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[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1010

D

Unique Paper Code : 2222511101

Name of the Paper : Mechanics

Name of the Course : B.Sc. (Prog.)

Semester : I

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **four** questions in all.
3. **All** questions carry equal marks.
4. Question No. 1 is compulsory.
5. Non-programmable calculator is allowed.

P.T.O.

1. Attempt all :

(5×3)

(a) Prove that $\vec{A} = 3y^4 z^2 \hat{i} + 4x^3 z^2 \hat{j} - 3x^2 y^2 \hat{k}$ is solenoidal.

(b) Write short note on inertial and non-inertial frame of reference.

(c) A particle of mass m moves along the curve

$\vec{r} = 2t^2 \hat{i} + (t^2 - 4t) \hat{j} - (t + 5) \hat{k}$, find its angular momentum.

(d) State and prove work-energy theorem.

(e) Calculate the period of revolution of Neptune around the sun, given that the diameter of the orbit is 30 times the diameter of the earth's orbit around the sun. Assume both orbits are circular.

2. (a) Evaluate $\vec{\nabla} \times \left(\frac{\vec{r}}{r^2} \right)$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$. (7)

(b) Solve the differential equation :

$$y'' + 2y' + y = 0; y(0) = 1, y'(0) = -1 \quad (5)$$

- (c) Find the speed at which the mass of an electron is double of its rest mass. (3)
3. (a) Deduce an expression for the moment of inertia of a rectangular lamina of length l and width b about an axis through its centre and parallel to one side. Hence also find the moment of inertia about an axis coinciding with one side. (7)
- (b) What are central forces? Give examples and show that under the influence of a central force field the angular momentum is conserved. (5)
- (c) Explain elastic and inelastic collision. (3)
4. (a) What is the simple pendulum. Derive the differential equation for simple pendulum having mass m and length l . What are the drawbacks of simple pendulum. (7)
- (b) If we double the length of the pendulum, what effect will you see on the time period of simple pendulum? Does mass affect the time period also? (5)

(c) If $\vec{F} = (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$, determine whether it is conservative or non-conservative force. (3)

5. (a) State and deduce the mathematical expression for the law of relativistic velocities. Show that the resultant velocity of a particle can never be greater than c . (7)

(b) A person in a train at a speed 3×10^7 m/s sleeps at 10:00 pm by his watch and gets up at 4:00 am. How long did he sleep according to the clock at the station? (5)

(c) Four particles each of mass m are kept at the four corners of a square of side 'a'. Find the moment of inertia of the system about a line perpendicular to the plane of the square and passing through the center of square. (3)

[Symbols :

C : speed of light.]