A–9078

Sub. Code
4MPH2C3

M.Sc. DEGREE EXAMINATION, NOVEMBER 2019

Second Semester

Physics

THERMODYNAMICS AND STATISTICAL PHYSICS

(CBCS – 2014 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is a state function? Point out whether entropy is a state function.

2. Write down the first law of thermodynamics for an open system in differential form.

3. Mention any two assumptions made in writing Boltzmann transport equation.

4. Write down one dimensional diffusion equation. Mention a physical process that is described by diffusion equation.

5. What is an ensemble?

6. Define the term “Thermodynamic Probability”.

7. Mention any two differences between classical statistics and quantum statistics.

8. Point out any four particles that obey Bose-Einstein statistics.

9. What is meant by density of states?

10. State any two characteristics of liquid Helium II.

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) What are first and second order phase transitions? What is a phase diagram and triple point?

Or

(b) Define the thermodynamic potentials

(i) enthalpy,

(ii) Helmholtz and

(iii) Gibbs. What is the significance of them?

12. (a) State and prove Boltzmann H-theorem.

Or

(b) Discuss the validity of Boltzmann equation.

13. (a) Show that the mean kinetic energy of a particle per degree of freedom is $\frac{kT}{2}$.

Or

(b) Obtain an expression for partition function in Gibb's canonical ensemble.

14. (a) Derive an expression for the probability distribution of particles governed by Fermi-Dirac statistics.

Or

(b) Three particles are to be distributed in four energy levels a, b, c and d. Calculate all possible ways of this distribution when particles are

(i) Fermions and (ii) Bosons.

15. (a) Discuss Einstein's model of specific heat of solids.

Or

(b) Discuss about fluctuations in pressure.

Part C $(3 \times 10 = 30)$

Answer any **three** questions.

16. Derive Maxwell's thermodynamical relations.

17. Deduce Boltzmann transport equation.

18. Obtain an expression for the probability of finding the particle in a particular microstate in grand canonical ensemble. Obtain expression for P, μ, and N in terms of grand partition function.

19. What is Bose-Einstein Condensation? Calculate the critical temperature at which the condensation will start.

20. Derive Planck's formula for black body radiation. Using this result deduce Stefan-Bolzmann law.

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