Centre for High Energy Physics
Faculty of Science
University of the Punjab, Lahore
Course Outline

Program	BSCP	**Course Code**	CPHY 231	**Credit Hours**	3
Course Title	**Modern Physics**				

Course Introduction

This course encloses the recent developments in modern physics and helpful to understand the basic relativistic and quantum mechanical tools can be applied in study of atomic physics and quantum physics.

Learning Outcomes

On the completion of the course, the students will:
The course will introduce modern physics and its applications. Its objectives are as following.

1. Understanding basic principles of relativity.
2. Study the experiments and phenomena that lead to quantum physics.
3. Be able to solve relevant numerical problems.

Course Content

Week 1	Postulates of special relativity, Lorentz transformations
	Derivations of time dilation and length contraction.
Week 2	Twin paradox with examples
	Doppler effect and applications
Week 3	Transformation of velocity and Relativistic Variation of mass
	Relativistic momentum and energy
Week 4	Black body radiation.
	Photo electric effect
Week 5	X-ray, X- ray diffraction.
	Compton effect and Pair production.
Week 6	De Broglie's hypothesis, Davisson-Germer experiment
	Bohr's atomic model, Energy levels and spectra
Week 7	Laser
	Heisenberg uncertainty principle
Week 8	Superposition principle, Wave packet, Phase, and group velocities.
	Quantum mechanics: Introduction Schrodinger equation (time dependent and independent).
Week 9	A particle in a box, Finite potential well.

	Transmission and reflection by step and barrier potentials.
Week 10	Quantum tunneling and its applications in technology.
	Nuclear Physics: Binding energy, Binding energy per nucleon curve
Week 11	Radioactive decay and its types, Law of radio activity
	Half-life and average life
Week 12	Nuclear reaction and its types, Q-value of nuclear reaction
	Fission and fusion reaction
Week 13	Life cycle of a star
	Elementary particles: Leptons, Hadrons, Quarks
Week 14	Fundamental interactions and Quantum fields
	Introduction to the standard model of particle physics
Week 15	Cosmology and cosmological principles
	Hubble law and its application
Week 16	History of the universe, formations of stars and galaxies
	Cosmic ray microwave background

Textbooks and Reading Material

Recommended Books:

1. Concepts of Modern Physics (6^{th}edition), Arthur Bieser, *McGraw-Hill Higher Education* (1994)
2. Physics Vol.1 (4^{th}edition), Halliday and Resnic, *John Wiley and Sons* (1992)
3. Physics Vol.1 (5^{th}edition), Halliday and Resnic, *John Wiley and Sons* (2002)
4. Modern Physics Simulation, R. Bigelow, J.R. Hiller and Moloney, *John Wiley and Sons* (1996)
5. Fundamentals of Physics (5^{th}edition), Halliday and Resnic, *John Wiley and Sons* (2002)
6. Physics for Scientists and Engineers (extended version), P. M. Fishbane, *Prentice-Hall International Editions* (2016)

Teaching Learning Strategies

The instructor is required to make use of Mathematica/Maple/Python to teach the concepts through visualization/antimutation and symbolic/numerical calculations. The students are required to solve a large portion of related exercises/questions/problems of the main textbooks.

Assignments: Types and Number with Calendar

At least two assignments and two quizzes. A course project may also be assigned.

Assessment

Sr. No.	Elements	Weightage	Details

1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.