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

SUBJECT CODE : 15MT/MC/PM65

B. Sc. DEGREE EXAMINATION, APRIL 2018
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 rigid body.
2. State Triangle law of forces.
3. Define Centre of reduction.
4. In a right-angled triangle ABC, $\angle A = 90^{\circ}$, $a = 5, b = 4, c = 3$. A force $\vec{F}$ has moments 0,9 and 16 in Newton cm. units respectively about A, B and C. Find the magnitude of $\vec{F}$.
5. Define Friction.
6. Define perfectly rough surface.
7. In a suspension bridge of 400 feet span and 40 feet dip the whole weight supported by the two chains is 2 tons per horizontal foot. Find the tensions in the chains at the lowest point.
8. Define span and sag.
9. Define Moment of Inertia.
10. State Theorem of perpendicular axes.

SECTION –B

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

11. A force of magnitude P acting along a smooth plane supports a weight W kept on the plane and a force Q acting horizontally supports the same weight W on the plane. If θ be the angle of the plane, find $P: Q$.

12. A light rod of length 1 metre rests on two pegs placed 40cm apart. At what distance from the end A are the pegs to be placed so that the reactions at the pegs are equal when weights 5 N and 8 N are suspended from A and B respectively.

13. A solid cone of height h and semi-vertical angle α is placed with its base against vertical wall and is supported by a string attached to its vertex and to a point in the wall. Show that the greatest possible length of the string is $h\sqrt{1 + \frac{16}{9}tan^2\alpha}$.

14. State the Laws of Statical Friction.

..2

15. A box kite is flying at a height h with a length l of the string paid out, and with the vertex of the catenary on the ground. Show that at the kite, the inclination of the string is $2tan^{-1}\left(\frac{h}{l}\right)$ and that its tension there and at the ground are respectively $w\left(\frac{l^2+h^2}{2h}\right)$ and $w\left(\frac{l^2-h^2}{2h}\right)$, where w is the weight of the string per unit of length.

16. Find the moment of inertia of a thin uniform rod of length $2a$ and mass M.

17. A circular disc of mass of 30 kgms and radius 1 metre 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) Forces of magnitudes 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 $(F_1^2 + F_2^2 + F_3^2 - 2F_2F_3cosA - 2F_3F_1cosB - 2F_1F_2cosC)^{1/2}$. Also discuss the case $F_1 = F_2 = F_3$.

    (b) State and prove Varignon's theorem. (8+12)

19. (a) The resultant of the three forces F_1, F_2, F_3 acting along the sides BC, CA, AB of a triangle ABC passes through the orthocenter. Show that the triangle must be obtuse-angled. If $\angle A = 120^\circ, \angle B = \angle C = 30^\circ$, show that $F_2 + F_3 = \sqrt{3}F_1$.

    (b) A right circular cone of vertical angle 2α rests with its base on a rough horizontal plane. A string is attached to the vertex and pulled in a horizontal direction with a gradually increasing force. Discuss the nature of the motion according as $\alpha \lesseqgtr \lambda$, the angle of friction. (12+8)

20. (a) Derive the intrinsic equation and Cartesian equation of the common catenary.

    (b) Find the moment of inertia of a circular lamina of radius a.

(12+8)