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 - NOV'2024
SEMESTER - III

22UPHCT3005 - Mathematical Physics and Statistical Mechanics

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

Section B

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

1. Diagonalise the matrix $A = \begin{pmatrix} 7 & -4 & 4 \\ -4 & 5 & 0 \\ 4 & 0 & 9 \end{pmatrix}$
2. Show that $\Gamma(n+1) = n\Gamma(n)$.
3. Prove that $2J_n^1(x) = J_{n-1}(x)$ - $J_{n+1}(x)$.
4. What are ensembles. Explain the types of ensembles.
5. Give postulates of quantum statistics. Distinguish between Bosons and Fermions.
6. Show that the matrix $A = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ \mathrm{i} & -\mathrm{i} \end{pmatrix}$ is unitary.
7. Compare MB, BE and FD statistics.
8. Apply Fermi-Dirac statistics to explain the energy levels of free electron gas.

Section C

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

9. Determine the eigen values and eigen vectors of $A = \begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$
10. i) Show that $\beta(m,n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.

    ii) Show that $\displaystyle\int_0^\infty \frac{x^8(1-x^6)}{(1+x)^{24}}dx = 0$
11. Obtain the solution of Legendre differential equation
    $(1-x^2)\dfrac{d^2y}{dx^2} - 2x\dfrac{dy}{dx} + n(n+1)y = 0.$
12. Applying Maxwell-Boltzmann distribution law, show that the internal energy of an ideal monoatomic gas depends only on its temperature.
13. Derive the Bose-Einsten distribution law.

*****