Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2023-2024

Course Handout Part II

Date: 11-08-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : PHY F211
Course Title : Classical Mechanics
Instructor-in-Charge : Meenakshi V

Scope and Objective of the Course:

The cosmos is filled with dynamical systems - that which evolve with time. In the foundational course on mechanics, Newton's laws were applied to comprehend mechanical systems. In this course, two elegant formulations of mechanics, namely, Lagrangian and Hamiltonian will be introduced: These formulations use energies rather than forces, and help develop a rich geometrical view of the temporal evolution of dynamical systems (goes beyond mechanics) in phase space formed by dynamical variables. It provides conceptual and mathematical underpinnings for various courses in the M.Sc. (Physics) program, covering topics like Legendre transform, Liouville's theorem (helps distinguish dissipative and conservative systems), Poisson brackets (help understand the origin of the uncertainty principle), theory of small oscillations, etc. The phenomenon of chaos, which has led to renewed interest in classical mechanics, will be briefly discussed.

Text Book:

Classical Mechanics by John R Taylor, University Science Books, 2005.

Reference Books:

1) Analytical Mechanics by Louis N Hand and Janet D Finch, Cambridge University Press, 1998.
2) H. Goldstein, C. Poole & J. Safko, Classical Mechanics, Third Edition, Pearson Education, Inc., 2002

Lecture No.	Learning objectives	Topics to be covered	Chapter
1	Introduction	Overview of the course Motivation for using Lagrangian formalism	
2 – 7	Calculus of Variation, Least Action Principle	Euler - Lagrange Equation and its application; The Brachistochrone Problem	6 (Taylor)
8 - 13	Lagrangian Mechanics	Unconstrained and constrained systems, Generalized coordinates, Cyclic coordinates, Noethers theorem	7 (Taylor)
14 - 17	Non-linear Mechanics and Chaos	Phase space trajectories, non linear dynamics and conditions for chaos, Liouville's theorem	12.7, 13.6, 13.7 (Taylor)
18 - 23	Central Forces and the Kepler problem	Lagrangian for central force motion, equation for the orbit, bounded and	8 (Taylor)

		unbounded orbits	
24 - 28	Coupled Oscillators and Normal Modes	Lagrangian approach to the double pendulum, Three coupled pendulum	11.4 – 11.6 (Taylor)
29 - 34	Hamiltonian Mechanics	Legendre transformation, Hamiltons equation of motion for one and higher dimensions	13.1 – 13.3 (Taylor) / 5.4 - 5.5 (Hand and Finch)
35 - 39	Canonical Transformations	Generating functions, Poisson Brackets, Hamilton Jacobi and integrable equations	6.1 – 6.6 (Hand and Finch)
40	Review and Conclusion		

Evaluation Scheme

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Surprise Quiz / Classwork (Lecture and Tutorial)	variable	30%	--	Open Book
Mid-semester Exam	90 min	30%	11/10 - 9.30 - 11.00AM	Closed Book
Comprehensive Examination	180 min	40%	12/12 FN	Closed Book

Chamber Consultation Hour: To be announced in class.

Notices: All notices concerning this course will be displayed in CANVAS.

Make-up Policy: No makeup will be provided for any surprise quiz component. For mid-semester and comprehensive exam, make-up will be granted only for genuine health issues (with supporting document) with prior permission.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester. Any form of academic dishonesty would lead to serious actions.

Instructor-in-charge