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

Course Outline

Program	BSCP	**Course Code**	CPHY 315	**Credit Hours**	3

Course Title	**Classical Mechanics**

Course Introduction

This course introduces classical mechanics concepts. Historically, a set of core concepts — space, time, mass, force, momentum, torque, and angular momentum — were introduced in classical mechanics in order to solve the most famous physics problem, the motion of the planets.

Learning Outcomes

The course introduces Classical Mechanics at undergraduate level. Its objectives are as following.

1. Solve advance problems of mechanics.
2. Learn different formalism of classical mechanics.
3. Learn basic principles of non-linear dynamics.

Course Content

Week 1	Review of Newtonian mechanics of a system of particles
Week 2	The Independent Coordinates of a Rigid Body
Week 3	The Euler angles, Rate of Change of a Vector, Rotational Kinetic Energy and Angular Momentum
Week 4	The Inertia Tensor, Euler's Equations of Motion, Motion of a Torque-free Symmetrical Top
Week 5	The Motion of a Heavy Symmetrical Top with One Point Fixed. Lagrange Formalism: Constraints
Week 6	Generalized coordinate
Week 7	D'Alembert Principle and Derivation of Lagrange equations
Week 8	Lagrange equations for nonholonomic constraints and Lagrange
Week 9	Central Force Problem
Week 10	Two body problem and its reduction to one body problem, equation of motion solution of one body problem, Planetary motion and derivation of Kepler's laws
Week 11	Rutherford scattering formula. Hamilton's Formalism: Legendre transformation and Hamilton's equations of motion; Calculus of variation and Hamilton's principle

Week 12	Derivation of Lagrange's equation from Hamilton's principle; Phase space and Liouville's theorem
Week 13	Solution of some elementary problems by Hamilton's Formalism
Week 14	The canonical transformation
Week 15	Poisson bracket. Hamilton-Jacobi theory
Week 16	Solution of Hamilton-Jacobi DE for some elementary systems

Textbooks and Reading Material

1. Classical Mechanics (2^{nd}edition), T. L. Chow, *John Wiley* (1995).
2. Classical Mechanics (2^{nd}edition), Greiner, *Springer* (2003).
3. Classical Mechanics Simulations, Bruce Hawkins and Randall Jones, *John Wiley & Sons* (1995).
4. Classical Mechanics (3^{rd}edition), H. Goldstein, *Addison-Wesley* (1950).
5. Classical Mechanics, V.D. Barger and M. G. Olsson, *McGraw-Hill,* (1995).
6. Classical Mechanics (2^{nd}edition), Atam and P. Arya, *Prentice Hall Int. Inc.* (1998).

Teaching Learning Strategies

The instructor is required to make use of examples of the text books and 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.