

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)