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

SUBJECT CODE: 11MT/ME/SM63

B. Sc. DEGREE EXAMINATION, APRIL 2016
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.
2. Write the centre of mass for the sector of a circle of radius 'a' subtending an angle 2α at the centre.
3. Write the intrinsic equation of the common catenary.
4. Prove that $y^2 = c^2 + s^2$ for a common catenary.
5. Define impulsive force.
6. State the principle of conservation of linear momentum.
7. Define Moment of inertia.
8. Write the moment of inertia of a circular ring of radius a about a diameter.
9. Write the length of a simple equivalent pendulum.
10. Define Compound pendulum.

SECTION-B

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

11. Find the centre of gravity of a solid hemisphere of radius 'a' .
12. A solid right circular cone of uniform density has its base scooped out so that the hollow is a right circular cone on the same base. How much must be scooped out so that the centre of gravity of the remainder may coincide with the vertex of the hollow?
13. Derive the cartesian equation of the common catenary.
14. A shot of mass m kgms is discharged from a gun of mass M kgms which is free to recoil and the relative velocity is v. Find the velocity of each and the kinetic energy generated.

..2

15. A ball impinges directly on a second ball of twice its mass which is moving in the same direction as the first but with one-seventh of its velocity. Given that e = ¾ , show that the first ball will come to rest after the impact.
16. Derive the moment of inertia of a thin uniform rod of length $2a$ and mass M about a line through the midpoint and perpendicular to it.
17. Prove that for a compound pendulum, the centres of suspension and oscillation are reversible.

SECTION-C

ANSWER ANY TWO QUESTIONS: 2 X20 = 40

18. (a) Find the centre of gravity of a solid cone of uniform density, of base radius r and height h.

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

(10 + 10)

19. (a) A particle falls from a height *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 $\left(\frac{1+e^2}{1-e^2}\right)h$.

    (b) A circular disc of mass 30 kgms and radius 1metre is mounted axially and rotates at the rate of 100 revolutions per minute. Find the kinetic energy of rotation.

(10 + 10)

20. (a) State the Perpendicular Axes Theorem. Use it to find the moment of inertia of a circular lamina of radius 'a' about a line through the centre and perpendicular to the plane of the lamina.

    (b) Show that the moment of inertia of a triangular plate about a side is $Mh^2/6$, where h is the length of the altitude through the opposite vertex.

(10 + 10)