LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **APRIL 2015**

MT 6607 - DYNAMICS

Date : 17/04/2015 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

PART – A

Answer ALL questions. **(10 × 2 = 20)**

1. State Newton's first two laws.
2. Define centre of inertia.
3. What is trajectory?
4. Define horizontal range of a projectile.
5. Give an example of a simple harmonic motion.
6. What is epoch of a simple harmonic motion?
7. An insect crawls at a constant rate u along the spoke of a cartwheel of radius a starting from centre , the wheel moving with velocity v. Find the acceleration along and perpendicular to the spoke.
8. Define apse.
9. State the perpendicular axes theorem for moment of inertia.
10. Define product of inertia of a lamina.

PART – B

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

11. A train of mass 200 tons is running at the rate of 40 m.p.h. down an incline of 1 in 200. Find the resistance necessary to stop the train in half a mile.
12. 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 decent shall be the same as taken by another particle in falling freely through a distance equal to the height of the plane is $\frac{(l^2-h^2)}{l}\sqrt{\frac{g}{2h}}$.
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 executing simple harmonic motion in a straight line has velocities 8 , 7 , 4 at three points distance one foot from each other. Find the period.
15. A particle of mass m is tied to one end of an elastic string which is suspended from the other end. The extension caused to its length is b. If the particle is pulled down and let go, show that it executes simple harmonic motion and that the period is $2\pi\sqrt{\frac{b}{g}}$.

16.A particle describes a central orbit under the action of a central force. Prove that the areal velocity of the particle is constant.

17.If the law of acceleration is $5\mu u^3 + 8\mu c^2 u^5$ and the particle is projected from an apse at a distance c with velocity $\frac{3\sqrt{\mu}}{c}$, prove that the equation of the orbit is $r = c\cos\frac{2\theta}{3}$.

18.Find the moment of inertia of the square lamina about a diagonal of length l.

PART – C

Answer any THREE questions. **(2 × 20 =40)**

19 (a) A train of mass W tons is moving with an acceleration of f ft/sce^2 and 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 lbs. wt. / ton.

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

20 (a) Find the velocity of the projectile in magnitude and direction at the end of time t. Show that the magnitude of the velocity at any time is the same as would be acquired by a particle in falling freely a vertical distance from the level of the directrix to that point.

(b) A particle is projected with velocity $2\sqrt{ag}$ so that it just clears two walls of equal height a which are at a distance 2a apart. Find the latus rectum of the path and the time of passing between the walls.

21 (a) Find the velocity and displacement of a particle executing simple harmonic motion.

(b) State and prove inverse square law.

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

(b) Show that the moment of inertia about the x axis of the parabola $y^2 = 4ax$ bounded by the latus rectum by assuming the density at each point to vary as the cube of the abscissa is $\frac{12}{11} Ma^2$ where M is the mass of the lamina.

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