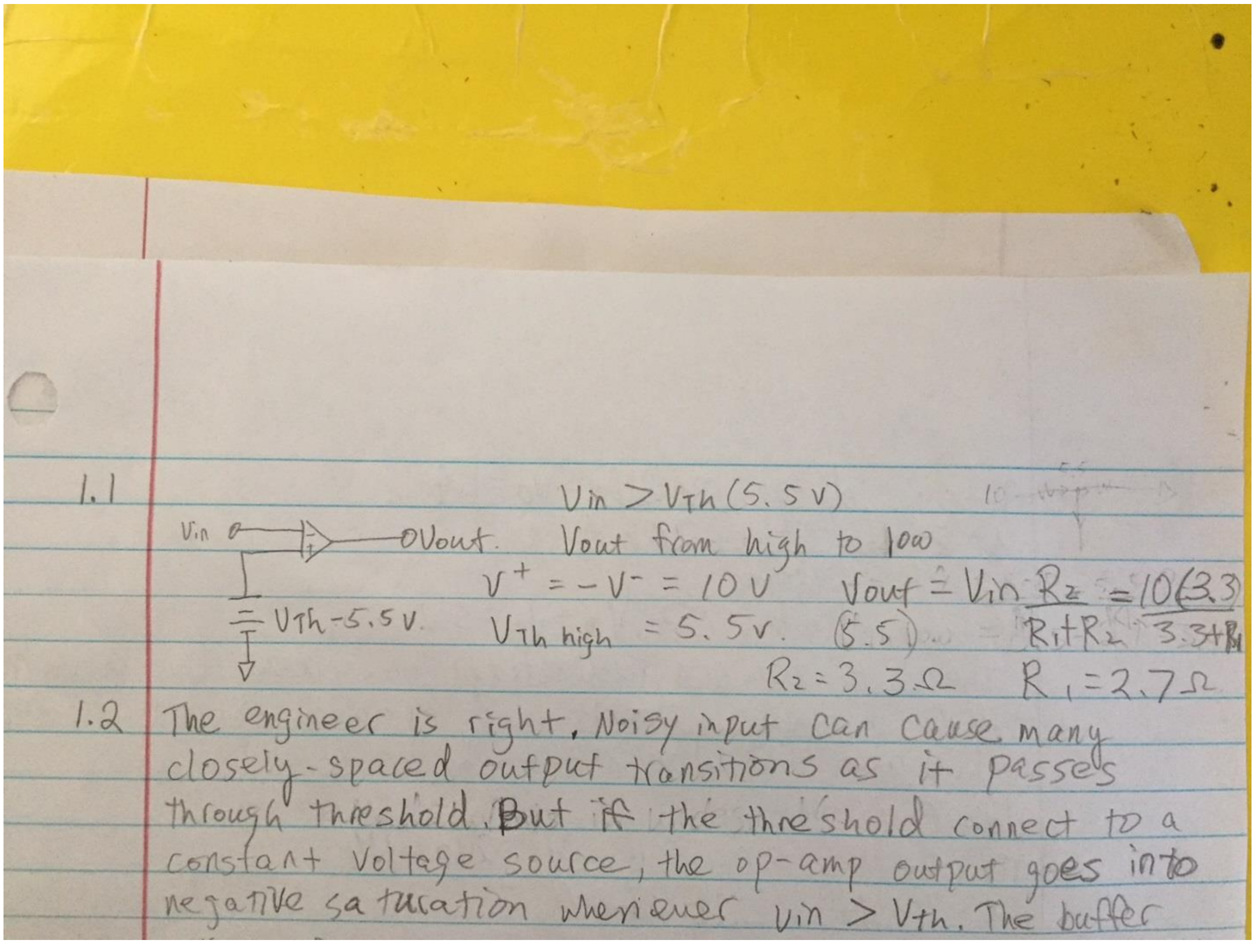
Rong Zheng Z23007381

Homework2 partA

1.1)



1.1

$V_{in} > V_{Th}$ (5.5 V)

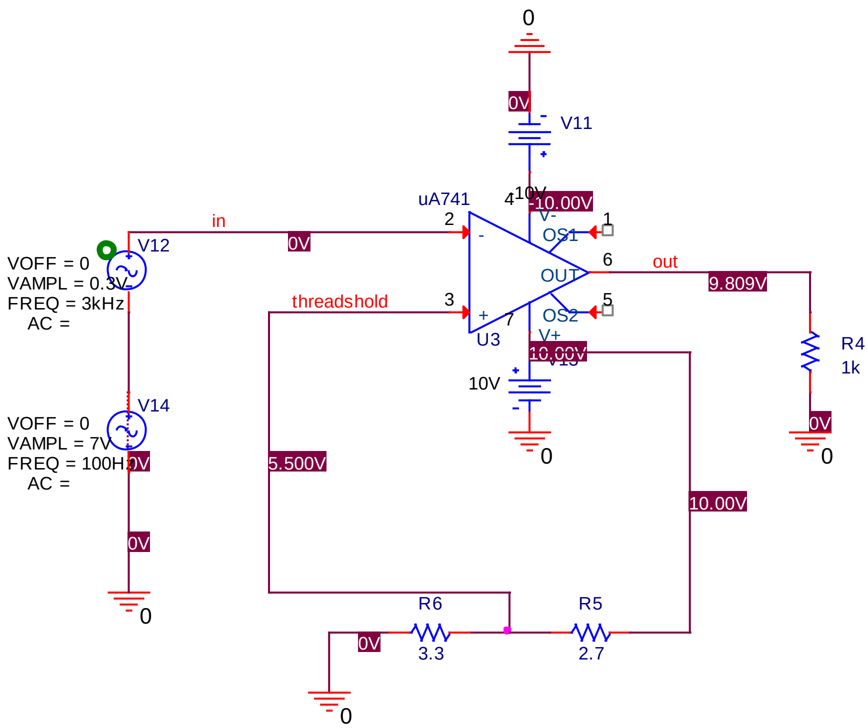
V_{in} — V_{out}. V_{out} from high to low

$V^+ = -V^- = 10V$ $V_{out} \doteq V_{in} \frac{R_2}{R_1+R_2} = \frac{10(3.3)}{3.3+R_1}$

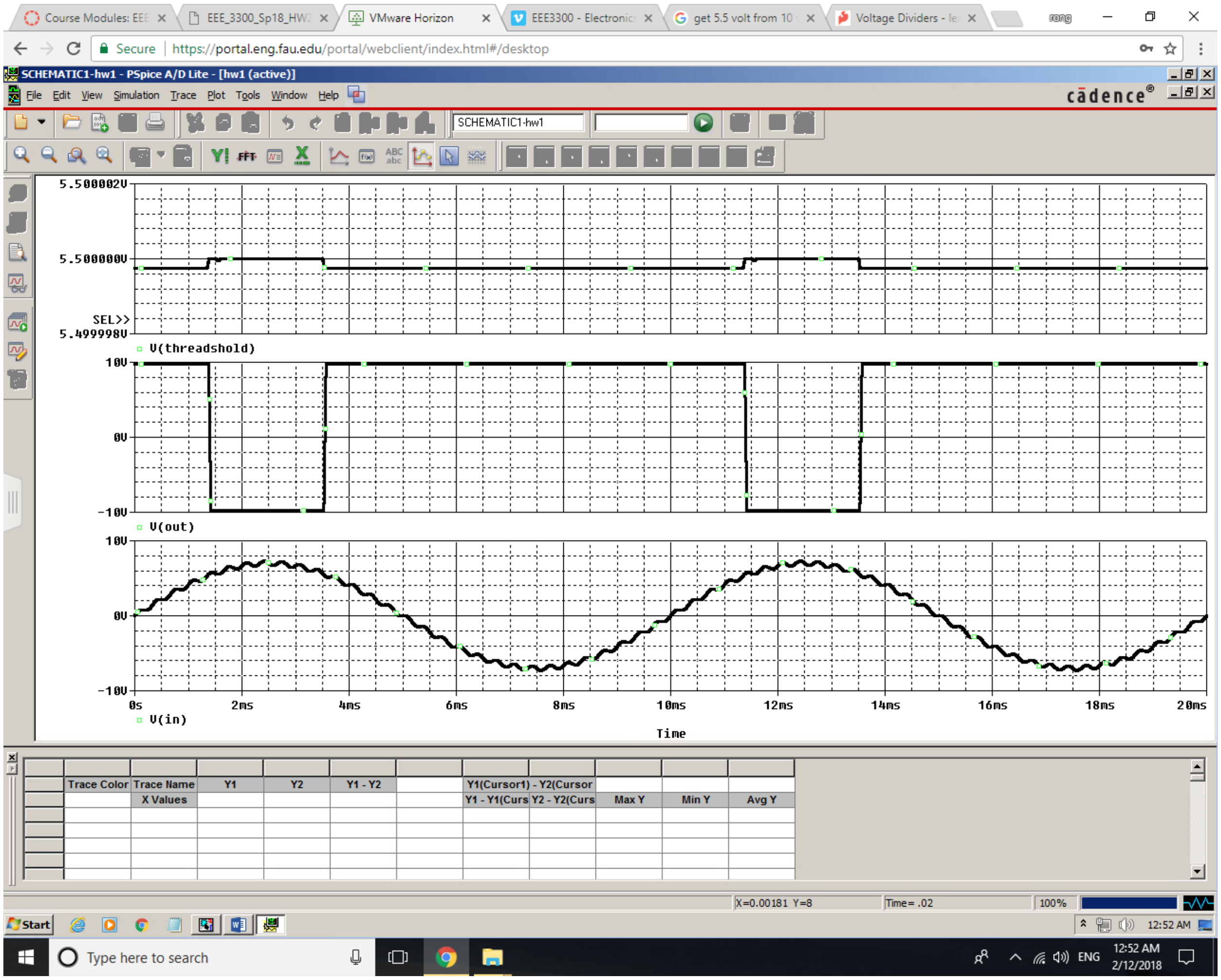
V_{Th} -5.5 V. V_{Th} high $= 5.5v$. (5.5)

$R_2 = 3.3\Omega$ $R_1 = 2.7\Omega$

1.2 The engineer is right, Noisy input can cause many closely-spaced output transitions as it passes through threshold. But if the threshold connect to a constant voltage source, the op-amp output goes into negative saturation wheniever $v_{in} > V_{th}$. The buffer



0
0V
V11
uA741
4
10V
-10.00V
V-
1
2
in
0V
OS1
V12
VOFF = 0
VAMPL = 0.3V
FREQ = 3kHz
AC =
6
out
OUT
9.809V
threadshold
3
5
OS2
+
7
V+
U3
10.00V
R4
1k
10V
V14
VOFF = 0
VAMPL = 7V
FREQ = 100Hz
AC =
0V
5.500V
0
0V
0
10.00V
0V
0
R6
R5
0V
3.3
2.7
0

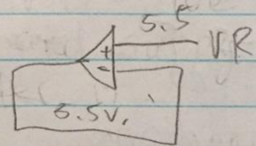

SCHEMATIC1-hw1 - PSpice A/D Lite - [hw1 (active)]
5.500002V
5.500000V
SEL>>
5.499998V
V(threadshold)
10V
0V
-10V
V(out)
10V
0V
-10V
0s
2ms
4ms
6ms
8ms
10ms
12ms
14ms
16ms
18ms
20ms
V(in)
Time
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
X Values
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
X=0.00181 Y=8
Time= .02
100%

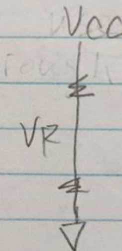
1.2)

$= V_{Th} - 5.5V.$ $\quad V_{Th\,high} = 5.5v.$ $\quad (5.5)$ $\quad R_1 + R_2 \quad 3.3 + R_1$

$R_2 = 3.3\Omega \quad R_1 = 2.7\Omega$

1.2 The engineer is right, Noisy input can cause many closely-spaced output transitions as it passes through threshold. But if the threshold connect to a constant voltage source, the op-amp output goes into negative saturation whenever $v_{in} > V_{th}$. The buffer will create constant voltage source when connect to a voltage divider.



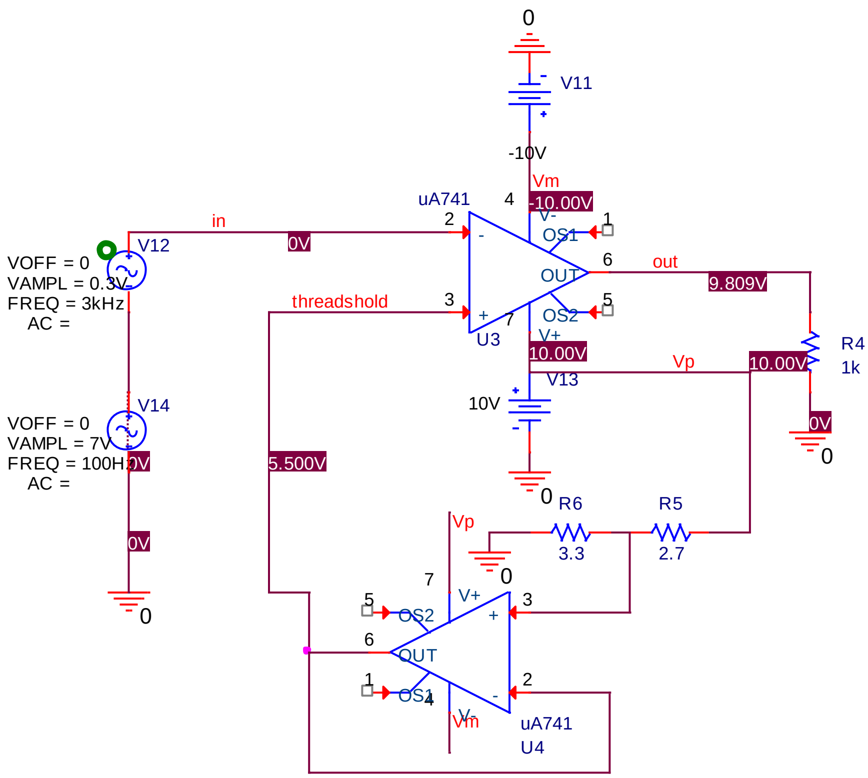


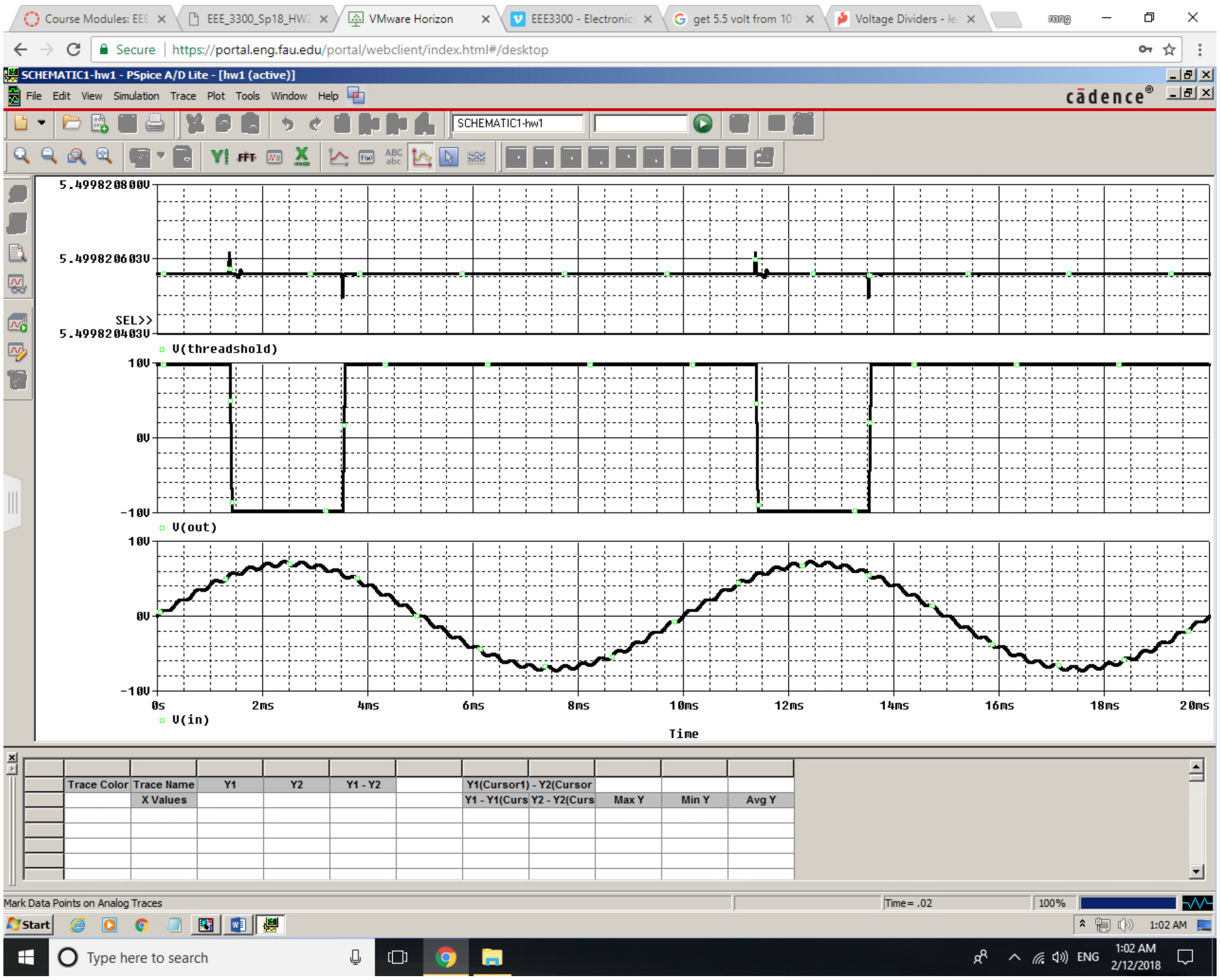
1.3 $V_R = V_{in} \dfrac{R_2}{R_1 + R_2} = \dfrac{9(3.3)}{3.3 + R_1} = 3.82V \qquad R_1 = 4.47k\Omega$

$R_2 = 3.3k\Omega$

$V_{2H} = V_{ref} = 4.1V.$

The noise peak-to-peak amplitude is .9V. In order to avoid "ringing" we have to take $\Delta > 0.9V.$


0
V11
-10V
Vm
-10.00V
uA741
4
2
V-
1
OS1
in
0V
V12
VOFF = 0
VAMPL = 0.3V
FREQ = 3kHz
AC =
6
out
OUT
9.809V
threadshold
3
5
OS2
7
V+
U3
10.00V
Vp
10.00V
R4
1k
V13
10V
V14
VOFF = 0
VAMPL = 7V
FREQ = 100Hz
AC =
0V
5.500V
0V
0
R6
R5
3.3
2.7
Vp
0
0
7
V+
3
OS2
OUT
OS1
2
Vm
uA741
U4



Course Modules: EEE
EEE_3300_Sp18_HW
VMware Horizon
EEE3300 - Electronic
get 5.5 volt from 10
Voltage Dividers - le
Secure
https://portal.eng.fau.edu/portal/webclient/index.html#/desktop
SCHEMATIC1-hw1 - PSpice A/D Lite - [hw1 (active)]
File Edit View Simulation Trace Plot Tools Window Help
cādence
SCHEMATIC1-hw1
5.49982080 0V
5.4998206 03V
SEL>>
5.4998204 03V
V(threadshold)
10V
0V
-10V
V(out)
10V
0V
-10V
0s
2ms
4ms
6ms
8ms
10ms
12ms
14ms
16ms
18ms
20ms
V(in)
Time
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
X Values
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
Mark Data Points on Analog Traces
Time= .02
100%
Start
1:02 AM
Type here to search
ENG
1:02 AM
2/12/2018

1.3)

6.5V.

V_R

1.3 $V_R = V_{in}\dfrac{R_2}{R_1+R_2} = \dfrac{9(3.3)}{3.3+R_1} = 3.82V$ $R_1 = 4.47k\Omega$
$R_2 = 3.3k\Omega$

$V_{2H} = V_{ref} = 4.1V$

The noise peak-to-peak amplitude is .9V. In order to avoid "ringing" we have to take $\Delta > 0.9V$.

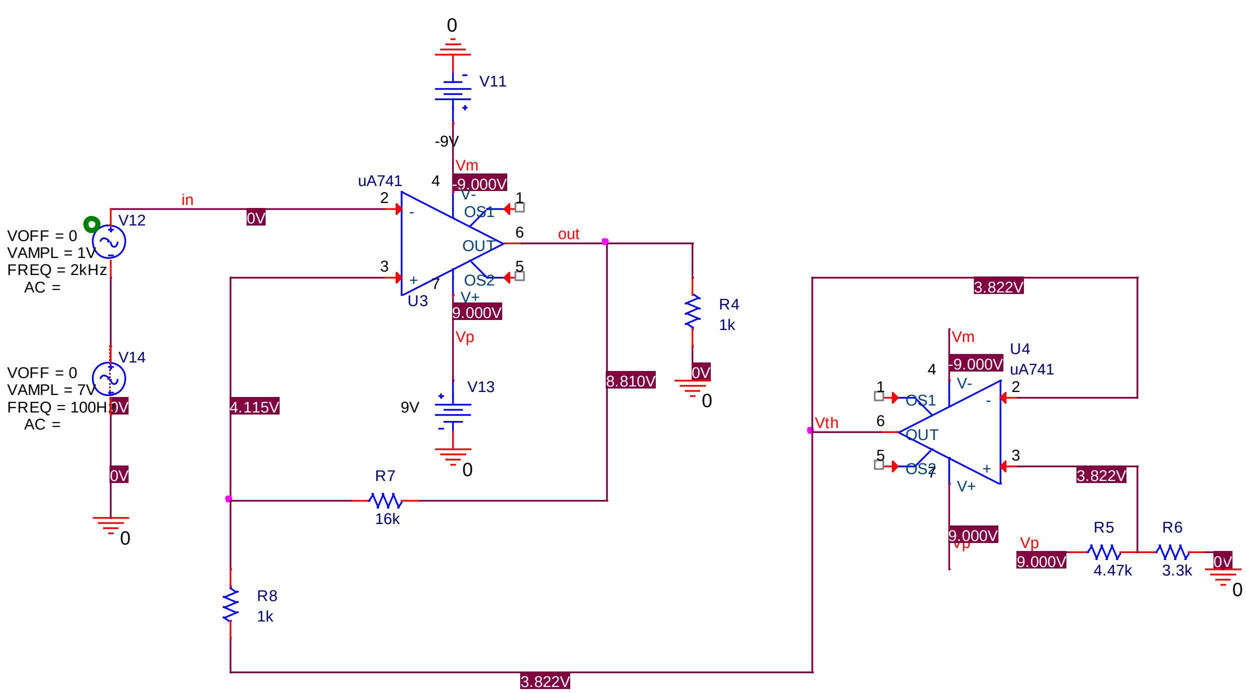
Let's choose $\Delta = 1.0V$

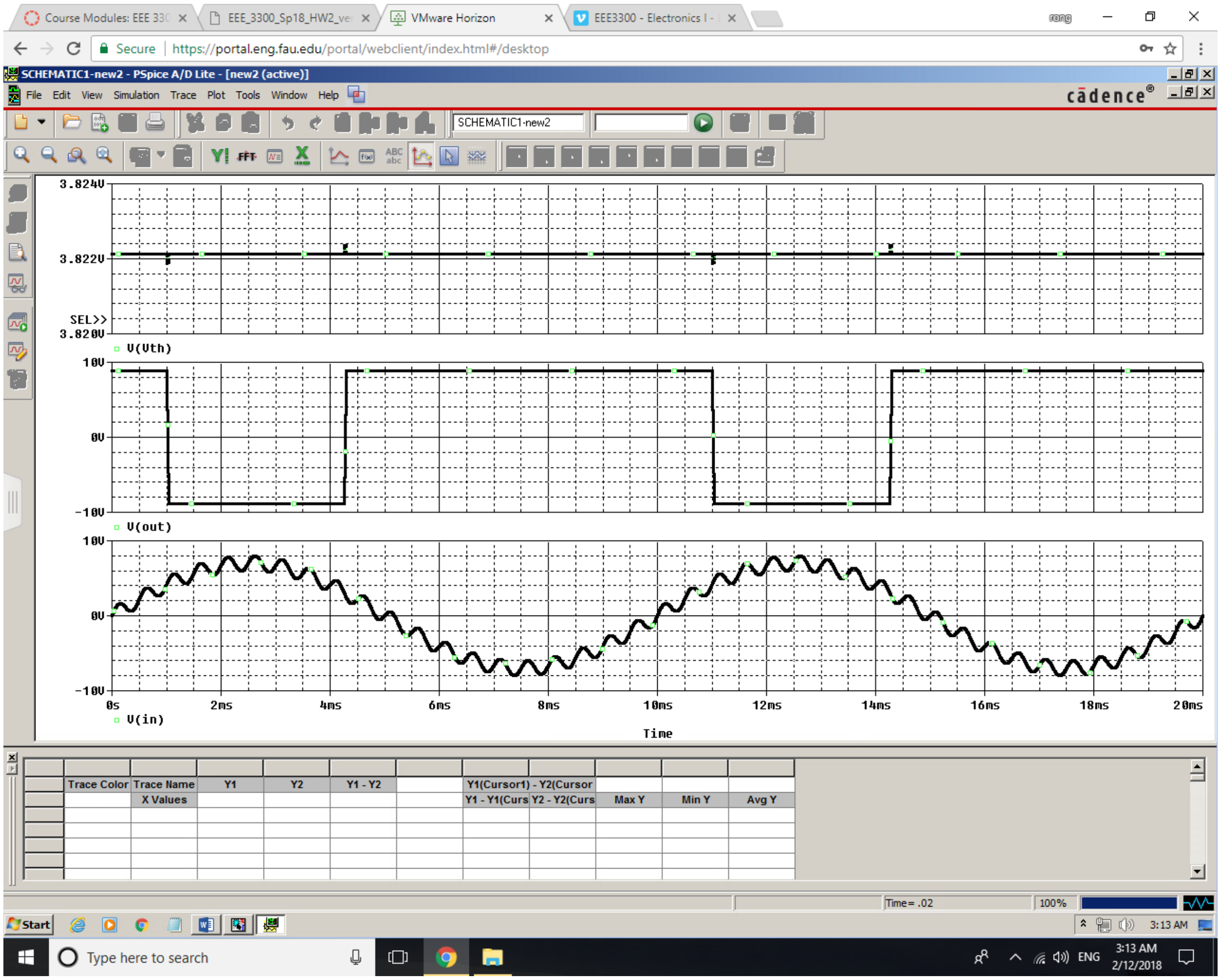
This choice of Δ dictates that $V_{2L} = 4.1 - 1.0 = 3.1V$

$\dfrac{R_1}{R_2} = \dfrac{2V^+}{\Delta} - 1 = \dfrac{2(8.5)}{1.0} - 1 = 17 - 1 = 16k\Omega$

$R_1 = 16k\Omega$ $R_2 = 1k\Omega$

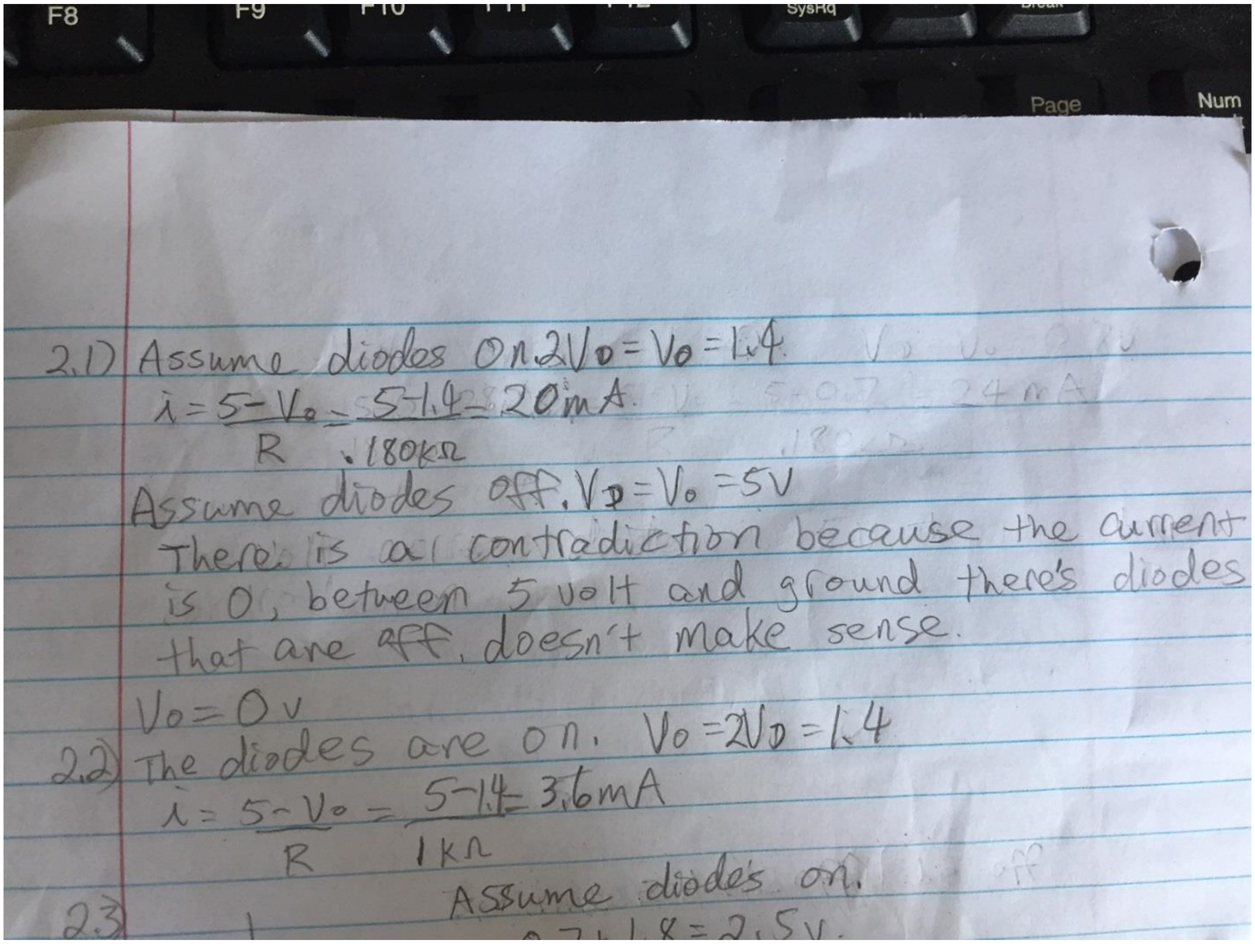
$V_R = \dfrac{V_{2H} + V_{2L}}{2}\left(1 + \dfrac{R_1}{R_2}\right) = \dfrac{4.1 + 3.1}{2}\left(1 + \dfrac{1}{17k}\right) = 3.82V$





SCHEMATIC1-new2 - PSpice A/D Lite - [new2 (active)]
File Edit View Simulation Trace Plot Tools Window Help
cādence
https://portal.eng.fau.edu/portal/webclient/index.html#/desktop
3.824V
3.822V
SEL>>
3.820V
V(Vth)
10V
0V
-10V
V(out)
10V
0V
-10V
0s
2ms
4ms
6ms
8ms
10ms
12ms
14ms
16ms
18ms
20ms
V(in)
Time
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
X Values
Max Y
Min Y
Avg Y
Time= .02
100%
3:13 AM
2/12/2018

2.1)



2.1) Assume diodes on $2V_D = V_o = 1.4$

$i = \frac{5 - V_o}{R} = \frac{5 - 1.4}{.180k\Omega} = 20mA$

Assume diodes off. $V_D = V_o = 5V$

There is a contradiction because the current is 0, between 5 volt and ground there's diodes that are off, doesn't make sense.

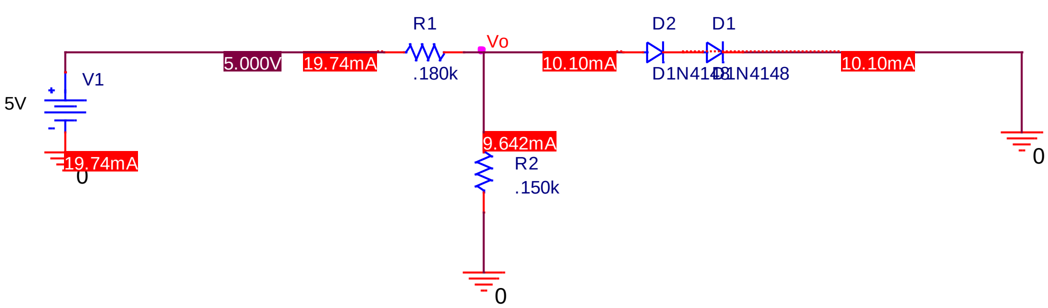
$V_o = 0v$

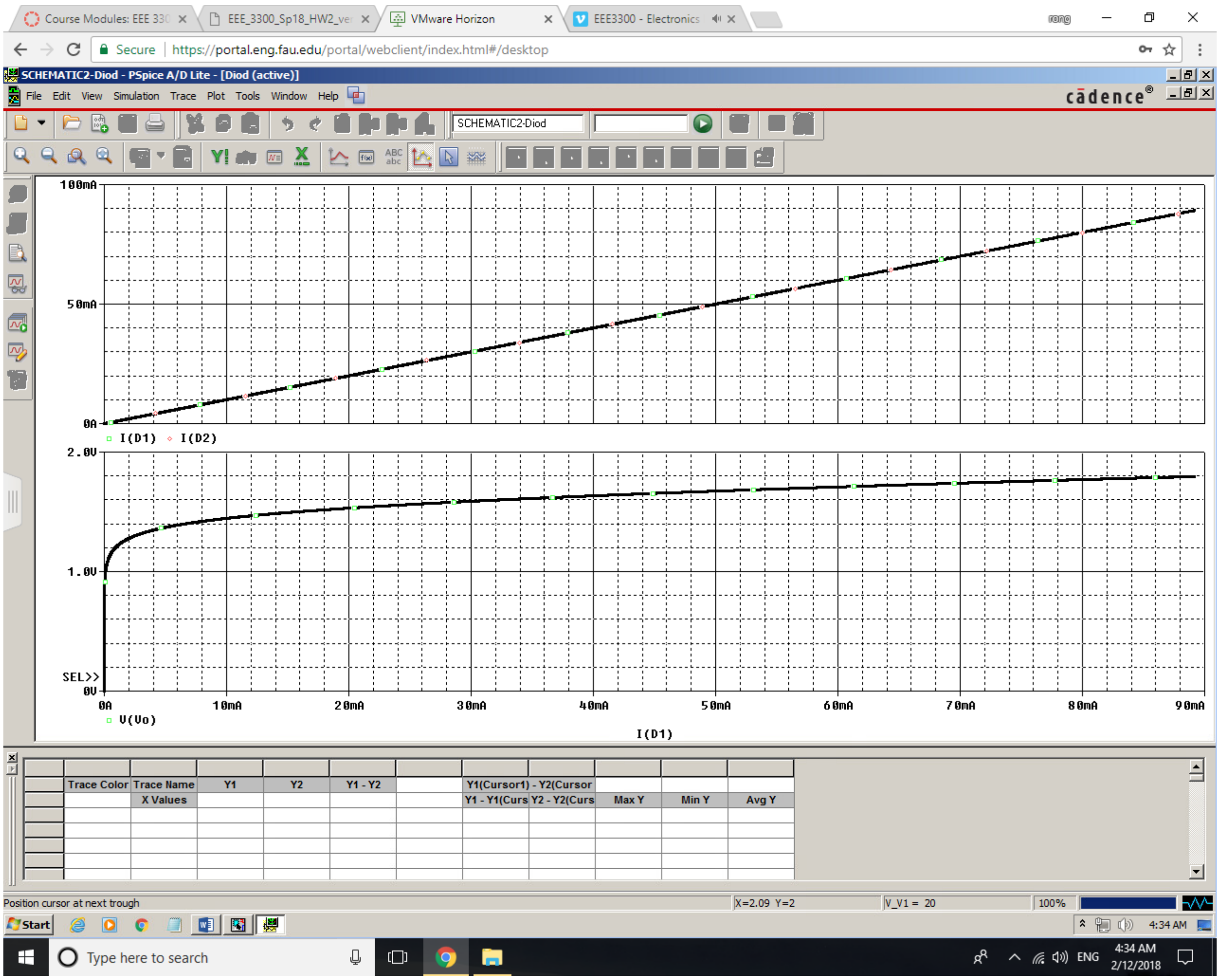
2.2) The diodes are on. $V_o = 2V_D = 1.4$

$i = \frac{5 - V_o}{R} = \frac{5 - 1.4}{1k\Omega} = 3.6mA$

2.3) Assume diodes on.

$0.7 + 1.8 = 2.5V$




SCHEMATIC2-Diod - PSpice A/D Lite - [Diod (active)]
100mA
50mA
0A
I(D1)
I(D2)
2.0V
1.0V
SEL>>
0V
0A
10mA
20mA
30mA
40mA
50mA
60mA
70mA
80mA
90mA
V(Vo)
I(D1)
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
X Values
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
Position cursor at next trough
X=2.09 Y=2
V_V1 = 20
100%

2.2)

2.1) Assume diodes on. $2V_D = V_o = 1.4$

$$i = \frac{5 - V_o}{R} = \frac{5 - 1.4}{.180k\Omega} = 20\,mA$$

Assume diodes off. $V_D = V_o = 5V$

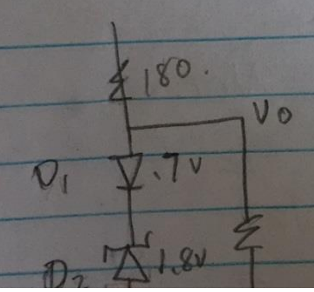
There is a contradiction because
is 0, between 5 volt and ground the
that are off, doesn't make sense.

$V_o = 0\,v$

2.2) The diodes are on. $V_o = 2V_D = 1.4$

$$i = \frac{5 - V_o}{R} = \frac{5 - 1.4}{1k\Omega} = 3.6\,mA$$

2.3)

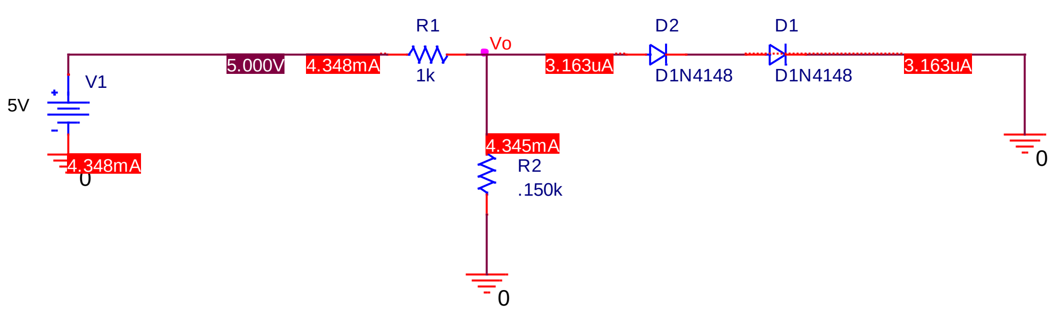


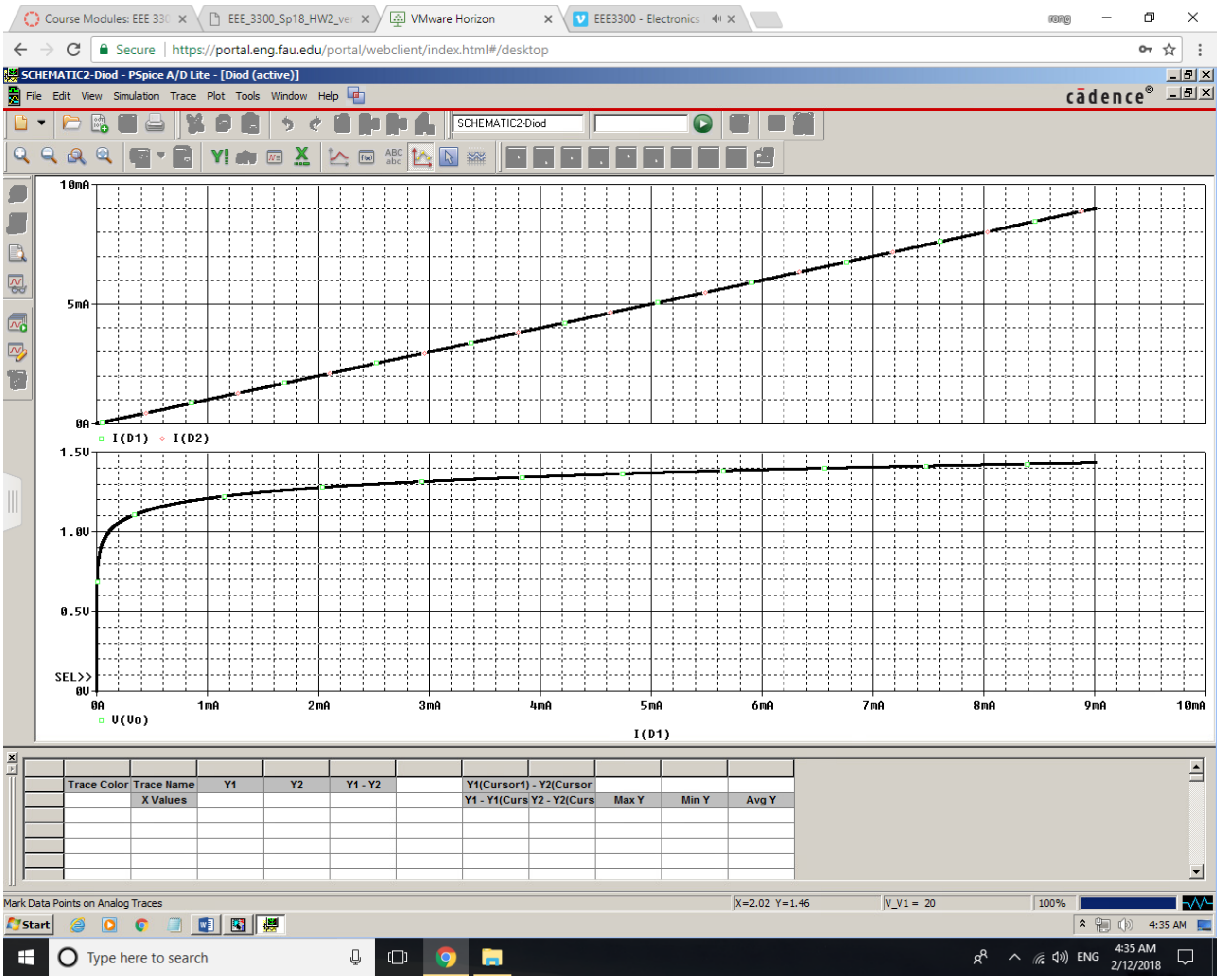
Assume diodes on.

$0.7 + 1.8 = 2.5\,v.$

$$i = \frac{5 - 2.5}{.180} = 14\,mA$$

No contradiction.




SCHEMATIC2-Diod - PSpice A/D Lite - [Diod (active)]
File Edit View Simulation Trace Plot Tools Window Help
SCHEMATIC2-Diod
10mA
5mA
0A
I(D1) I(D2)
1.5V
1.0V
0.5V
SEL>>
0V
0A 1mA 2mA 3mA 4mA 5mA 6mA 7mA 8mA 9mA 10mA
V(Vo)
I(D1)
Trace Color
Trace Name
X Values
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
Mark Data Points on Analog Traces
X=2.02 Y=1.46
V_V1 = 20
100%
4:35 AM
2/12/2018

2.3)

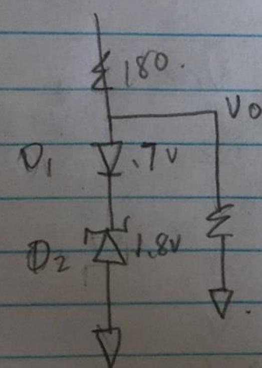
... contradiction because the ...
is 0, between 5 volt and ground there's ...
that are off, doesn't make sense.

$V_o = 0\,v$

2.2) The diodes are on. $V_o = 2V_D = 1.4$

$i = \frac{5 - V_o}{R} = \frac{5 - 1.4}{1k\Omega} = 3.6mA$

2.3)



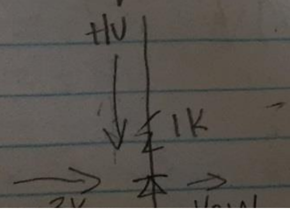
Assume diodes on.

$0.7 + 1.8 = 2.5v.$

$i = \frac{5 - 2.5}{.180} = 14mA$

No contradiction.

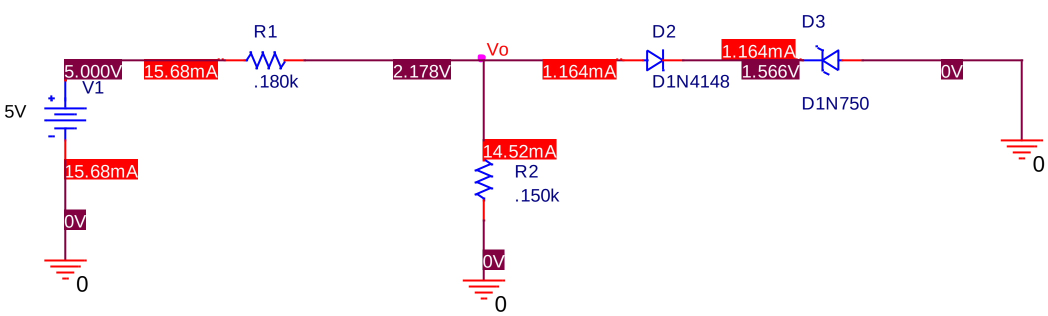
2.4)

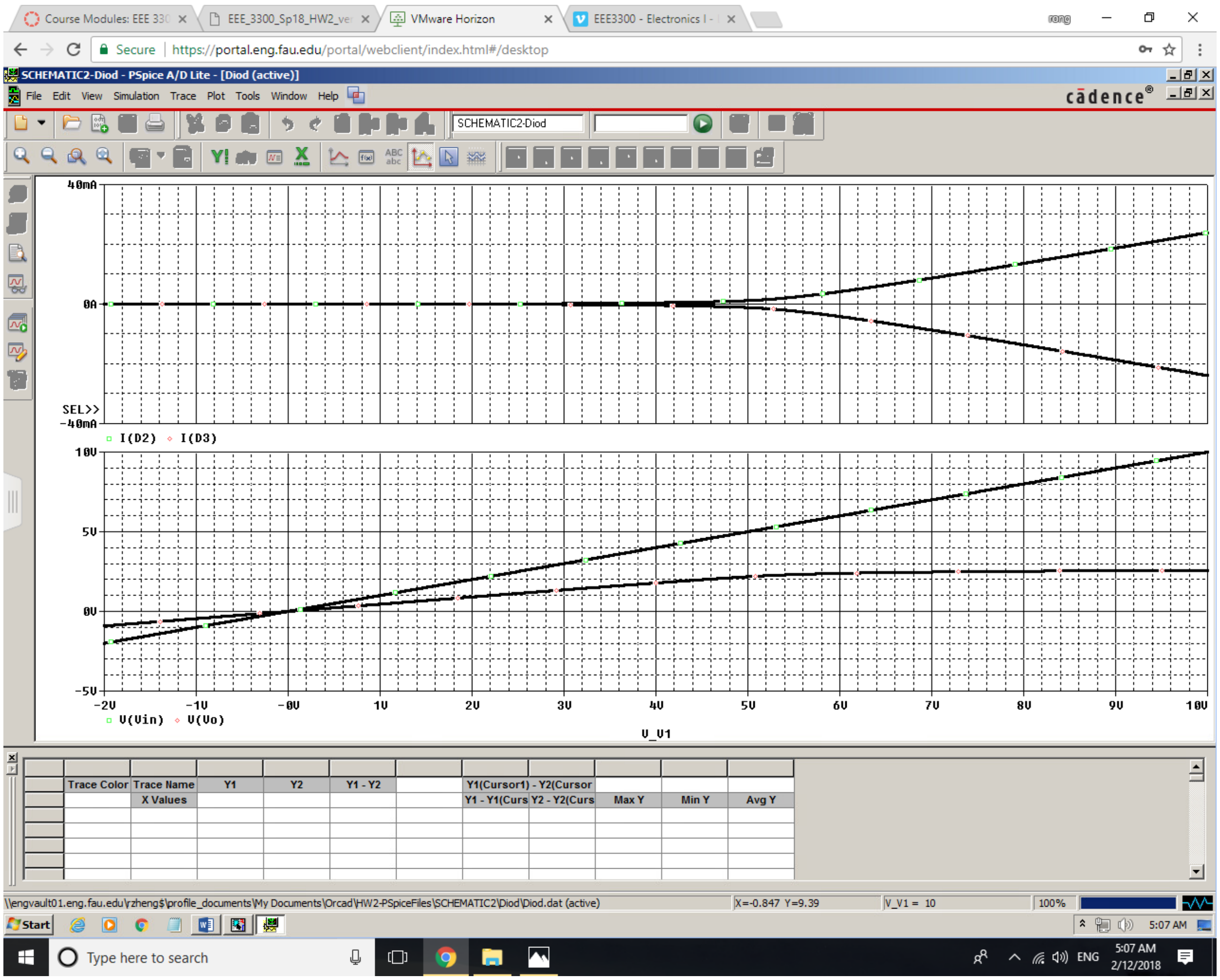


Assume all diodes on.

$I_{R1} = \frac{1 - (V_o + 0.7)}{1} = 0.3 - V_o$

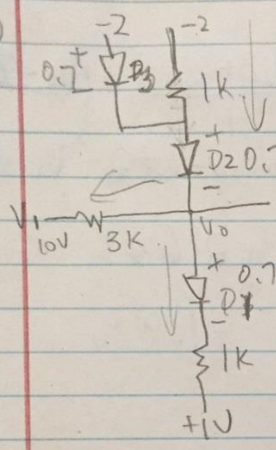
$I_{R2} = \frac{10 + V_o}{2}$




SCHEMATIC2-Diod - PSpice A/D Lite - [Diod (active)]
40mA
0A
SEL>>
-40mA
I(D2) I(D3)
10V
5V
0V
-5V
-2V -1V -0V 1V 2V 3V 4V 5V 6V 7V 8V 9V 10V
V(Vin) V(Vo)
V_V1
X=-0.847 Y=9.39
V_V1 = 10

2.4)

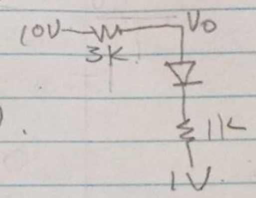
2.4)



Assume D_1 on, D_2 and D_3 off.

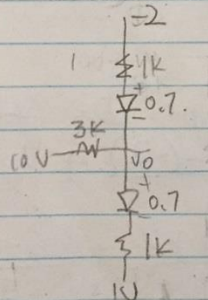
$$\frac{V_o - 10}{3} + \left(\frac{V_o + 0.7 - 1}{1}\right) = 0$$

$$\frac{4}{3}V_o - 3.63 = 0$$



$$V_o = 2.725\text{ V}.$$

Assume D_1 On, D_2 On, D_3 off.



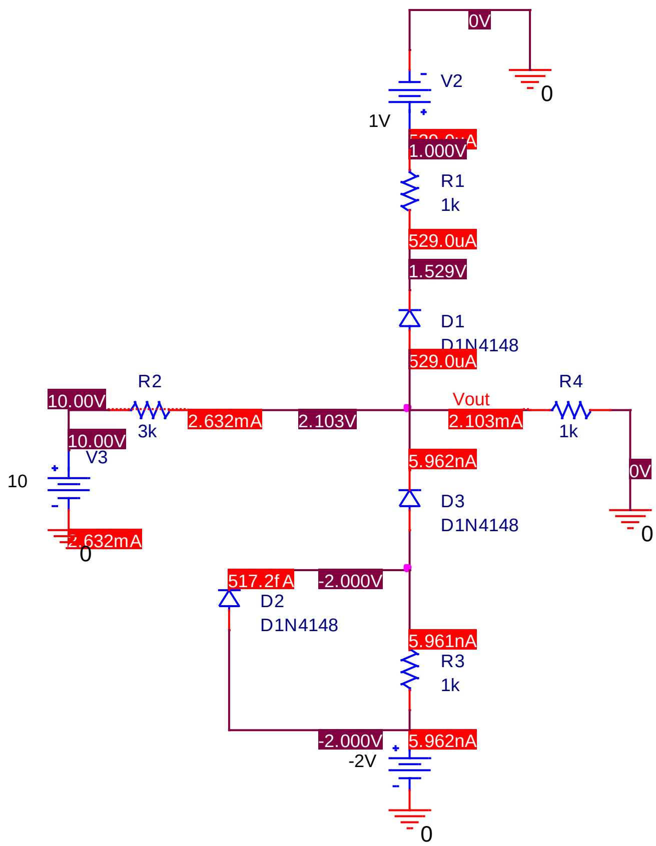
$$\frac{(V_o + 0.7) - (-2)}{1} + \frac{V_o - 10}{3} + \left(\frac{V_o + .7 - 1}{1}\right) = 0$$

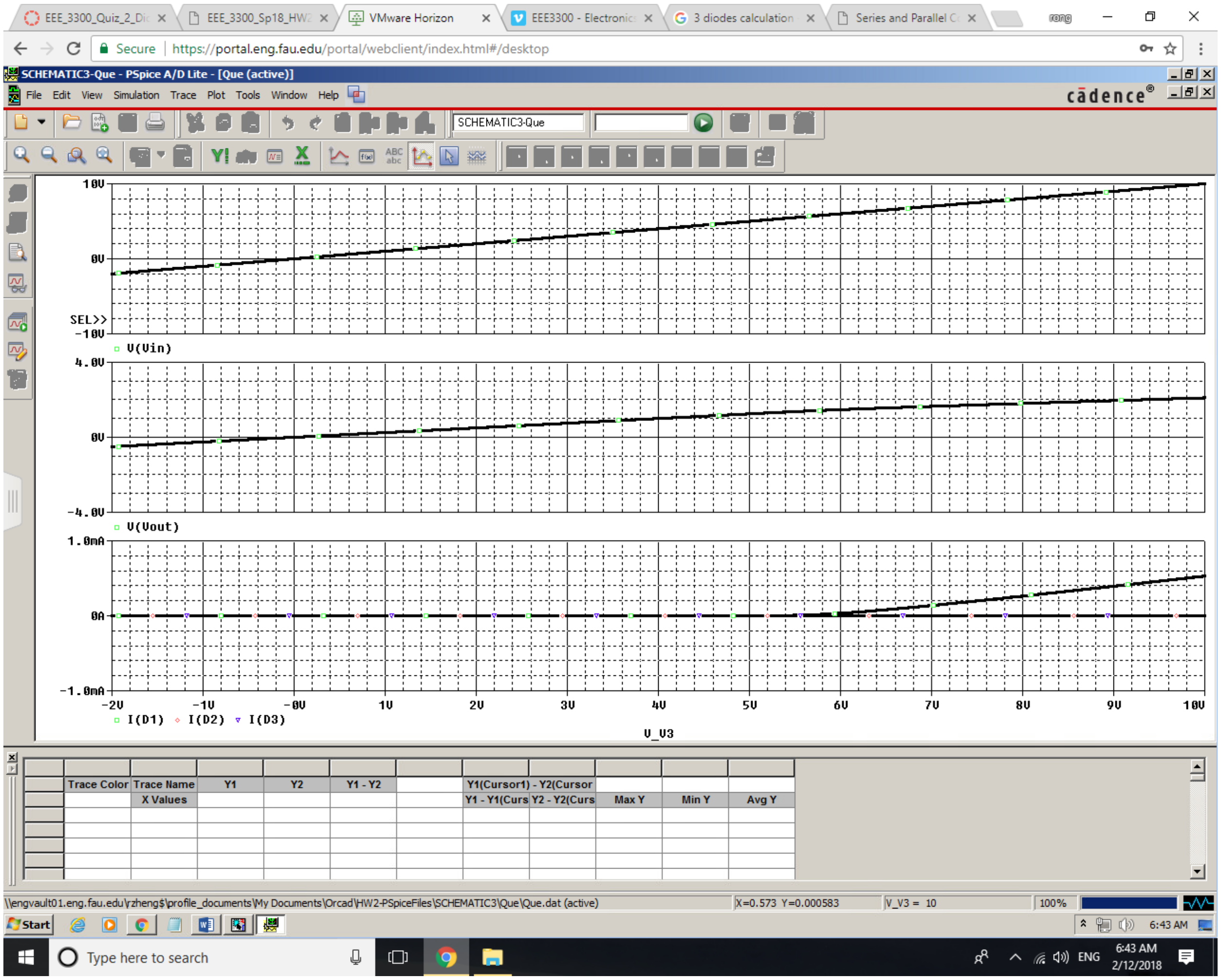
$$V_o + 2.7 + \frac{V_o}{3} - \frac{10}{3} + V_o - 0.3 = 0$$

$$7/3\, V_o - 0.9333$$

$$V_o = 0.4\text{ V}$$

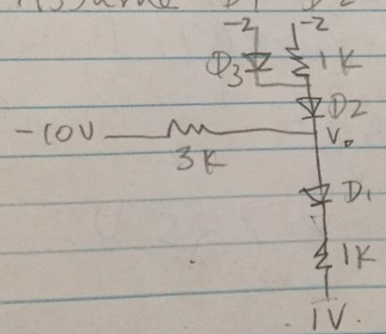
The voltage across D_3 = $-2 - 0.7 = -2.7$ V. The voltage across D_2 is $= 2 - (-2.7) = 4.7$ V which justifies the assumption D_2 is on. D_3 and D_1 also has to be on.


0V
V2
0
1V
1.000V
R1
1k
529.0uA
1.529V
D1
D1N4148
529.0uA
R2
10.00V
3k
2.632mA
2.103V
Vout
2.103mA
R4
1k
10.00V
V3
10
5.962nA
D3
D1N4148
0V
0
2.632mA
0
517.2fA
-2.000V
D2
D1N4148
5.961nA
R3
1k
-2.000V
5.962nA
-2V
0


SCHEMATIC3-Que - PSpice A/D Lite - [Que (active)]
File Edit View Simulation Trace Plot Tools Window Help
cādence
SCHEMATIC3-Que
10V
0V
SEL>>
-10V
V(Vin)
4.0V
0V
-4.0V
V(Vout)
1.0mA
0A
-1.0mA
-2V -1V -0V 1V 2V 3V 4V 5V 6V 7V 8V 9V 10V
I(D1) I(D2) I(D3)
V_V3
Trace Color
Trace Name
X Values
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
\\engvault01.eng.fau.edu\zheng$\profile_documents\My Documents\Orcad\HW2-PSpiceFiles\SCHEMATIC3\Que\Que.dat (active)
X=0.573 Y=0.000583
V_V3 = 10
100%
Type here to search
6:43 AM
2/12/2018

2.5)

2.5) Assume D_1 D_2 D_3 all on



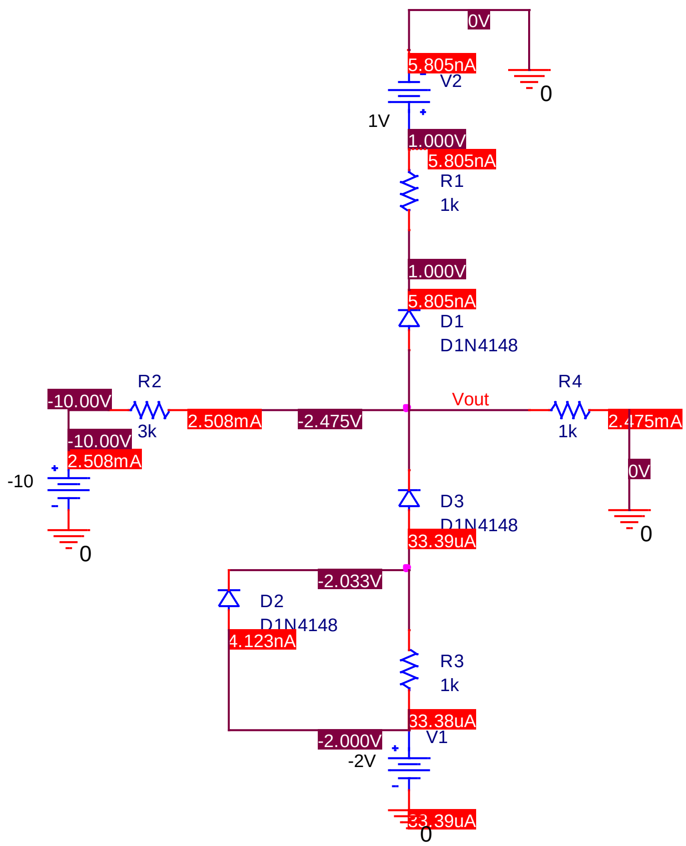
$$\frac{V_o-(-10)}{3} + \left(\frac{V_o+0.7-1}{1}\right) + \left(\frac{\cancel{V_o+0.7-(-2-.7)}}{1}\right)$$

$$\frac{V_o}{3} + \frac{10}{3} + V_o + 0.7 - 1 \cancel{+2} - V_o \cancel{+2} - 1.4$$

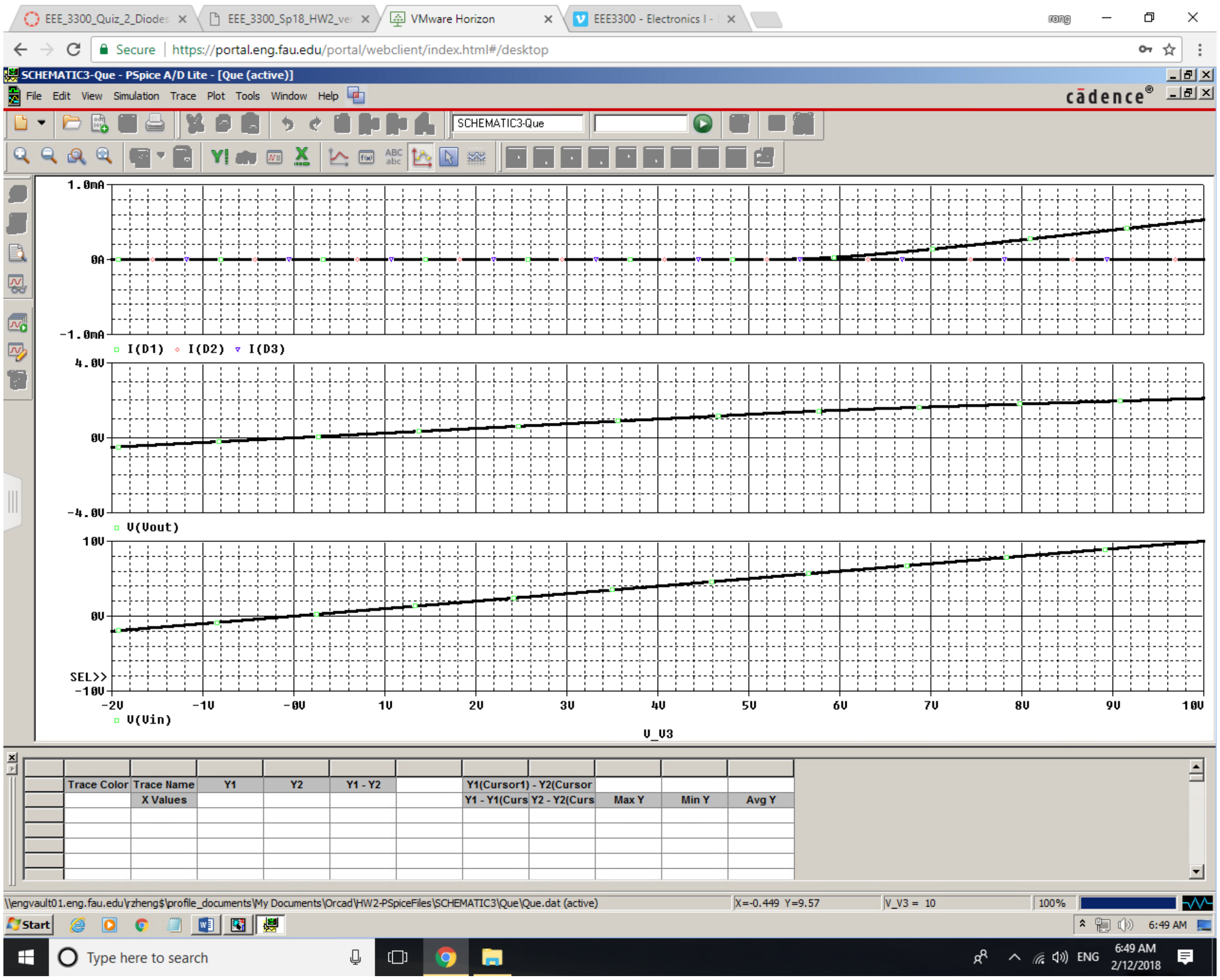
$$\frac{1}{3}V_o + 2.633 = 0$$

$$V_o = -1.9\ V$$

D_1 on, D_2 and D_3 off.



0V
5.805nA
V2
0
1V
1.000V
5.805nA
R1
1k
1.000V
5.805nA
D1
D1N4148
R2
-10.00V
Vout
R4
2.508mA
-2.475V
2.475mA
3k
1k
-10.00V
2.508mA
0V
-10
D3
D1N4148
33.39uA
0
0
-2.033V
D2
D1N4148
4.123nA
R3
1k
33.38uA
-2.000V
V1
-2V
33.39uA
0

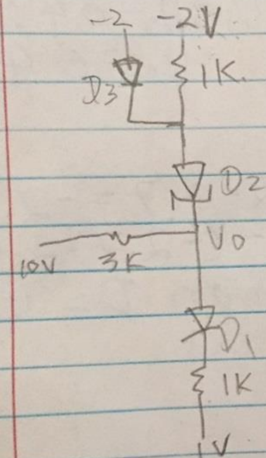


SCHEMATIC3-Que - PSpice A/D Lite - [Que (active)]
File Edit View Simulation Trace Plot Tools Window Help
cādence
SCHEMATIC3-Que
1.0mA
0A
-1.0mA
I(D1) I(D2) I(D3)
4.0V
0V
-4.0V
V(Vout)
10V
0V
SEL>>
-10V
-2V -1V -0V 1V 2V 3V 4V 5V 6V 7V 8V 9V 10V
V(Vin)
V_V3
Trace Color Trace Name Y1 Y2 Y1 - Y2 Y1(Cursor1) - Y2(Cursor
X Values Y1 - Y1(Curs Y2 - Y2(Curs Max Y Min Y Avg Y
\\engvault01.eng.fau.edu\rzheng$\profile_documents\My Documents\Orcad\HW2-PSpiceFiles\SCHEMATIC3\Que\Que.dat (active)
X=-0.449 Y=9.57
V_V3 = 10
100%
6:49 AM
2/12/2018

2.6)

D_1 on, D_2 and D_3 off.

2.c) Assume D_1 on, D_2 on, D_3 off.



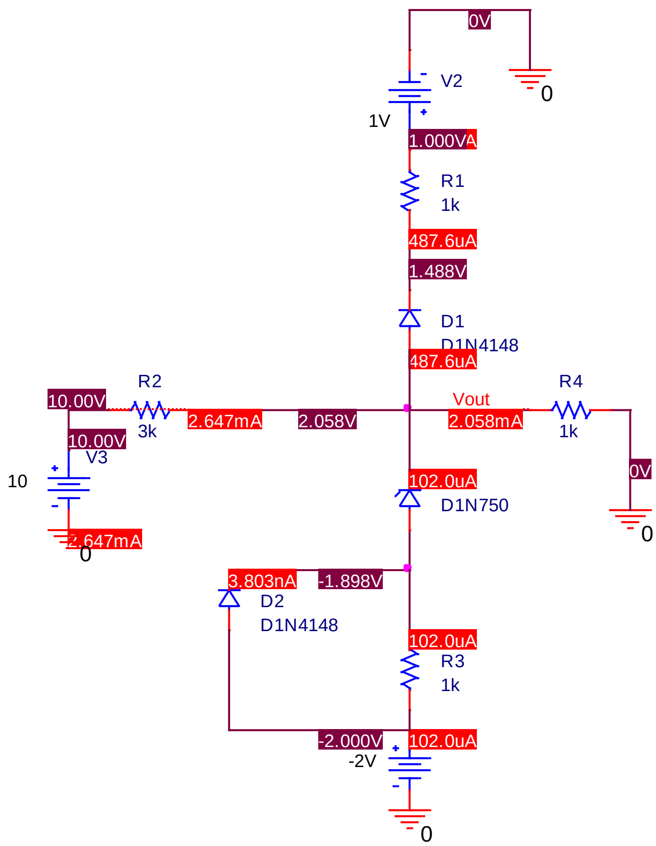
$$\frac{V_o + D_2 - (-2)}{1} + \frac{V_o - 10}{3} + \left(\frac{V_o + D_1 - 1}{1}\right)$$

$$\frac{V_o + 5.1 + 2}{1} + \frac{V_o - 10}{3} + \frac{V_o + 0.7 - 1}{1}$$

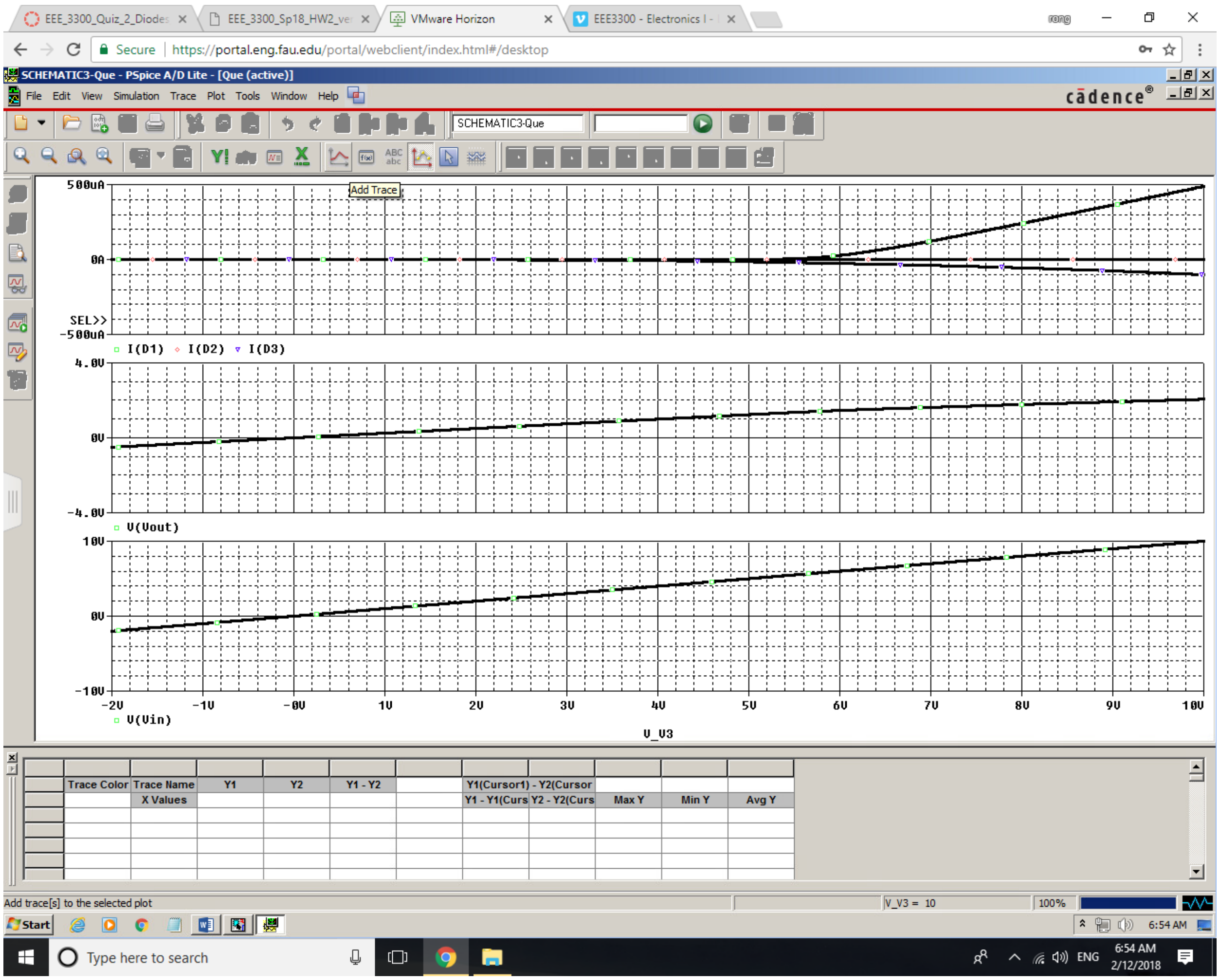
$$7/3\, V_o + 3.4667 = 0$$

$$V_o = -1.485\,V$$

D_3 off, D_2 on, D_1 on



0V
V2
0
1V
1.000V
R1
1k
487.6uA
1.488V
D1
D1N4148
487.6uA
R2
R4
10.00V
3k
2.647mA
2.058V
Vout
2.058mA
1k
10.00V
V3
10
0V
102.0uA
D1N750
0
2.647mA
0
3.803nA
-1.898V
D2
D1N4148
102.0uA
R3
1k
-2.000V
102.0uA
-2V
0



EEE_3300_Quiz_2_Diodes
EEE_3300_Sp18_HW2_ve
VMware Horizon
EEE3300 - Electronics I -
Secure
https://portal.eng.fau.edu/portal/webclient/index.html#/desktop
SCHEMATIC3-Que - PSpice A/D Lite - [Que (active)]
File Edit View Simulation Trace Plot Tools Window Help
cādence
SCHEMATIC3-Que
Add Trace
500uA
0A
SEL>>
-500uA
I(D1) I(D2) I(D3)
4.0V
0V
-4.0V
V(Vout)
10V
0V
-10V
-2V -1V -0V 1V 2V 3V 4V 5V 6V 7V 8V 9V 10V
V(Vin)
V_V3
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
Y1(Cursor1) - Y2(Cursor
X Values
Y1 - Y1(Curs
Y2 - Y2(Curs
Max Y
Min Y
Avg Y
Add trace[s] to the selected plot
V_V3 = 10
100%
Start
6:54 AM
Type here to search
ENG
6:54 AM
2/12/2018