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(Pages : 2)

Name.....

Reg. No.....

**SECOND SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY)  
EXAMINATION, APRIL 2021**

(CBCSS)

Physics

PHY 2C 07—STATISTICAL MECHANICS

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**General Instructions**

1. In cases where choices are provided, students can attend **all** questions in each section.
2. The minimum number of questions to be attended from the Section / Part shall remain the same.
3. There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.

**Section A**

8 Short questions answerable within 7.5 minutes.

Answer **all** questions, each question carries weightage 1.

1. What are the expected values of  $S$  and  $\Omega$  for a system at  $T = 0$  K ?
2. Differentiate between distinguishable and indistinguishable particles.
3. Define partition function. What is the significance of partition function in statistical mechanics ?
4. What is an Ensemble ? Write down the probability distribution function of a micro canonical ensembles ?
5. Which are the different motions a diatomic molecule is capable of performing ?
6. What is Bose-Einstein condensation ? Which property of boson is responsible for this phenomenon ?
7. Define black body radiation. What are its characteristic properties ?
8. Show that the Fermi distribution curve is symmetrical about the Fermi energy  $E_F$ .

(8 × 1 = 8 weightage)

**Turn over**

**Section B**

4 essay questions answerable within 30 minutes.

Answer any **two** questions, each question carries weightage 5.

9. Derive expressions for energy fluctuations in the case of canonical ensemble.
10. Describe the thermodynamic behaviour of an ideal Bose gas.
11. Derive the equation for thermodynamic probability of an ideal gas from micro-canonical ensemble. Hence derive thermodynamics of the system.
12. Describe the thermodynamic behaviour of an ideal Fermi gas.

(2 × 5 = 10 weightage)

**Section C**

7 problems answerable within 15 minutes.

Answer any **four** questions, each question carries weightage 3.

13. How does the number of microstates of 1 g of H<sub>2</sub> gas change, if its volume gets doubled by a process of reversible adiabatic expansion?
14. The entropy of a microstate of a system is 1 JK<sup>-1</sup> while that of another one is 1.001 JK<sup>-1</sup>. How many times more likely is the second microstate as compared to the first one ?
15. A system in contact with a heat bath at temperature T has two accessible energy states with energies 0 and 0.1 eV. If the probability of the system being in the higher energy state is 0.1 eV, find the temperature of the heat bath.
16. Find the condensation temperature for liquid helium with a density of 145 kgm<sup>-3</sup>.
17. What is Gibb's paradox ? How is it resolution ?
18. The peak wavelength of radiation coming out of a hole in an enclosure is 5 μm. Find the total energy density inside the cavity.
19. The density of electrons in copper is 8.51 × 10<sup>28</sup>m<sup>-3</sup>. Find (i) the fermi energy of copper ; (ii) The average zero point energy of a free electron in copper ; and (iii) The degeneracy pressure of the electron gas in copper.

(4 × 3 = 12 weightage)