

BPHCT-131

ASSIGNMENT BOOKLET

**BACHELOR'S DEGREE PROGRAMME
(BSCG)**

MECHANICS

Valid from 1st January, 2024 to 31st December, 2024



**School of Sciences
Indira Gandhi National Open University,
Maidan Garhi, New Delhi-110068
(2024)**

Dear Student,

Please read the section on assignments in the Programme Guide for B.Sc. that we sent you after your enrolment. 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, and it consists of two parts, Part A and B. The total marks of all the parts are 100, of which 35% 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) Solve Part A and Part B of this assignment, and **submit the complete assignment answer sheets containing Parts A and B 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, 2024 to 31st December, 2024**. If you have failed in this assignment or fail to submit it by December 31, 2024, then you need to get the assignment for the year 2025, 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: srjha@ignou.ac.in, slamba@ignou.ac.in

We wish you good luck.

Tutor Marked Assignment

MECHANICS

Course Code: BPHCT-131

Assignment Code: BPHCT-131//TMA/2024

Max. Marks: 100

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

PART A

1. a) Determine the projection of $\vec{A} + 2\vec{B}$ on \vec{B} where $\vec{A} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{B} = -\hat{i} + 4\hat{j} + \hat{k}$. (5)
- b) Obtain the derivative and unit tangent vector at $t = 1$ for a vector function $\vec{a}(t) = t\hat{i} + e^{t^2}\hat{j} + \sin 2t\hat{k}$. (5)
2. Solve the following ordinary differential equations:
- a) $\left(4x^3y^3 + \frac{1}{x}\right)dx + \left(3x^4y^2 - \frac{1}{y}\right)dy = 0$. (5)
- b) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$ for $y(0) = 1$, $y'(0) = 3$. (10)
3. a) A mass of 10 kg, is released from rest on an incline that makes a 30° angle with the horizontal. In 2 s, the mass is observed to have moved a distance of 4 m. What is the coefficient of kinetic friction between the mass and the surface of the incline? Draw the free body diagram. (10)
- b) A ball of mass 0.5 kg collides with a wall at a speed of 15.0 ms^{-1} and bounces back with a speed of 12.5 ms^{-1} . If the average force exerted by the ball is 1100 N calculate the impulse and the time for which the collision lasted. (5)
- c) A box of mass 8 kg slides at a speed of 10 ms^{-1} across a smooth level floor before it encounters a rough patch of length 3.0 m. The frictional force on the box due to this part of the floor is 70 N. What is the speed of the box when it leaves this rough surface? What length of the rough surface would bring the box completely to rest? (10)

PART B

4. a) A cylindrical drum has a radius of 0.45 m and is initially at rest. It is then given an angular acceleration of 0.40 rad s^{-2} . At time $t = 8.0 \text{ s}$ calculate (i) the angular speed of the drum, (ii) the centripetal acceleration of a point on the rim of the drum, (iii) the tangential acceleration at that point, and (iv) the resultant acceleration at that point. (10)
- b) The distance between the oxygen molecule and each of the hydrogen atoms in a water (H_2O) molecule is 0.96 \AA and the angle between the two oxygen-hydrogen bonds is 105° . Treating the atoms as particles, find the centre of mass of the system. (5)

- c) The planet earth is 1.5×10^{11} m from the sun and orbits the sun in one year. The planet Pluto takes 248 years to orbit the sun. How far is Pluto from the sun? (5)
- d) A 1400 kg car moving south at 11 ms^{-1} is struck by a 1800 kg car moving east at 30 ms^{-1} . The cars are stuck together. How fast and in what direction do they move immediately after the collision? (2016) (5)
5. a) The oscillation of a simple harmonic oscillator is described by the equation
- $$x(t) = 0.6 \sin(0.2t + 0.8) \text{ m}$$
- where t is expressed in seconds. Determine the amplitude, time-period and frequency of oscillation, maximum velocity, maximum acceleration and initial displacement of the oscillator. (5)
- b) The following two orthogonal oscillations act on a body simultaneously:
- $$x(t) = 0.4 \cos(10\pi t) \text{ m}, y(t) = 0.4 \cos\left(10\pi t + \frac{\pi}{2}\right) \text{ m}$$
- Determine the path of resultant motion of the body. (5)
- c) A damped harmonic oscillator has a first amplitude of 30 cm. The amplitude reduces to 3 cm after 100 oscillations. If the period of damping is 9.2s calculate the logarithmic decrement and damping factor. Also determine the number of oscillations in which the amplitude drops by 50 percent. (10)
- d) A progressive transverse wave is given by $y(x,t) = 0.06 \sin(1256t - 31.4x) \text{ m}$, where t is in seconds. Determine the direction of propagation of the wave and calculate its amplitude, wavelength, frequency and velocity. (5)
