EE420 Digital Electronics
Dep. of Electrical Engineering
Jordan University of Science and Tech.
First Exam

Answer all of the following questions

Question 1 (10 points)

For the following circuit shown in figure (2) if β=50, V_D=0.7V, V_{BEA}=0.7V, V_{BES}=0.8V, V_{CES}=0.2V

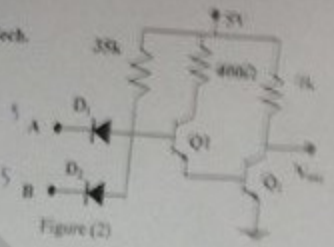


Figure (2)

a) If A=B=5V, then find

V_{B1}= $V_{BEA} + V_{BES} = 0.7 + 0.8 = 1.5$ V

I_{B1}=

I_{C1}= $\frac{5-1.5}{35K} = 1 \times 10^{-4}$ A

I_{B2}= $\frac{5-0.2}{400} = 0.012$

$I_{B2} = I_{E1} = (\beta+1) I_{B1} = (50+1)\, 1\times10^{-4} = 5.1 \times 10^{-3}$

b) Find the Fan out of the gate if I_{B2}=1mA

c) if A=B=0.2V, then V_{out}=

d) Find the noise margin of logic zero

$NM_L = V_{IL} - V_{OL}$

$= 0.7 - 0.2 = 0.5$

and find the noise margin of logic one

$NM_H = V_{OH} - V_{IH}$

$= 5 - 0.8 = 4.2$

Question II (10 points)

For the following circuit shown in figure (3)

if β=50, β_1=0.2, V_D=0.7V, V_{BEA}=0.7V, V_{BES}=0.8V, V_{CES}=0.2V

a) If A=B=Logic one and I_{B3}=2mA then find

- I_{E2}=

$V_E = 1.6 \Rightarrow I_{E2} = \frac{1.6}{2k} = 8 \times 10^{-4}$

- V_{C2}=

- I_{C2}=

- I_{B2}=

- R_X=

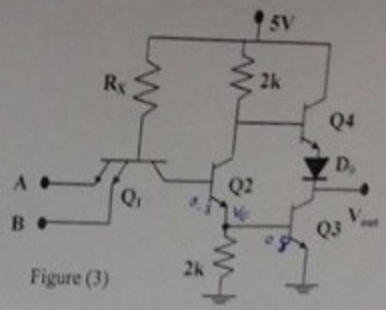


Figure (3)

b) If the Fan out the gate is 100 gates and R_X=2kΩ, find I_{B3}

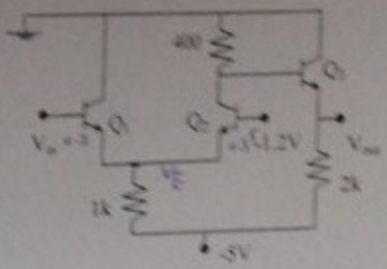
c) If A=B=Logic zero and R_X=2kΩ. If the gate is connected to 50 similar gates find

I_{E4}=

V_{out}=

Question III (10 points)

Consider the following circuit, If V_{BEA}=0.7V, β=100



a) If V_{in}=logic one

- Find V_{out}

$-0.2 + 0.7 + V_{out} = 0 \Rightarrow V_{out} = -0.5$

$-V_{in} + 0.7 + V_E = 0 \Rightarrow V_{in} = -0.85$

- Find I_{C1}

- Find I_{C2} $= 0$

- Find I_{C3}

- Find power dissipation

$P = V_c I_c$

b) If V_{in}=logic zero

- Find V_{out}

- Find I_{C1} $= 0$

- Find I_{C2}

- Find I_{C3}

- Find power dissipation

$P = V_c I_c$

Q3 a) Q1 on Q2 old $V_C =$

[illegible]

$V_C = -0 - 4 \times I_B R_B - 0.7 = -0.7$

(2/[illegible])

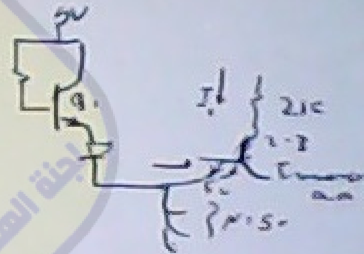
$I_{B_2} = (1+2\beta_1) I_{B_1} \Rightarrow I_{B_1} = 0.2847\,mA$

$I_{B_1} = \frac{5-2.8}{R_A} \Rightarrow \boxed{R_A = 9.45\,k\Omega}$

(b) $\beta I_{B_3} \geq N I_1$

$(50)(I_{B_3}) \geq 100\left(\frac{5-0.9}{2k}\right)$

$\boxed{I_{B_3} = 4.1\,mA}$



(c) $I_A = \frac{5-2.3}{2k} = 1.33\,mA$

$I = \beta_R I_A = 0.27\,mA$

$I_{BU} = 5 \cdot I = 13.5\,mA$

$V_{OH} = 5 - 2k\, I_{BU} - 0.7 - 0.7$

$V_{OH} = 5 - 2k\left(\frac{13.5m}{51}\right) - 0.7 - 0.7$

$\boxed{V_{OH} = 3V}$

$V_{M1} = 5 - 0.8 = 4.2$

Q2) $I_{C2} = \frac{2mA}{\text{given}} + \frac{0.8}{2K} = 2.4mA$

(a) $V_{C2} = 0.8 + 0.2 = 1V$

$I_{C2} = \frac{5-1}{2K} = 2mA$

(b) $I_{B2} = I_{E2} - I_{C2} = 0.4mA$

$I_{B2} = (1 + 2\beta_1) I_{B1} \Rightarrow I_{B1} = 0.2857mA$

$I_{B1} = \frac{5 - 2.3}{R_x} \Rightarrow R_x = 9.45K\Omega$

(b) $\beta I_{B3} \geq N I_x$

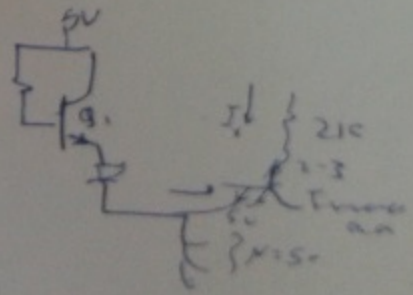
$(50)(I_{B3}) \geq 100\left(\frac{5-0.9}{2K}\right)$

$I_{B3} = 4.1mA$

(c) $I_x = \frac{5 - 2.3}{2K} = 1.35mA$

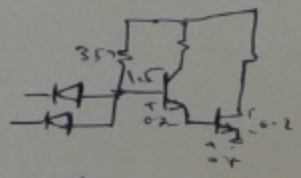
$I = \beta_1 I_x = 0.27mA$

$I_{Em} = 50 I = 13.5mA$



solution to first exam:

Q1.



(a) $V_{B_1} = 0.7 + 0.8 = 1.5V$

(b) $I_{B_1} = \frac{5-1.5}{35k} = 0.1$

$I_{C_1} = \beta I_{B_1} = 5mA$, $I_C^{sat} = 1mA$, $I_{B_2} = (1+\beta) I_{C_1} = 5.1mA$

Q_1 Act

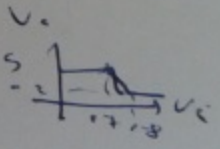
b) $\beta I_{B_2} > \frac{5-2}{11k} + N \frac{5-0.9}{35k}$

$N < 385.9$

c) $V_o = 5V$

d) $NM_0 = 0.7 - 0.2 = 0.5V$

$NM_1 = 5 - 0.8 = 4.2$



Q_2) $I_{C_2} = \frac{2mA}{\text{given}} + \frac{0.8}{2k} = 2.4mA$

(a) $V_{C_2} = 0.8 + 0.2 = 1V$

$I_{C_2} = \frac{5-1}{2k} = 2mA$

(5)