DECEMBER 2023 **U/ID 32511/UCM4B**

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 2 = 20$ marks)

Answer any TEN questions.

1. State Newton laws of motion.

2. If the resultant of forces $3P, 5P$ is equal to $7P$, find the angle between the forces.

3. Define moment of a couple.

4. Where will be the centre of gravity of a triangular lamina?

5. Define virtual work.

6. A man seated in a train whose velocity is 80 km.p.h. throws a ball horizontally and perpendicular to the train with a velocity of 60 km.p.h. Find the velocity of the ball immediately after the throw.

7. Define a conservative force.

8. A particle moving in a S.H.M. has amplitude 8 cm. If its maximum acceleration is 2 cm/sec^2, find its period.

9. What is the greatest height attained by a particle?

10. If the spheres are perfectly elastic, $e = 1$, what is the loss of kinetic energy?

11. If the velocity of the bob of a conical pendulum, is V and its length is l, find the inclination of the string to the vertical.

12. Write the polar equation of equiangular spiral.

PART B — ($5 \times 5 = 25$ marks)

Answer any FIVE questions.

13. State and prove Triangle law of forces.

14. If two like parallel forces of magnitudes $P, Q(P \geq Q)$ acting on a rigid body at A, B are interchanged in position, show that the line of action of the resultant is displaced through a distance $\frac{AB(P-Q)}{(P+Q)}$.

15. $ABCD$ is a square of side a. Forces $5P, 4P, 3P$, $6P$, $2\sqrt{2}P$ act along AB, BC, CD, DA, BD respectively. If the system reduces to a couple find its moments.

16. Find the centre of gravity of the sphere of radius a cut off by a plane at a distance c from the centre.

17. A car of mass 1 tonne attains a maximum speed of 45km.ph, when freely running down an incline of 1 in 10. What power must its engine develop to take it up an incline of 1 in 20 with the same speed if in both the cases the resistance is the same?

18. If U and V be the oblique components of the initial velocity in the vertical direction and in the direction of the line of greatest slope, show that the range on the inclined plane is $\frac{2UV}{g}$.

19. Find the moment of inertia of a elliptic lamina.

PART C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

20. Weights W, w, W are attached to the points B, C, D respectively of a light string AE where B, C, D divide the string into 4 equal lengths. If the string hangs in the form of 4 consecutive side of a regular octagon with the ends A and E attached to the points on the same level, show that $W = \left(\sqrt{2}+1\right)w$.

21. Four rods, each of the length a and weight w, are smoothly joined together to form a rhombus $ABCD$ which is kept in shape by a light rod BD. The angle BAD is 60° and the Rhombus is suspended in a vertical plane from A. Find the thrust of BD.

22. Find the components of velocity and acceleration of a particle in the radial and transverse directions.

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

24. Obtain the differential equation of the central orbit in P-r coordinate.
