# B.Sc. DEGREE EXAMINATION,NOVEMBER 2018
## II Year III Semester
## Core Major - Paper V
## MATHEMATICAL PHYSICS AND STATISTICAL MECHANICS

**Time : 3 Hours** **Max.marks :60**

**Section A** $(10 \times 1 = 10)$ Marks

Answer any **TEN** questions

1. The sum of the eigen values of matrix is equal to the ————- of the matrix.
2. What is diagonalisation of a matrix?
3. Define beta function.
4. Evaluate $\Gamma$-1/2.
5. Prove that$\sum_{\mathbf{n=0}}^{\infty} \mathbf{Pn}\,(\mathbf{x}) = \frac{\mathbf{1}}{\sqrt{\mathbf{2-2x}}}$.
6. Find the value of $H_1(x)$ in terms of x.
7. What is the phase point?
8. What is an ensemble?
9. What do you mean by Fermi energy and Fermi temperature?
10. What are Bosons?
11. How does probability depend upon the number of microstates?
12. What is characteristic equation?

**Section B** $(5 \times 4 = 20)$ Marks

Answer any **FIVE** questions

13. State and prove Cayley Hamilton's theorem.
14. Evaluate beta function.
15. Derive an expression for the generating function for Laguerre's polynomial.
16. Give the postulates of statistical mechanics.
17. Calculate the Fermi energy of aluminium that the metal has one free electron per atom. Given that Planck's constant (h) = 6.625 x $10^{-34}$JS,Mass of the electron (m)= 9x$10^{-31}$kg Density of aluminium ($\rho$) = 7700 kg/$m^3$ and atomic weight of aluminium M = 27.
18. Show that $\int_{\mathbf{0}}^{\mathbf{1}} [\mathbf{35x^2}/(32\sqrt{\mathbf{1-x}})]\ \mathbf{d}x = \mathbf{1}$ using gamma function.
19. Prove that $J_{-n}(x) = (-1)^n J_n(x)$ where n is a positive integer.

## **Section C** $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. Determine the eigenvalues and Eigen vectors of the matrix

$$\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

21. (a) Find the relation between Beta and Gamma function.
(b) Evaluate the integral $\int_0^\infty \mathbf{e^{-x^2}} \mathbf{d}x$.

22. Integrate in series Bessel's equation $x^2 \frac{\mathbf{d^2y}}{\mathbf{dx^2}} + x \frac{\mathbf{d}y}{\mathbf{d}x} + (x^2 - n^2)y = 0$ Where n is not an integer and obtain the general solution of it.

23. Find the average energy of a molecule to an ideal gas using Maxwell Boltzmann distribution law.

24. Obtain the expression for Fermi-Dirac distribution law.Using it derive expression for the fermi energy of an electron in a metal.

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