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

SUBJECT CODE : 19MT/MC/PM65

B. Sc. DEGREE EXAMINATION, APRIL 2022
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. State Lami's Theorem.
2. Two forces of magnitude *20 kg* and *8 kg* respectively are inclined at an angle of 60^0. Find the magnitude and direction of the resultant.
3. The resultant of two forces *P* and *Q* is *R*. If the direction of one of them is reversed then the resultant is *S*. Prove that $R^2 + S^2 = 2(P^2 + Q^2)$.
4. Define moment of a force.
5. Define couple.
6. Forces $\overline{3P}$, $\overline{4P}$, and $\overline{5P}$ act along the sides *BC*, *CA* and *AB* of a triangle *ABC* of side '*a*'. Find the moment of the resultant about *A*.
7. Define cone of friction.
8. Discuss toppling of the bodies.
9. Prove that $y^2 = c^2 + s^2$ for a common catenary.
10. Define terminal velocity.
11. Determine the moment of inertia of the rod of length $4a$ about a line through one end and perpendicular to it.
12. State parallel axis theorem.

SECTION –B

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

13. State and prove triangle law of forces. Prove the converse also.
14. A weight of *50 N* is suspended by two light inelastic strings of length 7 *m* and 24 *m* from two points at same horizontal level 25 *m* apart. Find the tensions in the string.
15. Two unlike parallel forces *P* and *Q* (*P*>*Q*) act at *A* and *B*. *P* and *Q* are each increased by *R*. Show that the resultant will move through a distance $\frac{R}{P-Q}AB$.
16. State and prove the theorem on reduction of coplanar forces.
17. A uniform ladder rests with its lower end on a rough horizontal floor and its upper end against a smooth vertical wall, if the ladder makes an angle 30^o with the vertical wall when it is in limiting equilibrium. Find the coefficient of friction at the floor.

..2

18. 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 $\frac{2l}{\sqrt{n^2-1}} log\left(n+\sqrt{n^2-1}\right)$.

19. Discuss the moment of inertia of a circular ring of radius 'a'.

SECTION –C

ANSWER ANY TWO QUESTIONS. (2X20=40)

20. a) The angle between two forces of equal magnitude is θ and the resultant is R. If the angle is decreased by $\pi/3$, then the resultant is $\sqrt{3}R$. Find θ.
    b) State and prove Varignon's theorem. (10+10)

21. a) 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 horizon in the position of equilibrium and 2α be the angle subtended by the rod at the centre of the sphere, then $tan\theta = \frac{b-a}{b+a} tan\alpha$.
    b) Derive the intrinsic equation and Cartesian equation of the common catenary. (8+12)

22. a) A particle falls under gravity in a medium whose resistance varies as the square of the velocity. Discuss the motion.
    b) Find the moment of inertia of the rectangular parallelepiped of edges $2a, 2b$ and $2c$. (12+8)