

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 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. Show that the matrix $A = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary.
2. Define Beta and Gamma function and show that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$.
3. Prove that $J_{-n}(x) = (-1)^n J_n(x)$ where n is a positive integer.
4. What do you understand by thermodynamic probability and how it is related with entropy of a system. Establish the necessary relation.
5. Derive Bose-Einstein distribution law.
6. Show that the square matrix $A = \begin{pmatrix} 1 & 2 & 4 \\ -2 & 5 & 3 \\ -1 & 6 & 3 \end{pmatrix}$ as a sum of a symmetry and a skew symmetric matrix.
7. Derive Recurrence formula :
a) $2xH_n(x) = 2nH_{n-1}(x) + H_{n+1}(x)$. b) $H_n'(x) = 2nH_{n-1}(x)$.
8. Discuss in detail the comparison of three statistics.

Section C

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

9. Illustrate Cayley Hamilton's theorem using the matrix $A = \begin{pmatrix} 1 & 2 & 0 \\ 2 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$.
10. a) Establish the relation between Gamma and Beta function.
b) Show that $\Gamma m \Gamma(1-m) = \frac{\pi}{\sin m\pi}$.

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11. Solve Legendre differential equation and find its polynomial solution, n being a positive integer.
12. Applying Maxwell Boltzmann distribution law, show that the internal energy of an ideal mono atomic gas depends only on its temperature.
13. Derive Fermi Dirac Distribution Law.
