LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FIFTH SEMESTER – **APRIL 2016**

MT 5506/MT 4501 – MECHANICS - I

Date: 30-04-2016 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART – A

ANSWER ALL THE QUESTIONS **(10 x 2 = 20)**

1. State parallelogram law of forces.
2. State triangle of forces.
3. Define torque of a force.
4. Define couple.
5. Define angular velocity.
6. If a point moves so that its angular velocity about two fixed points are same, prove that it describes a circle.
7. State Newton's first law of motion.
8. State the principle of conservation of linear momentum.
9. Write down the horizontal range for projectile.
10. Show that a particle starting with a velocity of 100 ft/sec at an angle $\tan^{-1}\frac{3}{4}$ to the horizontal will just clear a wall 36 feet high at a horizontal distance of 240 feet from the point of projection.

PART – B

ANSWER ANY FIVE QUESTIONS **(5 x 8 = 40)**

11. State and prove Lami's theorem.
12. Find the resultant of two like parallel forces.
13. A uniform rod AB of length 2a and weight W is resting on two pegs C and D in the same level at 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 are respectively. Show that $\frac{W_1}{W+W_1}+\frac{W_2}{W+W_2}=\frac{d}{a}$.
14. A and B describe concentric circles of radii a and b with speed u and v, the motion being the same way round. If the angular velocity of either w.r.t the other is zero, prove that the line joining them subtends at the centre an angle whose cosine is $\frac{au+bv}{av+bu}$.
15. Discuss the motion of a particle moving along a straight line with uniform acceleration f.
16. 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.
17. Two perfectly elastic smooth spheres of masses m and 3m are moving with equal momenta in the same straight line and in the same direction. Show that the smaller sphere is reduced to rest after it strikes the other.
18. Two spheres of equal masses moving in the same straight line with velocities u and u' collide and rebound, the coefficient of restitution being $\frac{1}{2}$. Prove that exactly half the energy is lost in collision if $\left(1-\sqrt{2}\right)u=\left(1+\sqrt{2}\right)u'$.

PART – C

ANSWER ANY TWO QUESTIONS **(2x 20 = 40)**

19. (a) Determine the magnitude and direction of the resultant of two given forces with common point of application.

(b) Two beads of weights W and $W'(W' > W)$ can slide on a smooth circular wire in a vertical plane. They are connected by a light string which subtends an angle 2β at the centre of the circle when the beads are in equilibrium on the upper half of the wire. Prove that the inclination α of the string to the horizontal is given by $\tan\alpha = \dfrac{W'-W}{W'+W}\tan\beta$. (10+10)

20. (a) Two like parallel forces P and Q (P > Q) act at A and B respectively. If the magnitudes of the forces are interchanged, show that the point application of the resultant on AB will be displaced through the distance $\dfrac{P-Q}{P+Q}AB$.

(b) State and prove Varignon's theorem on moments. (10 + 10)

21. Prove that the path of projectile is a parabola.

22. (a) A body, sliding down a smooth inclined plane, is observed to cover equal distances, each equal to a, in consecutive intervals of time t_1 and t_2. Show that the inclination of plane to the horizon is $\sin^{-1}\left[\dfrac{2a(t_1-t_2)}{gt_1t_2(t_1+t_2)}\right]$. (10+ 10)

(b) A Particle falls under gravity in a medium where resistance varies as the velocity - Discuss.

$$$$$$$