction, Born's interpretation, quantum interference, quantum uncertainty, mathematical tools to describe measurement	Entanglement, quantum computing, quantum algorithms, quantum erasure, delayed choice, and implications for philosophy
5-7	Quantum physicality: the quantum equation of motion (Schrodinger's equation), quantum tunneling, band theory	Atoms, periodic table, molecules, single-electron devices, tunneling microscope, quantum biology, magnetic resonance, lasers
8	Midterm	
9-11	Statistics and complex systems: energy, temperature, entropy, second law of thermodynamics	Implications for living cells, computation, cosmology and black holes
12-13	Special relativity: speed of light, simultaneity, time dilation, length contraction, paradoxes, $E=mc^2$	The GPS, lifetime of muons, electromagnetism
14	Review and unfinished topics	
15	Final exam	

Harassment Policy Harassment of any kind is unacceptable, whether it be sexual harassment, online harassment, bullying, coercion, stalking, verbal or physical abuse of any kind. Harassment is a very broad term; it includes both direct and indirect behaviour, it may be physical or psychological in nature, it may be perpetrated online or offline, on campus and off campus. It may be one offense, or it may comprise

of several incidents which together amount to sexual harassment. It may include overt requests for sexual favours but can also constitute verbal or written communication of a loaded nature. Further details of what may constitute harassment may be found in the LUMS Sexual Harassment Policy, which is available as part of the university code of conduct. LUMS has a Sexual Harassment Policy and a Sexual Harassment Inquiry Committee (SHIC). Any member of the LUMS community can file a formal or informal complaint with the SHIC. If you are unsure about the process of filing a complaint, wish to discuss your options or have any questions, concerns, or complaints, please write to the Office of Accessibility and Inclusion (OAI, oi@lums.edu.pk) and SHIC (shic@lums.edu.pk) —both of them exist to help and support you and they will do their best to assist you in whatever way they can. To file a complaint, please write to harassment@lums.edu.pk.

Honor Code This course and all our interactions are based on the premise that students and I (Sabieh Anwar) will not resort to any means of taking unfair advantage of one another. I will not penalize any student unfairly and will not unduly advantage another. I will stick to norms of decency and mutual respect to my students. Similarly, students will also stick to an honor code---they will not cheat or help others cheat or plagiarize. I will not actively go out looking for plagiarism or cheating. However, if something comes to my notice, I will immediately refer this case to the School's Disciplinary committee for subsequent attention. I will not invigilate exams. I expect students to make their conscience their invigilator.