17HS053 MECHANICS

Course Description and Objectives:

This course to create a solid foundation for understanding basic principles of mechanics and some classical problems. To learn Lagrangian and Hamiltonian formulations of classical mechanics and to learn the importance and consequences of canonical transformations.

Course Outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

COs	Course Outcomes
1	Derivation of Lagrange's equation using elementary calculus as an alternative to the more advanced variational calculus derivation.
2	The use of Hamilton-Jacobi in identifying conserved quantities for a mechanical system, even when the mechanical problem itself cannot be solved completely.
3	Defining different sets of generalized coordinates for a given mechanical system and the use of canonical transformations.
4	Familiarize with subject matter, which has been the single centre, to which were drawn mathematicians, physicists, astronomers and engineers together.
5	The use of analytical treatments in checking the numerical models.

Skills:

1. Understand the concepts of stress mechanical system and its generalized coordinates.
2. Know the analysis made on equations which are derived from the equation of continuity.
3. Analyze equations of Lagrange and Hamilton.

Unit – I : (10 hours)

D'Alembert's Principle and Lagrange's Equations : some definitions – Lagrange's equations for a Holonomic system – Lagrange's Equations of motion for conservative, nonholonomic system.

Unit – II: (10 hours)

Variational Principle and Lagrange's Equations: Variatonal Principle – Hamilton's Principle – Derivation of Hamilton's Principle from Lagrange's Equations – Derivation of Lagrange's Equations from Hamilton's Principle – Extension of Hamilton's Principle – Hamilton's Principle for Non-conservative, Non-holonomic system – Generalised Force in Dynamic

System – Hamilton's Principle for Conservative, Non-holonomic system – Lagrange's Equations for Non-conservative, Holonomic system - Cyclic or Ignorable Coordinates.

Unit –III: (15 hours)

Conservation Theorem, Conservation of Linear Momentum in Lagrangian Formulation – Conservation of angular Momentum – conservation of Energy in Lagrangian formulation.

Unit – IV: (15 hours)

Hamilton's Equations of Motion: Derivation of Hamilton's Equations of motion – Routh's procedure – equations of motion – Derivation of Hamilton's equations from Hamilton's Principle – Principle of Least Action – Distinction between Hamilton's Principle and Principle of Least Action.

Unit – V: (10 hours)

Canonical Transformation: Canonical coordinates and canonical transformations – The necessary and sufficient condition for a transformation to be canonical – examples of canonical transformations – properties of canonical transformation – Lagrange's bracket is canonical invariant – poisson's bracket is canonical invariant - poisson's bracket is invariant under canonical transformation – Hamilton's Equations of motion in poisson's bracket – Jacobi's identity for poisson's brackets.

Reference Text Books :

1. Classical Mechanics by C.R.Mondal, Prentice Hall of India, New Delhi.
2. A Text Book of Fluid Dynamics by F. Charlton, CBS Publications, New Delhi.
3. Classical Mechanics by Herbert Goldsteinm, Narosa Publications, New Delhi.
4. Fluid Mechanics by T. Allen and I.L. Ditsworth, McGraw Hill, 1972
5. Fundamentals of Mechanics of fluids by I.G. Currie, CRC, 2002
6. Fluid Mechanics : An Introduction to the theory, by Chia-shun Yeh, McGraw Hill, New Delhi, 1974
7. Introduction to Fluid Mechanics by R.W Fox, A.T Mc Donald and P.J. Pritchard, John Wiley and Sons Pvt. Ltd., 2003