Annexure-III

Course Information File (CIF) of core courses of the proposed M.Sc. Curriculum

Classical Mechanics

Programme: M.Sc. (Physics). Year: 1st Semester : 1

Course : Core Credits : 4 Hours (LTP): 40+12+0

Course Context and Overview (100 words):

Students will learn to use the Lagrangian and Hamiltonian formulations of Classical Mechanics. This is a standard course which is the bedrock of Physics.

Prerequisites Courses: None

Course outcomes(COs):

On completion of this course, the students will have the ability to:
CO1 Use mathematical and physical principles to describe the laws governing classical mechanics.
C02 Use the Lagrangian formulation to describe and understand the dynamics of particles.
C03 Use the Hamiltonian formulation to describe and understand the dynamics of particles
C04 Use the Lagrangian and Hamiltonian formulations to describe and understand the Central Force problem
C05 Acquire and use the knowledge of the Special Theory of Relativity and Four Vectors

Course Topics:

Units	Lectures
Introduction, Mechanics of a Particle, Mechanics of a System of Particles,	14

Degrees of freedom, generalized coordinates and velocities. Lagrangian action principle, Techniques of the Calculus of Variations, Euler-Lagrange equations. Constraints. Applications of the Lagrangian formalism. Generalized momenta, Hamiltonian, Hamilton's equations of motion. Legendre transform, relation to Lagrangian formalism. Phase space, Phase trajectories. Applications to systems with one and two degrees of freedom. Conservation of linear momentum, energy and angular momentum.	
Central force problem, Kepler problem, bound and scattering motions. Scattering in a central potential, Rutherford formula, scattering cross section. Noninertial frames of reference and pseudoforces: centrifugal Coriolis and Euler forces.Elements of rigid-body dynamics. Euler angles. The symmetric top. Small oscillations Normal mode analysis. Normal modes of a harmonic chain.	12
Elementary ideas on general dynamical systems: conservative versus dissipative systems. Hamiltonian systems and Liouville's theorem. Canonical transformations, Poisson brackets. Action-angle variables. Non-integrable systems and elements of chaotic motion.	10
Special relativity: Internal frames. Principle and postulate of relativity. Lorentz transformations.Length contraction, time dilation and the Doppler effect. Velocity addition formula. Four- vector notation. Energy-momentum four-vector for a particle. Relativistic invariance of physical laws.	4

In addition to the lecture hours mentioned there will also be tutorials.

Textbook references (IEEE format):

Text Book:

Classical Mechanics by H. Goldstein, C. Poole and J. Safko

Reference books:

The Classical Theory of Fields by L. Landau and E. Lifshitz.

Introduction to Dynamics, Percival and D. Richards, Cambridge University Press (1987) [Chapters 4, 5, 6, 7 in particular. also parts of Chapter 1-3, 9, 10].

Special Theory of Relativity, D. Rindler, Oxford University Press (1982).