K23P 3100

Reg. No. : ....

Name : ....

I Semester M.Sc. Degree (CBCSS – OBE – Regular) Examination, October 2023
(2023 Admission)
PHYSICS
MSPHY01C02 : Mathematical Physics – I

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **any 5**, **each** carries **3** marks.

1. S. T. the unitary transformation preserves the norm (magnitude) of a (complex) vector.
2. S. T. the eigen values of a Hermitian matrix is real.
3. Does the harmonic series $\left(1+\frac{1}{2}+\frac{1}{3}+\ldots\right)$ converging ? Justify.
4. How do you check the convergence of an alternating series ?
5. Show that $\int_0^{\infty} e^{-x^4}dx = \Gamma\left(\frac{5}{4}\right)$.
6. How are the stable critical points connected to the eigen values ?

SECTION – B

Answer **any 3**, **each** carries **6** marks.

7. Prove that $\det(cA) = c^n \det(A)$ where A is a $n \times n$ matrix and c is a constant.
8. State and prove the Fourier convolution theorem.
9. Prove the recurrence relation $xP_n(x) - P_{n-1}(x) = nP_n(x)$.

P.T.O.

10. Prove the recurrence relation $H_n(x) = (-1)^n H_n(-x)$.
11. S.T. the Helmholtz equation is separable in circular cylindrical co-ordinates if k^2 is generalized to $k^2 + f(\rho) + \frac{1}{\rho^2}g(\phi) + h(z)$.

SECTION – C

Answer **any 3**, **each** carries **9** marks.

12. Find eigen values and corresponding eigen vectors of the matrix $\begin{bmatrix} -7 & 4 \\ -12 & 7 \end{bmatrix}$.
13. Find Fourier transform of a derivative. Explain the result.
14. Prove the orthogonality relation for the Bessel functions.
15. Solve the 1D heat equation using the method of separation of variables.
16. Expand in Legendre series the function $f(x) = \begin{cases} 0 & -1 < x < 0 \\ 1 & 0 < x < 1 \end{cases}$.

____