

UNION CHRISTIAN COLLEGE, ALUVA  
B.Sc(Physics) Core Semester V  
(PH5B03U) Thermal and Statistical Physics

Internal Examination

Duration: 90 Minutes

Max. marks : 30

**Part A**(One mark each, answer **all** questions)

1. Entropy of a system \_\_\_\_\_ in all irreversible processes
2. Gibbs potential is defined as  $G =$  \_\_\_\_\_
3. A reversible engine can be 100% efficient, if the temperature of the sink is \_\_\_\_\_.
4. A macrostate that has only one microstate corresponding to it, has an entropy equal to \_\_\_\_\_.

**Part B**( 2 Marks each, answer any **three** questions.)

5. Prove that adiabatic elasticity of a gas is  $\gamma$  times isothermal elasticity.
6. One mole of a gas at  $92^\circ C$  expands isothermally until its volume is doubled. Calculate the work done.
7. State and explain first law of thermodynamics.
8. State true or false with reason: Number of microstates decrease with increase in energy  $E$  for a free particle having energy between  $E$  and  $E + dE$  in one dimension.
9. Energy of a photon is linearly proportional to its momentum  $E = pc$  where  $p = |\vec{p}|$ . Find an expression for the number of microstates in the phase space of a photon in a box of volume  $V$  with energy between  $E$  &  $E + dE$ . (Choose  $h^3$  as the smallest volume in phase space.)

**Part C**( 4 Marks each, answer any **two** question.)

10. Derive Mayers relation.
11. Derive Clausius Clapeyrons equation from Maxwells thermodynamic relations.
12. A shooter is aiming at 16 balloons of different colors - 7 red, 4 blue and 5 green - stuck on a board. The probability of hitting any balloon is the same. Let  $n$  represent the number of red balloons hit. If 4 shots are fired, find the probability and thermodynamic probability for the macrostate  $n = 3$ , (Assume that balloons of the color are indistinguishable).

**Part D**( 12 Marks each, answer any **one** question.)

13. Derive Maxwells thermodynamic relations.
14. Explain the working of Carnots engine. Deduce the expression for its efficiency.