STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2015-16 & thereafter)

SUBJECT CODE : 15MT/MC/PM65

B. Sc. DEGREE EXAMINATION, APRIL 2019
BRANCH I – MATHEMATICS
SIXTH SEMESTER

COURSE : MAJOR CORE
PAPER : PRINCIPLES OF MECHANICS
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION – A

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

1. Define : force.
2. State the Triangle law of forces.
3. Define : moment of a force about a point.
4. Define : couple
5. State any two laws of static friction.
6. Define : Cone of friction.
7. Write the intrinsic equation of the common catenary?
8. Prove that $y^2 = c^2 + s^2$ for a common catenary.
9. Define : Moment of inertia.
10. State the Perpendicular Axes Theorem.

SECTION –B

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

11. A weight of 50N is suspended by two light inelastic strings of length 7m and 24m from two points at the same horizontal level 25m apart. Find the tensions in the strings.

12. Two like parallel forces P and $Q(P > Q)$ act at points A and B of a rigid body. If P and Q are interchanged, show that the point of the resultant is displaced by $\frac{P-Q}{P+Q}AB$.

13. A rod whose centre of gravity divides it into two parts a and b is placed inside a smooth sphere. Show that if θ be its inclination to the horizonin the position of equilibrium and 2α be the angle subtended by the rod at the centre of the sphere, then $\tan\theta = \frac{b-a}{b+a}\tan\alpha$.

14. A body of weight W is in equilibrium on a rough inclined plane of angle $\alpha\ (\neq \lambda)$ under the action of a force P upwards at an angle θ to the line of greatest slope, in a vertical plane through the line of greatest slope. If the body is on the point of moving up the inclined plane, find P if the equilibrium is limiting and λ is the angle of friction.

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15. An endless uniform chain rests in equilibrium over a smooth pulley and is in contact with it over three quarters of the circumference. Show that the length of the free portion is $\frac{\sqrt{2}}{\log(\sqrt{2}+1)}$ times the radius of the pulley.

16. Discuss the motion of a particle falling under gravity in a medium whose resistance varies as the square of the velocity. Also find the relation between velocity and displacement.

17. 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.

SECTION –C

ANSWER ANY TWO QUESTIONS. (2X20=40)

18. (a) The resultant of two forces P and Q acting at an angle θ is R; that of the forces 2P and Q acting at the same angle is 2R and the resultant of forces P and 2Q acting at $(180^0 - \theta)$ is 2R. Prove that P : Q : R = $\sqrt{6} : \sqrt{2} : \sqrt{5}$.

    (b) A ladder rests in limiting equilibrium with its lower end on a rough horizontal plane and the other end against a rough vertical wall. The centre of gravity divides the ladder into two portions of lengths a and b. Find the position of limiting equilibrium.

(10 + 10)

19. (a) State and prove Varignons Theorem.

    (b) Find 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.

(10 + 10)

20. (a) Derive the cartesian equation of the common catenary.

    (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)