STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2011–12 & thereafter)

SUBJECT CODE : 11MT/MC/ME54

B. Sc. DEGREE EXAMINATION, NOVEMBER 2016
BRANCH I - MATHEMATICS
FIFTH SEMESTER

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

SECTION – A **(10X2=20)**
ANSWER ALL THE QUESTIONS

1. Define : Force.
2. State Varignons theorem.
3. Define : Angle of friction.
4. State the laws of kinetic friction.
5. If the distance x of a point on a straight line measured from a fixed origin on it and its velocity v are connected by the relation $4v^2 = 25 - x^2$, show that the motion is simple harmonic.
6. Define : Seconds Pendulum.
7. A particle is projected with a velocity of 490 m/sec, at an elevation of 30^0 . Find the horizontal range.
8. Write the formula for the greatest height attained and the time of flight for a projectile.
9. What are the components of acceleration in the radial and transverse directions?
10. Define : central force.

SECTION – B **(5X8=40)**
ANSWER ANY FIVE QUESTIONS

11. 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 $\frac{P-Q}{P+Q}AB$.
12. 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.
13. Prove that the composition of two Simple Harmonic motions of the same period and in the same straight line is again a Simple Harmonic Motion.
14. A particle is thrown over a triangle from one end of its horizontal base and, grazing the vertex, falls on the other end of the base. If B, C the base angles and α the angle of projection, prove that $\tan\alpha = \tan B + \tan C$.
15. Find the differential equation of a central orbit in $p - r$ form.
16. Three forces P, Q and R acting at O are in equilibrium. The angle between P and Q is double the angle between R and P. Show that $R^2 + PQ = Q^2$.
17. A seconds pendulum is carried down with a lift at a uniform acceleration of 20 cm/sec^2. How many seconds an hour will it lose?

..2

SECTION – C **(2X20=40)**

ANSWER ANY TWO QUESTIONS

18. (a) Two forces P and Q acting at a point have a resultant R. If Q be doubled , R is also doubled. If Q be reversed in direction only, then also R is doubled. Show that $P : Q : R = \sqrt{2} : \sqrt{3} : \sqrt{2}$.

(b) A body of weight W is in equilibrium on a rough inclined plane of angle α ($\neq \lambda$) 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. (10+10)

19. (a) A particle is moving with simple harmonic motion and while moving from the mean position to one extreme position its distances at three consecutive seconds are x_1, x_2, x_3 . Show that its period is $\frac{2\pi}{\cos^{-1}\left(\frac{x_1 + x_3}{2x_2}\right)}$.

(b) Show that the path of a projectile is a parabola. (10+10)

20. (a) Derive the differential equation to a central orbit in (u, θ) form.

(b) A particle moves in an ellipse under a force directed towards the focus. Find the law of force. (10+10)