

2025(Backlog)

Time : 3 hours

Full Marks : 75

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Answer from both the Groups as directed.

Group – A**(Compulsory)**

1. Answer the following questions : $1 \times 10 = 10$
 - (a) If X, Y, Z be the component of a force R along x, y, z axis respectively then $R^2 = ?$
 - (b) Define Wrench.
 - (c) Define Stable equilibrium.
 - (d) Define Uniform catenary.
 - (e) Define Null lines.

- (f) Define Central force.
- (g) Write the differential equation of the central orbit in the polar form.
- (h) Define compound pendulum.
- (i) Define two dimensional motion.
- (j) Write the formula for the greatest vertical height reached by the projectile during its motion.
2. (a) Obtain the general conditions of equilibrium of any given system of forces acting at given points of a rigid body. 2
- (b) Prove the equations of motion of the particle. 3

Group – B

Answer any four questions the following :

3. (a) Find the equation of the central axis of any given system of forces. 7
- (b) Two forces act, one along the line $y = 0, z = 0$ and the other along the line $x = 0, z = c$. As the forces vary, show that the surface generated by the axis of their equivalent Wrench is $(x^2 + y^2)z = cy^2$. 8

4. (a) Find the condition that the straight line $\frac{x-f}{l} = \frac{y-g}{m} = \frac{z-h}{n}$ may be a null line for any given system of forces. 7
- (b) State and prove the principle of virtual work for any system of forces in one plane. 8
5. (a) A uniform chain of length ℓ is to be suspended from two points A, B in the same horizontal line so that either terminal tension is n times that at the lowest point. Prove that the span AB must be $\frac{1}{\sqrt{n^2-1}} \log(n + \sqrt{n^2-1})$. 7
- (b) An open Cylindrical can whose height is equal to its diameter is placed on the top of a sphere. Find the least diameter of the sphere consistent with stability. 8
6. (a) Show that the central orbit is a Plane curve. 7
- (b) Prove the differential equation of Central orbit in the polar form. 8

7. (a) A Particle is projected with a velocity $2\sqrt{ga}$ so that it just clears two walls of equal height 'a' which are at a distance $2a$ from each other. Show that the latus rectum of the path is equal to $2a$ and the time of passing between the walls is $2\sqrt{\frac{a}{g}}$. 7

(b) State and prove D'Alembert's principle. 8

8. (a) A particle moves with a central acceleration $\left[= \frac{\mu}{(\text{distance})^2} \right]$ it is projected with a velocity V at a distance R . Show that its path is a rectangular hyperbola if the angle of projection is $\sin^{-1} \frac{\mu}{VR \left(V^2 - \frac{2\mu}{R} \right)^{\frac{1}{2}}}$. 7

(b) A particle describes a following curve under a force P to the plane. Find the law of force $r^2 = 2ap$. 8

