LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **APRIL 2018**

MT 6607– DYNAMICS

Date: 19-04-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

SECTION – A

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

1. State principle of physical independence of forces.
2. What is meant by relative acceleration of A with respect to B?
3. Define horizontal range of a projectile.
4. Define trajectory.
5. Define simple harmonic motion of a particle.
6. What is epoch?
7. Define apse of a central orbit.
8. Show that the central orbit is a plane curve.
9. State of theorem of perpendicular axes for moment of inertia.
10. Define product of inertia.

SECTION – 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 120. Find the resistance necessary to stop the train in half a mile.
12. 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.
13. A particle is thrown over a triangle from one end of a horizontal base and grazing the vertex, falls on the other end of the base. If α and β are the base angle and θ the angle of projection. Prove that $\tan\theta = \tan\alpha + \tan\beta$.
14. Find the resultant of two simple harmonic motions of the same period in the same straight line.
15. A point executes simple harmonic motion such that in two positions the velocities are u and v and the corresponding acceleration are α and β. Show that the distance between the positions is $\frac{v^2 - u^2}{\alpha+\beta}$.

16. Derive the differential equation of a central orbit.

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 a hollow sphere.

SECTION – C

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

19 (a) An engine weighing 120 tons is coupled to a carriage of mass 80 tons. The system starts from rest with constant acceleration and acquires a velocity of 45 mph on the level in 2 minutes. Find (i) force exerted by the engine (ii) tension in the coupling (neglecting resistances)

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

20 (a) A Particle is projected so as just to graze the tops of two walls, each of height 20 feet, at distance of 30 ft and 170 ft respectivelyfrom the point of projection, find the angle of projection and the highest point reached in the flight.

(b) Show that the path of the projectile is a parabola. **(8+12)**

21 (a) Find the radial and transverse components of velocity and acceleration.

(b) State and prove inverse square law. **(10+10)**

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

(10+10)

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