SAPTHAGIRI NPS UNIVERSITY
BE Semester End Examination 2024-25
Model Question Paper

Course code: 24BEPHY103   **Semester: I**
Course: Engineering Physics   **SRN:**
Time: 3Hrs   **Max Marks:** 100

PART – A

A. Answer any **Ten** of the following: **10x2=20**
1. State Heisenberg's Uncertainty principle. Give the expression for uncertainty in measurement of position and momentum.
2. Define zero-point energy with mathematical representation.
3. Define relaxation time or mean collision time.
4. Define current density and give its expression.
5. What are dielectric materials? Give any one example.
6. What are intrinsic semiconductors? Give one example.
7. What are p-type semiconductors? Mention the majority charge carriers of p-type semiconductors.
8. Mention the expression for electron concentration and explain the terms.
9. Define Critical Temperature & Critical Field.
10. What is SQUID? Give its Acronym.
11. Write any two properties of Qubits
12. Write the matrix representation for $|0\rangle$ and $|1\rangle$ states.

PART – B

B. Answer any **Seven** of the following: **7x5=35**
13. Derive an expression for de Broglie wavelength in terms of Kinetic energy and Accelerating Potential.
14. Define the following with mathematical representation **(i)** Density of states **(ii)** Fermi energy **(iii)** Fermi factor.
15. Define Carrier concentration? Mention the expression for hole and electron concentration & explain the terms.
16. Explain BCS theory for Superconductors.
17. An electron has a speed of 100 m/s. the inherent uncertainty in its measurement is 0.005%. What will be the uncertainty that arises in the measurement of its position?
18. Find the temperature at which there is 1% probability that a state with an energy 0.5eV above Fermi energy is occupied.
19. The resistivity of the intrinsic Ge at 27^0C is equal to 0.47 Ωm. Assuming electron and hole mobilities as 0.38 and 0.18m^2/Vs respectively, calculate the intrinsic carrier density.
20. The critical temperature of Nb is 9.15K. At 0 Kelvin, the critical field is 0.196T. Calculate the critical field at 8K.
21. Prove the matrix U = $\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$ is Unitary.

PART – C

C. Answer any **Three** of the following: 3x15=45

22. a) Set up the one-dimensional time independent Schrodinger wave equation.

b) Define Eigen functions and Eigen Values and hence derive the Eigen function of a particle inside infinite potential well of width 'a'. **(7+8)**

23. a) Discuss the failures of classical free electron theory.

b) What is internal Field? Using the internal field expression of the dielectric material, derive an expression for Clausius-Mosotti equation. **(7+8)**

24. a) What is Hall Effect? Derive an expression for Hall coefficient. Mention its applications.

b) Derive the expression for the electrical conductivity of a intrinsic semiconductor and extend the expression for P-type & N-type semiconductor. **(7+8)**

25. a) Discuss Meissner's effect. Explain Type-I and Type-II superconductors with graphs.

b) Write a note on DC Josephson effect. Explain the working of DC SQUIDS with diagram. **(7+8)**

26. a) Explain the following matrices with an example

(i) Conjugate of a matrix. (ii) Transpose of a matrix. (iii) Unitary Matrix

b) Discuss the CNOT gate and its operation on four different input states. **(7+8)**