STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2019 – 2020 and thereafter)

SUBJECT CODE : 19PH/PC/SM14

M.Sc., DEGREE EXAMINATION NOVEMBER 2022
PHYSICS
FIRST SEMESTER

COURSE : MAJOR CORE
PAPER : STATISTICAL MECHANICS
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION - A

ANSWER ALL QUESTIONS: **(10x3=30)**

1. Define phase space. How is phase space divided into cells?
2. Differentiate between microcanonical, canonical and grand canonical ensembles.
3. State the law of equipartition of energy.
4. Give the expressions for thermodynamic functions, Helmholtz free energy and entropy for canonical ensembles.
5. Write the virial expansion of the equation of state.
6. Write the postulate of *Equal a Priori Probability*.
7. What are the peculiar properties of Helium?
8. What is the difference between normal fluid and superfluid ?
9. What are white dwarfs? State their properties.
10. State the conditions for Fermi-Dirac statistics.

SECTION – B

ANSWER ANY FIVE QUESTIONS: **(5x5=25)**

11. Discuss Gibb's paradox. Explain how the paradox is resolved using quantum mechanics.
12. Explain the fluctuation of energy in canonical ensemble.
13. Discuss the concept of negative temperature in a 2-level system.
14. Write a note on density matrix and its use in statistical mechanics.
15. Derive the expression for the following thermal properties of a Bose-Einstein gas.
    (i) specific heat (ii) entropy
16. What is Bose-Einstein condensation? Derive the expression for Bose temperature.
17. Derive the expression for Chandrasekhar Limit.

SECTION – C

ANSWER ANY THREE QUESTIONS: **(3x15=45)**

18. State and prove Liouvelle's theorem.
19. Based on equipartition theorem, derive the expression for mean energy of a harmonic oscillator at both high and low temperatures.
20. Discuss the distribution of particles in grand canonical ensemble. Derive the equation that represents the grand canonical ensemble, number of particles in it and the energy of the particles.
21. Discuss the Debye's theory of specific heat of solids and derive Debye's T^3 Law.
22. Give an account of paramagnetism. Obtain the expression for paramagnetic susceptibility.

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