LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **NOVEMBER 2016**

MT 6607 – DYNAMICS

Date: 16-11-2016   Dept. No. [   ]   Max. : 100 Marks
Time: 01:00-04:00

SECTION – A

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

1. State principle of physical independence.
2. Define relative acceleration of A with respect to B.
3. Define trajectory.
4. What is meant by enveloping parabola?
5. What is frequency of a simple harmonic motion?
6. A particle is executing simple harmonic motion makes 100 complete oscillations per minute and its maximum speed is 15ft/sec. What is the length of its path?
7. Define central orbit,
8. Define apse of the central orbit.
9. State theorem of parallel axes theorem of moment of inertia.
10. Define the time of flight of a projectile.

SECTION – B

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

11. A train travelling at 30 m.p.h. reaches an incline 1 in 150 when steam is shut off. After travelling a distance of 2 miles down the incline, it reaches the horizontal level. Calculate how far it will travel without steam on the horizontal level before coming to rest. The friction due to rails is equivalent to 10 pounds per every ton of load of train.

12. A mass m lbs slides down a smooth inclined plane of inclination α and draws another mass from rest through a distance x feet in t secs along a smooth horizontal table which in the level with the top of plane over which the string passes. Prove that the mass on the table is $\frac{m\,(gt^2 \sin\alpha - 2x)}{2x}$ lbs.

13. If v_1 and v_2 be the velocities at the ends of a focal chord of a projectile's path and u, the horizontal component of the velocity , show that $\frac{1}{v_1{}^2} + \frac{1}{v_2{}^2} = \frac{1}{u^2}$.

14. A particle executing S.H.M. in a straight line has velocities 8 , 7 ,4 at three points distance one foot from each other. Find the period.

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

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generates a velocity na. If this velocity be away from O, show that the new amplitude is a $\overline{3}$.

16. A particle describes the equiangular spiral $r = ae^{\theta}$ in such a manner that its acceleration has no radial component. Prove that its angular velocity is constant and that the magnitude of velocity and acceleration is each proportional to r.

17. Derive the pedal equation of a central orbit.

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

SECTION – C

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

19. (a) A particle of mass m slides from rest down the smooth face of inclination α of a wedge of mass M resting on a smooth horizontal table. Show that when the particle has descended a vertical distance h, the wedge would have moved through a horizontal distance $\frac{mh\cot\alpha}{M+m}$.

   (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 $\frac{4}{m_1} = \frac{1}{m_2} + \frac{4}{m_3}$.   (10+10)

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

21. (a) Find the resultant of two simple harmonic motions of the same period in the same straight line.

   (b) State and prove perpendicular axis theorem.   (10+10)

22. (a) Show that the moment of inertia of the part of the parabola $y^2 = 4ax$ cut off by the double ordinate x = h is $\frac{3}{7}Mh^2$ about the tangent at the vertex and $\frac{4Mah}{3}$ about its axis , M being the mass.

   (b) 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 its base.   (10+10)

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