**Mansoura University** | **1st year Computer and control Dept.**

**Faculty of Engineering** | **Basic Electronics**

**Time: 3 Hours** | **Date: 11/1/201**

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**Question 1 [25 M]**

(1) Define the following terms

a- Semiconductors. b- Doping. c- Diffusion current. d- Zener effect.

(2) Draw and explain briefly the structure and operation of P-N junction diode.

(3) Consider a pn junction in equilibrium at $T = 27^{o}c$ for which the doping concentration are $N_A = 10^{18}/cm^3$ and $N_D = 10^{16}/cm^3$ and the cross-sectional area $A = 2 \times 10^{-4} cm^2$. Where $\epsilon_s = 1.04 \times 10^{-12}\ F/cm$, $n_i = 1.5 \times 10^{10}\ /cm^3, V_T = 25.9\ mV, q = 1.6 \times 10^{-19}\ eV$. Calculate the following:

a- Concentration of minority (electrons) in p-region ($n_{p0}$).
b- Concentration of minority (holes) in p-region ($p_{no}$).
c- Barrier voltage across the junction ($v_o$).
d- The width of the depletion layer (w).
e- Width of depletion region in p-region ($x_p$).
f- Width of depletion region in n-region ($x_n$).
g- Total stored charge on either side of depletion region ($Q_J$)

**Question 2 [20 M]**

(1) For the circuit shown in Figure 1. Calculate $I_D, V_o$.

(2) For the circuit shown in Figure 2, calculate $I_1, I_2, I_{D2}$.

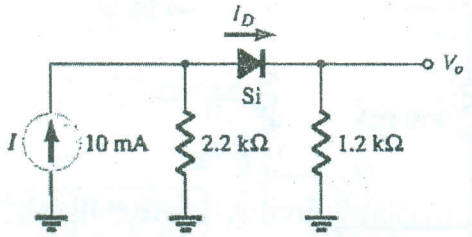


Figure 1

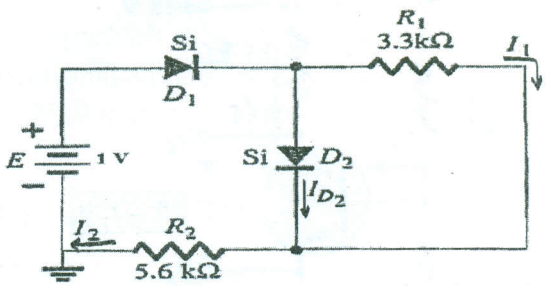


Figure 2

(3) For the circuit shown in Figure 3

a- Determine $V_L, I_L, I_Z$ *and* $I_R$ *if* $R_L = 180\ \Omega$.
b- Repeat (a) if $R_L = 470\ \Omega$.
c- Determine the value of $R_L$ that will establish maximum power condition for the zener diode.
d- Determine the minimum value of $R_L$ to ensure that the zener diode is in the "on" state.

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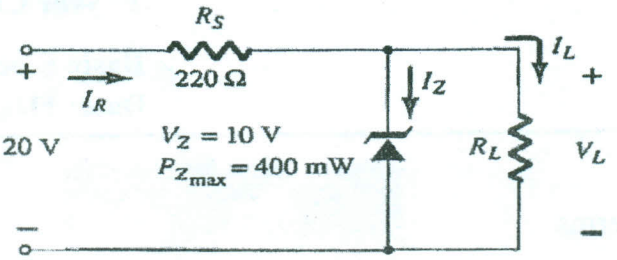


Figure 3

**Question 3 [20 M]**

(1) For the circuit shown in Figure 4, draw $i_R$ and $v_o$ for the input $v_i$.

(2) Draw $v_o$ for the circuit shown in Figure 5

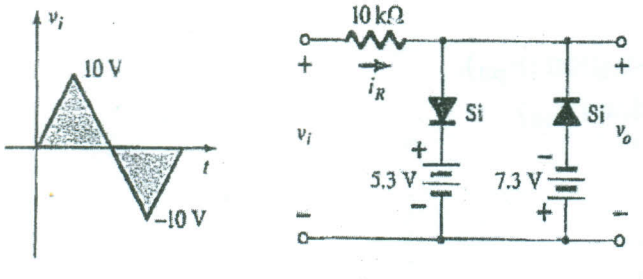


Figure 4

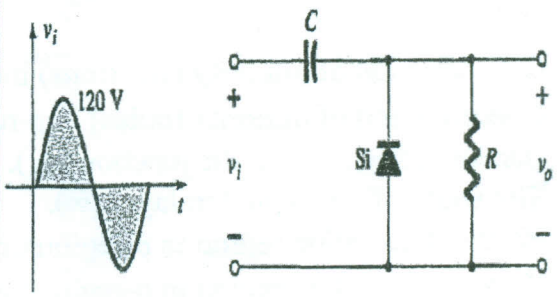


Figure 5

**Question 4 [25 M]**

(1) For the BJT circuit shown in Figure 6 determine: $I_B, I_C, V_B, V_C, V_E$.

(2) For the FET circuit shown in Figure 7 determine: $V_G, I_D, V_G, V_S, V_D$.

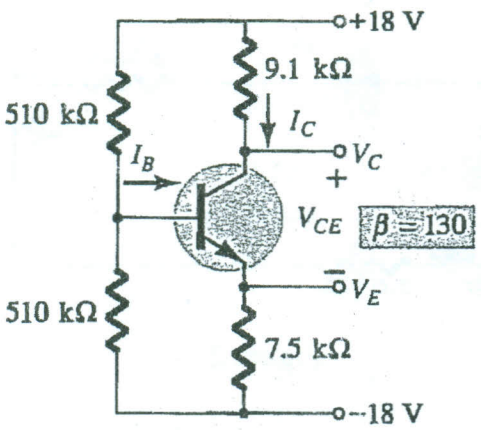


Figure 6

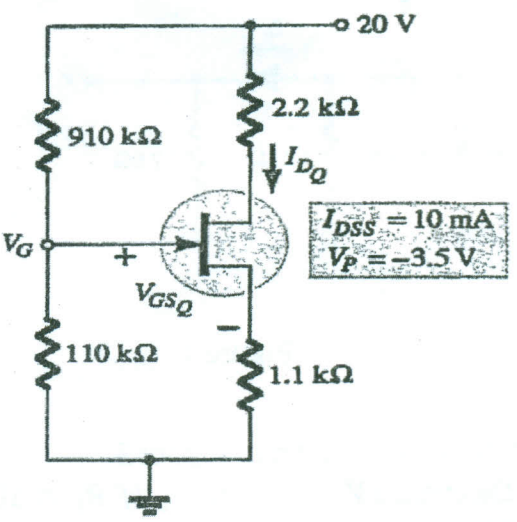


Figure 7

Good Luck

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