D 92956 (Pages : 2) Name.....

Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2015

(CUCSS)

Physics

PHY 1C 02—MATHEMATICAL PHYSICS—I

(2012 Admission onwards)

Time : Three Hours Maximum : 36 Weightage

Section A

Answer **all** *the questions.*
Each question carries a weightage of 1.

1. Define a vector in terms of its transformation under rotation of co-ordinates.
2. Which are the co-ordinate surfaces in spherical polar co-ordinates ?
3. Give the Laplacian operator in general currilinear co-ordinates.
4. State the quotient rule of tensors.
5. What is meant by Wronskian ?
6. Prove that the momentum operator is Hermitian.
7. Give an example for a self adjoint differential equation.
8. Define Dirac delta function.
9. What is meant by a unitary transformation ?
10. If λ is an eigenvalue of a matrix A, show that λ^2 is an eigenvalue of A^2.
11. What are the general properties of Fourier series ?
12. Show that $L\left\{e^{at}\right\} = \frac{1}{S-a}$ for $S > a$.

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions.*
Each question carries a weightage of 6.

13. Derive the transformation relations from rectangular to spherical co-ordinates. Show that the spherical co-ordinate system is orthogonal.

Turn over

14. Diagonalize the matrix A by a similarity transformation.

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}.$$

15. Explain the Gram-Schmidt orthogonalization procedure with a suitable example.

16. Establish the Orthogonality of Legendre Polynomials.

(2 × 6 = 12 weightage)

Section C

Answer any **four** *questions.*
Each question carries a weightage of 3.

17. Transform the unit vectors i, j and k in to their components in a spherical polar co-ordinate system.

18. Find the eigenvalues and eigenvectors of the matrix $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$.

19. Find the regular singularities of Legendre equation.

20. Show that $\overline{|y_2|} = \sqrt{\pi}$.

21. Show that $J_0(x)^2 + 2\left[J_1{}^2(x) + J_2{}^2(x) + \ldots\ldots\ldots\right] = 1$.

22. Find the Fourier series expansion of the function $f(x) = e^x$ in the interval $0 < x < 2\pi$.

(4 × 3 = 12 weightage)