Question Bank
M. Sc. I Physics
Quantum Mechanics - II (MPT 201)

Short note

1. What is Born approximation?
2. What is transition probability?
3. Give two examples of exactly solvable time dependent problems in QM.
4. Explain $H = H^0 + H'$ in perturbation theory.
5. Explain Dirac Delta potential.
6. What is Variational principle?
7. What is WKB approximation?
8. Give two examples of exactly solvable time independent problems in QM.
9. Explain Ramsauer-Townsend effect.
10. Write an equation of energy states of Harmonic Oscillator.
11. What is the transition probability for constant perturbation?
12. What is degeneracy?
13. What is Perturbation Theory?
14. Write a wave function of Harmonic Oscillator.
15. Operators in QM.
16. Fermi's Golden rule
17. Harmonic oscillator
18. Ground state energy of Hydrogen atom
19. Variational method
20. electric dipole

Long Answer Questions

1. Derive the expression for ground state energy of harmonic oscillator by Variational method.
2. Explain Time-dependent Perturbation Theory.
3. Explain Fermi's Golden rule in QM.
4. Explain Variational method for calculation of ground state energy of Hydrogen atom.
5. Write a short note on three pictures in quantum mechanics.
6. Obtain the expression for total cross section for low and high energy scattering by hard sphere.
7. Discuss the applications of WKB method.

8. Explain Time-dependent Perturbation Theory.
9. Derive an expression for transition probability treating electromagnetic induction as perturbation Hamiltonian.
10. Write a short note on WKB method and its applications.
11. Explain Ramsauer-Townsend effect in Details.
12. Derive an expression for transition probability treating electromagnetic induction as perturbation Hamiltonian.
13. Explain Variational method for its application to calculate First Exicited state energy of Hydrogen atom.

Short Answer Questions

1. What are electric dipole and forbidden transitions?
2. Write a note on resonance scattering.
3. Discuss the relation between the scattering potential and phase shift.
4. Explain semi classical theory of radiation.
5. Derive an expression for transition probability for constant perturbation.
6. Derive an expression for transition probability for harmonic perturbation.
7. What is Born approximation? Show that it tends to get better at higher energies.
8. Explain how a Born approximation can be interpreted as scattering viewedas two step process.
9. Explain validity condition for Born Approximation.
10. Obtain the expression for phase shift.
11. Explain the transition probability for constant perturbation.
12. Explain the transition probability for harmonic perturbation.
13. What are electric dipole and forbidden transitions?
14. Write a short note on three pictures in quantum mechanics
15. Explain Variational method for its application to find ground state wave function of Hydrogen atom.

Question Bank
M.Sc. I (Semester-II)
Subject: Physics
Statistical Mechanics (MPT 202)

Q.1. Definition or One sentence type answer (2Mark Questions)

1. State and explain third law of thermodynamics.
2. Write the postulate of equal priori probability.
3. Explain Phonon gas.
4. Using to Vander Waal's equation write the values of V_c and P_c.
5. What is statistical mechanics?
6. Explain the term constraint.
7. Define position space and momentum space.
8. Explain the term entropy.
9. State Zeroth law of thermodynamics.
10. Using to Vander Waal's equation write the values of P_c and T_c.
11. Using to Vander Waal's equation write equation of reduced volume and temperature.
12. Define accessible macrostate.
13. Derive an expression for change in entropy with the change in temperature.
14. What is ensemble and write its three types.
15. Define partition function of micro canonical ensemble?
16. Explain the term entropy.
17. Define inaccessible macrostate.
18. State second law of thermodynamics.
19. State law of conservation of energy.
20. Define Gamma space.

Q.2.Long Answers Questions. (06 marks each)

1. State the difference between Maxwell-Boltzmann and Fermi-Dirac statistics.
2. Explain the phenomenon of macrostate and microstate of a given system

3. What is phase transition? Explain triple point of water in brief.
4. Derive expression for partition function for canonical ensemble.
5. Obtain the values of thermodynamic variables P, V, T and S in terms of thermodynamic potentials, Enthalpy (H) and Gibbs function (G)
6. Write a note on liquid He_4 in detail.
7. Explain in brief Ehrenfest classification of phase transition.
8. State and prove relation between entropy and probability for canonical distribution.
9. Using the canonical distribution of the atomic magnetic moments, find the mean component of the magnetic moment and the magnetic susceptibility of a paramagnetic material.
10. Derive an expression for Clausius-Clapeyron equation.
11. State the difference between Maxwell-Boltzmann and Bose-Einstein statistics.
12. Consider four particles a, b, c and d. List the different ways in which they can be distributed in two identical valves of a box.
13. Write the Boltzmann limit of Boson and Fermion Gases.
14. Two particles are to be distributed in two non-degenerate energy states. Find the number of distributions according to M.B., B.E. and F.D. statistics. Show the distributions diagrammatically.
15. State and explain condition for phase equilibrium
16. State and explain phase space and μ space in detail.
17. State the difference between Fermi-Dirac and Bose-Einstein statistics.
18. Define entropy of a system and derive relation for specific heat of perfect gas.
19. Write a note on energy fluctuation in canonical ensemble.
20. Write a note on ensembles.

Q2. Short Answers Questions. (4 marks each)

1. A system consists of 5 particles arranged in two compartments. The first compartment is divided into 6 cells and second into 8 cells. The cells are equal size. Calculate the number of microstates in the macrostates (2, 3), if particles obey Fermi-Dirac statistics.
2. Write a note on micro canonical ensemble.
3. Write a note on Pauli paramagnetism.
4. A system is composed of twelve identical particles having different velocities. The velocities distribution among the particles is as follows

No. of particles	Velocity in m/s
5	11
3	16
4	18

Calculate the average velocity.

5. Write the quantum distribution functions of MB statistics.

6. Explain second order phase transition with suitable example.

7. Write a note on Fermi gas in metals.

8. Derive an expression for entropy in terms of probability.

9. Derive an expression for change in entropy with the change in volume.

10. Write a short note on critical indices.

11. State and explain first law of thermodynamics.

12. Write the quantum distribution functions of MB statistics.

13. State and explain second law of thermodynamics.

14. Write a note on canonical ensemble.

15. Distinguish between first and second order phase transition.

16. Write a note on grand canonical ensemble.

17. Write the Boltzmann limit of Boson and Fermion Gases.

18. Discuss canonical distribution and micro canonical distribution. Give comparison between these ensembles.

19. Two particles are to be distributed in two non-degenerate energy states. Find the number of distributions according to M.B., B.E. and F.D. statistics. Show the distributions diagrammatically.

20. Derive the reduced equation of state from Vander Waal's equation of gas.

21. A system is composed of nine identical particles having different velocities. The velocities distribution among the particles is as follows

No. of particles	Velocity in m/s
2	5

3	7
4	8

Calculate the average velocity.

M. Sc. I (Semester-II) Examination_____
PHYSICS
Physical Properties of Solids (Paper Code - MPT 203)
Sub Code: 92107
Question Bank

Short Notes

1) Define the terms free electron approximation and independent electron approximation
2) Define conductivity in metals also write down its formula for calculation.
3) Explain term Magnetic permeability
4) Write down statement of Ohms law with equation
5) Define conductivity in metals also write down its formula for calculation.
6) Explain term Magnetic permeability
7) Write upper and lower limit of 1^{st} brillouinzone
8) Write formula for Phase velocity in diatomic lattice vibration
9) Define the terms free electron approximation and independent electron approximation
10) What is formula for Resistivity and conductivity
11) Write formula for Phase velocity in diatomic lattice vibration
12) Write down statement of Ohms law with equation
13) What is drift velocity?
14) Discuss applications of magnetic materials
15) Define is ferrites and states its types.
16) What is magnetization and what are types of magnetic materials
17) Write upper and lower limit of 1^{st} brillouinzone
18) Define the term Free electron gas
19) What is diamagnetic material. Give its examples.
20) Write note on conductivity in metals

Short Answer Questions

1. Explain magnetic permeability and magnetization.
2. Discuss quantum theory of ferromanetism.
3. Write a short note on nuclear magnetic resonance (NMR).
4. Describe Weiss theory of paramagnetism.
5. Write short note on electric current in atoms-bohrmagneton.
6. Derive the expression for dispersion relation for monoatomic lattice vibration and plot ω against k graph.
7. Write a note on phonon momentum and derive expression for it.
8. Define dielectric functions and derive expression for dielectric function of gas.
9. What is plasma optics? Derive relation between plasma frequency and dielectric function.

10. Explain LTS relation.
11. Explain Electron-Phonon interaction.
12. Explain electron-electron collision.
13. Explain inelastic scattering of phonon by-
14. i)Emission of phonon ii)Absorption of phonon
15. Obtain dispersion relation for electromagnetic wave.

16.Derive Boltzmann transport equation

17 Discuss quantum theory of ferromagnetism

18 Explain Electron-Phonon interaction

19 Describe Weiss theory of paramagnetism

20 Draw a graph for first and second brillouinzone and derive expression for lower and upper limit

21 Write a short note on scattering mechanism of electron in metal occurs

22 Explain how filling up of electronic levels take place.

23 What are basic assumptions of drude model?

24 Write a note on dielectric properties of insulator.

25 Define and explain collision or relaxation time in drude model

26. Write a short note on nuclear magnetic resonance (NMR)

27 Write a note on saturation magnetization.

28. Discuss Sommerfeld theory of metals of electrical conductivity.

29. Derive Expression for acoustical bench in diatomic lattice vibration

Define and explain relaxation time in drude model

30. Write a short note on lattice specific heat

31 Explain failures of the free electron model

Long Answer type Questons

1. derive an expression for langevin's theory of Paramagnetism.
2. Discuss quantum theory of paramagnetism.
3. Explain spontaneous magnetization in ferromagnetic materials. Describe the term magnetization.
4. Derive the expression for dispersion relation for diatomic lattice vibration and plot ω against k graph.
5. Derive the relation for angular frequency of vibration for monoatomic and diatomic lattice .Plot ϕ against k graph.
6. What is plasma? Obtain an expression for plasma frequency. Discuss longitudinal plasma oscillation.
7. Discuss Free electron gas model with explanation of basic assumptions
8. Describe Sommerfeld theory of metals
9. Disscus Dc electrical conductivity of metal. write down failure

of free electron model of Drude Model

10. Explain spontaneous magnetization in ferromagnetic materials. Describe the term magnetization.

11. Draw a graphical representation of Acoustic and optical bench and explain in brief.

12 Derive expression for angular frequency in monatomic letters vibration.

13. Describe Weiss theory of Paramagnetism**.**

14. derive an expression for langevin's theory of Paramagnetism

15 Write a note on spontaneous magnetization

16 Explain how kinetic gas theory resembles Drude theory of metals with assumptions

17 Derive the relation for angular frequency of vibration for monoatomic and diatomic lattice.

M. Sc. I (Semester-II) Examination_____
PHYSICS
Condensed Matter Physics (Paper Code - MPT 204)
Question Bank

Short Answer Questions 2 Marks

1. Define anti-ferromagnetic material and give its example.
2. State any four properties of ferromagnetic material.
3. State any two examples of trivalent and pentavalent impurities.
4. Define coercivity and retentivity in case of ferromagnetic material.
5. Give two examples of Piezoelectric and pyroelectric crystals.
6. Define spontaneous polarization**.**
7. Define Curie temperature and Neel temperature.
8. Define ferroelectric domain.
9. Define Burgers vector.
10. Write a formula for magnetic susceptibility of an antiferromagnetic and paramagnetic material.
11. Define polarization.
12. Write a equation for polar and orientation polarization.
13. What are the twin boundaries in crystals?
14. What are the three dimensional defects.
15. Define anti ferromagnetic material.
16. Define Curie temperature.
17. Define Neel temperature.
18. Write down formula for magnetic susceptibility of an antiferromagnetic material.
19. Write down formula for magnetic susceptibility of a paramagnetic material.
20. Define coercivity in case of ferromagnetic material.
21. Define retentivity in case of ferromagnetic material.

6 marks Questions

1. Define polarization, write its type with its example and equation.
2. Derive an expression for concentration of Frenkel defects.
3. Define superconductor and write a note on type II superconductor with example.
4. Derive D.C. Josephson effect.
5. Derive an expression for concentration of Schottky defects.
6. Derive an expression for dipole moment in dielectric material.
7. Define Lorentz field and derive expression for it.
8. Define superconductor and write a note on type I superconductor with example.
9. Explain the terms I) Exchange forces II) Heisenberg model.
10. Explain exchange field and derive Curie-Weiss law.
11. Define polarization, write its type with its example and equation.
12. Derive Clausius Mossotti equation in dielectric.
13. Define superconductor and write a note on type II superconductor with example.
14. Derive A.C. Josephson effect.
15. Distinguish between diamagnetic, paramagnetic and ferromagnetic materials.
16. Discuss diamagnetic, paramagnetic and ferromagnetic materials. And distinguish between them.
17. Describe two sub lattice model of antiferromagnetic material.
18. Explain the following terms 1)Exchange forces 2)Heisenberg model.
19. Prove that
    $X_m = \frac{2C}{T+C\lambda}$,
    where χ is magnetic susceptibility, C is curie constant and T is temperature.
20. Explain exchange field and derive Curie-Weiss law
21. Derive a expression on kronnig penny model
22. Write a note on nearly free electron model
23. Write a note on tight bond approximation
24. Derive width band of simple crystal structure
25. Derive width band of hexagonal closed pack crystal structure
26. Derive width band of base center cubic crystal structure
27. Write a note on extrinsic semiconductor
28. Derive a expression for hole and electron concentration

4 marks Questions

1. Write applications and properties of dielectric material.
2. Write difference between dielectric and ferroelectric material.
3. Write a note on Maissner effect and define critical temperature.
4. Write a note on intrinsic semiconductor and type of doping material with two example of each .
5. Explain temperature dependence of the spontaneous magnetization?
6. Draw and explain hysteresis loop .
7. Explain in detail screw dislocation.

8. Write down brief explanation edge dislocation.
9. Define magnetic susceptibility .Draw graph of magnetic susceptibility $1/(\chi)$ vs. temperature (T) graph for ferromagnetic, paramagnetic and antiferromagnetic material.
10. Write classification and properties of ferroelectric material.
11. Write difference between dielectric and ferroelectric material.
12. Write a note on band model.
13. Write a note on intrinsic semiconductor.
14. Does spontaneous magnetization exist after Neel temperature? Justify your answer.
15. Define magnetic susceptibility .Draw graph of magnetic susceptibility $1/(\chi)$ vs. temperature (T) graph for ferromagnetic, paramagnetic and anti-ferromagnetic material.
16. Write a note on point defect in crystals.
17. Derive the equation for larmor frequency.
18. Describe two sub lattice model of antiferromagnetic material.
19. Write applications and properties of ferroelectric material.
20. What are the assumptions of BCS theory?
21. Draw and explain hysteresis loop.
22. Explain temperature dependence of the spontaneous magnetization?
23. Explain in detail point defects in crystals
24. Describe the term edge dislocation
25. Give brief explanation of screw dislocation
26. Write applications and properties of Pizo electric material.
27. Write applications and properties of piezoelectric material.
28. Write a note on classification on different types of and properties of ferromagnetic materials
29. Write a note on ferroelectric domains in oxygen
30. Write five applications of ferroelectric material