PH-8104

Classical Mechanics

L	T	P	C
4	1	0	5

Course outcomes:

After successful completion of the course, the students should be able to

CO1: Solve dynamical problems involving classical particles by using the Lagrangian formulation.

CO2: Relate symmetries to conservation laws in physical systems, and apply these concepts to practical situations.

CO3: Solve dynamical problems involving classical particles by using Hamiltonian formulation.

CO4: Demonstrate a working knowledge of classical mechanics and its application to standard problems such as central forces.

CO5: Explain different aspects of motion of rigid bodies, and their symmetry axes.

CO6: Distinguish between stable and unstable equilibrium and understand physics of small oscillations.

CO7: Use Canonical transformations and find out equations of motion using Poisson brackets.

CO/PO Mapping

(S/M/W/N indicates strength of correlation) S-Strong, M-Medium, W-Weak, N-No correlation

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	W	W	W	N	N	S	S	W	S
CO2	S	S	M	W	N	W	N	N	S	S	W	S
CO3	S	S	S	W	W	W	N	N	S	S	W	S
CO4	S	S	S	W	N	W	N	N	S	S	W	S
CO5	S	S	S	W	N	W	N	N	S	S	W	S
CO6	S	S	S	W	N	W	N	N	S	S	W	S
CO7	S	S	S	W	W	W	N	N	S	S	W	S

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UNIT-I

Lagrangian Formulation:
Mechanics of a system of particles; constraints of motion, generalized coordinates, D'Alembert's Principle, Lagrange's velocity-dependent forces and the dissipation function, Applications of Lagrangian formulation. **11 Hrs**

Hamilton's Principles:
Calculus of variations, Hamilton's principle, Lagrange's equation from Hamilton's principle, extension to non-holonomic systems, advantages of variational principle formulation, Noether's theorem, symmetry properties of space, time and conservation theorems. **11 Hrs**

Hamilton's Equations:
Phase space concept, Legendre Transformation, Hamilton's equations of motion, Cyclic coordinates, Hamilton's equations from variational principle, Principle of least action. **8 Hrs**

UNIT-II

Canonical Transformation and Hamilton Jacobi Theory:
Canonical transformation and its examples, Poisson's brackets, Equations of motion, Angular momentum, Poisson's Bracket relations, infinitesimal canonical transformation, Conservation Theorems. Hamilton Jacobi equations for principal and characteristic functions Action-angle variables for systems with one degree of freedom. **9 Hrs**

Small Oscillations:
Eigen value equation, Free vibrations, Normal Coordinates, Vibrations of a tri-atomic molecule. **4 Hrs**

Rigid Body Motion:
Rate of change of a vector, Coriolis force, independent coordinates of rigid body, orthogonal transformations, Euler Angles, infinitesimal rotation, angular momentum and kinetic energy of a rigid body, the inertia tensor, principal axis transformation, Euler equations of motion, Torque free motion of rigid body, motion of a symmetrical top. **12 Hrs**

Central force problem:
Equivalent one body problem, Equation of orbit, Stability of orbits, Kepler's problem and Rutherford scattering. **5 Hrs**

Total: 60 Hrs

BOOKS:

1. Classical Mechanics: H. Goldstein, C. Poole and J. Safko (Pearson Education Asia, New Delhi).
2. Analytical Mechanics: L.N. Hand and J.D. Finch (Cambridge University Press, Cambridge)
3. Mechanics: L.D. Landau and E.M. Lifshitz (Pergamon, Oxford).
4. Classical Mechanics of Particles and Rigid Bodies: K.C. Gupta (Wiley Eastern, New Delhi).
5. Classical Mechanics: N.C. Rana and P.J. Joag (Tata McGraw Hill, New Delhi).
6. Classical Mechanics by Gupta, Kumar, Sharma (Pragati Prakashan, MEERUT)

C/BOS

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