M. Sc. I Year		MPH-C102			Semester-I
		CLASSICAL MECHANICS			
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
60	**3 Hrs**	**30**	**70**	**100**	**04**

- ***Learning Objectives*** *-This course is designed to make students enable to deal with the Variational & least action principle, Lagrangian and Hamiltonian formalism for different classical systems with the importance of concepts such as generalized coordinates, constrained motion and canonical transformations. This paper also deals with the motion under central forces to know about conservative and central-conservative force as well as to establish that Kepler's laws of planetary motion. It also delineate with the linear approximation to any dynamical system near equilibrium and to derive and solve the wave equation for small oscillations.*

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain 10 short answer type questions of six marks each and student shall be required to attempt any five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllbus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

LAGRANGIAN FORMALISM AND VARIATIONAL PRINCIPLE

Mechanics of a particle and system of particles, Conservation laws, Constraints, Degree of freedom, Generalised coordinates, D'Alembert's principle, Lagrange's equation of motion from D' Alembert's principle, Application of Lagrange's equation of motion to a particle and system of particles,Conservation theorem, Hamilton's variational principle, Euler- Lagrange's differential equation. **(12 Lectures)**

UNIT-II

HAMILTONIAN FORMALISM

Need of Hamiltonian procedure, Legendre's transformation and Hamiltonian equations of motion, Physical significance of Hamiltonian, Cyclic coordinates, Hamiltonian equatons in cylindrical and spherical coordinates and their applications, Application of Hamiltonian equation of motion to a particle and system of particles. **(12 Lectures)**

UNIT-III

LEAST ACTION PRINCIPLE AND CANONICAL TRANSFORMATIONS

The principle of least action (no proof), Canonical or contact transformations, Their advantages and examples, Condition for a transformation to be canonical, Infinitesimal contact transformations (ICT), Poisson's Brackets: Definition and properties, Invariance with respect to canonical transformations, Equation of motion in Poisson Bracket form, Jacobian's identity.

(12 Lectures)

UNIT- IV

MOTION UNDER CENTRAL FORCES

Equivalent one body problem, General features of central force motion, Study of orbits, Virial Theorem, Kepler's laws of planatery motion, Laplace-Runge-Lenz vector, Unbound motion, Scattering in a central force field, Lagrangian and Hamiltonian formulation of relativistic mechanics. **(12 Lectures)**

UNIT-V

MECHANICS OF RIGID BODIES AND THEORY OF SMALL OSCILLATIONS

Coordinates for rigid body motion, Euler's angles, Angular momentum of a rigid body, Moments and products of inertia, Principal axes transformation, Euler's equation of motion of a rigid body, Stable and unstable equilibriums, Lagrange's equation of motion for small oscillaitons, Normal co-ordinates and normal mode, Frequencies of vibration, Free vibration of linear triatomic molecules. **(12 Lectures)**

Text Books / Reference Books

1. Classical Mechanics- N .C Rana and P.S. Joag (Tata Mcgraw-Hill, 1991)
2. Classical Mechanics- H. Goldstien (Addison Wesley, 1980)
3. Mechanics- A. Sommerfeld (Academic Press, 1952)
4. Introduction to Dynamics- I. Perceival and D. Richards (Canbridge Univ. Press)

- ***Learning Outcomes-*** *Upon successful completion of this course, it is intended that a student will be able to learn completely about Lagrangian and Hamiltonian formulation of classical mechanics. This course will make students able to state the conservation principles involving momentum, angular momentum and energy and to understand that they follow from fundamental equations of motion. It will also provide them a deep understanding of Newton's laws and motion of a particle under central force field. With the completion of the course, the students will also be able to understand the mechanics of rigid bodies and motion of small oscillations in a diversified scenario.*