D 72979 (Pages : 2) Name..

Reg. No.....................................

FIRST SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION DECEMBER 2019

(CBCSS)

Physics

PHY 1C 02—MATHEMATICAL PHYSICS–I

(2019 Admissions)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*
Each carry weightage 1.

1. Show that the matrix $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is an orthogonal matrix.
2. Write down the expression for gradient and divergence in spherical polar coordinates.
3. What are Hermitian and unitary matrices?
4. What is meant by similarity transformation?
5. Evaluate $\int_{-\infty}^{\infty} e^{-x^2} x dx$.
6. Evaluate $\int_{-\infty}^{+\infty} e^{-(x-4)} \delta(x-4) dx$.
7. Find the Laplace transform of $f(t) = t$.
8. Find the Laplace transform of $f(t) = e^{-at}$.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions.*
Each carry weightage 5.

9. Explain the idea of Schmidt orthogonalisation.
10. Define beta and gamma functions and derive the relation between the two.
11. Define Fourier transform and inverse transform. Show that the Fourier transform of a Gaussian function is Gaussian.

Turn over

12. Prove the recurrence relation :

$$(n+1)P_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x).$$

(2 × 5 = 10 weightage)

Section C

Answer any **four** *questions.*
Each carry weightage 3.

13. Show that divergence of curl of a vector is always zero.

14. Show that direct product of two vectors A^{μ} and B^{ν} given by $C^{\mu\nu}$ is a second rank tensor.

15. What are the eigen functions and eigen values of the operator $-\frac{d^2}{dx^2}$ with the eigen functions satisfying the boundary conditions $f(x) = 0$ at $x = 0$ and $x = L$?

16. Argue that the Gaussian function given by $f(x) = \sqrt{\frac{a}{\pi}}\, e^{-ax^2}$ goes over to the Dirac delta function in the appropriate limit.

17. State and prove the convolution theorem in the context of Fourier transform.

18. Give a general solution of the Laplace equation.

19. Find the inverse Laplace transform of $\frac{1}{s(s+2)}$.

(4 × 3 = 12 weightage)