SH-III/Physics/503/DSE-1/19

B.Sc. 3rd Semester (Honours) Examination, 2019-20

PHYSICS

Course ID : 32411 **Course Code : SH/PHS/301/C-5**

Course Title : Mathematical Physics-II

Time: 1 Hours 15 Minutes **Full Marks: 25**

The figures in the margin indicate full marks.

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

Section–I

Answer *any five* questions. 1×5=5

1. (a) State Cauchy's Residue theorem.

(b) Evaluate $\int_{-\infty}^{\infty} x\,\delta(x-4)dx$.

(c) Find the nature of the singularity of the function

$f(z) = e^{\frac{1}{z-2}}$ at z = 2.

(d) What do you mean by unitary matrix?

(e) Find the probability of drawing 2 aces in succession from a pack of 52 cards.

(f) Show that if a given co-ordinate is cyclic in the Lagrangian, it will also be cyclic in Hamiltonian.

(g) What are the properties of eigenvector and eigenvalues of Harmitian matrix?

(h) What do you mean by a pole?

Section–II

Answer *any two* questions. 5×2=10

2. (a) Prove that, if $\hat{A}$ is a linear operator and is invertible then $\hat{A}^{-1}$ is also a linear operator.

(b) Define the norm of a vector in linear vector space. What are their properties? 2+3=5

3. (a) Show that every diagonal element of a skew-Harmitian matrix is either zero or a pure imaginary number.

(b) Given $A = \begin{bmatrix} 0 & 1+2i \\ -1+2i & 0 \end{bmatrix}$

Show that $U = [I-A][I+A]^{-1}$ is unitary. 2+3=5

4. If the probability of a bad reaction from a medicine is 0.001, determine the chance that out of 2000 individuals more than two will get a bad reaction. 5

5. Derive canonical equation of motion from variational principle. 5

Section–III

Answer *any one* question. 10×1=10

6. (a) Find the square root of i.

(b) Using residue theorem evaluate $I = \int_{-\infty}^{\infty} \frac{dx}{1+x^2}$ 4+6=10

7. (a) Solve the following equations by matrix method

$$x - 2y + 3z = 5$$
$$4x + 3y + 4z = 7$$
$$x + y - z = -4$$

(b) Are the following vectors linearly dependent or not?

$$x_1 = (3, 2, 7)$$
$$x_2 = (2, 4, 1)$$
$$x_3 = (1, -2, 6)$$

(c) Show that

(i) $\delta[c(x-a)] = \frac{1}{|c|}\delta(x-a)$

(ii) $\delta[(x^2-a^2)] = \frac{1}{2a}[\delta(x-a) + \delta(x+a)], a > 0$ 5+2+3=10
