M.Sc Question Bank

Semester-IV

Paper-Solid State Physics

1. Give the measurement of phonon dispersion by inelastic neutron scattering.
2. Write down the Bloch equation.
3. What is Weiss molecular field?
4. What do you understand by Frenkel excitons?
5. Explain the phenomenon of Hall Effect in semiconductors.
6. What are type-I and type-II superconductor?
7. What is isotope effect for superconductors?
8. Discuss the salient feature of Debye's theory of specific heat and show how far it agrees with the experimental values?
9. Discuss the nature of acoustic and optical branches. Draw dispersion curve in first Brillouin zone showing all their essential features.
10. Explain the quantum theory of Para magnetism and derive the Curie law.
11. What is quenching of orbital angular momentum? Define Van Vleck temperature.
12. Explain different recombination mechanism in semiconductors and Shockley-Read-Hall theory of recombination.

13. Derive expression for carrier concentration in intrinsic semiconductor and prove that the Fermi level lies in the mid of valence band and conduction band.
14. Explain DC Josephson effect with proper mathematical treatment.
15. Write short notes on the following:

a) Persistent current

b) Critical magnetic field

c) Entropy of superconductors

d) Thermal conductivity in superconductors

e) Microwave and infrared properties of superconductors

Paper-Nuclear Physics II

1. Explain nuclear spin on the basis of single particle shell model.
2. Give any two evidences that show the existence of shell structure within the nuclei.
3. Define electrical quadrupole moment for strongly deformed nuclei.
4. What was the requirement to adopt the collective model? Explain with a suitable example.
5. What is parity change rules for Electric dipole (E1) and Magnetic dipole (M1) transitions?
6. What do you mean by stripping nuclear reaction, explain with an example?
7. Does parity change take place in zero-zero transition? Explain.
8. Write down the general form of Hamiltonian of permanently deformed nucleus; consider it as a deformed liquid-drop model.
9. (a) Derive the expression for nuclear magnetic moment of odd "A" nuclei.

   (b) Obtain magnetic moment of following nuclei:

   - ${}_{6}C^{11}$
   - ${}_{8}O^{17}$
10. Write a note on "Single particle transition probability" according to shell model.
11. Find out spin-parity of the following nuclei:

    - ${}_{13}Al^{27}$
    - ${}_{19}K^{40}$
12. Explain the vibrational energy spectrum even-even nucleus by giving an example.

13. Show that for rotational mode deformation odd "A" nuclei

$$E_{rot} = \frac{\hbar}{2I}[J(J+1) - 2k^2]$$

Where $I = moment\ of\ inertia\ of\ the\ rotating\ nuclei$

J= Rotational Angular Momentum

k=Projected angular moment of valence nucleon of the symmetry axis.

14. "Why" The region from about A=150 to A=190 shows values of E (2^+) {Energy of 2^+ state} are small and constant. Explain?
15. Describe and compare the kinematics of β^-, β^+ and electron capture process.
16. In the following γ-transitions, find the most probable multipole order-
    - $\frac{3^+}{2} \rightarrow \frac{1^+}{2}$
    - $\frac{11^-}{2} \rightarrow \frac{5^+}{2}$
    - $4^+ \rightarrow 2^+$
    - $\frac{7^+}{2} \rightarrow \frac{3^-}{2}$
17. Explain the compound nucleus model and discuss its different features.
18. Derive the single level Breit-Wigner relations for scattering and reaction cross section for l=0 neutrons.

Paper-Electronics and Communication-II

1. What are the various types of fading during microwave transmission?
2. What is the synchronous satellite?
3. Write down the characteristics of power diode.
4. What is a thyristor?
5. What are the drawbacks of half-wave rectifier circuits?
6. What is Horn Antenna?
7. What are various types of Antennas?
8. Define truncated parabola.
9. Derive an expression for field strength of tropospheric waves.
10. Find the basic loss for a communication form the moon to the earth operating at 3000 MHz, assure distance between moon and earth is 384000 km.
11. Derive an expression for LOS communication range.
12. What is SCR? Explain the construction, working and I-V characteristics of SCR circuit?
13. Explain the working and difference in between single and three phase full controlled rectifiers?
14. Explain the working of Array antennas and Microstrip patch Antennas?
15. Explain the term scalar and vector potential in antennas and write down the Helmholtz equation?
16. Discuss the measurements of VSWR and explain the double minimum method of measuring VSWR.
17. Explain the impedance measurement by using Magic Tee and slotted line technique.

Paper-Quantum Field Theory

1. What do you mean by field quantization?
2. What is Lagrangian density? Write down Euler Lagrangian equation.
3. Write short note on occupation number representation of fermions.
4. Explain the meaning of an scalar and vector field.
5. Define S-matrix.
6. State Wick's theorem.
7. Write Feymann rules of QED.
8. Differentiate between N-product and T-product.
9. Find out the energy Eigen values for three dimensional harmonic oscillator.
10. For one dimensional harmonic oscillator, prove that

a) $< \hat{x} >= 0$

b) $< \hat{p} >= 0$

c) $< K.E >=< P.E >= \frac{h\omega}{4\pi} < n + \frac{1}{2} >$

11. What do you mean by second quantization of Dirac field? Derive an expression for it
12. Derive an expression for the quantization of electromagnetic field.
13. State and prove Wick's Theorem.
14. Draw Feymann diagram for Bhabha scattering and pair production.
15. Define and discuss the S-Matrix on the basis of time evolution of states.
16. Make algebraic expansion of S-matrix.
17. What is time ordering of operators? How does it help in the solution of time integral series of S-matrix?

18. Derive the expression for Dyson expansion of S-matrix. Discuss the various scattering processes represented by the first order S-matrix expansion of the Dirac field. Draw the Feymann's diagram for each.
19. Discuss the Feymann's rules of QED. Draw the Feymann diagram for Compton scattering in momentum space. Write the scattering amplitude in momentum space and derive the expression for cross-section.