



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

SIXTH SEMESTER – APRIL 2017

MT 6607- DYNAMICS

Date: 22-04-2017
09:00-12:00

Dept. No.

Max. : 100 Marks

PART – A

Answer ALL questions.

(10 × 2 = 20)

1. State Newton's laws of motion.
2. What is meant by relative acceleration of A with respect to B?
3. What is the time of flight of a projectile?
4. Defining enveloping parabola.
5. Give an example of a Simple Harmonic Motion.
6. What is meant by frequency of a Simple Harmonic Motion.
7. State differential equation of a central orbit.
8. Define apse.
9. State units of moment of inertia in different systems.
10. State perpendicular axes theorem of moment of inertia.

PART – B

Answer any FIVE questions

(5 × 8 = 40)

11. A train of mass W tons is moving with an acceleration of f ft/sec² when a carriage of mass w tons is suddenly detached. Find the new acceleration if (i) resistance be neglected (ii) resistance be supposed to be k lb. wt. / ton.
12. 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 , t_2 . Show that the inclination of plane to the horizon is $\text{Sin}^{-1} \left[\frac{2a(t_1 - t_2)}{gt_1 t_2 (t_1 + t_2)} \right]$.
13. 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 $\frac{pq}{p+q}$.
14. A particle moves in a S.H.M. in a straight line. In the first second, after starting from rest, it travels a distance a and in the next second, it travels a distance b in the same direction. Prove that the amplitude of the motion is $\frac{2a^2}{3a-b}$.
15. State and prove parallel axes theorem.
16. A particle describes the equiangular spiral $r = ae^{\theta \cot \alpha}$. If the radius vector to the particle has a constant angular velocity, show that the resultant acceleration of the particle makes an angle 2α with the radius vector and is of magnitude $\frac{v^2}{r}$ where v is the speed.

17. Derive the p-r equation of a central orbit.

18. Show that the moment of inertia of the paraboloid of revolution about its axis is $\frac{Mr^2}{3}$ where M is its mass and r is the radius of the base.

PART – C

Answer any TWO questions.

(2 × 20 = 40)

19. (a) An engine and train weigh 420 tons and engine exerts a force of 7 tons wt. (i) If resistance of motion be 14 lbs. wt/ton, find the time the train will take to acquire a velocity of 30 m.p.h. from rest. (ii) If now steam is shut off, find the distance the train will run before coming to rest. (iii) Find this distance, if the brakes are also applied assuming resistance due to brakes is 126 lbs. wt./ton.

(b) Show that the velocity with which a particle must be projected down a smooth inclined plane of length l and height h so that the time of descent shall be the same as taken by another particle in falling freely through a distance equal to the height of the plane is

$$\frac{l^2 - h^2}{l} \sqrt{\frac{g}{2h}} \quad (10 + 10)$$

20 (a) 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 $\frac{u^2}{2g} - \frac{a^2g}{2u^2}$. (10+10)

(b) Show that M.I. of a truncated cone about its axis, radii of its ends is $\frac{3M}{10} \frac{a^5 - b^5}{a^3 - b^3}$.

21 (a) A particle executing S.H.M. has velocities v_1 , v_2 when its distances from O, the centre of oscillations are d_1 and d_2 respectively. Find the amplitude, periodic time and the velocity of the particle when its distance from O is $\frac{1}{2}(d_1 + d_2)$.

(b) A particle describes a central orbit under the action of a central force. Prove that the areal velocity of the particle is constant. (10 + 10)

22 (a) Find the M.I. of an elliptic lamina.

(b) Derive the equation of the enveloping parabola. (10 + 10)
