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18EC33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Electronic Devices

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write the figures of the resulting orbitals when isolated atoms brought together and explain the characteristics. **(10 Marks)**

b. Obtain the relationship between mobility and hall coefficient in a p-type bar placed in a magnetic field in the Z-direction. **(10 Marks)**

OR

2 a. Derive the equation which relates current density and mobility in a semiconductor in an applied electric field. **(10 Marks)**

b. A silicon bar 2μm long and 200μm^2 in cross sectional area is doped with 1.5×10^{17}/cm^3 phosphorus. Find the current at 300K with 30V applied voltage. How long does it take an average electron to drift 2μm in pure silicon at an electric field of 80V/cm? Also calculate the time required at 10^5V/cm. Assume mobility of electrons is 0.1350m^2/Vsec. Also assume that saturation of electron drift velocity for silicon is 10^7 cm/s for the electric field above 10^5 V/cm. **(10 Marks)**

Module-2

3 a. Show the effect of bias at a pn junction on transition region width, electric field, electrostatic potential, energy band diagram partic flow and current direction under the following conditions:
i) Equilibrium ii) Forward bias iii) Reverse bias. **(10 Marks)**

b. Illustrate the care and issues to be considered in the design of solar cells. **(10 Marks)**

OR

4 a. Explain Avalanche break down and obtain equation for the electron multiplication factor. **(10 Marks)**

b. Derive the relationship between the open circuit voltage and optic generation rate starting from the expression for the optically generated illuminated pn junction. **(10 Marks)**

Module-3

5 a. Show the hole and electron flow in a pnp transistor with proper biasing. **(08 Marks)**

b. For the circuit shown in Fig.Q.5(b) calculate β, I_B and I_C. Given that τ_p =18μs, and τ_t = 0.2μs. What happens to the output current when I_B increases and β increases?

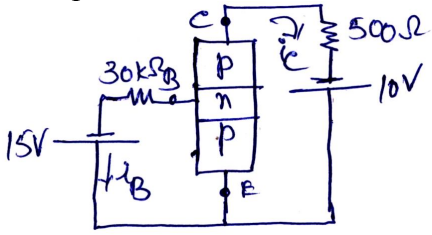

Fig.Q.5(b)

(06 Marks)

c. Explain the concept of base narrowing in a $p^+ - n - p^+$ transistor. **(06 Marks)**

OR

6 a. Obtain the Ebers-Moll equations and represent the same in the model form. **(12 Marks)**
b. Describe the switching effects in a CE transistor circuit. **(08 Marks)**

Module-4

7 a. Analyze the effect on gate-to-channel-space charge region and IV characteristics for the following conditions in a JFET:
i) Zero gate voltage of a small drain voltage
ii) Zero gate voltage of a large drain voltage
iii) Small V_{DS} value and small reverse-biased gate voltage. **(10 Marks)**
b. Draw the energy band diagram in an MOS capacitor structure for the following cases:
i) p-type substrate for a positive gate bias
ii) p-type substrate for a large positive gate bias
iii) n-type substrate for a positive gate bias. **(10 Marks)**

OR

8 a. Write the small signal equivalent circuit of a JFET, ideal low frequency small signal equivalent circuit and ideal equivalent circuit including r_s. **(10 Marks)**
b. Show the channel formation in the MOS structure and I_D versus V_{DS} curve for the following cases:
i) $V_{gs} > V_t$ and small V_{DS} value
ii) $V_{gs} > V_t$ and large V_{DS} value
iii) $V_{gs} > V_t$ and $V_{DS} = V_{DS}$ (sat) **(10 Marks)**

Module-5

9 a. What are the fabrication steps used in the fabrication of pn junctions? **(10 Marks)**
b. With figures, describe the complementary MOS structure. **(10 Marks)**

OR

10 a. Illustrate the evolution of integrated circuits. **(10 Marks)**
b. Explain the formation of resistors in integrated circuits. **(10 Marks)**

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