Roll.No. | 22UPHCT3005

SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN
(AUTONOMOUS)
(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai - 600 044.
B.Sc.Physics - END SEMESTER EXAMINATIONS - NOVEMBER 2025
SEMESTER - III
22UPHCT3005 - Mathematical Physics & Statistical Mechanics

Total Duration : 2 Hrs.30 Mins. Total Marks : 60

Section B

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Find the eigenvalues and eigenvectors of a matrix A $= \begin{pmatrix} 4 & 1 \\ 2 & 3 \end{pmatrix}$.
2. (i) Prove that $\Gamma(n+1) = n\Gamma n$.
   (ii) Show that $\beta(m,n) = \int_0^\infty \frac{e^{m-}}{(1+x)^{m+n}} dx$.
3. Prove that $2J_n^1(x) = J_{n-1}(x) - J_{n+1}(x)$.
4. Explain the different types of ensembles.
5. Compare the M-B, B-E and F-D statistics.
6. Diagonalize a matrix A $= \begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{pmatrix}$.
7. Show that $nP_n(x) = xP_n'(x) - P_{n-1}'(x)$.
8. Discuss the application of B-E distribution law.

Section C

Answer any **THREE** questions $(3 \times 10 = 30$ Marks)

9. Find the characteristic equation of the matrix A $= \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$ and verify Cayley-Hamilton theorem.
10. (a) Prove that $\beta(m,n) = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$.
    (b) Show that $\int_0^\infty e^{-ky} y^{n-1} dy = \frac{\Gamma n}{k^n}$

Contd...

11. Obtain the solution of Hermite differential equation $\frac{d^2y}{d_{x^2}} - 2x\frac{dy}{dx} + 2ny = 0.$
12. Analyze the Maxwell-Boltzmann distribution law and its application to a system of ideal gas particles.
13. Derive the Fermi-Dirac distribution law and deduce its physical significance for quantum systems like electrons in a solid.

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