U.G. 5th Semester Examination-2022

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

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

(Advanced Mathematical Physics-II)

Full Marks : 60 Time : $2\frac{1}{2}$ 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: $2\times5=10$

   a) Define Euler angles.

   b) What is meant by conditional probability?

   c) What is cyclic coordinate?

   d) What is generalised potential?

   e) What is probability density function?

   f) What is random variable in probability?

   g) State least action principle.

[Turn Over]

2. Answer any **four** question: 5×4=20

a) Show that for a system of one degree of freedom the transformation

$$Q = arc\left(tan\frac{\alpha q}{p}\right),\ P = \frac{\alpha q^2}{2}\left(1 - \frac{p^2}{\alpha^2 q^2}\right)$$

is canonical. 5

b) Derive Lagrange's equations from d'Alembert's principle. 5

c) Show that $q_k = [q_k, H]$, where q_k is the generalized coordinate and H is the Hamiltonian. What are the condition for canonical transformation? 2+3

d) State and explain binomial probability distribution function with example. 5

e) State and prove Bayers theorem. Define mean, variance and standard deviation of a variable. 2+3

f) Find the expression for standard deviation of Poisson distribution. 5

3. Answer any **three** questions: 10×3=30

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

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

b) State and prove Hamilton's principle. Use Hamilton's principle to find the equation of motion of the one dimensional harmonic oscillator. 10

c) i) A dynamical system has generalized co-ordinates q_i and generalized momenta p_i. Verify the following properties of the Poisson brackets:

$$[q_i, q_j] = [p_i, p_j] = 0, [q_i, p_j] = \delta_{ij}.$$

ii) If p is the momentum conjugate to a position vector $\boldsymbol{r}$ and $\boldsymbol{L}=\boldsymbol{r}\times\boldsymbol{p}$, evaluate $[L_x, L_y]$, $[L_y, L_x]$ and $[L_x, L_x]$. 5+5

d) 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

e) Discuss the Homomorphism and Isomorphism of group. Differentiate between spherical top and symmetric top. Write down the principle of least squares. 3+4+3
