(7 pages)

Reg. No. :

Code No. : 5857 Sub. Code : PPHM 12

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2020.

First Semester

Physics - Core

## MATHEMATICAL PHYSICS - I

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A —  $(10 \times 1 = 10 \text{ marks})$ 

Answer ALL questions.

Choose the correct answer :

- 1. If  $\phi = yz$ , then its gradient is \_\_\_\_\_
  - (a) zj + yk (b) o
  - (c) yj + zk (d) i + j + k
- 2. If  $\vec{r}$  is position vector, then curd  $\vec{r}$  is \_\_\_\_\_\_
  - (a) 0 (b) 3
  - (c)  $r^{-2}r$  (d)  $r^{3}$

3.	The eigen values of $\begin{bmatrix} 0\\1 \end{bmatrix}$	$\begin{bmatrix} -1\\ 0 \end{bmatrix}$ are
	(a) (0,0)	(b) (1,0)
	(c) (1,-1)	(d) (i, -i)
4.	The eigen values of a H	ermitian Matrix are all
	(a) Zero	(b) Imaginary
	(c) Complex number	(d) Real
5.	The value of is $J_{1/2}(\pi/2)$	lis
	(a) 0	(b) 1
	(c) $\pi/2$	(d) $\frac{2}{\pi}$
6.	Which of the following i	is not equal to 1?
	(a) $P_0(x)^{*}$	(b) $J_0(x)$
	(c) $H_0(x)$	(d) $L_0(x)$
7.	The average value of th interval 1 to 3 is ———	the function $f(x) = 4x^2$ in the
	(a) 15	(b) 20

(c) 40 (d) 80

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- 8. The trigonometric Fourier series of a periodic function can have only
  - (a) Cosine term
  - (b) Sineterm
  - (c) Both (a) and (b)
  - (d) None of the above
- 9. Laplace transform of  $t^n$  is

(a) 
$$\frac{n!}{s^n}$$
 (b)  $\frac{n!}{S^{n-1}}$ 

(c) 
$$\frac{n!}{S^{n+1}}$$
 (d)  $\frac{n}{S+1}$ 

10. Laplace transform of sinah

(a) 
$$\frac{a}{S^2 + a^2}$$
 (b)  $\frac{s}{S^2 + a^2}$ 

(c) 
$$\frac{S}{(S-a)^2}$$
 (d)  $\frac{S^2}{(s-a)}$ 

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PART B —  $(5 \times 5 = 25 \text{ marks})$ 

Answer ALL questions, choosing either (a) or (b). Each answer should not exceed 250 words.

11. (a) Using Gauss divergence theorem evaluate  $\iint_{s} (x^{3}dyd2 + y^{3}d2dx + z^{3}dxdy) \text{ where } S \text{ is the surface of the sphere } x^{2} + y^{2} + z^{2} = a^{2}$ 

Or

- (b) State and prove Green's theorem in a plane.
- 12. (a) Show that the eigen values of a real symmetric matrix are all real

Or

(b) Find the characteristic equation of the following matrix and verify the cayley Hamilton theorem.

13. (a) Show that 
$$xJ'_n(x) = nJ_n(x) - xJ_{n+1}^{(x)}$$

Or

(b) Prove that

$$x L'_{n}(x) = nL_{n}(x) - nL_{n-1}(x)$$

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	[P.T.O.]

14. (a) State and prove similarity theorem of Fourier transform.

Or

- (b) Find the Fourier transform of  $e^{-|t|}$
- 15. (a) Find Laplace transforms of
  - (i) Sinh at
  - (ii) Cos at

Or

(b) Find the inverse Laplace transform of  $\frac{1}{\sqrt{2S+5}}$ 

PART C —  $(5 \times 8 = 40 \text{ marks})$ 

- Answer ALL questions, choosing either (a) or (b) Each answer should not exceed 600 words.
- 16. (a) Verify divergence theorem for the vector  $A = x^2 i + y^2 J + Z^2 k \text{ taken over the cube}$  $0 \le x, y, z \le 1$

Or

- (b) State and prove Gauss divergence theorem
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17. (a) State and prove Cayley-Hamilton theorem.

Or

- (b) Discuss the rotation matrix in physics
- 18. (a) Find the solution of Bessel's equation

$$x^{2}\left(\frac{d^{2}y}{dx^{2}}\right) + x\left(\frac{dy}{dx}\right) + \left(x^{2} - n^{2}\right)y = 0$$

 $\mathbf{Or}$ 

- (b) Obtain the series solution of Laguarre's differential equation.
- 19. (a) Find the Fourier transform of the Gaussian distribution function  $f(x) = n e^{-\alpha x^2}$  where N and  $\alpha$  are constants.

## $\mathbf{Or}$

(b) Find Fourier sine and cosine transforms of  $f(t) = e^{-pt}, P > 0$  Hence evaluate

$$\int_{0}^{\delta} \frac{\cos wt}{p^{2} + w^{2}} dw \text{ and } \int_{0}^{\delta} \frac{w \sin wt}{p^{2} t w^{2}} dw$$

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20. (a) Find the Laplace transform of

(i) 
$$\frac{\sin at}{t}$$
  
(ii)  $\frac{\sin t}{t}$ 

(iii) Does the transform of 
$$\frac{\cos at}{t}$$
 exist?

Or

(b) Find the Laplace transform of  $f(t) = t^2 e^t \sin 4t$ .

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