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**Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET UNIVERSITY)**

M.Sc. (Third Semester – Regular) Examinations, December – 2025
24MPHPC23001 – Statistical Mechanics
(Physics)

Time: 3 hrs

Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A**(2 x 5 = 10 Marks)**Q.1. Answer *ALL* questions

| | CO # | Blooms Level |
|---|------|--------------|
| a. Define canonical ensemble, Micro-canonical ensemble and Grand canonical ensemble? | CO1 | K1 |
| b. State and explain Liouville's theorem for quantum statistical mechanics? | CO2 | K1 |
| c. What is Chandrasekhar limit? | CO3 | K1 |
| d. Bose-Einstein condensation is sometimes referred as 'condensation in momentum space'. Justify? | CO4 | K1 |
| e. Differentiate between a Normal Fluid and Super Fluid? | CO5 | K1 |

PART – B**(10 x 5 = 50 Marks)**Answer ALL the questions

| | Marks | CO # | Blooms Level |
|--|-------|------|--------------|
| 2. a. Explain Equipartition theorem? | 3 | CO1 | K1 |
| b. Calculate the partition function for a classical ideal mono-atomic gas? | 7 | CO1 | K2 |
| (OR) | | | |
| c. What is Gibb's paradox? How it can be resolved to get the correct Entropy of a system? | 10 | CO1 | K1 |
| 3.a. What are the different types of Ensembles? | 3 | CO2 | K1 |
| b. Derive the expression for the Entropy of an ideal gas in canonical Ensemble? | 7 | CO2 | K2 |
| (OR) | | | |
| c. Derive the necessary expressions for Bose-Einstein distributions? | 10 | CO2 | K1 |
| 4.a. Derive and explain about the Fermi-Dirac distribution with necessary theory and expression? | 10 | CO3 | K2 |
| (OR) | | | |
| b. What is ideal Fermi gas? Obtain the equation of state of ideal Fermi gas? | 10 | CO3 | K1 |
| 5.a. What is ideal Boson gas? Derive the Equation of state of ideal Boson gas? | 10 | CO4 | K2 |
| (OR) | | | |
| b. What is Bose-Einstein condensation? Derive the equation for the Bose-Einstein condensation? | 10 | CO4 | K2 |
| 6.a. What is 1st order and 2nd order phase transitions? | 3 | CO5 | K1 |
| b. Discuss about the 1 st and 2 nd order phase transition of ideal Bose gas? | 7 | CO5 | K1 |
| (OR) | | | |
| c. Discuss in detail about the Ising model (one dimensional) in Bose gas? | 10 | CO5 | K1 |

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