Roll No.............................

Serial No of Q.P - 3053

Name of the Department : Department of Physics

Unique Paper Code : 2223510024

Name of the Paper : Mathematical Physics-II

Name of Course : B.Sc. (Prog.)-Physical Sciences With Electronics_NEP: UGCF-2022

Semester : VI-Semester (DSE)

Question Paper Set number : Set-A

Duration: 3 Hours Maximum Marks :90

Instructions for candidates

Write your Roll No. on the top immediately on receipt of this question paper.

Attempt a total of Five Questions including Question no. 1, which is compulsory.

1. Attempt any **six** parts. (6x3=18)

(a) Is the function $f(z) = \frac{z}{|z|}$ continuous at the origin?

(b) Determine the residues at the poles of the following:

i. $\frac{\sin(Z)}{Z^2}$

ii. $\frac{Z+1}{(Z^2-16)(Z+2)}$

(c) State and prove Cauchy's integral theorem for simply connected region.

(d) Find the norm of the vector $u = (4, -6, 12) \in R^3$.

(e) What is Hibert space? Give two examples of Hilbert space.

(f) State Fourier Integral Theorem.

(g) If $F(\alpha)$ is the Fourier transform of $f(x)$, then show that

$$F[f(x-a)] = e^{i\alpha a}F(\alpha)$$

2. (a) Prove that the Cauchy-Riemann Conditions are necessary but not sufficient conditions for differentiability at a point. (10)

(b) Calculate the value of the contour integral

$$\int_C \frac{zdz}{(z-1)(z^2+9)} \text{ ; where C is a circle defined by } |z| = 4 \qquad (8)$$

3. (a) Define residue at a pole and state Cauchy's residue theorem? (2)

(b) Evaluate the integrals by the method of residues:

I. $\int_0^\infty \frac{dx}{x^4+1}$ (8)

II. $\int_0^{2\pi} \frac{d\theta}{(5+4sin\ \theta)}$ (8)

4. (a) What is linear vector space? Prove that the set of all continuous functions on the interval [a, b] forms a **linear vector space**. (8)

(b) State the **Cauchy-Schwarz inequality** and discuss the conditions under which the equality holds. (10)

5. (a) Find the eigenvalues and eigenvectors of the matrix (10)

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 4 \\ -1 & -1 & -2 \end{bmatrix}$$

(b) Prove that eigenvectors of a Hermitian operator corresponding to distinct eigenvalues are orthogonal. (8)

6. (a) Find the Fourier sine transform of e^{-ax} $(a > 0)$ (8)

(b) Using Convolution theorem, evaluate the integral

$$\int_{-\infty}^{\infty} \frac{dx}{(x^2+a^2)(x^2+b^2)} \qquad (10)$$