

D 93433

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Name.....

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 $4 \sin(x)$ 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)