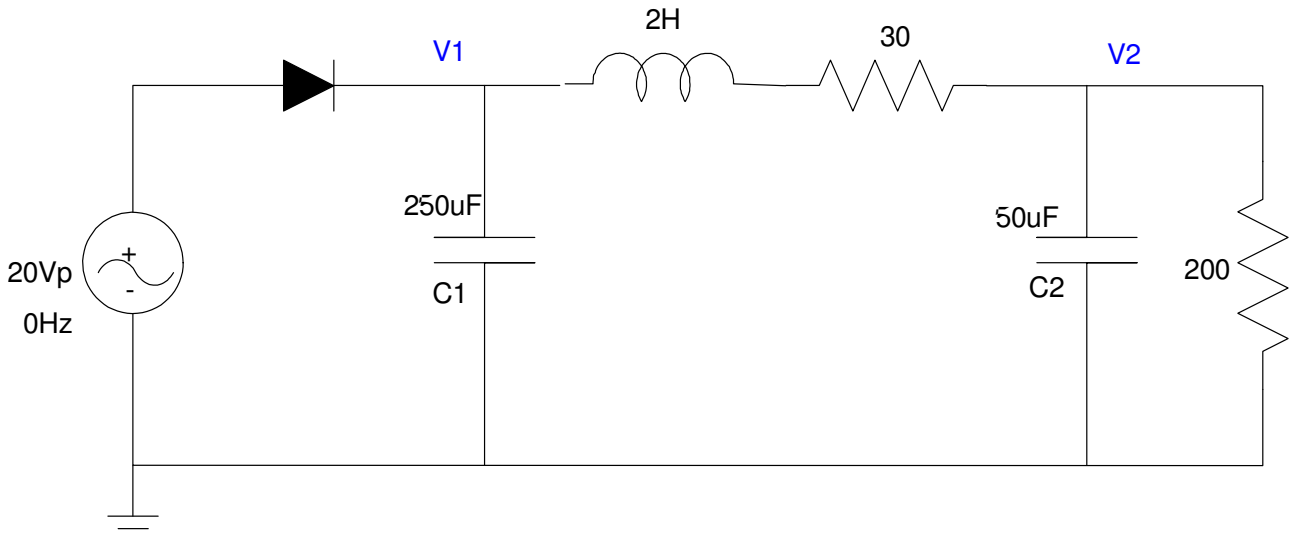
AC to DC Converters

5) Determine the votlages at V1 and V2 (DC and AC)



$$\max(V_1) = 19.3V$$

$$I \approx \left(\frac{19.3V}{230\Omega}\right) = 83.91mA \qquad \textit{worst case}$$

$$I = C\,\frac{dV}{dt}$$

$$83.91mA = 250\mu F\,\frac{dV}{1/60s}$$

V1 Analysis

$$V_1(AC) = dV = 5.594V_{pp}$$

$$V_1(DC) = 19.3V - \tfrac{1}{2}V_1(AC)$$

$$V_1(DC) = 16.50V$$

V2 Analysis

$$V_2(DC) = \left(\frac{200}{200+30}\right)V_1(DC) = 14.35V$$

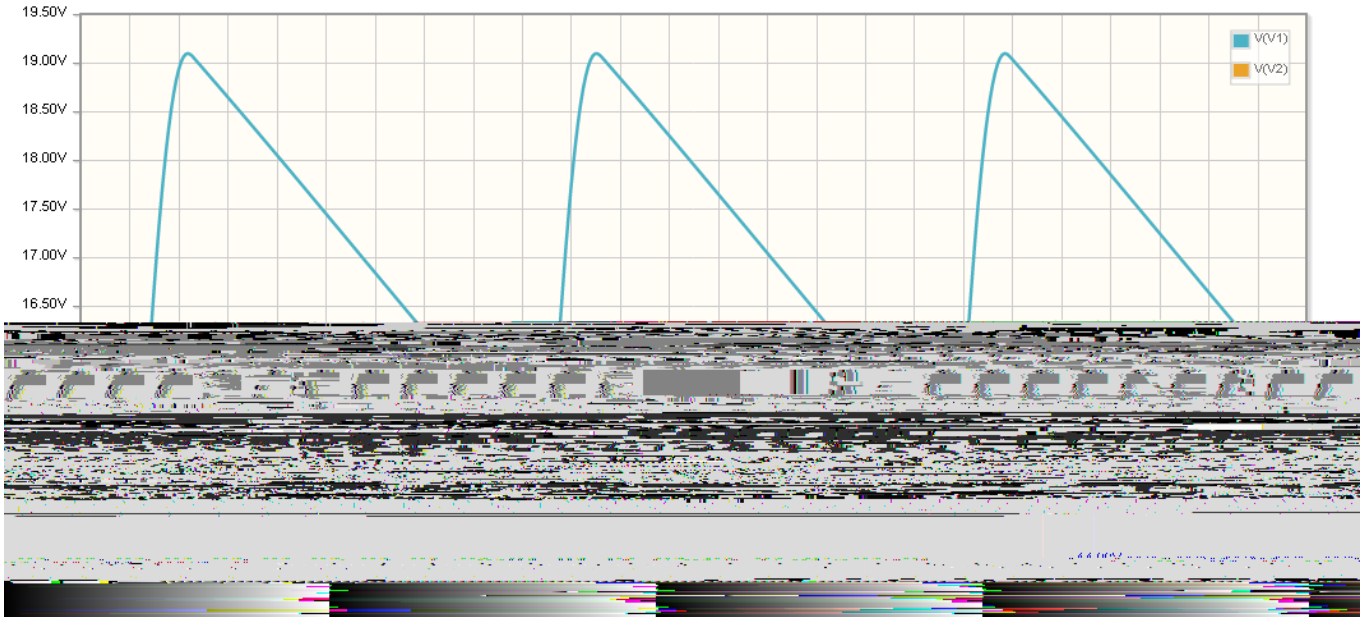
200 Ohms || 50uF = 200 || -j53.05 = 13.147 - j49.563

2H >> j754 Ohms

$$V_2(AC) = \left(\frac{(13.147 - j49.563)}{(13.147 - j49.563)+(30+j754)}\right)5.594V_{pp}$$

$$V_2(AC) = 406mV_{pp}$$

6) Build the circuit in CircuitLab (or similar program) and verify your calculations for problem #5



V1 (Blue)

- Max = 19.09V
- Min = 14.78V
- DC = (Max + Min)/2 = 16.93V (16.50V computed)
- AC = (Max - Min) = 4.310Vpp (5.594V computed)

V2 (orange)

- Max = 14.89V
- Min = 14.66V
- DC = 14.77V (14.35V computed)
- AC = 230mVpp (406mVpp computed)

7) Determine C1 and C2 so that AC voltages are: V1 = 2Vpp and V2 = 250mVpp.

$$V_1(AC) = 2V_{pp} \qquad given$$

$$V_1(DC) = 19.3V - \tfrac{1}{2}2V_{pp} = 18.3V$$

$$V_2(DC) = \left(\tfrac{200}{200+30}\right) V_1(DC) = 15.913V$$

Finding C1:

$$I = \left(\tfrac{18.3V}{230\Omega}\right) = 79.57mA$$

$$I = C_1 \, \tfrac{dV}{dt}$$

$$79.57mA = C_1 \, \tfrac{2V_{pp}}{1/60s}$$

$$C_1 = 663\mu F$$

Finding C2: Assume C2 = 0.

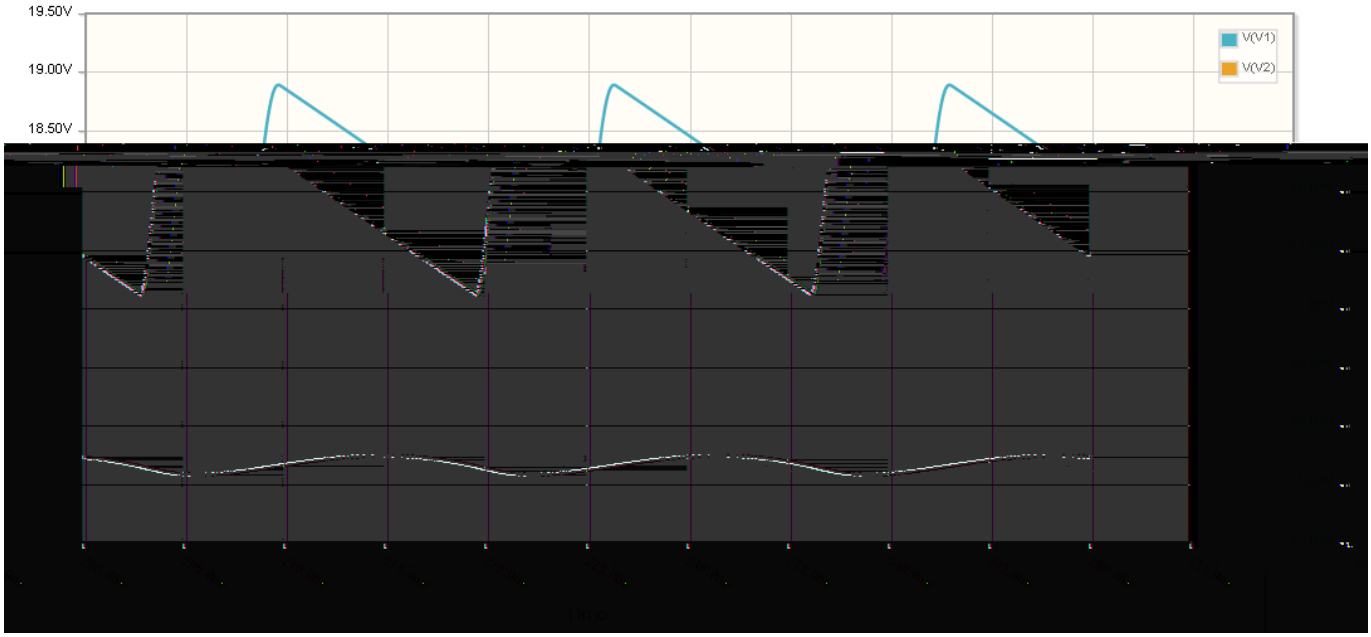
$$V_2(AC) = \left(\tfrac{200}{(200)+(5+j754)}\right) 2V_{pp} = 512mV_{pp}$$

For V2(AC) to be 250mVpp

$$\left|\tfrac{1}{j\omega C}\right| = \left(\tfrac{250mV}{512mV}\right) 200\Omega = 97.65\Omega$$

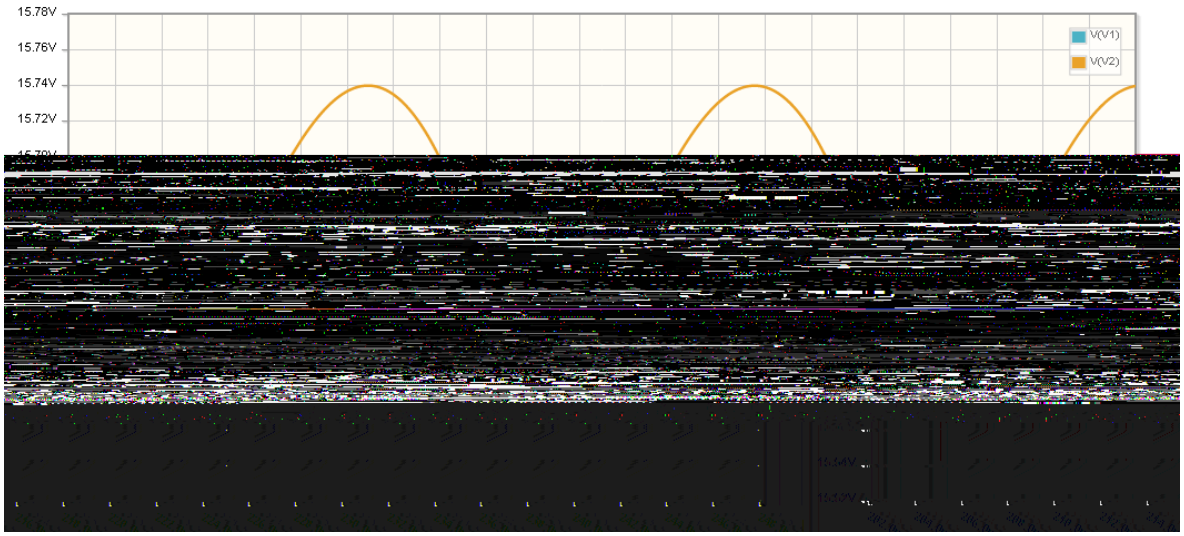
$$C_2 = 27.16\mu F$$

8) Build this circuit in CircuitLab (or similar program) and verify your calculations for problem #7



V1: (blue)

- max(V1) = 18.89V
- min(V1) = 17.13V
- V1(DC) = 18.01V (vs. 18.30V computed)
- V1(AC) = 1.76Vpp (vs. 2.00Vpp computed)



V2 (orange)

- max(V2) = 15.74V
- min(V2) = 15.58V
- V2(DC) = 15.66V (vs. 15.913V comptued)
- V2(AC) = 160mVpp (vs. 250mVpp computed)