STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2011–12)

SUBJECT CODE :11MT/ME/SM63

B. Sc. DEGREE EXAMINATION, APRIL 2015
BRANCH I – MATHEMATICS
SIXTH SEMESTER

COURSE : MAJOR ELECTIVE
PAPER : SPECIAL TOPICS IN MECHANICS
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION-A

ANSWER ALL QUESTIONS: **10 X 2 = 20**

1. Define: centre of mass of a system of particles.
2. Write the centre of mass of a triangular lamina.
3. What is the Cartesian equation of the common Catenary?
4. Prove that $y^2 = c^2 + s^2$ for a common Catenary.
5. Define: impulsive force.
6. State Newton's Experimental Law.
7. State the Perpendicular Axes Theorem.
8. Define: radius of gyration.
9. Write the equation of motion for a rigid body rotating about a fixed axis.
10. What is the length of a simple equivalent pendulum?

SECTION-B

ANSWER ANY FIVE QUESTIONS: **5 X 8 = 40**

11. Determine the centre of gravity of an arc of a circle of radius α, subtending an angle 2α at the centre.
12. Derive the intrinsic equation of the common catenary.
13. There are two equal perfectly elastic balls. One is at rest and is struck obliquely by the other. Show that after impact their directions of motion are at right angles.
14. A body of mass $(m_1 + m_2)$ is split into two parts of masses $m_1$and $m_2$by an internal explosion which generates kinetic energy E. Show that if after explosion the parts move in the same line as before, their relative speed is $\sqrt{\frac{2E(m_1+m_2)}{m_1 m_2}}$.
15. Find the moment of inertia of a circular plate about a tangent line.
16. Derive the moment of inertia of a thin uniform rod of length $2a$ and mass M about a line through one end and perpendicular to it.
17. A circular disc of mass 30 kgms and radius 1 metre is mounted axially and rotates at the rate of 100 revolutions per minute. Find the kinetic energy of rotation.

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SECTION-C

ANSWER ANY TWO QUESTIONS: 2 X20 = 40

18. a) Find the centre of gravity of a solid hemisphere of radius a.

    b) A uniform chain of length $2l$ is to be suspended from two points A and B in the horizontal line so that either terminal tension is n times that at the lowest point. Show that the span AB must be $\frac{2l}{\sqrt{n^2-1}} log_e\left(n+\sqrt{n^2-1}\right)$. (10+10)

19. a) Find the loss in kinetic energy when there is a direct impact between two smooth elastic spheres.

    b) A particle falls from a heights h upon a smooth fixed horizontal plane. If e be the coefficient of restitution, show that the whole distance H described by the particle before it has ceased to rebound is $\left(\frac{1+e^2}{1-e^2}\right) h$ and that the time T that elapses is $\left\{\frac{2h}{g}\right\}^{1/2} \frac{1+e}{1-e}$. (10+10)

20. a) Find the moment of inertia of a solid right circular cone of height h and semi vertical α about its axis.

    b) Prove that in a compound pendulum, the centres of suspension and oscillation are reversible. (10+10)

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