STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2019-20 & thereafter)

B. Sc. DEGREE EXAMINATION, APRIL 2024
BRANCH I – MATHEMATICS
SIXTH SEMESTER

COURSE : MAJOR CORE
PAPER : PRINCIPLES OF MECHANICS
SUBJECT CODE : 19MT/MC/PM65
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION – A

ANSWER ALL QUESTIONS. **(10 × 2 = 20)**

1. Define a force.
2. Define tension of a string.
3. Define Parallel forces.
4. Define Couple.
5. Define Cone of friction.
6. Define angle of friction.
7. Define Span and Sag of a common catenary.
8. Prove that $y^2 = c^2 + s^2$ for a common catenary.
9. Define Moment of Inertia.
10. State Perpendicular axes theorem.
11. State Triangle law of forces.
12. What is the Moment of Inertia of a circular ring about its diameter?

SECTION –B

ANSWER ANY FIVE QUESTIONS. **(5 × 8 = 40)**

13. State and prove Lami's theorem.
14. Two like parallel force $P\ and\ Q$ $(P > Q)$ act at a points $A\ and\ B$ or a rigid body.

    If $P\ and\ Q$ are interchanged, show that the point of the resultant is displayed by $\frac{P-Q}{P+Q}AB$.
15. Write the Laws of Statical friction.
16. Obtain the Cartesian equation of a common Catenary.
17. Obtain the Moment of Inertia of the rectangular lamina of sides 2a and 2b about its side 2a.
18. Show that if three forces acting on a rigid body are represented in magnitude and direction by the sides of a triangle taken in order, then they are equivalent to a couple of moment equal to twice the area of the triangle.
19. The resultant of two forces P and Q acting at an angle $\theta\ is\ (2m+1)\sqrt{P^2+Q^2}$ while when P and Q are act an angle $\frac{\pi}{2} - \theta$ the resultant is $(2m-1)\sqrt{P^2+Q^2}$. Prove that $tan\theta = \frac{m-1}{m+1}$.

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SECTION –C

ANSWER ANY TWO QUESTIONS. **(2 × 20 = 40)**

20. (i) Forces of magnitude F_1, F_2, F_3 act at a point parallel to and in the direction of the sides BC, CA, AB of a triangle ABC respectively. Prove that the magnitude of the resultant is $(F_1^2 + F_2^2 + F_3^2 - 2F_2F_3cosA - 2F_3F_1cosB - 2F_1F_2cosC)^{\frac{1}{2}}$ (10 marks)

(ii) State and prove Varignon's theorem. (10 marks)

21. (i) 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 of θ to the line of the greatest slope in a vertical plane through the line of greatest slope. Find P if equilibrium is limiting, where λ is the angle of friction. (10 marks)

(ii) Obtain the Moment of inertia of a circular lamina of radius 'a' about its diameter. (10 marks)

22. A particle falls under gravity (supposed constant) in a medium whose resistance varies as the square of the velocity. Discuss the motion and also calculate the velocity and displacement at any time t. (20 marks)