20P107 (Pages: 2) Name: …….....

Reg.No……..…....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CBCSS-PG)

(Regular/Supplementary/Improvement)

CC19P PHY1 C02 – MATHEMATICAL PHYSICS - I

(Physics)

(2019 Admission onwards)

Time: Three Hours Maximum: 30 Weightage

Section A

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

1. Write Laplace's equation in orthogonal curvilinear coordinates.
2. Show that the product of two unitary matrices are also unitary.
3. Define contravariant and covariant vectors.
4. What is Singular point of differential equation? Explain two kinds of singular points.
5. Prove that the product of two Hermitian operators is Hermitian if and only if the two operators commute.
6. Define Gamma function. Find the value of $\Gamma\left(\frac{1}{2}\right)$ and $\Gamma\left(-\frac{1}{2}\right)$
7. Define Neumann function. Write any one recurrence relation.
8. Write the Dirichlet conditions for Fourier series.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Express the divergence and curl operators in general orthogonal curvilinear coordinate and there from obtain these operators in spherical polar coordinate system.
10. (i) Discuss the diagonalization procedure of matrices.

    (ii) Diagonalize the matrix $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$
11. Describe the Gram–Schmidt Orthogonalization procedure. Illustrates how a power-series expansion in $u_n(x) = x^n$, which is not orthogonal, can be converted into an orthogonal series.
12. Discuss the Generating function and Rodrigues' Formula for Legendre polynomial.

(2 × 5 = 10 Weightage)

Section C

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

13. Show that Spherical polar coordinate system is orthogonal.
14. Explain pseudotensor. Show that the two-index Levi-Civita symbol ε_{ij} is a second-rank pseudotensor in two dimensional space.
15. Express the integral $I = \int_0^\infty \frac{x^3}{(1+x)^5} dx$ in terms of beta function and then find its value.
16. Prove the recurrence relation for Bessel function $J_{n+1}(x) + J_{n-1}(x) = \frac{2n}{x} J_n(x)$
17. Show that Hermite Polynomial $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n}\left(e^{-x^2}\right)$ and hence find the value of $H_2(x)$.
18. Find the Fourier series for the function e^x in the interval $-\pi < x < \pi$.
19. Find the Laplace transform of the following functions:

    (i) $\sin^2 t$ (ii) $\frac{e^{at}-1}{a}$

(4 × 3 = 12 Weightage)

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