Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NMEC520	Advanced Dynamics	3	1	0	4

Course Objective
• To learn the advanced topics in the dynamics of particles and rigid bodies using the approaches of Newtonian and analytical dynamics.
Learning Outcomes
• Develop insights into rigid-body rotation • To write equations of motions of 3D multi-body systems • To formulate trajectories of planetary bodies • Application of Variational principles to dynamical systems

Unit No.	Topics to be Covered	Lecture Hours (L+T)	Learning Outcomes
1	Coordinate systems, relative motion, kinematics of a particle in rotating frame and non-rotating frames	3+1	Students will be familiar with different coordinate systems and with kinematics in inertial and non-inertial frames.
2	Kinetics of system of particles, work-energy relation, conservation of linear and angular momentum for system of particles	5+2	Learning to apply the conservation laws for a system of particles
3	Central force motion, Conic-sections, energy analysis, perturbed two-body problem, restricted two-body problem	6+2	Formulating central force systems involving the motion of planetary bodies.
4	Dynamics of systems with steady and variable mass flow, incremental analysis, angular momentum in steady and variable mass flow, chain problems.	5+1	Students will learn to express equations of motion for systems with steady and variable mass flow.
5	Spatial kinematics of rigid bodies, Kinematics of rotation, Rotation Matrices, Euler's theorem, Euler angles, Euler-Rodriguez formula	6+2	Students will learn to visualize the rotations of a 3D rigid-boy.
6	Rigid Body Kinetics- Body- fixed frame of reference, Angular Momentum Tensor, Kinetic Energy for Spheric motion and General motion, Eulers equation of motion and modified Eulers equation, Application in Gyrodynamics	7+2	Students will learn to express the angular momentum and kinetic energy of 3D rigid bodies. Subsequently, write its equations of motion.
6	Introduction to analytical dynamics, generalized coordinates, Systems with Constraints- Holonomic and non-Holonomic constraints	4+2	To understand the concept of generalized coordinates, different types of constraints in dynamical systems
7	Hamilton's principle, Lagrange's equation of motion, its applications in obtaining equations of motion for discrete and continuous systems, Noether's theorem and symmetry.	6+2	Students will be familiar with the application of Hamilton's and Euler-Lagrange's techniques in analyzing the dynamics of mechanical systems.
	Total	42+14	

Text Books:

1. Methods of Analytical Dynamics by Leonard Meirovitch, Dover publications.
2. Engineering Dynamics by Meriam and Kraige, sixth edition, Wiley publications.

Reference Books:

1. Classical Mechanics by Herbert Goldstein, Charles P. Poole, John Safko, Pearson.
2. Advanced Dynamics by Donald T. Greenwood, Cambridge University Press.
3. Vector Mechanics for Engineers, Beer and Johnston, 12th edition, McGraw Hill Education