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MPHY-502

Classical Mechanics and Numerical Methods

M.Sc. Physics (MSCPHY)

1st Semester Examination, 2023 (June)

Time : 2 Hours] **[Max. Marks : 35**

Note : This paper is of Thirty Five (35) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein. Candidates should limit their answer to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

SECTION–A
(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Nine and Half (9½) marks each. Learners are required to answer any Two (02) questions only.
(2×9½=19)

1. Derive Lagrange's equations from De'Alembert's Principle for conservative system.

2. Derive Hamilton's equation of motion. Give the physical significance of Hamiltonian.

3. Explain Runge's formula and Runge-Kutta formula. Apply Runge- Kutta method (forth order), to find an approximate value of y when $x = 0.2$, given that $\frac{dy}{dx} = x + y^2$ and $y = 1$ when $x = 0$.

4. Show that the Poisson brackets are canonically invariant.

5. Derive Newton's formula for forward interpolation and explain the assumption for its validity.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Four (04) marks each. Learners are required to answer any Four (04) questions only. (4×4=16)

1. What are generalized coordinates? Define constraints.

2. Obtain the Lagrange's equation of motion for compound pendulum.

3. Show that the transformation

$$Q = \log(1 + \sqrt{q} \cos p)$$

$$P = 2\sqrt{q}\,(1 + \sqrt{q}\; \cos p) \sin p.$$

is canonical. Find the generating function $F(p, Q)$.

4. Define the shift operators E and E^{-1}, and difference operators Δ and ∇.

5. Define cyclic coordinates and discuss its applications.

6. Derive Lagrange's interpolation formula and explain its advantage.

7. Give the geometrical interpretation of Trapezoidal rule.

8. Evaluate the $I = \int_0^1 \frac{dx}{(1 + x^2)}$ using trapezoidal rule and a constant interval of 0.2.