|  |
| --- |
| Bon Secours College for Women Nationally Accredited with “A” Grade by NAAC (Affiliated to Bharathidasan University, Trichy-24) Recognized by UGC Under Section 2(f) & 12 (B)    Vilar Bypass, Thanjavur-613 006. |

**DEPARTMENT OF PHYSICS**

**STATISTICAL MECHANICS**

**UNIT – I**

**2marks**

1. State Kelvin statement.
2. Define phase transitions.
3. State Zeroth law of thermodynamics.
4. What is the latent heat of transition?
5. State the second law of thermodynamics.
6. Give the principle of increase of entropy.
7. State the third law of thermodynamics.
8. State first law of thermodynamics.
9. Define entropy
10. Define enthalpy
11. Define thermodynamic potential.
12. Define thermal equilibrium.
13. Define reversible process.
14. Define irreversible process.
15. Define change in entropy.
16. Write a note on isothermal expansion.
17. Write a note on adiabatic expansion.
18. Write the thermodynamic coordinates.
19. State clausius statement.
20. Write the Helmholtz functions.
21. Write the Gibbs function.

**5 MARKS**

1. State second law of thermodynamics and explain its consequences.
2. Obtain Helmholtz – Gibbs relation from thermo dynamical potentials.
3. Derive the thermo dynamic potentials.
4. Prove that Helmholtz free energy never increases for a mechanically isolated system kept at constant temperature.
5. Obtain the Vander Waals equation of state.
6. Deduce the Clausius- Clapeyron equation.
7. Prove that “a system kept at constant temperature and pressure the state of equilibrium is the state of minimum Gibbs potential”.
8. State Zeroth law of thermodynamics and explain its consequences.
9. State first law of thermodynamics and explain its consequences.
10. Explain the change in entropy.
11. Write a note on principle of increase of entropy.
12. Write a note on Gibbs relation.
13. Write a note on enthalpy
14. Write a note on phase transitions.

**10 MARKS**

1. Derive the equilibrium conditions and the Clausius – Clapeyron equation.
2. Derive Vander Waals equation of state.
3. Briefly explain the laws of tyhermodynamics.
4. Explain the principles of increase of entropy.
5. Write a note on change in entropy in reversible process.
6. Obtain expression for the Helmholtz functions.
7. Obtain expression for the Gibbs functions.

**UNIT – II**

**2 MARKS**

1. What is mean free path?
2. What is first order approximation?
3. What is meant by inverse collision?
4. State Boltzmann H- theorem.
5. What is zero order approximation?
6. Write down Navier – Strokes equation.
7. Express the collision time.
8. What is meant by distribution function?
9. Write the conservation laws.
10. What is first order approximation?
11. Define Mawell distribution law.
12. Define half width.
13. What is relative velocity?
14. Define collision rate.
15. Define collision probability.
16. Write the expression of mean free path.
17. Define distribution function.

**5 MARKS**

1. Explain the validity of the Boltzmann transport equation.
2. Write a short on conservation laws.
3. Explain the zero order approximation.
4. Explain Boltzmann transport equation.
5. Briefly explain Boltzmann’s H theorem.
6. Explain the mean free path in transport phenomena.
7. Write the features of kinetic theory of gases.
8. Explain the distribution function.

**10 MARKS**

1. Explain the Maxwell – Boltzmann distribution law for velocity.
2. Describe the transport phenomena and conservation laws in detail.
3. Explain in detail Boltzmann transport equation and its validity.
4. Briefly explain the mean free path.
5. Explain the Boltzmann H- theorem.
6. Briefly explain the hydrodynamics.

**UNIT – III**

**2 MARKS**

1. Define phase space.
2. State Liouvilles theorem.
3. Define microstate.
4. Define macrostate.
5. Define partition function.
6. Write down the condition for adiabatic transformation for an ideal gas.
7. What is statistical equilibrium?
8. Define ensemble.
9. Define microcanonical ensemble.
10. Define grandcanonical ensemble.
11. Define canonical ensemble.
12. Define density function.
13. Define distribution function.
14. Define partition function.
15. Define equipartition energy.
16. Define Boltzmann canonical distribution law.
17. Write the expression for maximum probability distribution Maxwell Boltzmann statistics.
18. **MARKS**
19. Write anote on probability theory.
20. Write a short note on microstates.
21. Write a short note on macrostates.
22. Explain the statistical equilibrium.
23. Explain entropy of an ideal gas.
24. Write a note on microcanonical ensemble.
25. Explain the grandcanonical ensemble.
26. Explain the canonical ensemble.
27. Write a short note on partition function.
28. Explain phase space and its applications.
29. Show that S = klog ∑ (E).
30. Compare three ensembles.

**10 MARKS**

1. Define ensemble and explain its types.
2. Briefly explain the liouvilles theorem.
3. Explain the equipartition function.
4. Deduce the Maxwell-distribution law and also evaluate the constants α and β.

**UNIT – IV**

**2 MARKS**

1. Write down the posulates of random phase.
2. Express sackur tetrode equation.
3. Compare Bose-Einstein and Fermi-Dirac statistics.
4. What is meant by correct Boltzmann counting?
5. What is Bose Einstein condensation?
6. Define density matrix.
7. Give the conditions for deriving the Fermi-Dirac distribution law.
8. What is degeneracy?
9. Write down the rules of correct Boltzmann counting.
10. Define Pauli Exclusion Principle.
11. Express the stirling approximation.
12. Write the expression for Bose Einstein statistics.
13. Write the expression for Fermi Dirac statistics.
14. Define Fermi energy.
15. Define Fermi level.
16. Write the expression for maximum probability distribution of Bose Einstein statistics.
17. Write the expression for maximum probability distribution Fermi Dirac statistics.
18. Give the difference between classical and quantum statistics.
19. Write the posulates of Bose Einstein distribution law.
20. Write the posulates of Fermi dirac distribution law.
21. Define Bosons.
22. Define Fermions.

**5 MARKS**

1. Explain the basic concepts of quantum statistics.
2. Obtain an expression for sacker tetrode equation.
3. Deduce the Fermi-Dirac distribution law.
4. Compare Bose-Einstein and Fermi-Dirac statistics.
5. Derive the Bose-Einstein distribution law.

**10 MARKS**

1. Describe the phenomenon of Bose – Einstein condensation.
2. Briefly explain the Fermi Dirac distribution statistics.
3. Briefly explain the Bose Einstein distribution statistics.
4. Explain the Quantum ideal gas.

**UNIT – V**

**2 MARKS**

1. Mention the role of Fermi temperature in Fermi Dirac gas.
2. State Plank’s radiation law.
3. Give the properties of photon.
4. State Dulong and Patti’s law.
5. Express the magnetic susceptibility.
6. What is black body radiation?
7. State Stefan’s law.
8. Define photon.
9. Give the expression for Planck’s radiation law.
10. Give the expression for Fermi energy.
11. Give the expression for Fermi temperature.
12. Give the expression for Zero point energy.
13. Give the expression for pressure of electron gas.
14. Define weak degeneracy.
15. Define strong degeneracy.
16. Define λ- line.
17. Give the properties of Helim I.
18. Give the properties of Helium II.
19. **MARKS**
20. Explain the black body radiation law.
21. Explain Einstein theory on specific heat of solids.
22. Briefly explain the one dimensional Ising model.
23. Obtain Planck’s radiation law formula using Bose- Einstein statistics.
24. Explain the Pauli paramagenetism.
25. Explain the Heisenberg model.
26. Outline the salient features of liquid Helium.
27. Obtain the expression for Fermi energy, Fermi temperature, Zero point energy and pressure of electron gas.
28. Write a short note on electron gas.
29. Explain the energy and pressure of ideal Fermi gas.
30. Write a note on slight degeneracy.
31. Write a note on strong degeneracy.
32. Explain the ferromagnetism.
33. Write a note on Heisenberg models.

**10 MARKS**

1. Explain Einstein theory on specific heat of solids.
2. Obtain the expression for Planck’s radiation law.
3. Briefly explain the Pauli paramagenetism.
4. Obtain the expression for energy and pressure of ideal Fermi gas.
5. Briefly explain the Ising model.