Enrollment No: _____ Exam Seat No:_____

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name: Introduction to Statistical Mechanics and Plasma Physics

Subject Code: 4SC06SMC1 Branch: B.Sc. (Physics)

Semester: 6 Date: 02/05/2018 Time: 02:30 To 05:30 Marks: 70

Instructions:

(1) Use of Programmable calculator & any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

Q-1 Attempt the following questions: (14)

a)	Differentiate between macroscopic and microscopic states.	1
b)	Name the bridge connecting statistical mechanics and thermodynamics.	1
c)	State the Liouville's theorem.	1
d)	State the Nernst heat theorem.	1
e)	Out of the three ensembles, which two are equivalent to each other?	1
f)	Name the distribution that follows classical mechanics.	1
g)	Give one difference between fermions and bosons.	1
h)	How are the constants α and β (in the three distributions) related to temperature (T)?	1
i)	What is the average energy for particles in three dimensions?	1
j)	Explain the process of Ionization of atoms.	1
k)	Define plasma.	1
l)	Name the three ensembles.	1
m)	State the equal priori probability theorem.	1
n)	Name at least one place where plasma is produced naturally.	1

Attempt any four questions from Q-2 to Q-8

Q-2 Attempt all questions (14)

a)	Derive the formula for the entropy of a perfect gas in a microcanonical ensemble.	**(07)**
b)	Define microcanonical ensemble. Express the ensemble mathematically and derive the normalized density distribution function.	**(07)**

Q-3 Attempt all questions (14)

a)	Derive the formula for Maxwell Boltzmann distribution of velocity.	**(10)**
b)	Explain the Gibb's paradox. How can it be removed?	**(04)**

Q-4		**Attempt all questions**	**(14)**
	a)	If the distribution function of a system is given by $= 4\pi\ (\frac{m}{2\pi kT})^{\frac{3}{2}} \exp(\frac{-mv^2}{2kT})v^2$, derive the formula for the mean (average) kinetic energy of the particles.	**(07)**
	b)	Define a grand canonical ensemble and derive the formula for the density distribution function for the same.	**(07)**
Q-5		**Attempt all questions**	**(14)**
	a)	Derive the formula for the number of particles (ni) distributed in energy levels (gi) following Maxwell-Boltzmann distribution.	**(07)**
	b)	Considering the Maxwell-Boltzmann distribution, derive the formula for the constant β.	**(07)**
Q-6		**Attempt all questions**	**(14)**
	a)	In a gas of identical particles, weakly interacting particles i^{th} state with degeneracy (gi) 4 has 3 particles (ni). Find the number of ways of selecting the particles under i) Maxwell-Boltzmann distribution ii) Fermi-Dirac distribution and iii) Bose-Einstein distribution.	**(07)**
	b)	If the number of particles having velocity between v and v+dv is given by $n(v)dv = 4\pi N(\frac{m}{2\pi kT})^{\frac{3}{2}} \exp\left(\frac{-mv^2}{2kT}\right) v^2 dv$, derive a formula for the average velocity of the particles.	**(07)**
Q-7		**Attempt all questions**	**(14)**
	a)	Name and explain the three different types of collisions in plasma.	**(07)**
	b)	Explain the concept of plasma oscillation and derive the formula for plasma frequency.	**(07)**
Q-8		**Attempt all questions**	**(14)**
	a)	Explain the following terms i) electron impact excitation ii) electron impact dissociation iii) penning ionization iv) recombination v) photoionization and vi) debye shielding	**(07)**
	b)	Derive the formula for the number of particles distributed in different energy levels following Bose-Einstein statistics.	**(07)**