LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **APRIL 2016**

MT 6607 – DYNAMICS

Date: 18-04-2016 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART-A

Answer ALL questions: (10 x 2 =20 marks)

1. Define dynamics.
2. A body of mass m is carried by a lift moving with upward acceleration, find the pressure on the lift.
3. Define projectile.
4. A body is projected with a velocity of 98 metres per sec. in a direction making an angle $\sin^{-1}(\frac{3}{\sqrt{10}})$ with the horizon, show that it rises to a vertical height of 441metres.
5. Define simple harmonic motion.
6. If the displacement of a moving point at any time given by the equation of the form $x = a\cos\omega t + b\sin\omega t$, show that the motion is simple harmonic.
7. Define central orbit.
8. Write down the pedal equations of the circle and the parabola.
9. Define moment of inertia of the particle about the straight line.
10. State perpendicular axes theorem.

PART-B

Answer any FIVE questions (5 x 8 = 40 marks)

11. An engine of mass 120 tons is coupled to an pulls a carriage of mass 80 tons. The resistance to motion of engine is $\frac{1}{80}$ of its weight and that of carriage is $\frac{1}{100}$ of its weight. Find the tension in the coupling if whole tractive force exerted by engine weight of 12152 lbs.

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. Find the range of a projectile on an inclined plane.

14. Find the velocity and displacement of the particle executing simple harmonic motion.

15. A particle is oscillating in a straight line about a centre of force O towards which when the distance is x, the force is mn^2x and a is the amplitude of oscillation. When at a distance $\frac{a\sqrt{3}}{2}$ from O, the particle receives a blow in the direction of motion which generates a velocity na. If this velocity be away from O then show that the new amplitude is $a\sqrt{3}$.

16. Find the radial and transverse components of velocity and acceleration in polar coordinates.

17. Derive the differential equation of a central orbit.

18. Find the moment of inertia of an elliptic lamina.

PART-C

Answer any **TWO** questions: (2 x 20 = 40 marks)

19. (a) An engine and train weigh 420 tons and engine exerts a force of 7 tons wt. If resistance of motion be 14 lbs.wt./ton,
(i) 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) A string passes over a fixed smooth pulley and to one 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 $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$. (12+8)

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

21. (a) Show that the composition of two simple harmonic motions of the same period along two perpendicular lines is an ellipse. (8+12)

(b) A point moves with uniform speed v along the cardioide $r = a(1 + \cos\theta)$. Show that
(i) its angular velocity ω about pole is $\frac{v}{2a}\sec\frac{\theta}{2}$.
(ii) radial component of acceleration is constant and is equal to $\frac{3v^2}{4a}$.
(iii) magnitude of resultant acceleration is $\frac{3v\omega}{2}$.

22. (a) State and prove parallel axis theorem. (10+10)

(b) Find the moment of inertia of a hollow sphere about a diameter its internal and external radii being b and a.

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