SCHOOL OF ENGINEERING AND TECHNOLOGY
D.C. COURT JUNCTION, DIMAPUR
MID-TERM EXAMINATIONS, October 2022

Course Code:	GET02	Semester:	I	Total:	40 Marks
Course Name:	Engineering Physics-I			Time:	1½ hours

(Write only the question number on the answer script)

Part – A

Q.1. Answer the following questions $5 \times 1 = 5$

a. A man is standing on a disc at a distance of 3 m from the disc's centre. The disc itself is rotating at constant angular speed of 2 rad/s. The speed of the man with respect to the ground is _____.

b. Consider a rigid body rotating around an axis. Though there are various forces acting on this rigid body, it turns out that the component of torque along this axis is zero. Then the angular velocity of the body around the axis is _____.

c. Suppose a force $\vec{F} = \hat{i} + 2\hat{j} - \hat{k}$ N acts on particle at a displacement of $\vec{r} = 2\hat{i} + \hat{j} + 3\hat{k}$ m from the origin. The torque of the particle around the origin is (give the vector expression) _____ N m.

d. A ball of mass 2 kg is moving in the positive X-direction with a speed of 3 m/s. Soon, it collides with a ball of mass 1 kg also moving in the positive X direction with a speed of 2 m/s. Suppose that after collision the two balls stick together and continue moving in the positive X direction. Their joint speed is _____.

e. An astronaut in the International Space Station gently releases a samosa in mid air inside her cabin. She observes that the samosa flies away to her left with an acceleration of 0.5 m/s^2. So she concludes that the space station must be non-inertial and accelerating to the right with an acceleration of _____.

Part – B

Q.2. Answer any three questions $3 \times 3 = 9$

a. Find the centre of mass of a water molecule H_2O. For simplicity assume that the two hydrogen-oxygen bonds subtend an angle of 120°, each bond has a length of 10^{-10} m and the oxygen atom is sixteen times heavier than a hydrogen atom.

b. A small bead of mass m is constrained to slide on a thin rod. The entire apparatus is kept on a frictionless horizontal table. The rod rotates about one of its ends at constant angular velocity ω. Assume that the bead's radial motion is given by $r(t) = Ae^{\omega t}$, where A is a constant. Find the full acceleration vector $\vec{a}(t)$ of the bead as a function of time, the condition under which the radial acceleration vanishes and the condition under which the tangential acceleration vanishes.

c. Find the moment of inertia of a hollow cylinder of mass M, radius R and length L around its axis.

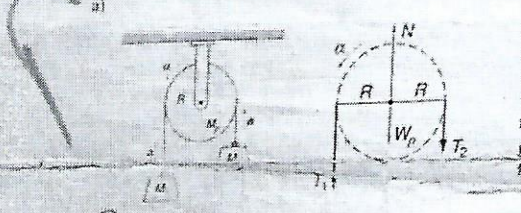
d. 

Cars A, B and C have the same mass. As shown, cars B and C have a small gap between them initially and they are at rest with their brakes off. Car A plows into B at high speed, pushing B into C. If all collisions are completely inelastic, what fraction of the initial energy is dissipated when car C is struck?

Part – C

Q.3. Answer the following questions

a) **(5 marks)**



Draw the force diagram for mass M_1 and M_2. Assume that the rope does not slip on the pulley. The torque τ_{net} acting on the pulley is given for your convenience. Recall that the moment of inertia of the disc shape pulley is given by $I_p = \frac{M_2 R^2}{2}$. Find the acceleration of for the arrangement shown.

(5 marks)

b) Consider a simple pendulum consisting of a bob of mass 1 kg suspended from a light string of length 1 m. The pendulum is oscillating in a plane. The bob's speed at the bottommost point of its trajectory is 0.1 m/s. What is the maximum angle from the vertical attained by the bob during the course of its oscillation?

(6 marks)

c) N persons, each of the same mass, stand on a truck of mass M. They decide to jump off the end of the truck, but always with velocity v relative to the truck. Assume that the truck can roll without friction. Initially the truck, together with the persons on it, is stationary.

(a) What is the final velocity of the truck if all the men jump off at the same time?

(b) What is the final velocity of the truck if they jump off one at a time?

(c) Which of the above cases yields the larger final velocity of the truck? Can you give a simple physical explanation for your answer?