Sanjay Ghodawat University, Kolhapur

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FY M. Sc.	**School of Science**	**Semester II**
PHS 506	**Statistical Mechanics**	**Max Marks: 100**
	End Semester Examination (ESE)	**Time: 3 Hrs.**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Neat diagrams must be drawn wherever necessary.
4) Use of logarithmic table and non-programmable calculator is allowed.

Q.1.A Select the correct alternative. **Marks (8)** **CO**

1. Which of the following is a property of entropy? 1 506.1

a) Entropy increases during an irreversible operation
b) Net change in entropy in a reversible cycle is zero
c) Change in entropy during an adiabatic operation is zero
d) All of the above

2. The state of the gas described in terms of the properties of its constituent is called 1 506.1

a) Macroscopic state
b) Microscopic state
c) Phase space
d) None of these

3. In a micro canonical ensemble, a system A of fixed volume is in contact with large reservoir B then 1 506.2

a) A can exchange only energy with B
b) A can exchange only particles with B
c) A can exchange neither energy nor particles with B
d) A can exchange both energy and particles with B

4. Which of the following relations between total energy E and the micro canonical partition function Z, is true? 1 506.2

a) $E = -N\frac{\partial}{\partial T}\log Z$
b) $E = NkT^2\left[\frac{\partial}{\partial T}\log Z\right]_V$
c) $E = -NkT\log Z$
d) $E = NkT\frac{\partial}{\partial T}\log Z$

5. The energy density of photon gas maintained at a temperature 'T', is proportional to T^n, where n is 1 506.3

a) 1
b) 2
c) 3
d) 4

6. Two identical particles are to be distributed over 3 energy levels. Treating the particles as distinguishable Maxwell-Boltzman particles, the number of ways in which the particles can distributed is 1 506.3

a) 6 b) 9

c) 3 d) 8

7. He^4 isotope has spin 1 506.4

a) ∞ b) 1

c) 1/2 d) 0

8. A second order phase transition is characterized by 1 506.4

a) A latent heat b) A discontinuous change in its specific heat

c) A change in volume d) Irreversible behavior during warming and cooling

Q.1.B Fill in the Blank

	Marks (6)	CO
1. Change in..... depends on the thermodynamic state	1	506.1
2. The internal energy of molecules is ..... in an isothermal change.	1	506.1
3. For large number of particles 'N' the relative root men square fluctuation in E are negligible hence canonical ensemble is equivalent to.....	1	506.2
4. The volume of a cell is.....if, it is in six dimensional phase space.	1	506.2
5. For Bose-Einstein statistics the symmetry of the wave function.....	1	506.3
6. Phase transition between the ordinary conductor to superconductor at critical temperature is an example of	1	506.4

Q.1.C State whether True or False

	Marks (6)	CO
1. For a thermodynamic system work done in a process is depend on the state of the system.	1	506.1
2. In classical microcanonical ensemble for a system of N interacting particles, the fundamental volume in phase space which is regarded as equivalent to one microstate is h^{3N}	1	506.2
3. The microscopic occupation of the zero momentum ground state is called Bose-Einstein Condensation of Boson	1	506.3
4. The chemical potential for photon is zero.	1	506.3
5. He^3 isotope has spin 0.	1	506.4
6. No heat is absorbed or absorbed during the second order phase transition.	1	506.4

Q.2 Answer the following questions.	**Marks (20)**	**CO**
a) Explain Liouville's theorem in classical presentation.	12	506.1
b) Explain laws of thermodynamics in brief.	8	506.1
OR		
b) i) Write a note on Postulate of equal a priori probability.	4	506.1
ii) Differentiate between macroscopic and microscopic states.	4	506.1

Q.3 Answer the following questions.	**Marks (20)**	**CO**
a) Explain the concept of grand canonical ensemble. Obtain the expression for Gibb's grand canonical distribution	12	506.2
b) Find the partition function for an ideal gas in canonical ensemble. Derive the relation for the thermodynamic variables P, S, U and C_v in this case	8	506.2
OR		
b) i) What are the energy fluctuations in canonical ensemble? Explain.	4	506.2
ii) Give the physical significance of the normalization factor in microcanonical distribution.	4	506.2

Q.4 Answer the following questions.	**Marks (20)**	**CO**
a) Discuss in detail the case of Weakly degenerate Ideal Fermi gas.	12	506.3
b) Write a note on Free electron model.	8	506.3
OR		
b) i) Differentiate MB, BE and FD statistics	4	506.3
ii) Write a note on Einstein's explanation of Planck's law	4	506.3

Q.5 Answer the following questions.	**Marks (20)**	**CO**
a) What is mean by Phase transition? Explain in details the types of phase transitions by giving appropriate examples.	12	506.4
b) Explain second order phase transition by giving the examples of $BaTiO_3$ and β brass	8	506.4
OR		
b) i) Write a note on peculiar properties of liquid He	4	506.4
ii) What are the conditions of phase equilibrium?	4	506.4