

them. Give the constant of the motion, associated with spatial translations.

$$2\frac{1}{2} + 2\frac{1}{2} + 5$$

**U.G. 5th Semester Examination-2025**

**PHYSICS**

**[HONOURS]**

**Discipline Specific Elective (DSE)**

**Course Code : PHY-H-DSE-T-01**

**(Advanced Mathematical Physics-II)**

**[CBCS]**

Full Marks : 60

Time : 2½ Hours

*The figures in the right-hand margin indicate marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **five** questions: 2×5=10
  - a) What is cyclic coordinate?
  - b) What is probability that a non-leap year should have 53 Weeks?
  - c) What is probability density function?
  - d) What do you mean by generalized coordinates?
  - e) State least action principle.
  - f) In a normal distribution 31% of items are under 45 and 8% are over 64. Find the mean standard deviation of the distribution.
  - g) Define Euler angles.

- h) Define Poisson Bracket.
2. Answer any **four** question:  $5 \times 4 = 20$
- a) State and explain binomial probability distribution function with example. 5
- b) Determine the curve joining to given points which produce the least area when it is resolved about  $x$ -axis lying in the plane of the curve.
- c) Derive Lagrange's equations from d'Alembert's principle. 5
- d) Prove that any finite cyclic group of order  $n$  is isomorphic to  $Z_n$  and any infinite cyclic group is  $Z$ .
- e) Find the expression for standard deviation of Poisson distribution. 5
- f) Write Euler-Lagrange's equation for a function  $f = f(x, y, y')$  hence prove that for the function  $f = f(y, y')$  this equation becomes  $f - y' \frac{df}{dy'} = \text{constant}$ .
3. Answer any **three** questions:  $10 \times 3 = 30$
- a) State and prove Hamilton's principle. Use Hamilton's principle to find the equation of motion of the one dimensional harmonic oscillator. 10

- b) Derive Lagrange's equation of motion from Hamilton's principle. 10
- c) i) Show that minimum distance between two points in a plane is a straight line.
- ii) Derive Euler-Lagrange's equation of motion using the method of calculus of variations. 5+5
- d) Find the equation of motion of one dimensional harmonic oscillator using Hamilton's principle. Using Poisson bracket, show that the transformation

$$Q = (e^{-2q} - p^2)^{1/2}$$

$$P = \cos^{-1}(pe^q)$$

is canonical. 5+5

- e) i) Define cyclic groups.
- ii) Let  $G$  be a group. Suppose  $a, b \in G$ , such that (a)  $ab=ba$  and (b)  $[0(a), 0(b)] = 1$ . Show that  $0(ab) = 0(a)0(b)$ .
- iii) Let us consider a system formed with three particles, of equal mass  $m$ , constrained to move on a straight line. They interact via a potential that depends only on the relative distance between