SYLLABUS OF DSC 19
THEORY COMPONENT
(Credits: 3; Hours: 45)

Unit I (10 Hours)

Variational Principle and Lagrangian Formulation
Calculus of Variation with applications. Generalized coordinates. Lagrangian, Hamilton's Principle, Euler-Lagrange equations of motion. Constrained systems. Cyclic coordinates and conserved quantities. Applications to physical systems.

Unit II (10 Hours)

Hamiltonian Formulation and Phase Space
Legendre transformation, Hamilton's equations of motion. Phase space, phase trajectories, Phase portraits. Canonical transformations, Poisson brackets, Liouville's theorem and conservation of phase space volume. Applications to Physical Systems.

Unit III (11 Hours)

Rigid Body Dynamics
Rotation Matrices, Euler Angles. Angular momentum and kinetic energy of rigid bodies, The Inertia Tensor, Principal Axis Transformation. Euler's equations of motion for rigid body. Torque-free motion. The symmetrical top with one point fixed.

Unit IV (14 Hours)

Central Force and Orbital Mechanics
Equation of motion under central force, Classification and Stability of orbits**.** Virial Theorem. Conditions for Closed Orbits (Bertrand's Theorem). The Kepler Problem. Scattering in central force field. Rutherford scattering as an application.
Theory of small oscillations: Linearization of equations of motion. The Eigenvalue Equation and the Principal Axis Transformation, Normal coordinates and normal frequencies of oscillations. Damped and forced oscillations, Coupled oscillators.

References

Essential Readings

1. Classical Mechanics, H. Goldstein, C. P. Poole, J. L. Safko, 3/e, Pearson Education (2014).
2. Classical Mechanics, John R. Taylor, University Science Books (2005).
3. Classical Mechanics, R. Douglas Gregory, Cambridge University Press (2015).
4. Mechanics, L. D. Landau and E. M. Lifshitz, Pergamon (2010).
5. Classical Mechanics, P. S. Joag, N. C. Rana, McGraw Hall Education (2017).
6. Classical Dynamics of particles and system, S. T. Thornton, J. B. Marion, Cengage Learning (2012).
7. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, McGraw Hill Education (1997).