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 2015
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 Lamis Theorem.
2. State the Triangle law of forces.
3. Define : friction.
4. Define : Angle of friction.
5. The maximum velocity of a particle executing Simple Harmonic Motion is 1 metre/sec and its period is $\frac{1}{5}$ of a second. Find the amplitude.
6. Define : Simple Harmonic Motion.
7. Prove the relation $gT^2 = 2R\tan\alpha$, where T is the time of flight, R is the horizontal range and α the angle of projectile.
8. A particle is projected with a velocity of 49 m/sec, at an elevation of 30^0. Find the time of flight.
9. Write the differential equation to a central orbit in (u,θ) form.
10. Define : central force.

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

11. 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 = $\sqrt{6} : \sqrt{2} : \sqrt{5}$.

12. 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 $\frac{P-Q}{P+Q}AB$.

13. 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.

..2

14. A particle is moving with simple harmonic motion and while moving from the man 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 composition of two Simple Harmonic motions of the same period and in the same straight line is again a Simple Harmonic Motion.

16. Two masses projected from the same point with the same velocity, at elevation of α and β to the horizontal are aimed at a target on the horizontal plane through the point of projection. The first one falls *x* metres too short of the target while the second one falls *y* metres beyond the target. If θ is the elevation to hit the target correctly with the same velocity of projection, show that $(x + y)\sin 2\theta = x\sin 2\beta + y\sin 2\alpha$.

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

SECTION – C (2X20=40)

ANSWER ANY TWO QUESTIONS

18. (a) State and prove Varignons Theorem.

(b) 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. (10 + 10)

19. (a) 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.

(b) A particle falls under gravity in a medium whose resistance varies as the square of the velocity. Discuss the motion. (8+ 12)

20. (a) Prove that the path of a projectile is a parabola.

(b) Derive the differential equation of a central orbit in p - r form.

(10 + 10)