Ref. No.: Ex/ET/PC/B/T/424/D/2025

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING
FOURTH YEAR SECOND SEMESTER EXAM, 2025

ADVANCED ELECTRON DEVICES **Time: 3 hours** **Full Marks: 100**

(All parts of the same question must be answered together)

PART-I (60)

Answer Any Three (3×20=60)

1. Explain VCA for compound semiconductors. Explain the origin of bowing factor. If band gap of Si and Ge are 1.2 eV and 0.7 eV, respectively, calculate the bandgap of $Si_{0.8}Ge_{0.2}$ with b=0.1. [4+2+4]

2. Explain the growth of heterostructures using Knudsen cell in Molecular Beam Epitaxy (MBE). [10]

3. What is Built-in Strain in Heterostructures? Explain tensile and compressive strain. [4+6]

4. What are the different types of metal semiconductor junction. Explain with energy band diagram for both p and n-type semiconductors. [2+8]

5. Write a short note on resonant tunneling diode (RTD). [10]

6. Explain quantum confinement in low dimensional structures. Explain Frenkel excitons and Wannier-Mott excitons. [4+6]

Answer Any Four (4×15=60)

7. Write advantages of HBT over BJT. Draw the schematic and explain the working. Explain the energy band diagram for active region of operation. [4+6+5]

8. Define Quantum Efficiency and Responsivity of photodetectors. Classify photodiodes. Draw and explain the working of p-n photodiodes and its characteristics. [4+3+8]

9 Define density of states. Derive DOS in an infinite potential quantum well. Determine electron concentration n_s in a 2D GaAs system at T=300K when $E_F - E_C = 0.15eV$. [2+6+7]

[Turn over

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(All parts of the same question must be answered together)

10. What are the different types of heterojunctions. Explain with energy band diagrams. Give examples. [3+9+3]

11. Draw and explain the energy band diagram of AlGaAs/GaAs heterostructure in thermal equilibrium. χ_{AlGaAs}=3.77 eV, χ_{GaAs}=4.07 eV, Eg_{AlGaAs}= 1.82eV, Eg_{GaAs}= 1.42 eV. AlGaAs is doped to n-type whereas GaAs is p-type. $(E_C-E_F)_{AlGaAs}$=0.1 eV and $(E_F-E_V)_{GaAs}$=0.12 eV. Label the energy band diagram. [10+5]

12. What is MQW. Explain the formation of MQW. What are the differences between super lattice and MQW. Mention few applications of super lattice and MQW. [2+4+5+4]
