

M. Sc. DEGREE END SEMESTER EXAMINATION APRIL 2017

SEMESTER - 2: PHYSICS

COURSE: 15P2PHYT07, THERMODYNAMICS AND STATISTICAL PHYSICS

(For Supplementary - 2015 Admission)

Time: Three Hours

Max. Marks: 75

Part A (Objective Type)

(Answer all questions) Each question carries 1 Mark

1. The average energy of the molecules of mono atomic gas at temperature T is
 - (a) $\frac{1}{2}KT$
 - (b) $\frac{3}{2}KT$
 - (c) KT
 - (d) $\frac{5}{2}KT$
2. The efficiency of Carnot engine working between steam point and ice point is
 - (a) 1
 - (b) 0
 - (c) 26.81%
 - (d) 16.81%
3. A reversible heat engine can be 100% efficient if the temperature of the sink is
 - (a) Less than that of the source
 - (b) Equal to the source
 - (c) $0^{\circ}C$
 - (d) 0K
4. The unit of entropy is
 - (a) JK^{-1}
 - (b) Jkg^{-1}
 - (c) $JK^{-1}Kg^{-1}$
 - (d) None of these
5. Enthalpy is given by
 - (a) $H=U-PV$
 - (b) potential?
 - (c) What are the conditions for thermodynamic equilibrium?

(2 x 5 =

10)

(d)

(e)

(f) **Part C(Problem/Short essay)**

(g) (Answer any 3 question) Each question carries 4 Marks

(h)

- (i) With the help of partition function prove that
- (j) $C_v = -T \left(\frac{\partial^2 F}{\partial T^2} \right)_v$
- (k) Average internal energy
- (l) $\bar{U} = k_B T^2 \left[\frac{\partial (\ln Z)}{\partial T} \right]_v$
- (m) A Carnot engine is operated between two reservoirs at temperatures of 450K and 350K. If the engine receives 4200 Joules of heat from the source in each cycle. Calculate the amount of heat rejected to the sink in each cycle. Calculate the efficiency of the engine.
- (n) Calculate the root mean square speed and average speed of nitrogen molecules of mass 4.65×10^{-26} kg at 27°C.
- (o) Calculate the increase in entropy in irreversible process while extending a spring.
- (p) Show that with the help of Maxwell's relations
- (q) $T ds = C_v dT + T \left(\frac{\partial P}{\partial T} \right)_v dv$
- (r) $T ds = C_p dT - T \left(\frac{\partial v}{\partial T} \right)_p dp$
- (s) = 12) (4 x 3)

(t)

(u) **Part D (Essay)**

(v) (Answer all question) Each question carries 12 Marks

(w)

- (x) (a) 1. Discuss the relation between entropy and second law of thermodynamics.
- (y) thermodynamics.
- (z) 2. What is meant by equal a priori probability?
- (aa) 3. State the limitations of classical probability.
- (bb) 4. Bring out the salient features of statistical probability.
- (cc) **OR**
- (dd) (b). What is entropy? Discuss the law of increase of entropy. Write down Maxwell's thermodynamic relations.
- (ee) 20. (a). Distinguish $H=U+PV$
- (ff) $H=U-TS$
- (gg) $H=U+TS$

(1 x 5 = 5)

Part B (Short Answer)

(Answer any 5 questions) Each question carries 2 Marks

6. Write down the axioms of probability theory.
7. State and explain Rayleigh-Jean's law.
8. Distinguish between symmetric and anti-symmetric wave functions.
9. How bosons and fermions are identified?

10. Explain Bose-Einstein condensation.
11. State and explain equipartition theorem.
12. What is grandtween identical particles that obey Pauli's Exclusion principle and those that do not. Derive Sackur-Tetrode formula for entropy of an ideal gas.

OR

(b) Briefly discuss rotational and vibrational energy levels for diatomic molecules.

21. (a) What is Debye's model of lattice specific heat.

OR

(b) What do you mean by the term chemical potential. Discuss one method of calculating and measuring chemical potential.

22. (a) Discuss the Ising model for ferromagnetism. What do you mean by the term order parameter.

OR

(b) Discuss the thermodynamic properties of Fermi gas at low and high temperature region

(12 x 4 = 48)
