MAY 2025 **U/ID 32511/UCM4B**

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer any TEN questions.

1. State Newton's law of motion.

2. Find the magnitude and direction of the resultant of three coplanar forces P, 2P, 3P acting at point and inclined mutually at an equal angle of 120°.

3. State Lami's theorem.

4. Define Couple.

5. Define Centre of mass.

6. What is meant by virtual work?

7. Define angular velocity.

8. What is conservative forces?

9. Write the formula for maximum height attained by the particle when projected from the ground.

10. What is impulsive force?

11. Define Conical pendulum.

12. Define moment of inertia.

PART B — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

13. State and prove Triangle of forces.

14. Three forces P, Q, R act along the sides BC, CA, AB of a triangle ABC. If their resultant passes through the incentre and centroid then show that

$$\frac{P}{a(b-c)} = \frac{Q}{b(c-a)} = \frac{R}{c(a-b)}.$$

15. Find the centre of mass of a thin wire in the form of a circular arc.

16. A ship is streaming north at $8\sqrt{3}$ km.ph and a man walks a cross its deck in a direction due west at 8 km.ph. Find his resultant velocity in space.

17. Show that the force field $2x\vec{i} + 6y\vec{j}$ is conservative while $6y\hat{i} + 2x\vec{j}$ is not.

18. A particle is projected with a velocity whose horizontal and vertical components are U and V. If P_1 and P_2 are the point on its trajectory at the same height h above the point of projection show that $P_1P_2 = \frac{2v}{g}\sqrt{V^2 - 2gh}$.

19. A pendulum which beats seconds at the surface of the earth loses 10 seconds in 24 hours when taken to the summit of a hill, taking the radius of the earth to be 6400 km.

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

20. O is the orthocentre of the triangle ABC. If forces of magnitudes P, Q, R acting along DA, OB, OC are in equilibrium. Show that $\frac{P}{a} = \frac{Q}{b} = \frac{R}{c}$.

21. ABCDEF is a regular hexagon. Forces P, 2P, 3P, 2P, 5P, 6P act along AB, BC, DC, ED, EF, AF. Show that six forces are equivalent to a couple and find the moment of the couple.

22. A vertical circular disc of the radius ‘a’ roles on a ground without slipping along a straight line with a linear velocity ‘u’. Find the velocity of any point on its rim.

23. When two smooth spheres collide directly, to find the impulse imparted to each sphere and the change in the total kinetic energy of the spheres.

24. Obtain the differential equation of a central orbit in polar coordinates.

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