LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **APRIL 2022**

16/17/18UMT6MC02 – DYNAMICS

Date: 17-06-2022   Dept. No.   Max. : 100 Marks
Time: 01:00 PM - 04:00 PM

PART – A

Answer All Questions   **(10×2= 20)**

1. Show that a particle starting with a velocity of 100ft/sec at 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.

2. Explain the physical independence of forces.

3. Define Newton's third law of motion with an example.

4. Define simple harmonic motion.

5. What is called epoch?.

6. Define projectile with an example.

7. A point P describes with a constant angular velocity about O the equiangular spiral $r = a\,e^{\theta}$. O being the pole of the spiral. Obtain the radial and transverse acceleration of P.

8. Define central orbit.

9. Find Moment of Inertia of a particle about a straight line.

10. Define Moment of Inertia.

PART – B

Answer any FIVE Questions   **(5×8=40)**

11. A train of mass 60 tons is ascending an incline of 1 in 100. The engine exerts a constant force equal to the weight of 1 tons and the resistance due to friction etc, is 10 lbs. wt/ton. Find the acceleration with which the train ascends the incline.

12. A string passes over a fixed smooth pulley and tone end, there is attached a mass m_1 and to the other a smooth light pulley over which passes another string with masses m_2 and m_3 at the ends. If the system is released from rest, show that m_1 will not move if $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$.

13. A particle is projected so as just to graze the tops of 2 walls, each of height 20 feet, at distance of 30 ft and 170 ft respectively, from the point of projection. Find the angle of projection and the highest point reached in the flight.

14. Show that the greatest height which a particle with initial velocity u can reach on a vertical wall at a distance a from the point of projection is $\frac{u^2}{2g} - \frac{ga^2}{2u^2}$.

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15. Find the resultant of two simple harmonic motion of the same period in the same straight line.

16. Derive the differential equation of a central orbit.

17. If the law of force is μu^5 and the particle is projected from an apse at a distance 'a'. Find the orbit when the velocity of projection is $\frac{\sqrt{\mu}}{a^2\sqrt{2}}$.

18. Find the moment of inertia of a triangular lamina.

PART – C

Answer any TWO Questions (2×20=40)

19. (a) Two particles of masses m_1 and m_2 ($m_1 > m_2$) are connected by means of a light inextensible string passing over a light, smooth, fixed pulley. Discuss the motion. **(10)**

    (b) A train of mass 200 tons is running at the rate of 40 m.p.h. down an incline of 1 in 120. Find the resistance necessary to stop the train in half a mile. **(10)**

20. (a) Show that the path of the projectile is a parabola. **(14)**

    (b) From a point on the ground at a distance p from the foot of a vertical wall, a ball is thrown at an angle of $45°$ which just clears the wall and afterwards strikes the ground at a distance q on the other side. Show that the height of the wall is $\frac{pq}{p+q}$. **(6)**

21. (a) A particle executing simple harmonic motion in a straight line has velocities 8, 7, 4 at three points distant one foot from each other. Find the period. **(10)**

    (b) State and prove the theorem of parallel axes. **(10)**

22. (a) Find the moment of inertia of a solid sphere. **(10)**

    (b) A particle describes the orbit $r^n = A\cos\theta - B\sin\theta$ under a central force, the pole being the centre. Find the law of force. **(10)**

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