



Date: 20-06-2022

Dept. No.

Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

**PART – A**

**(10X2 =20)**

**Answer all Questions**

1. When do you say that a body is in equilibrium?
2. If two forces P and Q are at right angles, find the magnitude and direction of the resultant.
3. State the conditions of equilibrium of three coplaner parallel forces.
4. Define couples.
5. State Newton's law of motion.
6. What are absolute units of force?
7. Define trajectory.
8. What is time of flight?
9. State theorem of Parallel Axis for moment of inertia.
10. State Dr. Routh's rule.

**PART – B**

**(5X8=40)**

**Answer any five Questions**

11. Two forces act on a particle. If the sum and difference of the forces are at right angles to each other, show that the forces are of equal magnitude.
12. State and prove converse of the triangular law of forces.
13. Three like forces acting at the vertices of a triangle, have magnitudes proportional to the opposite sides. Show that their resultant passes through the incentre of the triangle.
14. State and prove like parallel forces theorem
15. A mass of 20kg falls 500cms from rest and then penetrates to a depth of 50 cm. into the sand before coming to rest. Find the average thrust of the sand.
16. Explain Atwood's Machine.
17. A stone is thrown with a velocity of 39.2 m/sec. at  $30^\circ$  to the horizontal. Find at what times it will be at a height of 14.7m.
18. Find the moment of inertia of uniform rectangular parallelepiped of edges  $2a, 2b, 2c$ .

**Answer any two Questions**

19.(a) The resultant of two forces P,Q acting at a certain angle is X and that of P,R acting at the same angle is also X. The resultant of Q,R again acting at the same angle is Y. Prove that  $P = (X^2 + QR)^{1/2} = \frac{QR(Q+R)}{Q^2+R^2-Y^2}$ . If  $P+Q+R = 0$  show that  $Y=X$ .

(b) ABCDEF is a regular hexagon and at A, act forces represented by  $\overline{AB}, 2\overline{AC}, 3\overline{AD}, 4\overline{AE}$  and  $5\overline{AF}$ . Show that the magnitude of the resultant is  $AB\sqrt{351}$  and that it makes an angle  $\tan^{-1}\left(\frac{7}{\sqrt{3}}\right)$  with AB.

20. (a) Show that when masses  $P$  and  $Q$  are connected by a string passing over the edge of a smooth table, the tension is the same whether  $P$  hangs and  $Q$  is on the table or  $Q$  hangs and  $P$  is on the table.

(b) Two particles of masses  $m_1$  and  $m_2$  are connected by a light inextensible string passing over a light smooth pulley placed at the top of a smooth inclined plane of inclination  $\alpha$  to the horizon,  $m_1$  is hanging freely and  $m_2$  is lying on the inclined plane the portion of the string on the inclined plane being parallel to the inclined plane. If  $m_1$  descends, find the resulting motion and the tension in the string.

21. (a) A particle is thrown over a triangle from one end of a horizontal base and grazing the vertex falls on the other end of the base. If  $A$  and  $B$  are the base angles and  $\alpha$  the angle of projection, show that  $\tan \alpha = \tan A + \tan B$ .

(b) The range of a rifle bullet is 1000m when  $\alpha$  is the angle of projection. Show that if the bullet is fired with the same elevation from a car travelling 36km/h towards the target, the range will be increased by  $\frac{1000\sqrt{\tan \alpha}}{7}$  m.

22(a) Find the M.I. for the uniform elliptic lamina.

(b) Show that the moment of inertia of a triangular lamina of mass  $M$  about a side is  $\frac{Mh^2}{6}$  where  $h$  is the altitude from the opposite vertex.