

Ref. No.: Ex/SC/PHY/UG/CORE/TH/14/2022(S)

B. Sc. PHYSICS EXAMINATION, 2022

(3rd Year, 2nd Semester)

SUBJECT: STATISTICAL MECHANICS

Time: 2 hours

(Answer any *five*)

Full marks: 40

1. Derive an expression for number of microstates of an ideal monatomic gas. The volume of an ideal gas is doubled, keeping its energy fixed. Find the change in entropy.
(8+2)
2. A paramagnetic system consists of N magnetic dipoles. Each dipole carries a magnetic moment μ , can be treated classically. If the system is at finite temperature T, placed in a uniform magnetic field B, then considering angle between $\vec{\mu}$ and \vec{B} : (a) find average magnetization of the system per unit volume. (b) hence calculate magnetic susceptibility at high temperature and low temperature limits.
(6+4)
3. State and explain the central limit theorem. Prove that the measure of fluctuation in canonical ensemble: $\langle (\Delta E)^2 \rangle = K_B T^2 C_v$, where all symbols have their usual meaning.
(3+7)
4. Derive the statistical expression of most probable distribution for distinguishable particles. A system has 7 particles arranged in two compartments. The first compartment has 8 cells and the second has 10 cells. Calculate the number of microstates in macrostate (3, 4) when particles obey the above mentioned statistics.
(7+3)
5. What is diffused radiation pressure? Deduce the relation of energy density with diffused radiation pressure. Deduce Wien's displacement law of radiation for black body.
(2+3+5)
6. Derive Planck's radiation formula and hence deduce Rayleigh Jeans law for the distribution of energy in the spectrum of black body.
(6+4)