

U.G. 5th Semester Examination-2021

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHS-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 **six** questions: 1×6=6
 - a) What are canonical variables?
 - b) What is principle of Least Action?
 - c) What do you mean by contact transformations?
 - d) What is generalized force?
 - e) What is quaternion group?
 - f) Define cyclic groups.
 - g) What do you mean by mutually exclusive events?
 - h) What is meant for conditional probability?
2. Answer any **five** questions: 2×5=10
 - a) What are the conditions for canonical transformation?

- b) Show that $q_k = [q_k, H]$; where q_k is the generalized coordinate and H is the Hamiltonian.
 - c) Let G be a group. Suppose $a, b \in G$, such that
 - i) $ab = ba$ and
 - ii) $(o(a), o(b)) = 1$, Show that $o(ab) = o(a)o(b)$.
 - d) If a finite group possesses an element of order 2, show that it possesses an odd number of such elements.
 - e) Show that elements of finite order in any abelian group form a sub group.
 - f) Show that the Poisson's bracket of two constants of motion is a constant of motion.
 - g) Define the Euler angles.
 - h) If A and B are two independent events, show that \bar{A} and \bar{B} are also independent.
3. Answer any **four** questions. 6×4=24
 - a) Show that the transformations $Q = q \tan p$, $P = \log(\sin p)$ is canonical. 6
 - b) What is Kernel? If $f: G \rightarrow G$ be a homomorphism. Show that the Kernel of f is defined by $Ker f = \{x \in G \mid f(x) = e'\}$, where e' is identity of G' 2+4

c) What is the definition of a subgroup? If N is a normal subgroup of G and $N \cap G' = \{e\}$, show that $N \subseteq Z(G)$. 6

d) State and prove Bayes' theorem. 2+4

e) What is Poisson distribution? Find the expression for standard deviation of Poisson distribution. 2+4

f) What do you mean by expectation value of a discrete random variable? Find the mean and standard deviation of the uniform distribution

$$f(x) = \frac{1}{n}; |x = 1, 2, 3, \dots, n| \quad 2+2+2$$

4. Answer any **two** questions: 10×2=20

a) i) Define Poisson's bracket. What are the different fundamental Poisson's brackets? 2+2

ii) What do you mean by generating function for a transformation? Determine the canonical transformations defined by the generating function

$$G(q, Q, t) = \frac{1}{2} m \omega q^2 \cot Q. \quad 2+4$$

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

10

c) i) Derive Euler- Lagrange's equations of motion using the method of calculus of variations.

ii) Show that the minimum distance between two points in a plane is a straight line.

5+5
