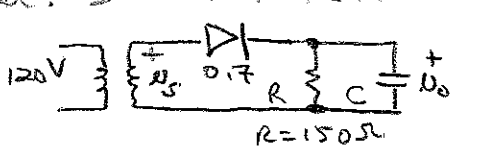
Assignment 4 – sorry probs are out of order. IOU #7 of 8 6.

(3.) (3.86) a. Specify rms voltage @ secondary coil of transformer. $v_o|_{peak} = V_p - 0.7 = 16$



(for avg dc output = 15 ± 1V ripple) ← needs to start @ 16 to sag to 14.4 avg 15.

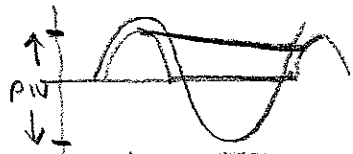
$V_p = 16.7\,V \Rightarrow \boxed{V_{s\,rms} = \frac{16.7}{\sqrt{2}} \simeq 11.8\ V}$

b. Find C. eq 3.28 $\Rightarrow V_r = (V_p - 0.7)\frac{T}{RC} = \frac{V_p - 0.7}{fRC} \Rightarrow C = \frac{16}{fRV_r} = \frac{16}{60 \cdot 150 \cdot 2}$

or $\boxed{C = 889\ \mu F}$

c. Find $PIV = V_p - 0.7 - \frac{V_r}{2} + V_p$

$= 31.7\ V$



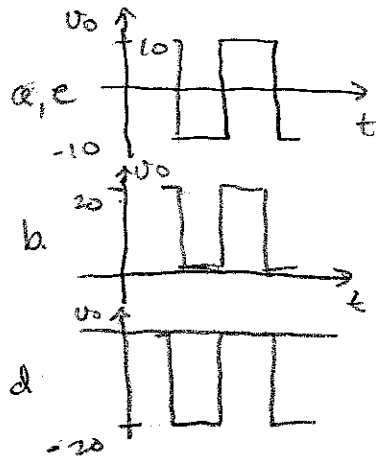
W/ safety margin of 50 or 100 % $\Rightarrow \boxed{PIV = 47.6\ V \text{ or } 63.4\ V}$

d. Find $i_D|_{avg}$ during conduction eq 3.31 $i_D|_{avg} = I_L\left[1 + \pi\sqrt{\frac{2V_p}{V_r}}\right]$

where $I_L = \frac{V_o|_{avg}}{R} = \frac{15}{150}$, $V_p = 16$, $V_r = 2$

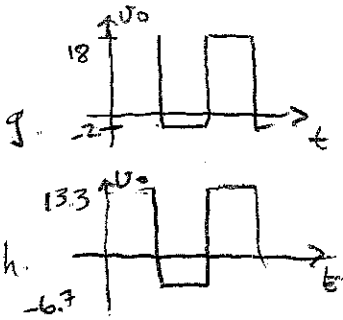
e. Find $i_D|_{max} = I_L\left[1 + 2\pi\sqrt{2V_p/V_r}\right]$ (eq. 3.32)

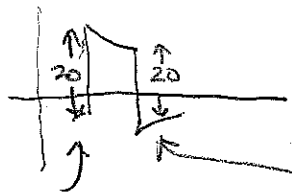
(6.) (3.105)



f. during T_1, $v_o = V_1 e^{-t/RC} \simeq V_1\left(1 - \frac{T}{RC}\right)$ @ $t = T$

during T_2, $|v_o| = |V_2|\, e^{-t'/(RC/2)} \simeq |V_2|\left(1 - \frac{2T}{RC}\right)$ @ $t' = T$



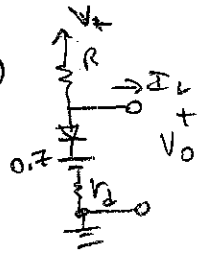


$V_1 + |V_2|\left(1 - \frac{2T}{RC}\right) = 20$

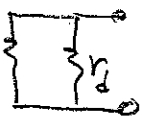
$V_1\left(1 - \frac{T}{RC}\right) + |V_2| = 20$

$\Rightarrow V_1 = 2V_2$ or $\begin{matrix} V_1 = 13.3 \\ |V_2| = 6.7 \end{matrix}$

(1.) (3.60)



a. equivalent resistance: set dc sources to 0 & replace ideal diode w/ S.C.



$R_{eq} = r_d \| R$

$r_d = nV_T/I_D$ so $\frac{\Delta V_o}{\Delta I_L} = -\frac{r_d R}{r_d + R}$

b. @ dc, $I_D = \frac{V_+ - 0.7}{R} \Rightarrow \frac{\Delta V_o}{\Delta I_L} = -\frac{nV_T}{I_D}\,\frac{V_+ - 0.7}{V_+ - 0.7 + nV_T}$

so $R = (V_+ - 0.7)/I_D$

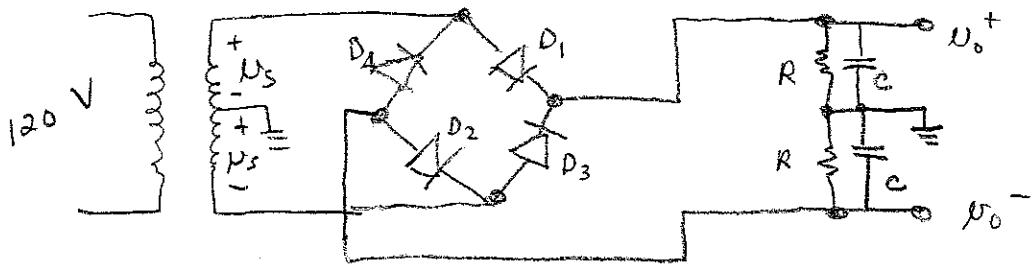
$V_+ = 10$, $n = 2$, $\frac{\Delta V_o}{\Delta I_L} \le 5\ mV/mA \Rightarrow I_D > 9.9\ mA$ use $I_D = 10\ mA$.

so $R = \frac{V_+ - 0.7}{I_D} \simeq 930\ \Omega$.

c. For m diodes, r_d all in series $\Rightarrow r_d = m\,\frac{nV_T}{I_D}$

0.7 V sources also in series $\Rightarrow 0.7 \to 0.7\,m$

(4) (3.90) 2 equal filter caps across the load resistor



use 0.7 V model.

provide ± 15 V outputs w/ $V_r|_{p-p} \leq 1$ V & $i_R = 200$ mA dc

Specify diodes, C, & transformer

$v_o = 15 \pm \frac{1}{2}$ V $\Rightarrow$ peak $v_s = 15.5 + 0.7 = 16.2$ V

so total drop across secondary = $2(16.2) = 32.4$ V.

& $rms = \frac{32.4}{\sqrt{2}} = 22.9$

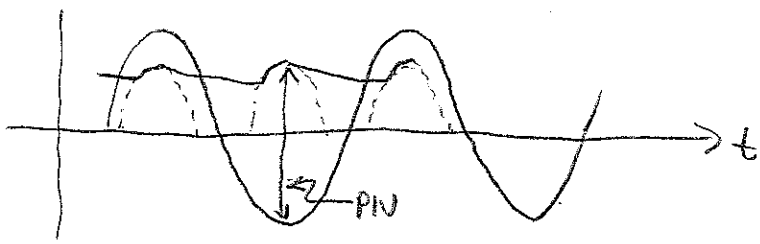
$\therefore$ Turns ratio $\frac{120}{22.9} = \frac{5.24}{1}$

eq. 3.35 $i_D|_{max} = I_L\left(1 + 2\pi\sqrt{\frac{V_p}{2V_r}}\right) = 0.2\left(1 + 2\pi\sqrt{\frac{15.5}{2(1)}}\right)$

$= 3.70$ A

eq. 3.28 $v_r = \frac{V_p}{2fRC} = 1$ for discharge over 1/2 period

$\Rightarrow C = \frac{15.5}{2(60)(75)}$ $\left(R = 75 = \frac{15\text{ V}}{0.2\text{ A}}\right)$ $C = 1722\,\mu$F

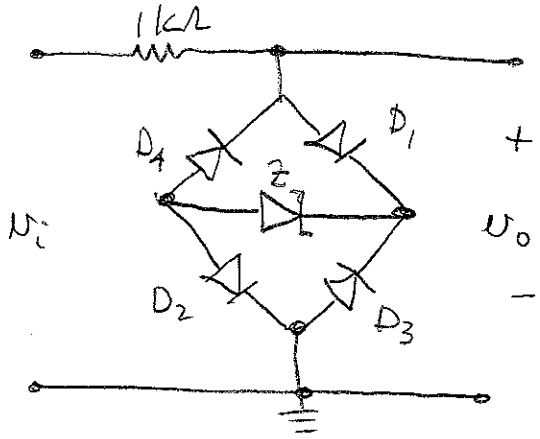


$PIV = \hat{v}_o + \hat{v}_s = 15.5 + 16.2 = 31.7$ V ; Safety Margin 50%

$PIV = 1.5(31.7) = 47.6$ V

eq. 3.34 $i_D|_{avg} = I_L\left(1 + \pi\sqrt{\frac{V_p}{2V_r}}\right) = 0.2\left(1 + \pi\sqrt{\frac{15.5}{2(1)}}\right) = 1.95$ A

5 3.97



Find transfer char.
for $-20 \le v_I \le 20$ V

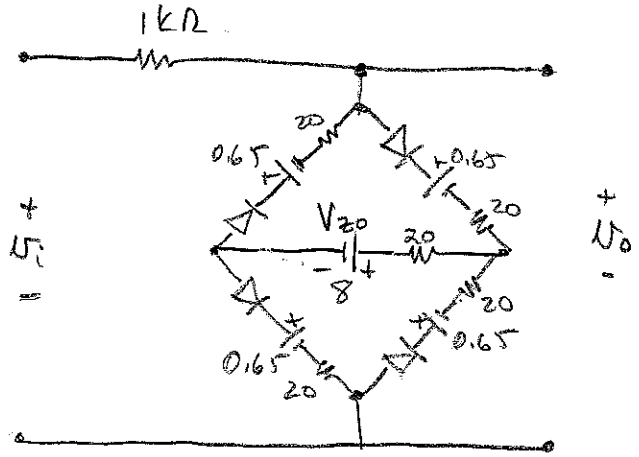
Model diodes as

$V_{D0} = 0.65$ V

$r_D = 20\ \Omega$

$V_Z = 8.2$ V @ $I_Z = 10$ mA

$r_Z = 20\ \Omega$

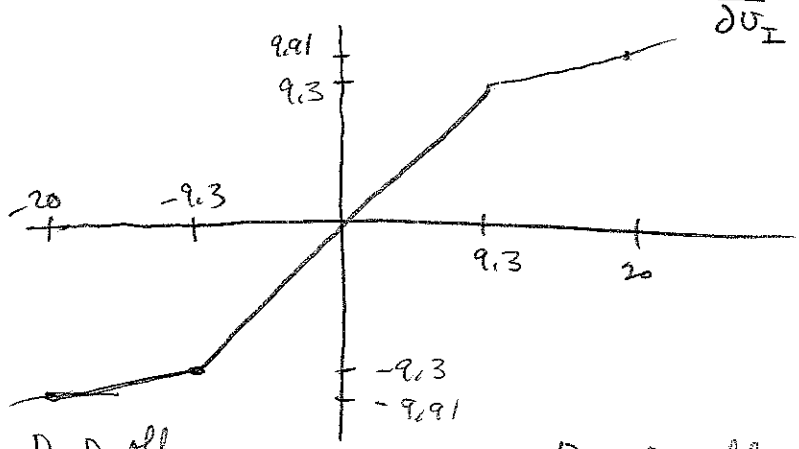


$V_Z = V_{Z0} + 20(.01) = 8.2$

$\Rightarrow V_{Z0} = 8$

$\pm(8 + 0.65 + 0.65) = \pm 9.3 = L_\pm$

$$\frac{\partial v_O}{\partial v_I} = \frac{r_{D1} + r_Z + r_{D2}}{1k + r_{D1} + r_Z + r_{D2}} = 0.057 \frac{V}{V}$$



D_1, D_2 off
D_3, D_4, Z on

All D off

D_3, D_4 off
D_1, D_2, Z on.