Total number of printed pages–7

3 (Sem–6/CBCS) PHY HE 3

2023

PHYSICS

(Honours Elective)

Paper : PHY-HE-6036

(Advanced Mathematical Physics-II)

Full Marks : 80

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer ***any ten*** of the following : 1×10=10

   (a) State Hamilton's Principle.

   (b) Define Generalized co-ordinates.

   (c) What is meant by a Geodesic ?

Contd.

(d) Generalized coordinates are:

(i) Independent

(ii) Dependent

(iii) Spherical polar coordinates

(iv) None of the above

(e) A particle is moving doing the arc of a circle. The suitable generalized coordinate (s) is/are :

(i) r only

(ii) θ only

(iii) r and θ both

(iv) x and y

(f) For a conservative system, the potential energy does not depend upon :

(i) force

(ii) generalized velocity

(iii) generalized coordinator

(iv) All of the above

(g) For a conservative system Hamiltonian represents :

(i) $T + V$

(ii) $T - V$

(iii) $L + V$

(iv) $2T - V$

(h) If the Lagrangian of a system does not depend on time explicitly, then :

(i) the Hamiltonian can not be constant

(ii) the Hamiltonian is constant

(iii) potential energy is constant

(iv) kinetic energy is constant

(i) The shortest distance between two points in a plane is :

(i) an arc of a circle

(ii) an arc of ellipse

(iii) a straight line

(iv) arbitrary arc

(j) What is Mutually Exclusive Events ?

(k) Give an example of Collectively Exhaustive events.

(l) What is Probability Distribution Function ?

(m) What is Compound Probability ?

(n) Define Cyclic group.

2. Answer ***any five*** of the following : 2×5=10

(a) Write Euler - Lagrange's differential equations.

(b) Explain Principle of List action.

(c) What do you mean by canonical coordinates ?

(d) What do you mean by *Lagrangian* and *Hamiltonian* ?

(e) Define Mathematical Probability and Statistical Probability.

(f) Define *relation* and *mapping*.

(g) What are Homomorphism and Isomorphism of group ?

(h) If $A = \{4, 5\}$ and $B = \{1, 2, 3\}$ are two sets, then find their Cartesian products $A \times B$ and $B \times A$.

3. Answer ***any four*** of the following : 5×4=20

(a) Find the equation of a motion of a simple pendulum using Lagrange's equation.

(b) What are Poisson - Brackets and Lagrange - Brackets ? Prove that both of them do not obey the commutative law of algebra.

(c) Define a group and state its postulates.

(d) Show that in a group G, identity elements e is unique.

(e) Show that a non empty subset H of a group G is a subgroup of G iff

(i) $a, b \in H \Rightarrow ab \in H$

(ii) $a \in H \Rightarrow a^{-1} \in H$

(f) Prove that if $P(A)$ and $P(B)$ are probabilities of two Mutually Exclusive Events A and B then the probability of either of them is $P(A \text{ or } B) = P(A) + P(B)$.

4. Answer ***any four*** of the following : 10×4=40

(a) Using Euler-Lagrange equation prove that the shortest distance between two fixed points in a plane is a straight line. 3+7=10

(b) Use Hamilton's Principle to find the equation of motion of one dimensional harmonic oscillator. What is modified Hamilton's Principle ? 7+3=10

(c) Show that a non empty subset H of a group G is a subgroup of G iff

(i) $a, b \in H \Rightarrow ab \in H$

(ii) $a \in H \Rightarrow a^{-1} \in H$ 5+5=10

(d) Show that under canonical transformation, Poisson-Bracket is invariant.

(e) What is the law of Conditional Probabilities ? State and prove Bayes' theorem. 4+6=10

(f) What is Random Variable ? Explain about probability distribution of a discrete random variable and a continuous random variable. 2+4+4=10

(g) What is Normal Distribution ? Explain with schematic diagrams that how the shape of Normal Distribution curves depends upon the Mean and Standard Deviation. Write importance of Normal Distribution. 2+6+2=10

(h) Explain the Poisson distribution. Consider an emergency room of a hospital where the past records indicate an average of 5 arrivals daily. The demand for emergency room service at this hospital is distributed according to a Poisson distribution. Calculate the probability of exactly 0, 1, 2, 3, 4 and 5 arrivals. What is the probability of more than 3 arrivals ? 3+5+2=10
