Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Statistical Mechanics **Semester: II**
Program: M Sc (Physics) **Time : 03 hrs.**
Course Code: PHYS7017 **Max. Marks: 100**

Instructions:
All questions are compulsory (Q9 and Q11 have an internal choice)
Scientific calculators can be used for calculations.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Describe the postulate of equal a priori probability.	**4**	**CO1**
Q 2	What is the Dulong Petit's law?	**4**	**CO1**
Q 3	State Nernst Heat theorem use it to show heat capacity vanishes at the absolute zero.	**4**	**CO2**
Q 4	Differentiate between Fermi-Dirac and Bose-Einstein statistics	**4**	**CO3**
Q 5	Define ensembles, make a comparison between different types of ensembles.	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks): Q9 has an internal choice.**		
Q 6	Define entropy and probability. Show that the entropy of the system is proportional to the logarithm of probability of that system.	**10**	**CO2**
Q 7	(a) Establish the correlation of Classical partition function with the enthalpy and Gibbs free energy. (b)Calculate the fraction of oxygen, molecules within 1% of the most probable velocity at N.T.P. What is the effect of changing (i) the gas to hydrogen (ii) the temperature to 500^0C	**10**	**CO2**
Q 8	Define thermodynamic potentials, and derive all the Maxwell relations.	**10**	**CO4**
Q 9	Consider two identical particles. Each particle can be in one of the three possible quantum states of energy 0, ε and 3ε. Calculate the number of microstates of the system for M-B, B-E and F-D statistics. Also determine the ratio of the probability that the two particles are found in the same state to the probability that the two particles are found in each of the three cases. **Or**	**10**	**CO3**

	Show that in a highly degenerate Fermi-Dirac gas the specific heat is directly proportional to its absolute temperature.		
SECTION-C (2Qx20M=40 Marks): Q11 has an internal choice.			
Q 10	What are the phase transitions of second order, discuss Ising model for the phase transitions of the second order.	**20**	**CO4**
Q 11	(a) Deduce Bose-Einstein distribution formula (b) Explain the phenomenon of Bose-Einstein condensation. **Or** (a) Calculating the degeneracy parameter and the average energy of the resonators, obtain the Planck's Law and discuss its various cases. (b) Derive thermodynamical properties for phonons in a mono-atomic solid.	**10+10** **10+10**	**CO3**