K24P 3917

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (CBCSS – OBE – Reg./Supple./Imp.)
Examination, October 2024
(2023 Admission Onwards)
PHYSICS/PHYSICS WITH COMPUTATIONAL AND NANO SCIENCE SPECIALIZATION
MSPHN01C02/MSPHY01C02 : Mathematical Physics – 1

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **any 5. Each one** carries **3** marks.

1. Define symmetric, skew-symmetric and orthogonal matrices.
2. Differentiate between covariant and contravariant tensors.
3. Find $\Gamma\left(\frac{1}{2}\right)$.
4. List the Dirichlet's conditions for a Fourier series.
5. Show that $P_n(-1) = (-1)^n P_n(1)$.
6. List the three classes of second order partial differential equations. **(5×3=15)**

SECTION – B

Answer **any 3. Each one** carries **6** marks.

7. Find the eigen values of the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.
8. Derive the relation between beta and gamma functions.

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9. Starting from the definition of $J_n(x)$, prove that $J_{n+1}(x) + J_{n-1}(x) = \frac{2nJ_n(x)}{x}$.
10. Obtain a Fourier expression for $f(x) = x^3$ for $-\pi < x < \pi$.
11. Prove that $\int_{-\infty}^{\infty} e^{-x^2} H_m(x) H_n(x)\, dx = 0$, for $m \neq n$. **(3×6=18)**

SECTION – C

Answer **any 3. Each one** carries **9** marks.

12. Find the eigen values and corresponding eigen vectors of the matrix $\begin{bmatrix} -5 & 2 \\ 2 & -2 \end{bmatrix}$.
13. Find the solution to the 1D heat equation using the method of separation of variables.
14. Prove the orthogonality of the Legendre polynomials.
15. Define Fourier transform of a function. Find the Fourier transform of $f(x) = \begin{cases} \frac{1}{2a}, & \text{if } |x| \le a \\ 0, & \text{if } |x| > 0 \end{cases}$.
16. State and prove Leibniz's rule for the convergence of an alternating series. **(3×9=27)**