



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – APRIL 2013

MT 5506/MT 4501 - MECHANICS - I

Date: 10/05/2013
Time: 9:00 - 12:00

Dept. No.

Max. : 100 Marks

PART – A

Answer ALL the questions:

(10 x 2 = 20 marks)

1. What is the resolved part of a force \vec{F} .
(i) along the direction of the force?
(ii) Perpendicular to the direction of the force?
2. State Lami's theorem.
3. Define moment of a force.
4. Show that the K.E of a particle of mass m moving with velocity v is $\frac{1}{2}mv^2$.
5. State Newton's third law.
6. Define angle of friction and cone of friction.
7. Define a couple.
8. State the principle of conservation of linear momentum.
9. If a man could throw a ball 49 feet vertically upwards, find the greatest horizontal distance he could throw it.
10. Define coefficient of elasticity.

PART – B

Answer any FIVE questions:

(5 x 8 = 40 marks)

11. Prove Lami's theorem.
12. A weight is supported on a smooth plane of inclination α by a string to the vertical at an angle r . If the slope of the plane be increased to β and the slope of the string unaltered, the tension of the string is doubled prove that $\cot \alpha - 2 \cot \beta = \tan r$.
13. State and prove Varignon's theorem on moments.
14. A uniform rod AB of length $2a$ and weight W is resting on two pegs C and D in the same level cut a distance d apart. The greatest weights that can be placed at A and B without tilting the rod are W_1 and W_2 respectively. Show that $\frac{W_1}{W + W_1} + \frac{W_2}{W + W_2} = d$.
15. A and B describe concentric circles of radii a and b with speeds u and v , the motion being the same way round. If the angular velocity of either with respect to the other is zero, prove that the line joining them subtends at the centre an angle whose cosine is $\frac{au + bv}{av + bu}$.
16. Find the resultant of two like and unlike parallel forces.
17. A particle projected upwards under the action of gravity in a resisting medium where the resistance varies as the square of the velocity. Discuss the motion.
18. Two perfectly smooth spheres of masses m and $3m$ are moving with equal momenta in the same straight line. Show that the smaller sphere reduces to rest after it strikes the other.

PART – C

Answer any TWO questions:

(2 x 20 = 40 marks)

19. a) The angle between two forces of magnitudes $P + Q$ and $P - Q$ is 2α and the resultant of forces make an angle θ with the bisector of the angle between the forces. Show that $P \tan\theta = Q \tan\alpha$.

b) Two weights P and Q are suspended from a fixed point O by strings OA and OB and they are kept apart by a light rod AB . If the strings OA and OB make angles α and β with the rod, show that the angle θ which the rod makes with the vertical is given by

$$\tan \theta = \frac{P + Q}{Q \cot \beta - P \cot \alpha}. \quad (8+12)$$

20. a) One end of a uniform rod is attached to a hinge and the other end is supported by a string attached to the extremity of the rod. The rod and the string are inclined at the same angle θ to the horizontal. Show that the action at the hinge is $\frac{W\sqrt{9 + \cot^2 \alpha}}{4}$, W being the weight of the rod.

b) A ladder which stands on a horizontal ground leaning against a vertical wall is so loaded that its centre of gravity is at the distance a and b from the lower end and upper ends respectively. Show that if the ladder is in limiting equilibrium, its inclination θ to the horizontal is given by

$$\tan \theta = \frac{a - b\mu\mu^1}{(a + b)\mu}, \quad \mu, \mu^1 \text{ being the coefficients of friction between the ladder and the ground wall respectively.} \quad (10 + 10)$$

21. a) Two particles of masses m_1 and m_2 ($m_1 > m_2$) are connected by means of a tight inextensible string passing over a light, smooth, fixed pulley. Discuss the motion.

b) A ball is thrown with a velocity of 96 feet/sec from the top of a tower 200 feet high. If the angle of projection is 45° , find at what distance from the foot of the tower the ball will strike the ground. (10 + 10)

22. Prove that the path of the projectile is a parabola and also determine the time of flight, greatest height and horizontal range.

\$\$\$\$\$\$\$\$