MPH-002

ASSIGNMENT BOOKLET

M.Sc. (Physics) Programme
(MSCPH)

CLASSICAL MECHANICS-I

Valid from 1st July, 2023 to 30th June, 2024

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2023-24)

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 complete assignment answer sheet 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 July, 2023 to 30th June, 2024**. If you have failed in this assignment or fail to submit it by June 30, 2024, then you need to get the assignment for the year 2024-25, 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: mbnewmai@ignou.ac.in, slamba@ignou.ac.in

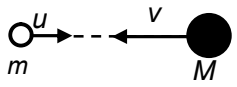
We wish you good luck.

Tutor Marked Assignment
CLASSICAL MECHANICS-I

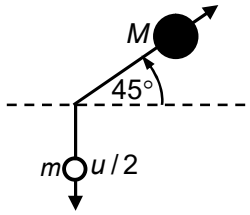
Course Code: MPH-002
Assignment Code: MPH-002/TMA/2023-24
Max. Marks: 50

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

1. a) A particle of mass m moving to the right with an initial velocity u collides elastically with a particle of unknown mass M coming from the opposite direction. After the collision m has a velocity $u/2$ at right angles to the incident direction, and M is deflected back making an angle of 45° degrees to its incident direction as shown below. Calculate the ratio M/m.



Before



After

b) Write down the equations of constraint/s for the following systems and classify them as holonomic/nonholonomic and scleronomic/rheonomic:

i) a particle of mass m sliding down the surface of a sphere of radius R without friction, under the action of gravity.

ii) a simple pendulum of length L for which the point of support is oscillating vertically with an angular speed ω and amplitude A. (5+5)

2. Using the D' Alembert's Principle determine the equation of motion for an Atwood's machine with masses M and $3M$. (10)

3. The kinetic and potential energies for a mechanical system with two generalized coordinates q_1 and q_2 are

$$T = q_2^2 \dot{q}_1^2 + 2\dot{q}_2^2 \;\; ; V = q_1^2 - q_2^2$$

i) Write down the Lagrangian for the system.

ii) Obtain the expressions for the generalized momenta.

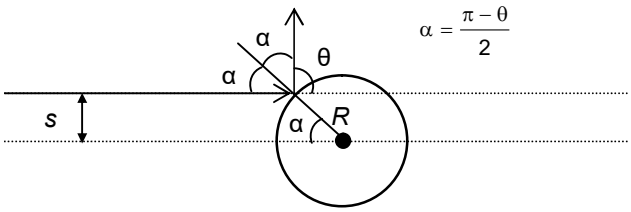
iii) Derive the Euler Lagrange equations of motion for the system.

iv) Obtain the energy function for the system.

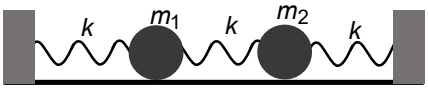
(2+2+4+2)

4. A particle moves under a central force, $f(r) = -k r^3 \hat{r}$, $k > 0$. Is this an attractive or a repulsive force? Find the radius and energy of the circular orbits. (5)

5. A particle is scattered by a rigid sphere of radius R, as given in the figure. Determine the differential scattering cross-section and the total scattering cross-section. (5)



6. Consider three identical springs and two masses $m_1 = m$ and $m_2 = 2m$, as shown in the figure. The motion of the two masses are constrained along the line joining them. Find the normal mode frequencies and the normal coordinates. (10)



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