



'সমানো মন্ত্র: সমিতি: সমানী'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 1st Semester Examination, 2023

CC2-PHYSICS

MECHANICS

Time Allotted: 2 Hours

Full Marks: 40

The figures in the margin indicate full marks.

GROUP-A

1. Answer any **five** questions from the following: 1×5 = 5
- (a) State the principle of conservation of angular momentum.
 - (b) Write down any two relations between the elastic constants.
 - (c) What is the amount of angular deflection of a projectile shot horizontally at the north pole having a time of flight of 100 sec?
 - (d) A particle is subjected to a linear restoring force $\vec{F} = -k\vec{x}$ (k is constant). Find out the potential energy.
 - (e) Write down the Poiseuille's formula for fluid motion.
 - (f) State the condition under which the orbit of a planet will be hyperbolic.
 - (g) What do you mean by massless particles? Give examples.
 - (h) Does the Lorentz force remain invariant under the Galilean transformation?

GROUP-B

Answer any three questions from the following 5×3 = 15

2. (a) Determine the time-average of the total energy for a single harmonic motion. 3
- (b) Distinguish between the transient and steady states for oscillators. 2
3. (a) Explain the concept of time dilation and obtain the expression for it for a moving system. 3
- (b) Find out the change in length of a rod of length ' l ' along the x -axis and moving with a velocity of $0.85c$ relative to a stationary observer, where c is the velocity of light and $l = 2$ cm. 2
4. (a) Compare the gravitational potential at the centre and the surface of a spherical shell. 2
- (b) For a solid sphere, draw the graph showing the variation of the gravitational potential and the field with distance. 3

5. Show that the total energy of a system of particles moving under the action of a central force is conserved. 5
6. (a) Two particles of mass m_1 and m_2 connected by a massless string are at a distance x apart. Find out the moment of inertia of this system a about an axis passing through the C. M. and perpendicular to the line joining the particles. 3
- (b) What is Reynold's number? Write down its significance. 2

GROUP-C

Answer any two questions from the following

10×2 = 20

7. (a) Derive Poiseuille's equation for the steady flow of an incompressible viscous liquid, through a horizontal capillary of uniform cross section. What are the major corrections that should be applied to this formula for a more realistic system? 6+1
- (b) A body of mass m at rest disintegrates into two pieces of masses m_1 and m_2 . Show that their energies E_1 and E_2 will have a ratio like, $E_1 : E_2 = m_2 : m_1$. 3
8. (a) State Einstein's postulates of special theory of relativity. 2
- (b) Derive the Lorentz space-time transformation formulae by using these postulates. 5
- (c) On the basis of Lorentz transformation discuss the phenomenon of length contraction. 3
9. (a) Write down the expression for the differential equation of motion of a particle under damped oscillation. 2
- (b) Solve the differential equation for all possible types of damping. 6
- (c) Estimate the energy lost per cycle of oscillation. 2
- 10.(a) Show that $\frac{dT}{dt} = \vec{F} \cdot \vec{v}$, where T is the kinetic energy, \vec{F} and \vec{v} are respectively the force and velocity of a particle. 3
- (b) For a conservative force field $\vec{F}(r)$, prove that $\vec{\nabla} \times \vec{F}(r) = 0$. 2
- (c) Three particles each of mass ' m ' are placed at $(a, 0, 0)$, $(0, a, 0)$ and $(0, 0, a)$. Set up the principal axes for the system and calculate the principle moment of inertia. 5

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