

---

## QUESTION BANK 2025 SCHEME – FOR CSE STREAM

### MODULE WISE IMPORTANT QUESTIONS

#### MODULE- 1 - QUANTUM PHYSICS

1. State and explain the Heisenberg uncertainty principle. Discuss natural broadening of spectral lines using uncertainty relation. 2019-18S) (July 2019-18S) (Jan 2020-18S) (Aug 2020-18S) (Jan 2021-18S) (July 2021-18S) (Feb 2022-18S) (Feb 2022-21S) (July 2022-21S) (MODEL QP SET-1-22S) (MODEL QP SET-2-22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
2. Derive time-independent Schrödinger wave equation. (Jan 2018-17S) (Jan 2019-18S) (Jan 2021-18S) (July 2022-18S) (Feb 2022-21S) (July 2022-21S) (MODEL QP SET-1-22S) (Jan 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
3. Write down the Schrödinger equation for a particle in one-dimensional box. Obtain the Eigen functions and Eigen values for this particle and hence obtain the normalized wave equation. (July 2019-18S) (Jan 2020-18S) (Aug 2020-18S) (July 2021-18S) (Feb 2022-18S) (Feb 2022-21S) (July 2022-21S) (MODEL QP SET-2-22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S)
4. State and explain de Broglie's hypothesis. (MODEL QP SET-2-22S) (Jan 2023-22S) (July 2023-22S) (Jan 2025-22S) (Jan 2025-22S) (MODEL QP-25S)
5. What is wave function? Give its Physical significance and properties. (MODEL QP SET-1-22S) (MODEL QP SET-2-22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S)

---

(June/July – 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S) (MODEL QP-25S)

6. Write a short note on Principle of complementarity and physical significance of a wave function (June/July – 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)

7. What is wave function, Probability density and Normalization of wave function? Give the Physical significance of a wave function and its properties. (JAN/FEB – 2024 | 22S)

## **MODULE- 2 - ELECTRICAL PROPERTIES OF METALS AND SEMICONDUCTORS**

1. Write the assumptions of quantum free electron theory. Discuss about the success (merits) of quantum free electron theory. (OR) Describe how quantum free electron theory has been successful in overcoming the failures of classical free electron theory. (Jan 2019-18S) (July 2019-18S) (Jan 2020- 18S) (July 2021-18S) (Feb 2022-18S) (July 2022-18S) (Feb 2022-21S) (July 2022-21S) (Makeup-Dec23-22S) (MODEL QP-25S)

2. Explain Matthiessen's rule of resistivity.

3. Discuss the merits of quantum free electron theory. (Jan 2018-17S) (Aug 2020-18S) (JAN/FEB – 2024 | 22S)

4. Explain Fermi energy and Fermi factor. Discuss the variation of Fermi energy with temperature.

(Jan 2018-17S) (Jan 2019-18S) (July 2019-18S) (Aug 2020-18S) (Jan 2021-18S) (July 2021 18S) (Feb 2022-18S) (Feb 2022-21S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)

5. Explain classical free electron theory of metals. Discuss in details about the failures of classical free electron theory. (Aug 2020-18S) (MODEL QP-25S)

6. Derive the expression for electron concentration in an intrinsic semiconductor.

---

(MODEL QP-25S)

7. Derive an expression for Fermi level for intrinsic semiconductor. (OR) Show that the Fermi level lies at the center of the band gap in case of an intrinsic semiconductor with the relevant equations. Jan 2020-18S) (July 2022-18S) (MODEL QP SET-1-22S) (MODEL QP SET-2-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S)

8. What is Hall Effect? Obtain the expression for the Hall coefficient and express Hall voltage in terms of Hall coefficient. (Jan 2019-18S) (July 2019-18S) (Aug 2020-18S) (Jan 2021-18S) (July 2021-18S) (July 2022-18S) (Feb 2022-21S) (July 2022-21S) (MODEL QP SET-1-22S) (MODEL QP SET-2-22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)

---

## MODULE- 3 SUPERCONDUCTIVITY

1. Explain Meissner effect. Discuss briefly about Type I and Type II superconductors. (MODEL QP SET-1-22S) (Jan 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (Makeup June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
2. What are cooper pairs? Explain in detail about BCS theory of superconductivity. (MODEL QP SET-2-22S) (June/July – 2024 | 22S)
3. With the help of a diagram, explain the concept of Cooper pair tunneling process and retro-reflection at N-S interface. (MODEL QP-25S)
4. Explain the concept of Cooper pair formation and the role of phonons. (MODEL QP-25S)
5. Derive an expression for a cylindrical wire using Ampere's law. (MODEL QP-25S)
6. Describe the critical current with Silsbee's effect. (MODEL QP-25S)
7. Discuss about (i) High temperature superconductor (ii) Application of superconductor on DC and RF SQUID and MAGLEV TRAIN. (MODEL QP SET-1-22S) (MODEL QP SET-2-22S) (July 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S)
8. Explain in detail about two fluid Model. (OR) Describe the two-fluid Model with the normal and super electrons and hence explain the thermal conductivity. Give examples for low and high electron-phonon coupling.

- 
9. Using the concept of the Cooper pair tunnelling process and retro reflection at the N-S interface, explain the Andreev reflection with necessary diagrams.
  10. Explain the formation of the Josephson junction and hence the flux quantization with a neat diagram. Explain DC and AC Josephson effect.(MODEL QP-25S)

## MODULE- 4 – PHOTONICS (LASERS AND OPTICAL FIBER)

1. Derive the expression for energy density of radiation using Einstein's coefficients. Compare the expression with Planck's equation? Obtain an expression for energy density of radiation under thermal equilibrium conditions in terms of Einstein's coefficients. (Jan 2019- 18S) (July 2019 18S) (Jan 2020-18S) (Aug 2020-18S) (Jan 2021-18S) (July 2021-18S) (Feb 2022- 18S) (July 2022-18S) (Feb 2022-21S) (July 2022-21S) (MODEL QP SET-1-22S) (Jan 2023 22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
2. Describe the construction and working of Semiconductor laser with the help of energy band diagram. (Jan 2020-18S) (Jan 2021-18S) (July 2022-18S) (MODEL QP SET-2-22S) (July 2023 22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
3. Explain the requisites and conditions of a laser system. (July 2022-21S) (MODEL QP SET-1 22S)
4. Define Acceptance Angle, Numerical aperture and Fractional index change  $\Delta$ ? Obtain an expression for numerical aperture of an optical fibre with suitable diagram. (Jan 2018-17S) (Jan 2019-18S) (July 2019-18S) (Jan 2020-18S) (Aug 2020-18S) (July 2021-18S) (Feb 2022-18S) (July 2022-18S) (July 2022-21S) (MODEL QP SET-1-22S) (MODEL QP SET-2 22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S) (MODEL QP-25S)
5. What is meant by Attenuation and attenuation coefficient? Explain the different

---

attenuation mechanism. (OR) Explain different types of attenuation in an optical fiber.(OR)  
Mention the expression for attenuation co-efficient in a fibre of length L. Mention any  
two merits and demerits of an optical fibre. (Jan 2021-18S) (Feb 2022-18S) (MODEL  
QP SET-1-22S) (Makeup-Dec23-22S) (JAN/FEB – 2024 | 22S) (June/July – 2024 |  
22S) (Makeup-June/July– 2024 | 22S)

6. Explain the working of a SNSPD with a neat diagram. (MODEL QP-25S)

7. Describe the construction and working of Single-Photon Avalanche Diodes (SPAD) with  
a neat diagram. (MODEL QP-25S)

## **MODULE- 5 – QUANTUM COMPUTING**

1.Explain Moore’s law & its end. (Makeup-June/July– 2024 | 22S)

2. Elucidate the differences between classical and quantum computing. (MODEL QP SET-1-  
22S)  
(Jan 2023-22S) (July 2023-22S) (Jan 2024-22S) (June/July – 2024 | 22S)

3. Define a bit and qubit and explain the properties of qubit. (MODEL QP SET-1-22S)

4. Define a qubit. Explain the concept of superposition and represent it on the Bloch  
sphere. Explain the representation of qubit using Bloch Sphere. (MODEL QP SET-2-22S)  
(Jan 2023-22S) (Makeup-Dec23-22S) (Jan 2024-22S) (Makeup-June/July– 2024 | 22S) (Jan  
2025  
22S) (MODEL QP-25S)

5. Explain about a harmonic oscillator. Give the expression for the energy for harmonic  
oscillator.

6. Discuss the need of anharmonicity.

- 
7. State the Pauli matrices and apply Pauli matrices on the states  $|0\rangle$  and  $|1\rangle$ . (MODEL QP SET-1 22S) (Jan 2023-22S) (Makeup-Dec23-22S) (Jan 2024-22S) (June/July – 2024 | 22S) (Jan 2025-22S)
  8. Explain the Matrix representation of 0 and 1 States and apply identity operator I to  $|0\rangle$  and  $|1\rangle$  states. (MODEL QP SET-2-22S)
  9. Explain Pauli X,Y and Z gate on the states 0 and 1 with proper gate representations and their truth table. (Jan 2023-22S) (Makeup-Dec23-22S)
  10. Discuss the working of phase gate mentioning its matrix representation and truth table.(MODEL QP SET-2-22S) (Jan 2023-22S)
  11. Show that S gate can be formed by connecting two T-gates in series. (Makeup-Dec23-22S) (Makeup-June/July– 2024 | 22S)
  12. Discuss the CNOT gate, matrix representation and its operation on four different input states. (MODEL QP SET-1-22S) (Jan 2023-22S) (July 2023-22S) (Makeup-Dec23-22S) (Jan 2024-22S) (June/July – 2024 | 22S) (Makeup-June/July– 2024 | 22S) (Jan 2025-22S)
  13. Explain in detail about the quantum entanglement and discuss its importance in quantum communication. (MODEL QP-25S)
  14. Discuss the operation of the CNOT gate and explain how it can create Bell states. (MODEL QP-25S)
  15. Explain Single qubit gate and multiple qubit gate with an example for each. (MODEL QP SET-2-22S) (July 2023-22S) (Makeup-Dec23-22S)
  16. Explain Hadamard gate. Show that the Hadamard gate is unitary. (Jan 2023-22S) (MODEL QP-25S)
  17. Explain the working of T-gate mentioning its matrix representation and truth table.

