MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.										

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc. (Physics)
MAKE-UP EXAMINATIONS, JUNE 2019

THERMODYNAMICS AND STATISTICAL PHYSICS [PHY 5202]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 07/06/2019 MAX. MARKS: 50

Note: (i) Answer **ALL** questions

(ii) Draw diagrams, and write equations wherever necessary

1.

a) Derive the Euler relation in the entropy representation. Express the following fundamental relation in the Euler form:

$$U = \frac{CS^3}{NV}$$

b) Derive the three Maxwell's relations from the fundamental relation,

$$A = A(T, V, N)$$

(7 + 3 = 10 Marks)

2.

a) Explain Gibbs paradox.

b) Derive the Liouville's theorem for phase space distribution function ($\rho(q, p, t)$).

(5 + 5 = 10 Marks)

3.

a) Obtain the canonical partition function $Q_N(V, T)$ for a system of N, one-dimensional quantum oscillators and hence obtain expressions for Helmholtz free energy (A) and pressure (P).

b) Distinguish between canonical and grand canonical ensemble. Write down the general partition functions for these ensembles.

(7 + 3 = 10 Marks)

4.

a) Calculate the most probable speed, average speed and RMS speed of N_2 at 300K. (Given: Mass of nitrogen molecule is 28 AMU).

b) Prove that for a free electron gas, the average energy ($\bar{E}$) is given by the expression

$$\bar{E} = \frac{3}{5} E_F ,$$

where E_F is the Fermi energy.

(6 + 4 = 10 Marks)

5.

a) Prove that for Bosons, the occupation number

$$n_i = \frac{g_i}{\exp \alpha \,.\, \exp \beta \epsilon_i - 1}$$

Given:

$$W_{BE}\{n_i\} = \prod_i \frac{(n_i + g_i - 1)!}{n_i!\,(g_i - 1)!}$$

b) Derive the Langevin equation for Brownian motion.

(6 + 4 = 10 Marks)

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