D 13158 **(Pages : 3)** **Name..................................**

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

FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2021

(CBCSS)

Physics

PHY IC 02—MATHEMATICAL PHYSICS—1

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend* **all** *questions in each section.*
2. *The minimum number of questions to be attended from the Section / Part shall remain the same.*
3. *The instruction if any, to attend a minimum number of questions from each sub section / sub part / sub division may be ignored.*
4. *There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.*

Section A

8 *Short questions answerable within* 7½ *minutes.*
Answer **all** *questions, each carry weightage* 1.

1. If V represents a vector derive the curl of V in orthogonal curvilinear coordinates.
2. Is the given matrix Hermitian $\begin{bmatrix} 1 & -i & -3i \\ i & 5 & 0 \\ 3i & 0 & 2 \end{bmatrix}$.
3. Explain concept of outer product in tensors.
4. With an example explain features of a hyperbolic partial differential equation.
5. Show that $\int_{-1}^{+1} x\mathrm{P}_n(x)\,\mathrm{p}_{n-1}(x)\,dx = \frac{2n}{4n^2-1}$.

Turn over

6. Explain the convolution theorem of Fourier transform.

7. Explain when can a second-order linear homogeneous differential equation can be called self-adjoint.

8. Distinguish between Fourier integral and Fourier transform.

(8 × 1 = 8 weightage)

Section B

4 essay questions answerable within 30 *minutes.*

Answer any **two** *questions, each carry weightage* 5.

9. What are orthogonal curvilinear co-ordinate systems ? Obtain the mathematical expression for divergence in terms of curvilinear coordinates.

10. Using appropriate differential equation explain Laguerre polynomials and associated Laguerre polynomials. Obtain their representation in series form.

11. Explain the following properties of Fourier series: (1) Convergence (2) Integration ; and (3) Differentiation. Obtain the sine and cosine series in the interval $(0, \pi)$ for a function $f(x)$.

12. Explain the Frobenius' method of finding solution to homogenous differential equation of second order.

(2 × 5 = 10 weightage)

Section C

7 problems answerable within 15 *minutes.*

Answer any **four** *questions, each carry weightage* 3.

13. Is the given matrix orthogonal $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$.

14. Prove that $P_{2m+1}(0) = 0$.

15. A string of length n is stretched until the wave speed is 40 m/sec. It is given an initial velocity of 4 sin (x) from its initial position. What is location of maximum displacement ?

16. Evaluate $\Gamma\left(-\frac{1}{2}\right)$.

17. Evaluate Laplace transform of $\frac{\cos\sqrt{t}}{\sqrt{t}}$.

18. Prove that $H_{2n}(0) = (-1)^n \frac{(2n)!}{n!}$.

19. Expand the function $f(x) = \sin x$ as a cosine series in the interval $(0, \pi)$

(4 × 3 = 12 weightage)