MPH-002

ASSIGNMENT BOOKLET

M.Sc. (Physics) Programme
(MSCPH)

CLASSICAL MECHANICS I

Valid from 1st January, 2025 to 31st December, 2025

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2025)

Dear Student,

Please read the section on assignments in the Programme Guide for M.Sc. (Physics). A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet. The total marks for this assignment is 50, of which 20 marks are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO.: ……

NAME: ……

ADDRESS: ……

COURSE CODE:……..

COURSE TITLE: ……

ASSIGNMENT CODE: ……..

STUDY CENTRE: …….. **DATE:** ……

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) **Submit the assignment answer sheets within the due date.**

6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted. We strongly suggest that you retain a copy of your answer sheets.**

7) This assignment is **valid from 1st January, 2025 to 31st December, 2025**. If you have failed in this assignment or fail to submit it by December 31, 2025, then you need to get the assignment for the year 2026, and submit it as per the instructions given in the Programme Guide.

8) **You cannot fill the examination form for this course** until you have submitted this assignment. For any queries, please contact: slamba@ignou.ac.in and mbnewmai@ignou.ac.in

We wish you good luck.

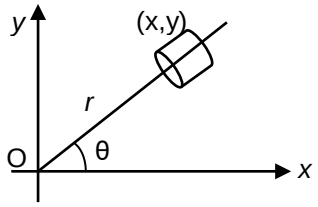
Tutor Marked Assignment
CLASSICAL MECHANICS I

Course Code: MPH-002
Assignment Code: MPH-002/TMA/2025
Max. Marks: 50

Note: Attempt all questions. The marks for each question are indicated against it.

1. a) (i) What are holonomic and non- holonomic constraints ? Write down the equations for the constraints for three point masses connected by rigid rods of length L. (5)

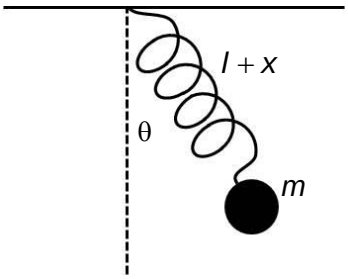
(ii) A bead of mass m slides on a smooth rod which is rotating about one fixed end in a vertical plane with uniform angular velocity ω.



Write the Lagrangian for the system and obtain the equation of motion. (5)

b) (i) Derive the Euler-Lagrange equation of motion for a bead of mass m sliding due to gravity on a circular wire. (5)

(ii) Consider a spring mass pendulum, where m is the mass of the pendulum. The motion of the pendulum is constrained as given in the figure:



The motion is assume to take place only in the vertical plane. The equilibrium length of the spring is l, while its angle with the vertical is $\theta(t)$. Obtain the equations of motion for x and θ. (10)

2. a) Consider a potential $V(r) = kr^2$, $k > 0$

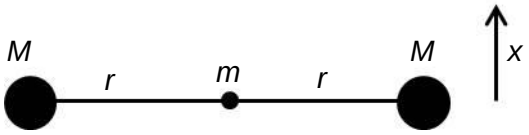
(i) Obtain the expression for effective potential $V_{eff}(r)$.

(ii) Determine the nature of the force associated with the potential.

(iii) Obtain $r_{\min}$ and for a two-body system.

(iv) Show that the Laplace-Runge-Lenz vector is not conserved for the given potential. (10)

b) Consider a system as given in the figure, where the masses *M* are fixed and *m* is the dynamical system:



(i) Write the change in potential for a small displacement.

(ii) Write the change in potential for a small perpendicular displacement.

Explain whether the displacement is stable or unstable for the two cases. (5)

c) A mass on the end of a spring, has a natural frequency 2ω, The system is immersed in a fluid that causes the motion to be overdamped, $\Gamma = -b\dot{q}$. Obtain the times at which the speed of the mass becomes maximum. (10)

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