**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086**
**(For candidates admitted from the academic year 2004–05)**

**SUBJECT CODE : MT/MC/DY64**

**B. Sc. DEGREE EXAMINATION, APRIL 2007**
**BRANCH I – MATHEMATICS**
**SIXTH SEMESTER**

**COURSE : MAJOR CORE**
**PAPER : DYNAMICS**
**TIME : 3 HOURS** **MAX. MARKS : 100**

## SECTION – A

**ANSWER ALL QUESTIONS (10X2=20)**

1. Find an expression for the terminal velocity of a particle projected upward under gravity in a medium whose resistance varies as the square of its velocity.
2. If the distance x of a point moving on a straight line measured from a free fixed point on it and its velocity v are connected by the relation $4v^2 = 25 - x^2$ show the motion is simple harmonic.
3. A particle is projected with a velocity $8\sqrt{2}$ m/sec at an angle of elevation $45^o$. Find the range of the projectile.
4. Write down the expression to find the time of flight of a particle projected over an inclined plane of inclination '$\beta$' making an angle '$\alpha$' to the horizontal with speed '$u$' ?
5. Write the differential equation of the central orbit in polar form ?
6. Define impulse of a force and an impulsive force.
7. A shot of mass 68kg. fired with a velocity 1000 m/sec from a gun of mass 50,000kg. Find the velocity of recoil of the gun if it is free to recoil in the direction of the shot ?
8. What is the moment of inertia of a sphere of raidus 'r' about the tangent at the end of the diameter.
9. State the parallel axis theorem.
10. Write down the expression for angular momentum and kinetic energy of a rigid body rotating about a fixed axis.

## SECTION – B

**ANSWER ANY FIVE QUESTIONS (5X8=40)**

11. A particle of mass is projected vertically upwards the resistance of air being "mk" times the velocity. Show that the greatest height attained by the particle is $\frac{v^2}{g}[\lambda - \log(1+\lambda)]$ where v is the terminal velocity of the particle and $\lambda v$ is the initial velocity.
12. A particle executing simple harmonic motion and while moving from the mean position to one extreme position its distances at three consecutive seconds are $x_1, x_2, x_3$. Show that its period is $\frac{2\pi}{\cos^{-1}(x_1 + x_3)/2x_2}$.

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13. Prove the path of a projectile is a parabola.

14. Find the range of the projectile on an inclined plane through the point of projection.

15. Find the law of force under which the conic $\frac{l}{r} = 1 + e\cos\theta$ is described.

16. A particle falls from a height '$h$' in time '$t$' upon a fixed horizontal plane. Prove that it rebounds and reaches the maximum height $e^2 h$ in time $et$.

17. Find the M.I. of an ellipse about the major axis.

## SECTION – C

### ANSWER ANY TWO QUESTIONS (2x20=40)

18. a) Discuss the motion of a particle falling under gravity in a medium where resistance varies as the velocity.
    b) Prove the composition of two SHM's of the same period and same straight line is again a simple harmonic motion.

19. a) A ball is projected so as just to clear two walls, the first of height '$a$' at a distance '$b$' from the point of projection and the second of height '$b$' at a distance '$a$' from the point of projection. Show that the range on the horizontal plane is $\frac{a^2 + ab + b^2}{a + b}$.
    b) A ball of mass 2 kg. impinges directly on a ball of mass 1 kg. which is at rest. If the velocity of the former before impact be equal to the velocity of the latter after impact show that the coefficient of restitution is ½.

20. a) Derive the differential equation $\frac{d^2u}{d\theta^2} + u = \frac{P}{h^2u^2}$ for the central orbit.
    b) Define compound pendulum and show that the centre of suspension an oscillation are interchangeable in the case of a compound pendulum.