

201021

M. Sc. (First Semester) Examination, Dec. 2021

(For Regular/ATKT/Ex. Students)

PHYSICS

Paper : First

(Mathematical Physics-I)

Time Allowed : Three hours

Maximum Marks : 42

Note : Attempt all questions of all sections as directed.

Section-'A'

(Objective Type questions)

7×1=7

Note : Attempt all questions. Each question carries 1 mark.

I. Choose the correct answer :

(i) Unit Vector  $i_r$  and  $i_\theta$  in cylindrical coordinate :

- (a) are constant
- (b) change in magnitude
- (c) change in direction
- (d) change in both

(ii) If  $\theta_c$  and  $\theta_s$  are  $\theta$  coordinate in cylindrical and spherical coordinates respectively, then :

- (a)  $\sin \theta_c = \sin \theta_s$
- (b)  $\cos \theta_c = \cos \theta_s$
- (c)  $\sin \theta_c = \cos \theta_s$
- (d)  $\tan \theta_c = \tan \theta_s$

(iii) Function  $f(x) = 1/2\pi \int_{-\infty}^{+\infty} e^{+imx} dw \int_{-\infty}^{+\infty} f(t) e^{-imt} dt$ 

represents :

- (a) Fourier transform  
 (b) Laplace transform  
 (c) Inverse Laplace transform  
 (d) None of these
- (iv) In given green function identity which represent symmetry property :
- (a)  $G(x, x') = G(x', x)$   
 (b)  $G(x, x') = -G(x', x)$   
 (c)  $G(x, x') = G(x - x')$   
 (d)  $G(x, x') = G(x + x')$
- (v) Residue of function  
 $f(z) = z^2/z^2 + 4$  at  $z = 2i$  is :
- (a)  $e^{i\pi/2}$   
 (b)  $e^{i\pi}$   
 (c)  $e^{3i\pi/2}$   
 (d) None of these

- (vi) Which equation represents the correct Hermite differential equation :
- (a)  $y'' - 2xy' + 2xy = 0$   
 (b)  $y'' + 2xy' - 2xy = 0$   
 (c)  $y'' - 2xy' - 2xy = 0$   
 (d)  $y'' + 2xy' + 2xy = 0$
- (vii) If  $z = x + iy$  then its complex conjugate  $z^*$  can be represented as ;
- (a)  $z^* = x - iy$   
 (b)  $z^* = (x + iy)^2$   
 (c)  $z^* = x + iy$   
 (d)  $z^* = (-x - iy)$

## Section-'B'

(Short Answer Type Questions)  $5 \times 2 = 10$ 

Note : Attempt all questions. Each question carries 2 marks.

2. Explain Recursion relation and their properties.

Or

Write short note on inverse fourier transform.

3. Write fourier transform of time dependent functions. What is the significance of
- $f(w)$
- in these transform.

Or

Define Laplace transform of a function  $f(t)$ . Hence obtain the Laplace transform for following functions :

(i)  $f(t) = 1$

(ii)  $f(t) = t$

4. Discuss expansion of Green's function.

Or

Write various properties of Green's function.

5. What is the condition for a function to be analytic? Write Cauchy-Riemann equation.

Or

Prove that

(i)  $\sin(-z) = -\sin z$

(ii)  $\cos(-z) = \cos z$

6. Write a short note on Damped Harmonic Oscillator.

Or

Describe the representation of  $\nabla$  operator in cartesian, cylindrical and spherical polar co-ordinates system.

## Section-'C'

(Long Answer Type Questions)  $5 \times 5 = 25$ 

Note : Attempt all questions. Each question carries 5 marks.

7. Explain in detail Orthogonality of associated Legendre's polynomials.

Or

- Obtain the solution of Hermite's differential equation and derive the generating function of Hermite's differential equation.
8. Describe the fourier transform method of constructing the Green's function.

Or

Find the Laplace transform of the following :

(i)  $\sin h$  at

(ii)  $t^h$

9. Give solution of Laplace equation in cartesian coordinates.

Or

Explain convolution theorem in detail.

10. Describe in detail about the Eigen functions. Give example also.

Or

Write in detail on Green's function for quantum mechanical scattering problem.

11. Give a detailed note on Laurent Series and Mapping.

Or

State and prove Taylors theorem for a complex function.