EF-512

M.Sc. Ist Semester (New/ATKT)

Examination, 2021-22

Physics

Paper - I

Mathematical Physics

Time : 3 Hours]   [Maximum Marks : 85

Note :- Attempt all the questions.

SECTION - 'A'

Objective Type Questions   1.5×10=15

1. Choose the correct answer.

(i) Find the value of $\frac{2}{5} P_1(x) + \frac{3}{5} p_1(x)$

    (a) Zero

    (b) x^3

    (c) $x^3/5$

    (d) None of these

(ii) Value of the integral $\int_0^\infty e^{-ax} J_n(x) dx$ is written as $\frac{1}{p}(p-a)^n$, what is the vlaue of P ?

    (a) 1

    (b) $1+a^2$

    (c) $\sqrt{1+a^2}$

    (d) None of these

(iii) What is the value of $\int_0^\infty e^{-x} \left[L_n(x) \right]^2 dx$?

    (a) n!

    (b) $(n!)^2$

    (c) 1

    (d) None of these

(iv) Which of the following is not correct.

    (a) $H'_{2n+1}(0) = 0$

    (b) $H_{2n+1}(0) = 0$

    (c) $H'_{2n}(0) = 0$

    (d) None of these

(v) The coefficient of the term $(z-1)^2$ in the taylor's series

    of the function $f(z) = \dfrac{1}{z^2 - a}$ about the point $z = 1$ is

    (a) $\dfrac{-1}{32}$

    (b) $\dfrac{1}{32}$

    (c) $\dfrac{-3}{128}$

    (d) $\dfrac{3}{128}$

(vi) What is ratio of the coefficients of Z^n and $\dfrac{1}{z^n}$ in the

    laurent's expansion of the function $\cos t \left(z + \dfrac{1}{2} \right) -$

    (a) 0

    (b) 1/2

    (c) 1

    (d) None of these

(vii) Find the analytic function $f(z)$ whose real function is

    $u(x,y) = x^2 - y^2$

    (a) z

    (b) z^2

    (c) $|z|^2$

    (d) $|z^2|$

(viii) What is the sum of residues at all poles of function

    $\dfrac{1}{z^4 + 1}$

    (a) Zero

    (b) $2i\sqrt{2}$

    (c) $-2i\sqrt{2}$

    (d) None of these

(ix) Equation $f(s) = \int_0^\infty F(t)e^{-st}\, dt$ represents which

    transform

(a) Mellin

(b) Hankel

(c) Fourier

(d) laplace

(x) The solution of equation $\nabla^2 \psi = 4\pi\delta(r)$ is

(a) $\dfrac{1}{r^2}$

(b) $\dfrac{1}{r}$

(c) $\dfrac{e^{ikr}}{r}$

(d) None of these

SECTION - 'B'

Short Answer Type Questions   5×5=25

2. Find P.I. of inhomogeneous equation $y^{11} + a_1 y^1 + a_2 y = e^\alpha$

OR

Derive laplaciaoperator L^2 in spherical polar coordinates.

3. For any closed contour, prove that $\int\limits_c z\,dz = 0$

OR

Give two examples of non-homogeneous partial disfferential equations.

4. Obtain generating function for bessel's function.

OR

Find the values of $J_{\pm\frac{1}{2}}(x)$

5. Find the laplace transform of

(i) $t^2 e^{-at}$

(ii) $t^2 \sin at$

OR

Show hat $L\left\{\int_0^\infty \dfrac{\sin xt}{\sqrt{x}}dx = \dfrac{\pi}{(2s)^{1/2}}\right.$

6. Write properties of greins functions.

OR

Show that $f(x)\,\delta\,(x-a) = f(a)\,\delta\,(x-a)$

SECTION - 'C'

Long Answer Type Questions   5×9=45

7. Write lagurre differential equation and find its solution.

OR

Using generating function in bessel's function to prove that

$$J_{n-1}(x) + J_{n+1}(x) \frac{2n}{x} J_n(x)$$

8. Find laplace transform of bessel's function of zero order.

OR

Disucss linearity theorem, similarity theorem and conjugate theorem on fourier transforms.

9. Derive expression for Green's function using homogeneous equation.

OR

Describe seattering problem using Green's function.

10. Define analytic function and find its necessary and sufficient condition. Give source examples of it.

OR

Discuss in detail graphical representation of complex functions (Mapping).

11. Write short notes on

   (i) Spherical coordinate system

   (ii) Convolution theorem

   (iii) Fourier transforms

   (iv) Jordan's lemma intergrals.

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