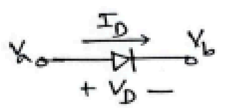
Solutions

Q2

Set-02

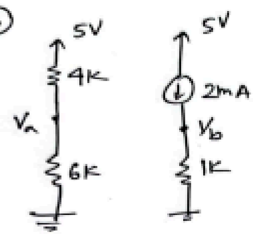
(a)



to verify ON states $I_D > 0$

to verify off states $V_{ab} < V_{D0}$

(b)



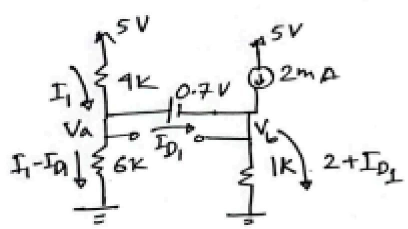
$V_a = 5 \times \frac{6}{6+4}$

$= 3V$

$V_b = 1 \times 2$

$= 2V$

(c) Assume D_1 ON, D_2 off



$5 = 4I_1 + 0.7 + (2 + I_{D1}) \times 1$

$5 = 4I_1 + 6(I_1 - I_{D1})$

$\therefore I_1 = 0.553$ mA

$I_{D1} = 0.088$ mA

Verify

I_{D1} is positive $\therefore D_1$ ON

$\cancel{V_a = 6(I_1 - I_{D1}) = 2.79V}$

$\cancel{V_b = 1(2 + I_{D1}) = 2.088}$

$V_{ba} = -0.7 < 0.7 \therefore D_2$ off

So our assumption OK

$\therefore I_{D1} = 0.088$ mA $I_{D2} = 0$ mA

(d) if two diodes are in a opposite direction in a series ckt the overall network is off so current in line $I_{ab} = 0$.

~~Set 0~~ Set 01

(a) Same as set 02

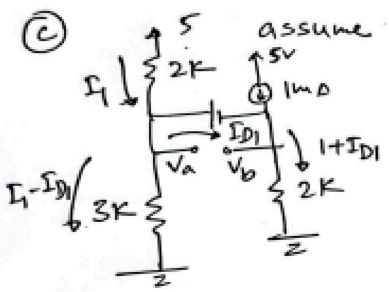
(b) $V_a = 5 \times \frac{3}{2+3}$

$= 5V$

$V_b = 1 \times 2 = 2V$

Va=3V (here it's a mistake)

(c) assume D_1 ON, D_2 off



$5 = 2I_1 + 0.7 + (1+I_{D1}) \times 2$

$5 = 2I_1 + 3(I_1 - I_{D1})$

$\therefore I_1 = 1.056$

$I_{D1} = 0.093$.

Verify

$I_{D1} > 0 \quad \therefore D_1$ ON

$V_{ba} = -0.7V < 0.7V$

$\therefore D_2$ off

(d) same as set 02.

Q3

Set- A/Set-1

(a) Gain $= -\frac{R_F}{R_1}$

(b) Nodal Analysis at V_a node : $\frac{V_a-5}{2}+\frac{V_a}{10}+1=0 \quad \Rightarrow V_a = 2.5\,V$. Also, $V_a = V^+ = 2.5\,V$

(c) When S1 is **closed**, the op-amp is in closed loop.

$V^+ = V^- = 2.5\,V$. Nodal Analysis at V^- node: $\frac{V^- -3.3}{4}+\frac{V^- - V_0}{0.33}=0$

$\Rightarrow V_0 = 2.434\,V$

(d) When S1 is **open**, the op-amp is in **open** loop.

$V^+ = 2.5\,V$ (from 'b') $V^- = 3.3\,V$ (from the left side of $4k\Omega$)

Since, $V^+ < V^-$ $\Rightarrow V_0 = -8\,V$

(e) A differentiator (RC=0.2) series with an inverting amplifier (R1=RF). Or, any other appropriate choices for R and C which finally gives +0.2 factor.

Set- B/Set-2

(a) Gain $= 1+\frac{R_F}{R_1}$

(b) Nodal Analysis at V_a node : $\frac{V_a-5}{2}+\frac{V_a}{10}=1 \quad \Rightarrow V_a = 5.83\,V$. Also, $V_a = V^+ = 5.83\,V$

(c) When S1 is **closed**, the op-amp is in closed loop.

$V^+ = V^- = 5.83\,V$. Nodal Analysis at V^- node: $\frac{V^- -3.3}{4}+\frac{V^- - V_0}{0.48}=0$

$\Rightarrow V_0 = 6.134\,V$

(d) When S1 is **open**, the op-amp is in **open** loop.

$V^+ = 5.83\,V$ (from 'b') $V^- = 3.3\,V$ (from the left side of $4k\Omega$)

Since, $V^+ > V^-$ $\Rightarrow V_0 = +10\,V$

(e) A differentiator (RC=0.8) series with an inverting amplifier (R1=RF). Or, any other appropriate choices for R and C which finally gives +0.8 factor.

Q4

Set 01

a. Open Circuit
b. Vx = 4.56 V, ID1 = 0 mA, ID2 = 1.36 mA
c. VO = 7 V. (9.12 V > 7 V)

Set 02

d. Short Circuit
e. Vx = 4.48 V, ID1 = 1.38 mA, ID2 = 0 mA
f. VO = 7 V. (8.96 V > 7 V)

Q5

Set 01

a. CVD+R diode I-V graph
b. Vo1 = 1.7 V, Vo2 = 1.9 V
c. Vo = 2.7 V
d. D3, D4 -> Reverse Bias. Vo2 = (10 * (5-1) / (10+30)) = 1 V. VO = 2 V

Set 02

a. Diode I-V graph
b. Vo1 = 1.7 V, Vo2 = 1.9 V
c. Vo = 2.7 V
d. D3, D4 -> Reverse Bias. Vo2 = (10 * (5-1) / (10+30)) = 1 V. VO = 2 V