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 APRIL - 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. Show that the matrix A=$\begin{pmatrix} \cos\theta & -\sin\theta \\ \text{sind}\theta & \cos\theta \end{pmatrix}$ is orthogonal.
2. Show that $\Gamma(n+1) = n\Gamma n$
3. Show that $xJ_n^{;}(x) = nJ_n(x) - xJ_{n+1}(x)$
4. Classify the various types of ensembles.
5. Distinguish between three statistics.
6. Find the eigen values of the matrix $\mathbf{A}=\begin{pmatrix} \mathbf{2} & \mathbf{-2} & \mathbf{3} \\ 1 & \mathbf{1} & 1 \\ 1 & 3 & \mathbf{-1} \end{pmatrix}$
7. Prove that $H_n^{;}(x) = 2nH_{n-1}(x)$
8. State the postulates of statistical mechanics. What are micro and macro states?

Section C

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

9. Find the characteristic equation of the following matrix and verity Cayley-Hamilton theorem
   $\mathbf{A}=\begin{pmatrix} \mathbf{1} & \mathbf{2} & \mathbf{3} \\ \mathbf{2} & \mathbf{-1} & 4 \\ \mathbf{3} & 1 & \mathbf{1} \end{pmatrix}$
10. (i) Show that $\beta(m,n) = \dfrac{\Gamma m \Gamma n}{\Gamma(m+n)}$ where m>0, n>0.
    (ii) Show that $\beta(m,n) = \displaystyle\int_0^\infty \frac{y^{n-1}}{(1+y)^{m+n}} dy$
    .
11. Give the series solution of Legendre differential equation
    $(1-x^2)\dfrac{d^2y}{dx^2} - 2x\dfrac{dy}{dx} + n(n+1)y = 0$

Contd...

12. Discuss the classical Maxwell-Boltzmann's distribution law regarding the distribution of particles into various energy states.
13. Give the Fermi-Dirac distribution of energy in an electron gas in metals.

*****