PHY 104: Modern Physics

Instructor: Muhammad Sabieh Anwar **Year:** 2012-13

Office: **Email**: sabieh@gmail.com **Semester:** Spring

Office Hours: **Category:** Undergrad

Course Code: PHY 104 **Course Title:** **Modern Physics:**
Credits: 4

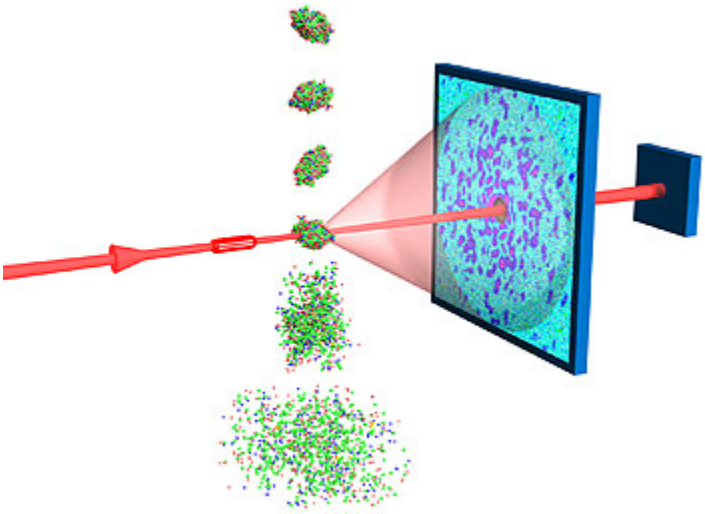
Teaching Fellow: **TF's Office Hours:** will be announced

Website: http://physlab.lums.edu.pk/

Lecture format: Two 75 minutes lectures and one 50 minutes lecture. One 75 minute recitation.

Course Description:

The course is a continuation of the Physics narrative from PHY 101 and is generally concerned with nonclassical aspects on physics. We will emphasize the applications of quantum physics in microscopic-scale physics, atomic and molecular structure and processes. Quantum mechanics answers such fundamental questions as why do pigments have the colors that they do, why are some materials hard and others soft, why do metals, for example, conduct electricity and heat easily, while glass doesn't. Quantum physics also forms the basis of our understanding of the chemical world, materials science, as well as electronic devices permeating the modern digital age. The course is aimed at introducing the students to key concepts, devices and applications ranging from cosmology to medical physics, archeology to microscopy.



Course Status:

Core for SSE.

Pre-requisites:

PHY 101: Mechanics

Text books:

Modern Physics by R. A. Serway, C.J. Moses and C.A. Moyer

Physics for Scientists and Engineers by Fishbane, Thornton and Gasiorowizc

Grading scheme:

Quizzes 20%

Homeworks: 10%

Mid-Term 30%

Final Exam 40%

The instructor has the liberty of varying these grade assignments by 5%.

Tentative Course Schedule & Topics:

Week	Topic	Some Particular Applications
1-2	**Molecular basis of thermodynamics:** continuing from the last part of the course PHY101, these lectures will build upon the statistical foundations of thermal physics, will end with blackbody radiation	This is an applied introduction to statistical physics and thermodynamics, rusting, osmosis, thermodynamics of evolution
3A	**Motivation for nonclassical physics:** Double-slit intereference captures all, or most, of quantum physics;	Interfering bacteria and bucky balls
3B	**Light is grainy:** Photoelectric effect; Compton effect; X-rays	Does gravity effect light? Solar cells.
4	**But can light also be a wave:** wave-particle duality; wavegroups and dispersion; uncertainty principle	X-ray diffraction reveals the structure of crystals including DNA; Construction and working of an electron microscope
5	**Light comes from atoms, so what are atoms**	Electrolysis; Spectroscopy:

	composed of? Contributions of Faraday (atoms, molecules, charges exist), Thomson (electrons exist), Rutherford (nucleus exists) and Bohr (electrons are bound to orbits)	looking at stars
6	**Quantum Mechanics in One Dimension:** Wavefunction; free particle; particle in a box	Charge-couple devices (CCD)
7	**Tunneling:** Finite square well, Tunneling	α decay; decay of black holes; scanning tunneling microscope
8	**Review and Mid-Term**	
9-10	**Quantum Mechanics in Three Dimensions:** The Hydrogen atom, orbitals, angular momentum and its quantization	
11	**Angular Momentum and Magnetism:** orbital magnetism, Zeeman effect, concept of spin, Pauli's exclusion principle	Building of the periodic table; magnetic resonance and MRI; why is iron magnetic? White dwarfs, and neutron stars
12	**How do atoms build molecules?** Ionic bonds; covalent bonds; hydrogen bonds; molecular orbitals	Raman spectroscopy; graphene
13	**How do atoms build solids and stars?** How are crystals different from amorphous solids? Why and how do metals conduct electricity? Bands in solids; Semiconductors.	Light emitting diodes; lasers; superconductors, black holes, white dwarfs and neutron stars
14	**Nuclear Structure:** Size and structure of nucleus; nuclear forces; radioactivity and nuclear reactions	Determining the age of the earth; Radiation therapy
15	**Review and Final Exam**	