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 2014
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. State the Triangle law of forces.
2. Define moment of a force about a point.
3. Define cone of friction.
4. State any two laws of static friction.
5. Define Simple Harmonic Motion.
6. Prove that in a SHM, if f is the acceleration , v is the velocity at any moment and T is the periodic time, then $f^2T^2 + 4\pi^2v^2$ is a constant.
7. Define time of flight of a projectile.
8. A particle is projected with a velocity of 490 m/sec, at an elevation of 30^0. Find the greatest height attained.
9. Define central force.
10. Write the components of acceleration in the radial and transverse directions.

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

11. A string ABCD hangs from fixed points A, D carrying a weight of 12 kgm at B and a weight W at C. AB is inclined at 60^0 to the horizontal; BC is horizontal and CD is inclined at 30^0 to the horizontal. Find W.
12. 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. Find P if the equilibrium is limiting, where λ is the angle of friction.
13. A rectangular thin plate *a* feet long, *h* feet high rests on a rough horizontal plane. A string attached to the top of the plate is pulled horizontally with an increasing force. Prove that the plate will tilt when $\mu > \frac{a}{2h}$.

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14. 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 $\frac{2\pi}{\cos^{-1}\left(\frac{x_1+x_3}{2x_2}\right)}$.

15. Prove that the path of a projectile is a parabola.

16. Prove the relation $gT^2 = 2R\tan\alpha$, where T is the time of flight and R is the horizontal range, α is the angle of projection. If $\alpha = 60^0$, find in terms of R, the height of the projectile, when it has moved through a distance equal to $\frac{3R}{4}$.

17. Derive the p - r equation of a central orbit.

SECTION – C (2X20=40)

ANSWER ANY TWO QUESTIONS

18. (a) The resultant of two forces P and Q acting at an angle θ is R; that of the forces 2P and Q acting at the same angle is 2R and the resultant of forces P and 2Q acting at $(180^0 - \theta)$ is 2R. Prove that P : Q : R = $\sqrt{6} : \sqrt{2} : \sqrt{5}$.

(b) State and prove Varignons Theorem. (10 + 10)

19. (a) A uniform ladder of length l metres rests on a rough horizontal ground with its upper end projecting very slightly over a smooth horizontal rod at a height a metres above the ground. If the ladder is about to slip down, show that the coefficient of friction is equal to $\frac{a\sqrt{l^2 - a^2}}{l^2 + a^2}$.

(b) Discuss the motion of a particle falling under gravity in a medium whose resistance varies as the square of the velocity. Also find the relation between velocity and displacement . (10 + 10)

20. (a) A particle is projected so as to clear a wall of height h at a horizontal distance a and to have a range b from the point of projection. Find the velocity of projection.

(b) Find the law of force towards the pole for the orbit $r^n = a^n \cos n\theta$.

(10 + 10)