

School of Computing Science and Engineering

**Bachelor of Technology in Computer Science and Engineering
Semester End Examination - Jun 2024**

**Duration : 180 Minutes
Max Marks : 100**

Sem II - C1UD124B - Semiconductor and Optoelectronic Devices

General Instructions

Answer to the specific question asked

Draw neat, labelled diagrams wherever necessary

Approved data hand books are allowed subject to verification by the Invigilator

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|----|--|--------|
| 1) | Draw the energy level diagram of He-Ne Laser. | K1(3) |
| 2) | Classify the solids based on energy band gap. Write down the values of energy band gap for Silicon and Germanium. | K2(4) |
| 3) | Explain the action of optical resonator in LASER | K2(6) |
| 4) | Explain why four level Laser is more efficient than a three level laser. | K3(6) |
| 5) | Explain the various components of Laser: | K3(6) |
| | (i) Active centres | |
| | (ii) Meta-stable state | |
| | (iii) Life time | |
| | (iv) pumping | |
| | (v) Resonant cavity | |
| 6) | Discuss the mobility and conductivity of materials. Obtain an expression for the conductivity of an intrinsic semiconductor. | K3(9) |
| 7) | Explain the effective mass and concept of holes using E-k curve. Relation between energy (E) and wave vector (k) semiconductor material is given by $E = Ak^2 - Bk^4$, here A and B are constants. Prove that the maximum energy (E_{max}) will be found when $k = (A/2B)^{1/2}$ and $E_{max} = A^2/4B$. | K3(9) |
| 8) | Find the de Broglie wavelength of (a) an electron whose speed is 10^6 m/s, and (b) a ball of mass 1g, whose speed is 40 m/s. With these results, justify why dual nature of matter is not observed in macroscopic world? | K4(8) |
| 9) | Draw and explain the V-I characteristics of a p-n junction diode. Interpret the knee voltage and breakdown voltage in a p-n junction | K4(12) |

diode. How can a diode be used as switch in electronic circuit?

10) Discuss the top-down and bottom-up approaches for the fabrication of low dimension materials with suitable diagram K5(10)

11) Analyze the behavior of an electron in a periodic potential. Show that the effective mass of an electron is inversely proportional to the second derivative of the E-K curve. K5(15)

OR

Analyze the process of absorption, spontaneous emission and stimulated emission and explain from which process the LASER light is produced. K5(15)

12) Using Heisenberg's uncertainty principle show that electrons cannot exist inside the nucleus K6(12)

OR

Explain the idea of wave function for a quantum particle. Write the basic characteristics of well-behaved wave function K6(12)