

2023

PHYSICS

Paper-C-VIII

Full Marks : 60

Time : 3 hours

Answer all questions as directed.

The figures in the right-hand margin indicate marks.

GROUP—A

1. Answer all bits : 1 × 8

(a) Modular of  $(1 + \cos 2\alpha) + i(\sin 2\alpha)$  is \_\_\_\_\_.

(b) Complex conjugate of  $\left(\frac{2+3i}{1+2i}\right)$  is \_\_\_\_\_.

(c) Value of  $(i)^{109}$  is \_\_\_\_\_.

(d) For the function  $\left(\frac{\sin z}{z}\right)$ ,  $z = 0$  is \_\_\_\_\_ singularity.

(e) Polar form of  $\left(\frac{1+3i}{1-2i}\right)$  is \_\_\_\_\_.

(f) Laplace transform of 2 is \_\_\_\_\_.

(g) Laplace transform of  $\sin t$  is \_\_\_\_\_.

(h) Inverse Laplace transform of  $\left(\frac{1}{s-a}\right)$  is \_\_\_\_\_.

GROUP—B

2. Answer any eight bits :

( 3 )

- (a) Find Laplace transform of  $(e^{-4t} + e^t)$ .
- (b) Define change of scale property.
- (c) Define Laplace transform.
- (d) State linear property of Fourier transform.
- (e) Find  $z$ , if  $z^4 + 1 = 1$ .
- (f) Find cube root of  $(-11 - 2i)$ .
- (g) Define essential singularity.
- (h) Define analytic function.
- (i) Check  $\tan z$  is analytic or not.
- (j) Find the value of  $(-i)^{\frac{1}{6}}$ .

( 4 )

GROUP—C

3. Answer any *eight* bits : 2 × 8

- (a) Determine cube roots of unity.
- (b) Find the standard form of  $\left(\frac{1}{2+5i}\right)$ .
- (c) Find Laplace transform of  $(te^{3t})$ .
- (d) State second translation property.
- (e) Find the derivative of Fourier transform.
- (f) Express  $f(z) = \frac{1}{z(z-1)}$  in Laurent's series for  $z = 0$ .

( 5 )

(g) Prove  $(z\bar{z} + \bar{z}^2)$  is not analytic.

(h) Prove that  $(1+w+w^2)=0$ .

(i) Write down Cauchy's integral formula.

(j) Write Laplace transform of unit step function.

GROUP—D

4. State and prove De Moivre's theorem. 6

Or

State and prove Cauchy's integral formula.

5. (a) Find Fourier transform of 3

$$f(x) = \begin{cases} 1, & |t| < a \\ 0, & |t| > a \end{cases}$$

( 6 )

(b)  $f(t) = \begin{cases} 0, & t < 0 \\ e^{-at}, & t \geq 0, a > 0 \end{cases}$  3

Or

Find Fourier transform of 6

$$f(x) = \begin{cases} \sin x, & 0 < x < \pi \\ 0, & \text{otherwise} \end{cases}$$

6. Verify convolution theorem of Fourier transform if  $f(x) = g(x) = e^{-x^2}$ . 6

Or

State and prove (i) linearity property and (ii) shifting property of Fourier transform.

7. Find Laplace transform of 3+3

(i)  $\frac{\sin at}{t}$  3+3

(ii)  $t^2 e^t \sin 4t$

( 7 )

*Or*

Using Laplace transform, solve problems of damped Harmonic Oscillator. 6

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