STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the year 2019-20 and thereafter)

SUBJECT CODE: 19MT/PE/ME15

M. Sc. DEGREE EXAMINATION, APRIL 2022
BRANCH I - MATHEMATICS
SECOND SEMESTER

COURSE : ELECTIVE
PAPER : MECHANICS
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION – A

ANSWER ALL THE QUESTIONS (5 × 2 = 10)

1. Define degrees of freedom.
2. State principle of virtual work.
3. Define Coriolis Force.
4. Define Routh function.
5. Which generating function generates identity canonical transformation? Justify!

SECTION – B

ANSWER ANY FIVE QUESTIONS (5 × 6 = 30)

6. Show that the kinetic energy of the system can be written as a sum of three homogeneous functions of generalized velocities.
7. Find the shortest distance between two points in the plane using calculus of variation.
8. Obtain the expression of kinetic energy of a rigid body with one point fixed in terms of inertia coefficient.
9. Discuss about the Routh's procedure for non-cyclic coordinates.
10. Prove that the Hamiltonian equation of motion is constant when time t is explicitly absent.
11. Obtain the new Hamiltonian function for the generating functions $F_1(q_i, Q_i, t)$ and $F_2(q_i, P_i, t)$.
12. Derive the conditions for restricted transformations to be canonical.

SECTION – C

ANSWER ANY THREE QUESTIONS (3 × 20 = 60)

13. a) State and prove conservation theorem for the total angular momentum of a system of particles.
    b) State and prove D'Alembert's Principle. (10+10)

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14. a) Using calculus of variations, find the curve joining two fixed points, for which the surface of revolution obtained by revolving the curve about the *Y*-axis is minimum.
    b) Derive Lagrange's equation for conservative system using Hamilton's integral principle. (10+10)

15. a) Obtain the amount of deflection from the vertical of a freely falling particle due to Coriolis force.
    b) Define dyad and derive the inertial matrix of a rigid body with one point fixed in the nonian form. (10+10)

16. a) Consider the motion of a single particle of mass *m* and charge *q* moving in an electromagnetic field. Find its Hamiltonian equation of motion.
    b) Define Legendre transformation and use it to derive Hamilton's equations of motion. (10+10)

17. Define canonical transformation and solve the problem of the simple harmonic oscillator in one dimension using a canonical transformation.
