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

Program	BSCP	**Course Code**	CPHY 111	**Credit Hours**	3
Course Title	**Mechanics**				

Course Introduction

The Mechanics course is an exploration of the fundamental principles governing the motion of objects in the universe. It covers concepts like position, velocity, and acceleration vectors, Newton's laws of motion, and forces driving motion. The course also delves into projectile motion and uniform circular motion. It explores momentum, linear momentum, impulse, and conservation of momentum, and systems of particles. It also covers rotational kinematics and dynamics, including torque, rotational inertia, equilibrium, and angular momentum. The course also delves into work and energy, including potential energy, conservative forces, and conservation of mechanical energy. The course concludes with a profound understanding of the mechanics that govern our physical world, from the smallest particles to celestial bodies.

Learning Outcomes

1. Understanding basic principles of mechanics and its applications.
2. Be able to solve relevant numerical problems.
3. Be able to use calculus in studying the mechanics systems.

Course Content

Week 1	Position, velocity, and acceleration vectors
	Motion with constant acceleration in 1D and 3D
Week 2	Force, Newton’s laws of motion, weight
	Projectile motion
Week 3	Uniform circular motion
	Tension and normal forces, frictional forces
Week 4	The dynamics of uniform circular motion
	Non-inertial frame & pseudo forces;
Week 5	Linear momentum, Impulse and momentum
	Conservation of momentum, two body collision
Week 6	Elastic and inelastic collisions
	System of many particles,
Week 7	Centre of mass of solid objects
	Linear momentum of system of particles and its conservation
Week 8	System of variable mass
	Rocket motion

Week 9	Rotational kinematics, Rotational dynamics
	Torque, rotational inertia, rotational inertia of solid objects, torque due to gravity
Week 10	Equilibrium and nonequilibrium applications of Newton's law for rotational motion
	(Problem Solving)
Week 11	Angular Momentum and angular velocity, the spinning top,
	Work: work done by variable force, work kinetic energy theorem
Week 12	Work and kinetic energy in rotational motion
	Kinetic energy in collisions
Week 13	Potential energy, Conservative forces,
	Conservative forces, Conservation of mechanical energy
Week 14	Gravitation: Newton's law of universal gravitation,
	The shell theorems
Week 15	(Problem Solving)
	Gravitational potential energy
Week 16	The motion of planets.
	The motion of planets and satellites.

Textbooks and Reading Material

1. Physics Vol.1 (4^{th}edition), Halliday and Resnic, *John Wiley and Sons* (1992).
2. Physics Vol.1 (5^{th}edition), Halliday and Resnic, *John Wiley and Sons* (2002).
3. Fundamentals of Physics (5^{th}edition), Halliday and Resnic, *John Wiley and Sons* (1999).
4. Physics for Scientists and Engineers (Extended version), P. M. Fishbane, *Prentice-Hall International Editions* (2016).
5. Classical Mechanics Simulations, Bruce Hawkins and Randall Jones, *John Wiley & Sons* (1995)

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. At least fifty percent of the question paper would involve new problems related to the concepts learned in the course. 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.