ECE B

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Department of Electronics and Communication Engineering

Third Semester Second Series Examination December- 2022 (2019 Scheme)

Course code: ECT201

Course Name: SOLID STATE DEVICES

Max. Marks: 50 Duration: 90 Minutes

PART A

Answer all questions. Each question Carries 3 marks

1. What is depletion region or space charge region? Explain.
2. What is contact potential? Why it is important?
3. What is the difference between Schottky contacts and Ohmic contacts? Explain.
4. Explain the methods that can be used to increase the current amplification factors of a transistor.
5. What is base width modulation? Explain.

PART B

6. (a) Derive an expression for contact potential of a P-N junction diode.

   (b) An n type sample of Ge contains $N_d=2X10^{16}cm^{-3}$. A junction is formed with p type sample of $Na=5*10^{18}cm^{-3}$. (a) Calculate the Fermi level positions at 300K with respect to Ei. b) Draw the equilibrium band diagram and determine the contact potential from band diagram. Compare the result with that calculated from eqn.

   (7+7 Marks)

OR

7. (a) With the help of minority carrier profile at the junction of a p-n junction, derive diode equation. What is reverse saturation current?

   For a p-n junction diode with $Na=2X10^{16}$ atoms/cm^3, $Nd=3X10^{16}$ atoms/cm^3, $ni=1.5X10^{10}$ carriers/cm^3, $D_n=30$ cm^2/s, $D_p=12$ cm^2/s, $L_n=50$ μm, $L_p=30$ μm, $A=100$ mm^2 , $k_bT/q=26mV$. Calculate (a) Contact potential (b) Reverse saturation current (c) Current flowing through the device when V=0.8V. (e) Dynamic resistance when I=1mA

   (7+7 Marks)

8. (a) Define the terms emitter injection efficiency, base transport factor, and amplification factors (α and β) with the help of current components. Consider an NPN Si transistor with. Calculate α, β, I_B and I_C if I_E=2mA, emitter injection efficiency, γ=0.995, Base transport factor, B=0.995.

(b) What are the different modes in which transistor can be biased? Explain.

(8+6 Marks)

OR

9. (a) Derive expressions for the current components of BJT. Show minority carrier profile in the base region under forward bias to illustrate the same.

(b) What is base width modulation? Explain.

(10+4 Marks)

10. What is a Schottky contact? Explain how a Schottky contact is made between (1) metal- n type semiconductor and (2) metal- p type semiconductor. Explain the same using energy band diagrams. (7 Marks)

OR

11. Write equations for charges in the space charge region of an abrupt junction diode, electric field distribution and potential distribution. Also derive an expression for depletion width of the space charge region. (7 Marks)