18P107 (Pages: 2) Name: …………………….

Reg. No…………………...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(Regular/Supplementary/Improvement)

(CUCSS-PG)

CC15P PHY1 C02 / CC17P PHY1 C02 - MATHEMATICAL PHYSICS - I

(Physics)

(2015 Admission onwards)

Time: 3 Hours. Maximum: 36 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. Obtain the relation between unit vectors in cylindrical and Cartesian system.
2. What is meant by symmetric, anti symmetric matrices? Give examples.
3. Prove that the determinant and trace of a matrix are invariant under similarity transformation.
4. Illustrate with example, how the rank of tensors is affected by the operation, contraction.
5. What is a pseudo Tensor? Give example.
6. What do you mean by singular points? Check the singularities of Bessels equation.
7. Show that $J_n(x)$ and $J_{-n}(x)$are not independent for integral values of n
8. Define a self adjoint operator and show that the Legendre equation is a self adjoint equation.
9. What do you mean by an Hermitian operator? Explain the significance of Hermitian operator in theoretical Physics.
10. Write fist two Hermite Polynomials and Plot the normalized form of the respective functions.
11. Define Laplace transform. Find the Laplace transform of t^n, where 'n' is an integer.
12. Show that Fourier series for an even function consists of cosine terms alone.

(12 x 1 = 12 Weightage)

Section B

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

13. What are orthogonal curvilinear coordinate systems? Form general mathematical expressions for different vector differential operations, and from that form expressions for it in Cartesian, cylindrical and spherical polar systems
14. Discuss Frobenious method to find series solution and use this method to find solution

of Harmonic oscillator equation.

15. Show that Legendre polynomial are Orthogonal functions and obtain normalization constant of Legendre polynomials.

16. a) State and prove Fourier convolution theorem.

    b) Deduce Fourier integral theorem and Fourier transform and its inverse.

(2 x 6 = 12 Weightage)

Section C

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

17. Find the Eigen values and Eigen vectors of $H = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ and find the matrix that diagonalises H.

18. Separate Laplace equation in spherical polar coordinates.

19. Check whether the equation $\int_0^\infty e^{-x^4} = \Gamma\left(\frac{5}{4}\right)$ is correct or not.

20. Generate Legendre Polynomials from the set of functions $u_n(x) = x^n$, $n = 0, 1, 2, 3, \ldots$by Gram-Schmidt orthogonilisation.

21. Evaluate the integral $\int_0^\infty \frac{\sin tx}{x}\, dx$ using Laplace transform method for $\mathrm{t} > 0, \mathrm{t} = 0$ and $\mathrm{t} < 0$

22. Show that $P'_{n+1}(x) - P'_{n-1}(x) = (2n + 1)P_n(x)$

(4 x 3 = 12 Weightage)

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