SOLUTION - DTCB (CTT) - 9/5/2015

PROBLEM 1 (2M)

Express the right voltage source and two right-most resistors as a Thevenin equivalent , with Thevenin voltage 20/(20+30) *(-10V)= -4V and Thevenin resistance 20 Ω//30 Ω = 20x30 / (20+30) = 12 Ω

According to superposition theorem , two output voltages are calculated as follows

Case 1 : $V_{IN\,1}$ = -4V , $V_{IN\,2}$ = +5V (short-cuited) , OPAMP becomes inverting amplifier

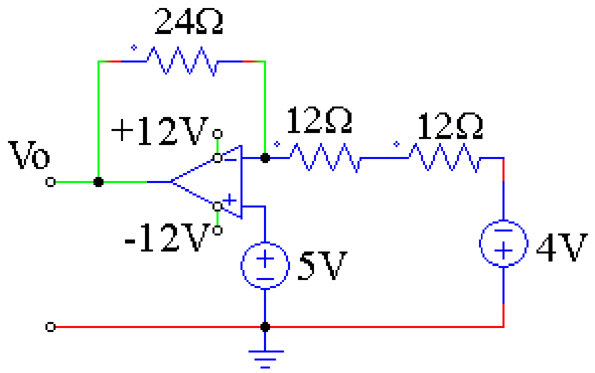
Hence, $V_{OUT\,1}$ = (- 24 / 12 + 12) (-4) = + 4V

Case 2 : $V_{IN\,2}$ = +5V , $V_{IN\,1}$ = -4V (short-circuited) , OPAMP is known as noninverting amplifier

Hence , $V_{OUT\,2}$ = (1 + 24 / 12 + 12) (+5) = +10V

Finally , V_{OUT} = $V_{OUT\,1}$ + $V_{OUT\,2}$ = +14V > + 12 V (positive power supply)

It's said that OPAMP is in positive saturation and V_{OUT} = + 12 V



PROBLEM 2 (2M)

$I_{ZMAX} = P_{ZMAX} / V_Z$ = 150mW / 12 = 12,5mA

I_S = (36 - 12) / 1,5K = 16mA

$I_S = I_Z + I_B$ = const (from KCL at node B)

I_{BMIN} = 16 - 12,5 = 3,5mA

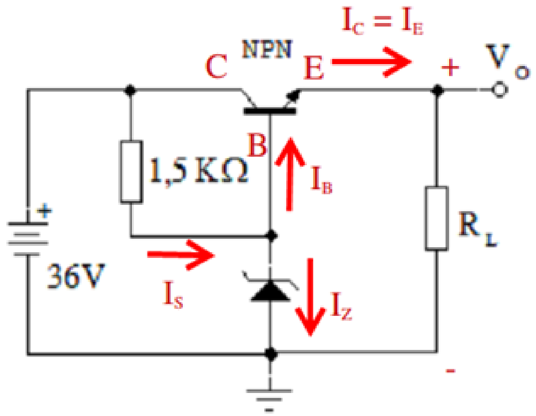
I_{CMIN} = 100 x 3,5mA = 0,35A

R_{LMAX} = 12 / 0,35 = 34,3 Ω

$I_{BMAX} = I_S - I_{ZMIN}$ = 16mA

I_{CMAX} = 100 x 16mA = 1,6A

R_{LMIN} = 12 / 1,6 = 7,5 Ω



PROBLEM 3 (2M)

$I_C = I_E = 100\, I_B$

$6 = 10K*I_B + 0,7 + 0,1K*100I_B$

I_B = 0,265 mA

$I_C = I_E$ = 26,5 mA

V_{CE} = 36 - 1K*26,5 - 0,1K*26,5 = 6,85V

V_E = 0,1K*26,5mA = 2,65V

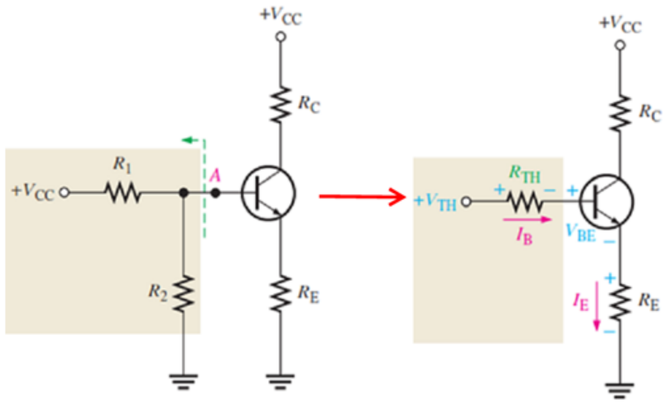
$V_{TH} = (R_2 / R_1 + R_2) *V_{CC}$

$R_2 / (R_1 + R_2)$ = 6 / 36 = 1 / 6

$R_1 * R_2 / (R_1 + R_2)$ = 10KΩ

R_1 = 60KΩ

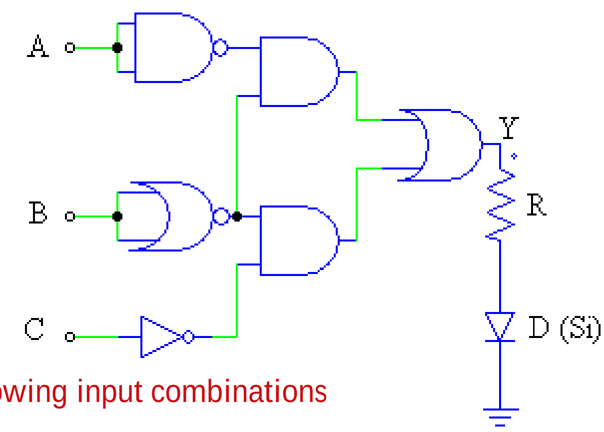
R_2 = 12KΩ



PROBLEM 4 (2M)

$$Y = \bar{A}\,\bar{B}\,X + X\,\bar{B}\,\bar{C} = 000 + 001 + 000 + 100$$

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0



Diode ON in one of three following input combinations such as 000 , 001 , 100 .

R = (5 - 0.7) / 2mA = 2,15 KΩ

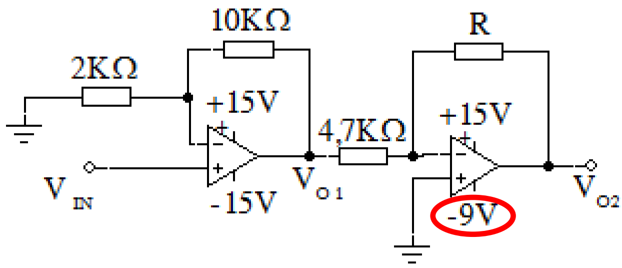
PROBLEM 5 (2M)

OPAMP 1 given as A_{v1} = +6 (noninverting amp)

Hence , V_{o1} = (+6) * 0,5 sin ωt [V]

V_{o1} = 3 sin ωt [V]

V_{o2} = -9 sin ωt [V]



OPAMP 2 known as inverting amp

Hence , A_{v2} = - 9 / 3 = - 3

The total voltage gain determined by

A_v = (+6) (-3) = -18

R= 4,7KΩ * 3 = 14,1KΩ