STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2023-24)

B. Sc. DEGREE EXAMINATION, APRIL 2026
BRANCH I – MATHEMATICS
SIXTH SEMESTER

COURSE : MAJOR CORE
PAPER : PRINCIPLES OF MECHANICS
SUBJECT CODE : 23MT/MC/PM65
TIME : 3 HOURS **MAX. MARKS : 100**

Q. No.	SECTION A (5 × 2 = 10) Answer any FIVE questions	CO	KL
1	State Parallelogram law of forces.	1	1
2	Define moment of a force $\vec{F}$ about a point O.	1	1
3	Define angle of friction.	1	1
4	Define Terminal velocity.	1	1
5	Define Moment of inertia of a system of masses $m_1, m_2, \ldots, m_n$ about a line.	1	1
6	State Perpendicular axis theorem.	1	1
Q. No.	**SECTION B (10 × 1 = 10)** **Answer ALL questions**	**CO**	**KL**
7	An assemblage of particles is called a _____ if the distance between any two particles remain constant. a) Liquid b) Gaseous c) Rigid Body d) None of these	2	2
8	If a particle or a body does not move or is at rest acted on by forces, then it is said to be in _____. a) motion b) equilibrium c) acceleration d) Oscillation	2	2
9	Two parallel forces acting in opposite directions are called as _____. a) Unlike b) Like c) Coplanar d) Concurrent	2	2
10	The moment of a couple is _____. a) Zero b) Dependent on the point of application c) Independent on the point of application d) None of these	2	2
11	The force that opposes motion between two surfaces in contact is called _____ a) Normal b) Friction c) Tension d) Gravity	2	2
12	When the friction attains its maximum, then it is called as _____. a) Maximal friction b) Kinetic friction c) Static friction d) Limiting friction	2	2

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13	The shape of a cable under its gravity is called as_____. a) Catenary b) Parabola c) Ellipse d) Hyperbola	2	2
14	The horizontal distance between the supports of a suspension cable is known as _____. a) Sag b) Length c) Span d) Height	2	2
15	If M denotes mass of a body, then the relationship between moment of inertia (I) and radius of gyration (k) is _____. a) $I = Mk^2$ b) $I = Mk$ c) $I = M/k^2$ d) none of these	2	2
16	The moment of inertia of a circular disc about its diameter a is _____. a) $I = Ma^2$ b) I = $\frac{Ma^2}{4}$ c) I = $\frac{Ma^2}{2}$ d) none of these	2	2
Q. No.	**SECTION C (2 × 15 = 30)** **Answer any TWO questions**	**CO**	**KL**
17	(i) State and prove Lami's theorem. (ii) The resultant of two forces P and Q acting at an angle θ is $(2m+1)\sqrt{(P^2+Q^2)}$ while when P and Q act at an angle $\frac{\pi}{2} - \theta$, the resultant is $(2m-1)\sqrt{(P^2+Q^2)}$. Prove that $tan\theta = \frac{m-1}{m+1}$. (8+7)	3	3
18	(i) State and prove Varignon's theorem. (ii) Three forces $\vec{P}, \vec{Q}, \vec{R}$ act along $\overrightarrow{BC}$, $\overrightarrow{CA}$ and $\overrightarrow{AB}$ of triangle taken in order. Show that if the resultant passes through a) incenter, then $\vec{P} + \vec{Q} + \vec{R} = 0$, b) circumcenter, then $\vec{P}\,cosA + \vec{Q}\,cosB + \vec{R}\cos C = 0$. (8+7)	3	3
19	(i) Two forces $\vec{F}_1$, $\vec{F}_2$ acting at a point have a resultant $\vec{R}$. If $\vec{F}_2$ be doubled, $\vec{R}$ is also doubled. Also if $\vec{F}_2$ is reversed in direction only, then also $\vec{R}$ is doubled. Show that $F_1 : F_2 : R = \sqrt{2} : \sqrt{3} : \sqrt{2}$. (ii) Find the equation of Suspension bridge. (8+7)	3	3
20	(i) A particle moving in a straight line is subjected to a resistance kv^3 where v is the velocity at time t. Show that when the distance is $'s'$ and u is the initial velocity, the velocity $v = u/(1+kus)$ and $t = \left(\frac{s}{v}\right) + \frac{1}{2}ks^2$. (ii) Find the Moment of Inertia of a uniform triangular lamina about one side. (7+8)	3	3

Q. No.	SECTION D (2 × 15 = 30) Answer any TWO questions	CO	KL
21	(i) Explain various types of Forces. (ii) A weight is supported on a smooth plane of inclination α to the horizon by a string inclined to the vertical at an angle β. If the slope of the plane be changed γ and the slope of the string is unaltered, the tension in the string is doubled to support the weight. Prove that $cot\alpha - 2cot\gamma = \cot\beta$ (8+7)	4	4
22	(i) Derive the resultant of two like parallel forces. (ii) Describe conditions for sliding and toppling. (12+3)	4	4
23	(i) Describe any two laws of statical friction. (ii) Prove Parallel axis theorem. (5+10)	4	4
24	(i) Derive the Cartesian equation of the common catenary. (ii) 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. (8+7)	4	4
Q. No.	**SECTION E (2 × 10 = 20)** **Answer any TWO questions**	**CO**	**KL**
25	State and prove converse of Triangle law of forces.	5	5
26	Prove that any number of coplanar couples which are equivalent to a single couple of moment is equal to the vector sum of the moments of the individual couples.	5	5
27	Find the equation of motion of a particle falling under gravity in a medium whose resistance varies as the square of the velocity.	5	5
28	Find the Moment of Inertia of a rectangular parallelepiped about an axis through its centre and parallel to one of its edges.	5	5