SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai — 600 044.
M.Sc. - END SEMESTER EXAMINATIONS APRIL - 2022
SEMESTER - I
20PPHCT1002 - CLASSICAL MECHANICS AND RELATIVITY

Total Duration : 3 Hrs. **Total Marks : 60**

Section A

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Obtain equation of motion of a simple pendulum using Hamilton's equation of motion.
2. Show that the transformation defined by
   q=$\sqrt{2}$P $\sin$Q
   P=$\sqrt{2}$P $\cos$Q is canonical
3. Derive Euler's equation of motion of a rigid body.
4. Two identical pendulums, each having mass m and length l are coupled to each other by a spring of force constant k. x_1 and x_2 are displacements of the pendulums from their mean positions. Find the normal frequencies of this system.
5. What is Lorentz transformation. Show that the four dimensional volume element is invariant under Lorentz transformation.
6. A mass m moves in a circular orbit of radius r_0 under the influence of a central force whose potential is $-k/r^n$. Show that the circular orbit is stable under small oscillations if n<2.
7. Find the Coriolis force acting on a body of mass 1.5kg, moving with a horizontal velocity of 100m/sec., at 30°N latitude on earth.
8. Illustrate the two body central force problem.

Section B

Part A

Answer any **TWO** questions $(2 \times 10 = 20$ Marks)

9. State Hamilton's principle and use it to derive the Lagrangian equations of motion for an N-dimensional system.
10. Illustrate with diagrams Euler's angles involved in the transformation from one set of three dimensional coordinate system to another having the same origin. Obtain the complete transformation matrix for such.

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11. (a) Explain what is meant by Hamiltons principal function in Hamilton Jacobi theory.
    (b) solve the simple harmonic oscillator problem using Hamilton-Jacobi theory.

12. Use the method of small oscillations to obtain the normal mode frequencies and the corresponding normal co-ordinates for a linear symmetrical triatomic molecule.

Part B

Compulsory question $(1 \times 10 = 10$ Marks)

13. Derive Lorentz transformation equations. State your assumptions clearly.

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