Course Type	Course Code	Name of Course	L	T	P	Credit
DC	PHC201	CLASSICAL MECHANICS	3	0	0	9

Course Objective

The objective of the course is to educate students about the advanced methods to solve the problems of the mechanics of classical bodies and to introduce the basics of special theory of relativity.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of the mechanics of classical objects.
- have a understanding of advanced techniques of solving mechanics problems of classical objects.
- be able to appreciate the limitations of classical mechanics.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Lagrangian Formulation:** Constraints and generalized Coordinates, degrees of freedom, D'Alembert's principle, Lagrange's equations from D'Alembert's principle, Hamilton's principle, Calculus of Variation and Lagrange's equations from Hamilton's principle. Conservation Theorems and Symmetry Properties, Simple applications of the Lagrangian formulation, Numerical Problems.	10	At the end of this unit students should be able to use the advanced techniques of Lagrangian formulation to solve classical mechanical problems. They should be able to appreciate the versatility of the Lagrangian formulation in comparison to Newtonian Formulation.
2	**Motion in a non-inertial frame:** Motion of a point particle in a general (rigid) non-inertial frame of reference, centripetal acceleration, Pseudo force, Coriolis force and its applications, Galilean Relativity.	8	At the end of this unit students will be able to deal with the mechanics of bodies in non-inertial frames. In particular the motion of objects in rotating frames such as earth.
3	**Rigid body dynamics:** Degrees of freedom of a rigid body, Moment of inertia and their products, principal moments and axes, Orthogonal transformations, Euler angles, Euler's equations, Precessional motion, heavy symmetrical top.	8	At the end of this unit students should be able to understand the exact representation of the orientation of an arbitrary rigid body using Euler angles and its application in understanding the motion of heavy tops.
4	**Motion under central force:** Equivalent one body problem, Differential equation of an orbit, Kepler's law, Center of mass and laboratory coordinates, Scattering in center of mass and laboratory frames, Scattering cross-section, Rutherford scattering, Elastic and inelastic collisions.	7	At the end of this unit students will have the understanding of dealing with motion in central forces and it application in explaining the out of scattering experiments.
5	**Hamiltonian Formulation:** Definition of Hamiltonian, Legendre transformations, Hamilton equations and its application to simple cases, cyclic coordinates and conservation theorems, Canonical transformations, Poisson theorem, Poisson brackets.	9	At the end of this unit students should able to understand the use of Hamiltonian technique to solve mechanics problem. They should be able to appreciate the importance of canonical transformations in solving problems.
	Total	**42**	

Textbooks:

1. Classical Mechanics; Goldstein, Safko & Poole; Pearson; 2002.
2. Classical Mechanics, R. Douglas Gregory, Cambridge University Press, 2006.
3. Mechanics (Berkeley Physics Course, Vol. 1), 2nd Edition, C. Kittel, W. D. Knight, M. A. Ruderman,,Helmholz .C .A B. J. Moyer, McGraw-Hill Book Company, 1973.

Reference Books:

1. Mechanics and General Properties of Matter; P.K. Chakraborti, Kolkata Books and Allied; 2009
2. Classical Mechanics; J. C. Upadhyay; Himalaya Publication House; 2008.
3. Introduction to Classical Mechanics: With Problems and Solutions, 1st Edition, David Morin, Cambridge University Press, 2008.
4. Classical Mechanics, John R. Taylor, Univ Science Books, 2005.
5. Mechanics: Volume 1 (Course of Theoretical Physics), 3rd Edition, L. D. Landau and E.M. Lifshitz, Butterworth-Heinemann, 1982.