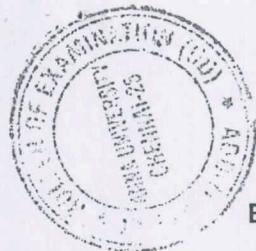


29/5/2025 FN



Reg.No. _____

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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2025

Artificial Intelligence and Data Science

Semester - II

PH23C09 - Semiconductor Devices and Quantum Technology
(Regulation2023)

Time:3 Hrs

Max. Marks: 100

| | |
|-----|---|
| CO1 | Express knowledge on the electrical properties of materials |
| CO2 | Have an insight into the semiconductor junction and display devices |
| CO3 | Explore the magnetic and optical data storage devices |
| CO4 | Implement the essential principles behind Nanodevices |
| CO5 | Envisage the basics of quantum computing |

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10×2 = 20 Marks)

| Q. No. | Questions | Marks | CO | BL |
|--------|--|-------|----|----|
| 1 | What is effective mass of electron? | 2 | 1 | L1 |
| 2 | In a solid, consider energy level lying 0.05 eV above Fermi level. What is the probability of this level being occupied by an electron at 300 K. ($k = 1.38 \times 10^{-23} \text{ JK}^{-1}$.) | 2 | 1 | L2 |
| 3 | How to make degenerate semiconductor? | 2 | 2 | L2 |
| 4 | What is Phosphors? | 2 | 2 | L2 |
| 5 | Define magnetic flux density (B) and magnetic susceptibility (χ). | 2 | 3 | L1 |
| 6 | How DVD differ from CD? | 2 | 3 | L2 |
| 7 | What is quantum confinement? | 2 | 4 | L2 |
| 8 | Write a note on resonant tunneling. | 2 | 4 | L1 |
| 9 | How classical bits differ from qubits? | 2 | 5 | L2 |
| 10 | Write the types of quantum computers. | 2 | 5 | L1 |

PART- B (5×13 = 65 Marks)

| Q. No. | Questions | Marks | CO | BL |
|------------|---|-------|----|----|
| 11 (a) | Derive an expression for density of states and carrier concentration of metal. | 13 | 1 | L3 |
| OR | | | | |
| 11 (b) | Explain intrinsic semiconductor with diagram and obtain expression for carrier concentration of electron. | 13 | 1 | L3 |
| OR | | | | |
| 12 (a) (i) | Explain Hall effect Phenomena with neat diagram and derive expression for hall coefficient. | 10 | 2 | L4 |
| (ii) | A silicon plate of thickness 1 mm and length 10 mm is placed in a magnetic field of 0.5 wb/m^2 acting perpendicular to its thickness. If 10^{-2} A current flows along its length, calculate the Hall voltage developed if the Hall coefficient is $3.66 \times 10^{-4} \text{ m}^3/\text{coulomb}$. | 3 | | |

OR

| | | | | |
|------------|---|----|---|----|
| 12 (b) (i) | Explain the construction and working of LED with neat diagram | 10 | 2 | L4 |
| (ii) | Calculate the wavelength and mention the colour of laser emission from GaAs semiconductor with bandgap 1.44 eV. | 3 | | |
| 13 (a) (i) | Explain giant magneto resistance (GMR) for multilayer structures with diagram. | 10 | 3 | L4 |
| (ii) | In a magnetic material the field strength is found to be 106 A/m. if the magnetic susceptibility of the material is 0.5×10^{-5} , calculate the intensity of magnetization and flux density in the material. | 3 | | |
| OR | | | | |
| 13 (b) (i) | Describe the construction and reconstruction technique for hologram. Mention its advantages. | 10 | 3 | L4 |
| (ii) | Calculate the diameter of the focal spot in CD when 10 mm focal length lens to focus the collimated output of a He-Ne laser (632.8 nm) that has a 1 mm diameter beam. | 3 | | |
| 14 (a) | Explain various quantum structures and bandgap of nanomaterials. | 13 | 4 | L3 |
| OR | | | | |
| 14 (b) | What is single electron phenomena? Explain single electron transistor with diagram. | 13 | 4 | L3 |
| 15 (a) | Explain one-QUBIT quantum gates and two-QUBIT gates (CNOT gate). | 13 | 5 | L4 |
| OR | | | | |
| 15 (b) | Explain Quantum cellular automata (QCA) with binary encoding. | 13 | 5 | L4 |

PART- C (1×15 = 15 Marks)

| Q. No. | Questions | Marks | CO | BL |
|--------|---|-------|----|----|
| 16. | Explain Peltier effect with neat diagram and application of this effect in coolers. | 15 | 2 | L5 |