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Reg. No.....

FIRST SEMESTER M.Sc. DEGREE [REGULAR/SUPPLEMENTARY] EXAMINATION, NOVEMBER 2020

(CBCSS)

Physics

PHY 1C 02—MATHEMATICAL PHYSICS—I

(2019 Admissions)

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. *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 7.5 minutes.

Answer **all** *questions, each question carries weightage* 1.

1. Obtain the expression for line element in spherical polar co-ordinates.
2. With an example explain Hermitian operators.
3. Explain concept of extension of rank by differentiation for a tensor.
4. With an example explain features of an elliptic partial differential equation. Laplace equation- its features.
5. Using Rodrigue's formula evaluate $\int_{-1}^{+1} P_0(x)\,dx$.
6. Explain Gram-Schmidt orthogonalization.
7. Explain the general form of a second order differential equation and classify them based on being elliptic, parabolic or hyperbolic.
8. Explain briefly any *two* uses of Fourier series.

(8 × 1 = 8 weightage)

Turn over

Section B

4 essay questions answerable within 30 minutes.
Answer any **two** *questions, each question carries weightage 5.*

9. Explain the algebraic operations of Tensors.

10. Explain the origin of Spherical Bessel function. What is the required orthogonal property of spherical Bessel functions ?

11. Explain any *five* properties of Fourier series.

12. What are orthogonal curvilinear coordinate systems ? Obtain the mathematical expression for divergence in terms of curvilinear coordinates.

(2 × 5 = 10 weightage)

Section C

7 problems answerable within 15 minutes.
Answer any **four** *questions, each question carries weightage 3.*

13. Expand the function $f(x)=x^2$ in the interval $-\pi<x<\pi$ and hence evaluate $\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}$.

14. Using Frobenius' method find solution of linear oscillator equation $\frac{d^2y}{dx^2}+\omega^2 y=0$.

in powers of x i.e near $x=0$.

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

16. A string of length π is stretched until the wave speed is 40 m/sec. It is given an initial velocity of $\sin(x)$ from its initial position. When does the maximum displacement occur ?

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

18. For the Legendre polynomial prove that $P_n(x)=1$.

19. If H is a Hermitian matrix prove that e^{iH} is unitary ?

(4 × 3 = 12 weightage)