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B.Sc. B.Ed. Examination, 2024

(Fourth Semester)

MATHEMATICS-II

Mechanics

Time : 3 Hours]

[Maximum Marks : 30

Note : Attempt any *two* parts from each question.

1. (a) Explain analytical conditions of equilibrium of coplanar forces and give the application of coplanar forces.
- (b) Write the principle of virtual work. Why do we need virtual work ?
- (c) A sphere of given weight rests on two smooth planes inclined to the horizon at given angles. Determine the pressure on the planes.

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2. (a) A particle is describing a plane curve. If that tangential and normal accelerations are each constant throughout the motion. Prove that the angle ψ , through which the direction of motion, turns in time 't' is given by $\psi = A \log (1 + \beta t)$.
 - (b) To find the radial and transverse velocity and acceleration of a particle in a plane curve.
 - (c) A point moves in the plane curve so that its tangential and normal acceleration are equal to angular velocity of the tangent is constant. Find the curve.
3. (a) Show that in a simple harmonic motion of amplitude 'a' and period T, the velocity 'V' at a distance 'x' from the centre is given by the relation : $V^2 T^2 = 4\pi (a^2 - x^2)$.
 - (b) Define common catenary and vertex of the catenary. Give example. Write the mathematical equation of catenary.

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- (c) An elastic string of natural length $2l$ can just support a certain weight. When it is stretched till its length is $3l$ one end of the string is now attached to a point on a smooth horizontal table and the same weight is attached to the other end. Prove that if the weight be pulled to any distance and let go, the string will become slack

after a time $\frac{\pi}{2} \sqrt{\frac{l}{g}}$.

4. (a) A solid sphere rests inside a fixed rough hemispherical bowl of twice its radius. Show that however large a weight is attached to, the highest point of the sphere the equilibrium is stable.
- (b) If P and Q be two non-intersecting forces whose directions are perpendicular, show that the ratio of distance of the central axis from their lines of action all are Q^2 to P^2 .
- (c) State and prove Poinot's central axis theorem.

5. (a) A particle falls under gravity (supposed constant) is a medium in which the resistance is proportional to velocity. If the particle falls vertically downwards from a position of rest to find the velocity and displacement in time ' t '.
- (b) A particle describes the equiangular spiral $r = ae^{\theta \cot \alpha}$ under a force to the pole. Find the law of force.
- (c) Define forces in three dimension. Give examples and write their applications.