**QUESTIONS BANK**

**BBS01T1002 SEMICONDUCTOR PHYSICS**

**CAT-1 (Syllabus)**

**Unit -1 : Quantum and Band Theory of electron**

**Quantum free electron theory, Fermi Dirac distribution function and Fermi level, density of states Energy band in solids, E-K diagram and Brillouin zone.**

**Unit -2 : Semiconductor**

**Types of semiconductor, Fermi level in semiconductor, effect of carrier concentration and temperature on Fermi- level, direct-indirect band gap semiconductors, compound semiconductors**

**Unit-1\_ (CO1):** Identify the energy band in solids and electron occupation probability

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| Questions | S.No. | Marks |
| Find the least energy of an electron moving in one dimensional infinitely high potential box of width 0.05 nm. [Given Planck’s Constant (h) =6.625x10-34 J.s. and mass of electron (m)= 9.1x10-31 kg. ] | 1 | 2 |
| An electron is bound in a one dimensional potential box which has a width 2.5x10-10 m. Assuming the height of the box to be infinite, calculate the lowest two permitted energy values of the electron.[Given Planck’s Constant ( h) =6.625x10-34 J.s. and mass of electron (m) = 9.1x10-31 kg.] | 2 | 2 |
| Find the minimum energy of an electron moving in one dimension in an infinitely high potential box of width 1Å. [Given Planck’s Constant (h) =6.625x10-34 J.s. and mass of electron (m) = 9.1x10-31 kg.] | 3 | 2 |
| The Fermi Energy for a given solid is 5.0 eV at T=0K. What is the average energy of the electron in the metal at 0 K? | 4 | 2 |
| The Fermi level for potassium is 2.0 eV. Calculate the velocity of the electrons at the Fermi level. | 5 | 2 |
| What is the value of Fermi-Dirac distribution function for T=0, when (i) energy is greater than Fermi Energy and (ii) when energy is less than Fermi Energy. | 6 | 2 |
| Define the Fermi Energy. If the Fermi energy is 10eV, calculate the mean energy of electron at 0 Kelvin. | 7 | 2 |
| Write Schrodinger’s time-independent equation for matter waves. Explain the physical significance of the wave function? | 8 | 5 |
| Explain the idea of wave function for a quantum particle. Write the basic characteristics of well-behaved wave function? | 9 | 5 |
| Draw the E-K diagram of a semiconductor based on band theory of solids. Explain the Brillouin zones in a solid. | 10 | 5 |
| What would be the band structure if the barrier strength is extremely high or negligible? Justify your answer with a suitable diagram. | 11 | 5 |
| Define the density of energy state in a solid. Find the expression for density of states. | 12 | 8 |
| An electron is in motion along a line between x=0 and x= L with zero potential energy. At points for which x ≤ 0 and x ≥ L, the potential energy is infinite. The wave function for the particle in the nth state is given by ψn=A Sin (nπx/L). Find the expression for the normalized wave function. | 13 | 8 |
| An electron is in motion along a line between x=0 and x=L with zero potential energy. At points for which x ≤ 0 and x ≥ L, the potential energy is infinite. Solving Schrodinger’s equation, obtain energy Eigen values | 14 | 8 |
| Explain the energy band in solids and classify the materials based on energy gap. | 15 | 8 |

**Unit- 2\_(CO2):** Understand the physics of semiconductor and develop the ability to choose the appropriate semiconductor for engineering applications

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| Questions | S.No. | Marks |
| Which types of charge carries are available in n-type of semiconductors? Justify your answer. | 1 | 2 |
| Which types of charge carries are available in p-type of semiconductors? Justify your answer | 2 | 2 |
| Define the relaxation time and Drift velocity of an electron in a semiconductor | 3 | 2 |
| What is the wavelength corresponding to the bandgap of GaAs (1.42eV) approximately? | 4 | 2 |
| Outline the nature of charge on an intrinsic semiconductor on addition of neutral pentavalent or trivalent atoms. | 5 | 2 |
| Discuss the variation of Fermi- level position with temperature and doping concentration. | 6 | 2 |
| Distinguish between elemental and compound semiconductors with examples. | 7 | 2 |
| Draw and interpret the graph for the Fermi Energy variation with temperature for P and N type semiconductors. | 8 | 5 |
| Based on band theory of solids, distinguish between conductors, semiconductors, and insulators. | 9 | 5 |
| Define the Fermi energy and Fermi distribution function. Plot the Fermi distribution function at two different temperatures. | 10 | 5 |
| Distinguish between elemental and compound semiconductors with two examples | 11 | 5 |
| Distinguish between intrinsic and extrinsic types of semiconductor with examples. Outline the nature of charge in an intrinsic semiconductor on addition of neutral trivalent impurity atoms. | 12 | 8 |
| Distinguish between the direct and indirect band gap semiconductors with one examples. | 13 | 8 |
| Describe the P and N types semiconductors and indicate the Fermi level and energy level of impurity atoms in band diagram | 14 | 8 |
| Explain the extrinsic semiconductor. Using suitable diagram, discuss how the Fermi level changes with change of temperature in extrinsic semiconductors. | 15 | 8 |