

M.Sc. DEGREE (CSS) EXAMINATION, AUGUST 2015**Second Semester**

Faculty of Science

Branch II – Physics – A – Pure Physics

PH 2C 07 – THERMODYNAMICS AND STATISTICAL MECHANICS

(2012 Admission onwards)

Time : Three Hours

Maximum Weight : 30

Part A*Answer any six questions.**Weight 1 each.*

1. Distinguish between State function and Path function.
2. In a Carnot cycle which are the Isentropic processes?
3. Define Quantum state of a system with reference to phase space.
4. What are the conditions for thermodynamic equilibrium?
5. How does partition function connect thermodynamics and statistical mechanics?
6. Explain why Fermion wavefunctions have to be antisymmetric.
7. Explain Wein's Displacement Law.
8. What will be colour of black body? Explain.
9. Explain the term Chemical Potential.
10. Give two examples for second order phase transitions.

(6 × 1 = 6)

Part B*Answer any four questions.**Weight 2 each.*

11. A system has two energy levels 0 and E with degeneracies g_0 and g_1 . Find the partition function.
12. Calculate the pressure at which boiling point of water becomes 120° C. Specific volume of water and steam at 100° C are 1 cm³ and 1647 cm³. Specific Latent heat 2268 J/kg.
13. Starting from Boltzmann formula for probability occurrence obtain Maxwell's velocity distribution formula.

14. Calculate the relative population of molecules in two energy levels with energy difference 1.2×10^{-4} Joule, at 400 k assuming Maxwell-Boltzmann statistics.
15. Discuss the physical significance of the result $S = k \sum Pr \ln Pr$.
16. For an electron gas Fermi Energy is 3.14 eV. Calculate the Fermi temperature and specific heat at constant volume at 100 k.

(4 × 2 = 8)

Part C

Answer all questions.

Weight 4 each.

17. (a) Define Entropy. What is its physical significance? How does entropy change in reversible and irreversible processes? Explain using second law of thermodynamics.

Or

- (b) Develop the idea of Statistics and distributions. Find volume occupied by a quantum state in phase space. Postulates of quantum statistical mechanics lead to equipartition of energy. Explain.

18. (a) Obtain the Boltzmann Probability distribution for a Canonical Ensemble.

Or

- (b) Distinguish between Identical particles that okay Pauli principle and those that do not. Find an expression for entropy for an Idea gas.

19. (a) What is Delicyi's model of lattice specific heat?

Or

- (b) Discuss the grand canonical ensemble and density fluctuations in it.

20. (a) Obtain the thermodynamic potential that does not vary during first order phase transitions. Discuss phase transitions in gas-liquid systems.

Or

- (b) Discuss the Ising model. What are critical exponents?

(4 × 4 = 16)