K25P 3561

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (C.B.C.S.S. – O.B.E. – Reg./Supple./Imp.) Examination, October 2025
(2023 Admission Onwards)
PHYSICS/PHYSICS WITH COMPUTATIONAL AND NANO SCIENCE SPECIALIZATION
MSPHY01C02/MSPHN01C02 : Mathematical Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

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

1. What is the condition for a matrix to be Hermitian ? Provide an example.
2. Assuming that all the entities denoted by capital letters in $A(i,l,k,p)B^{p}_{lj} + C(j,k,l,m)D^{im}_{l} + E(i,j)F_k = 0$ are tensors. Rewrite this equation in a proper tensorial form.
3. State and prove similarity theorem of Fourier transform.
4. Determine absolute convergence of $\sum_{n=1}^{\infty}(-1)^n \frac{n!}{n^n}$.
5. Given that $\sum_{n=0}^{\infty} \frac{H_n(x)t^n}{n!} = e^{-t^2+2tx}$. Obtain the value of $H_4(0)$.
6. Define the Wronskian of a system of ODEs and what is its significance ? **(5×3=15)**

SECTION – B

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

7. Show that every square matrix is uniquely expressible as the sum of a Hermitian and skew-Hermitian matrix.
8. Prove that $\varepsilon_{ijk}\varepsilon_{ist} = \begin{vmatrix} \delta_j^s & \delta_j^t \\ \delta_k^s & \delta_k^t \end{vmatrix}$, where ε_{ijk} is the Levi-Civita symbol.

P.T.O.

9. Find the Fourier series of the function $f(x) = |\sin x|$, where $-\pi < x < \pi$.

10. Prove that $\beta(m,n) = \frac{(m-1)}{(m+n-1)}\beta(m-1,n)$, where $\beta(m,n)$ is the beta function.

11. Prove that $\int_{-\infty}^{\infty} xe^{-x^2}H_n(x)H_m(x)dx = \sqrt{\pi}\{2^{(n-1)}n!\delta_{m,n-1} - 2^n(n+1)!\delta_{m,n+1}\}$. **(3×6=18)**

SECTION – C

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

12. Obtain the Fourier series for the function $f(x)=x^2$ in the interval $-\pi \le x \le \pi$ and using Parsevel's theorem, deduce that $\sum_{n=1}^{\infty}\frac{1}{n^4} = \frac{\pi^4}{90}$.

13. Find the Fourier Cosine Transform of $f(x) = e^{-x}$ and prove that $\int_0^{\infty}\frac{\cos mx}{1+x^2}dx = \frac{\pi}{2}e^{-m}$.

14. Prove that $\int_{-1}^{1}P_m(x)P_n(x)dx = \frac{2\delta_{mn}}{2n+1}$, where $P_n(x)$ is the Legendre Polynomial.

15. Solve the system $X' = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix} X$ and compute the Wronskian.

16. Solve the vibrating string using method of separation of variables. **(3×9=27)**

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