

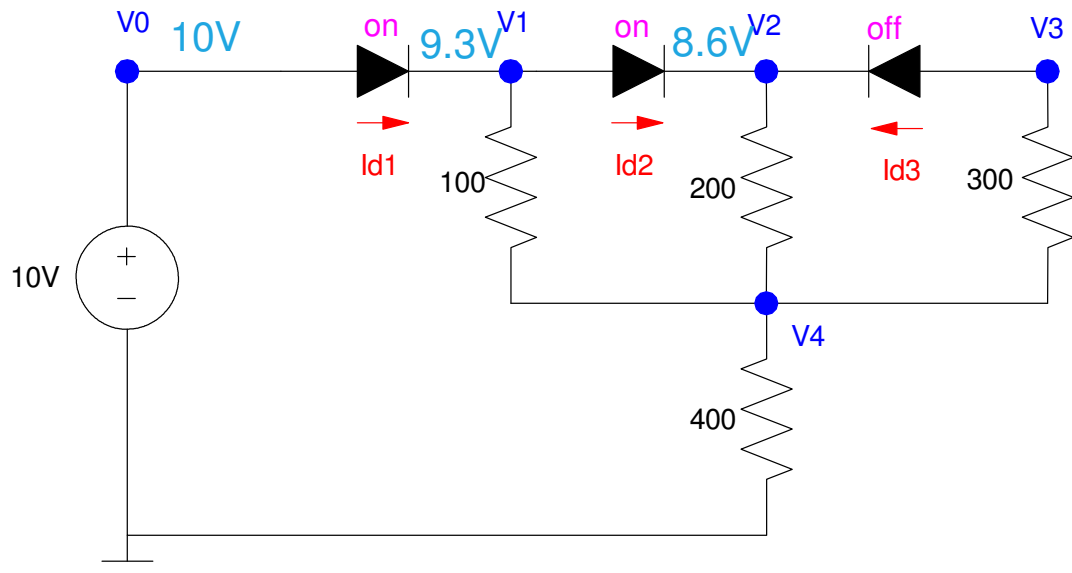
ECE 320 - Quiz #3 - Name _____

Ideal Diodes, LEDs, AC to DC Converters - Spring 2023

1) Determine the voltages for the following circuit.

- Assume ideal silicon diodes ($V_d = 0.7V$ when on)

V1	V2	V3	V4
9.3V	8.6V	7.771V	7.771V



To solve for V4

$$\left(\frac{V_4 - 9.3V}{100} \right) + \left(\frac{V_4 - 8.6V}{200} \right) + \left(\frac{V_4}{400} \right) = 0$$

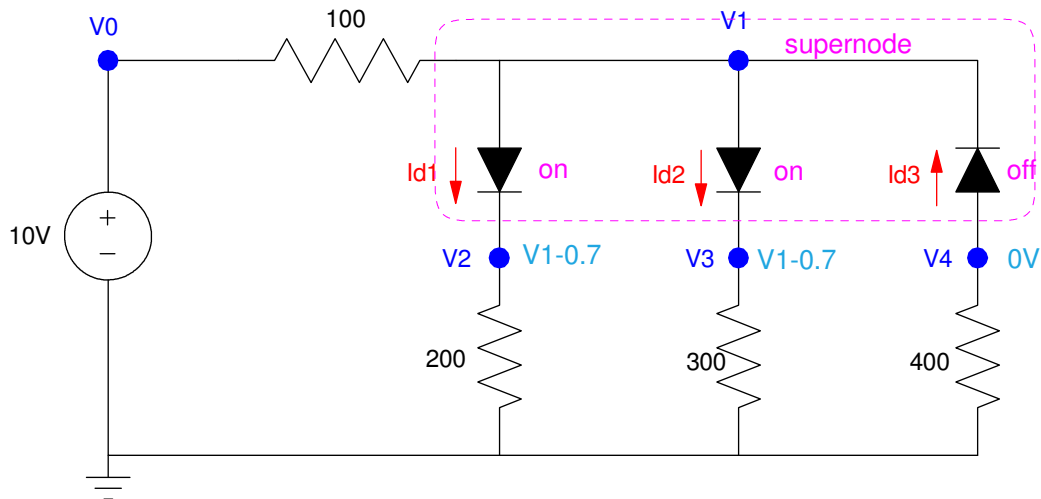
$$\left(\frac{1}{100} + \frac{1}{200} + \frac{1}{400} \right) V_4 = \left(\frac{9.3V}{100} \right) + \left(\frac{8.6V}{200} \right)$$

$$V_4 = 7.771V$$

2) Determine the voltages for the following circuit. Assume

- Assume ideal silicon diodes ($V_d = 0.7V$ when on)

V1	V2	V3	V4
5.773V	5.073V	5.073V	0V



Writing the supernode equation

$$\left(\frac{V_1 - 10}{100} \right) + \left(\frac{V_1 - 0.7}{200} \right) + \left(\frac{V_1 - 0.7}{300} \right) = 0$$

$$\left(\frac{1}{100} + \frac{1}{200} + \frac{1}{300} \right) V_1 = \left(\frac{10}{100} \right) + \left(\frac{0.7}{200} \right) + \left(\frac{0.7}{300} \right)$$

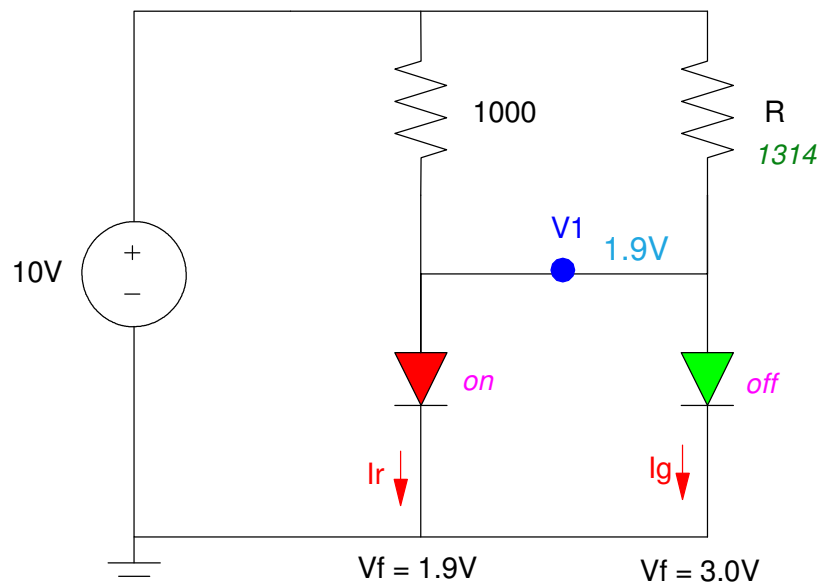
$$V_1 = 5.733V$$

$$V_2 = V_1 - 0.7 = 5.0733V$$

3) A red and green are connected to a 10V source. Determine the current and brightness of each LED. Assume

- R is $800 + 100 \cdot (\text{your birth month}) + (\text{your birthday})$.
- Red LED: $V_f = 1.9V @ 100mA$ $5000 \text{ mcd} @ 100mA$
- Green LED: $V_f = 3.0V @ 100mA$ $5000 \text{ mcd} @ 100mA$

R $800 + 100 \cdot \text{mo} + \text{day}$	V1 Volts	Red LED		Green	
		I_r	mcd	I_g	mcd
1314	1.9V	14.26mA	713.2 mcd	0	0



$$R \parallel 1000 = 567.84 \text{ Ohms}$$

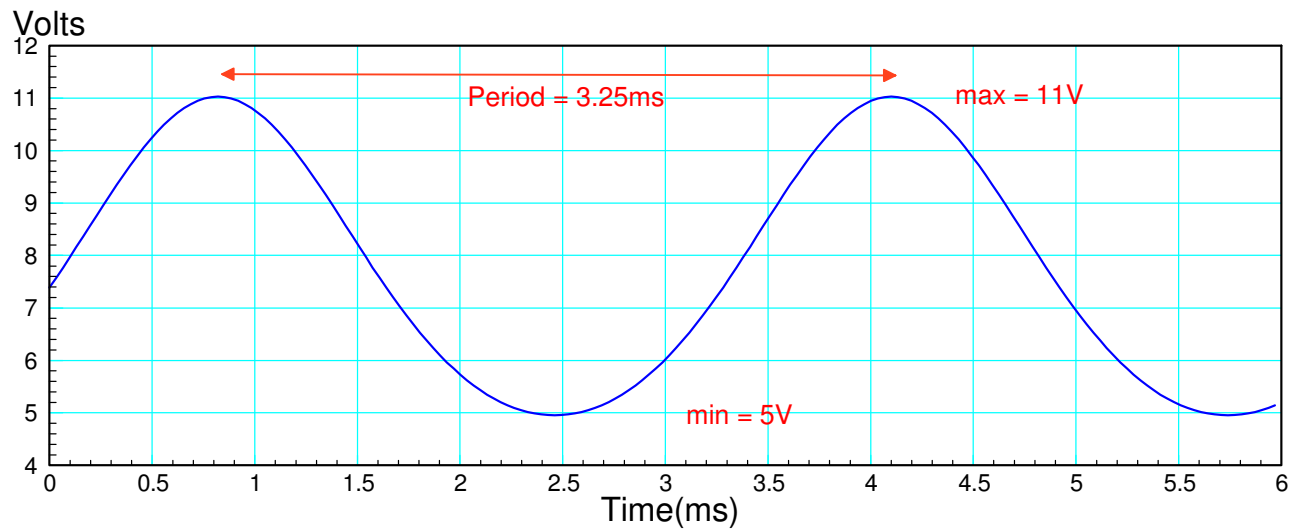
$$I_r = \left(\frac{10V - 1.9V}{567.84\Omega} \right) = 14.264mA$$

mcd

$$\left(\frac{14.264mA}{100mA} \right) 5000mcd = 713.2mcd$$

4) The following waveform is found using CircuitLab for an AC to DC converter. Determine the following

Frequency (Hz)	Voltage	
	DC (average)	AC (Vpp)
307 Hz	8.0V	6.0Vpp



$$frequency = \frac{1}{period} = \frac{1}{0.00325s} = 307Hz$$

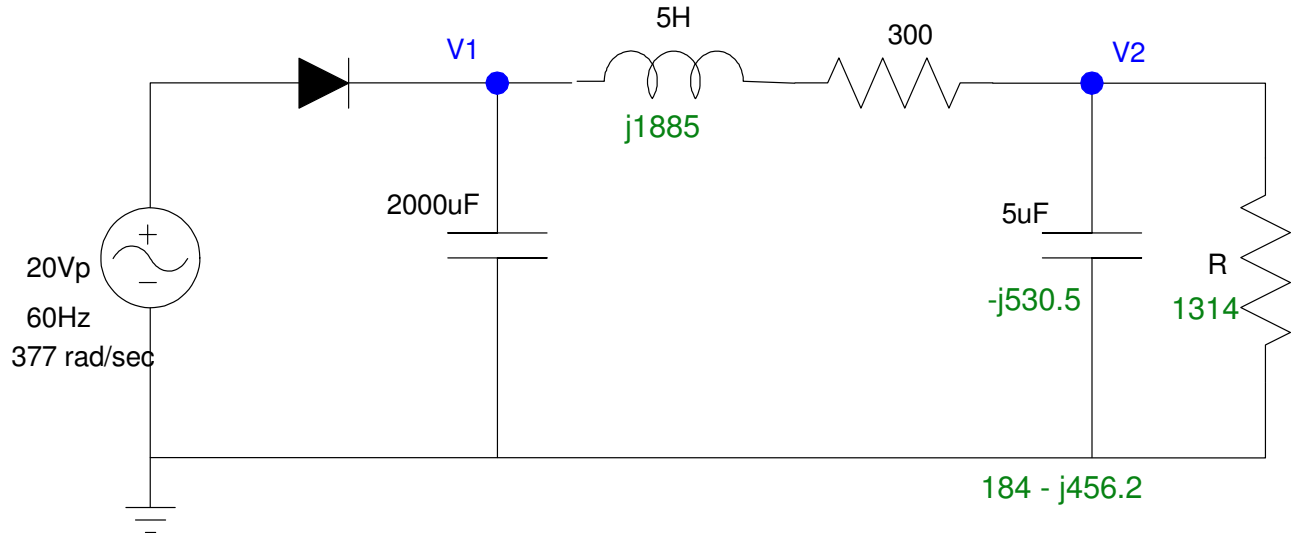
$$DC \approx \left(\frac{max+min}{2} \right) = 8.0V$$

$$AC \approx (max-min) = 6.0V_{pp}$$

5) Determine the voltages V1 and V2 (both DC and AC). Assume

- Ideal silicon diodes ($V_f = 0.7V$)
- $R = 800 + 100 \cdot (\text{your birth month}) + (\text{your birthday})$

R 800 + 100*mo + day	V1		V2	
	DC	AC (V1pp)	DC	AC (V2pp)
1314	19.25V	99.71mVpp	15.67V	32.51mVpp



$$I \approx \left(\frac{19.3V}{1314+300} \right) = 11.97mA$$

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

$$11.97mA = 2000\mu F \cdot \frac{dV}{1/60s}$$

$$dV = 99.71mV_{pp} = V1(AC)$$

$$V1(DC) = 19.3V - \frac{1}{2}V1_{pp} = 19.25V$$

$$V2(DC) = \left(\frac{1314}{1314+300} \right) V1(DC) = 15.67V$$

$$V2(AC) = \left(\frac{(184-j456.2)}{(184-j456.2)+(300+j1885)} \right) \cdot V1(AC)$$

$$|V2(AC)| = 32.51mV_{pp}$$

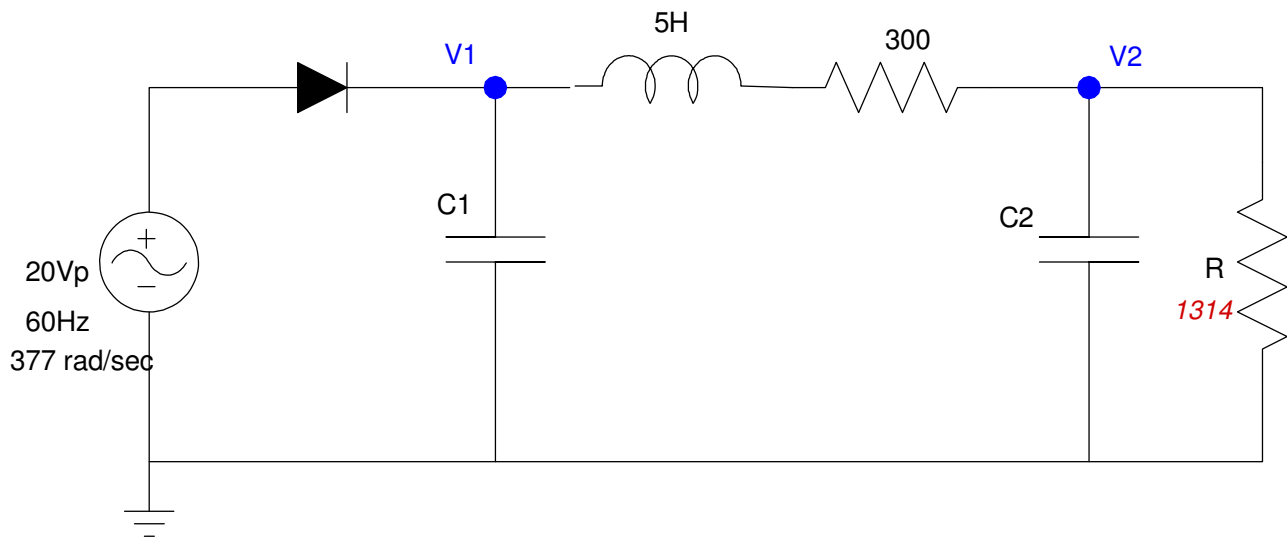
6) Determine C1, and C2 so that

- The ripple at V1 is 5V_{pp} and
- The ripple at V2 = 1V_{pp}

Assume

- Ideal silicon diodes ($V_f = 0.7V$)
- $R = 800 + 100 \cdot (\text{your birth month}) + (\text{your birthday})$

R	C1	C2
1314	34.7uF	5.24uF
		C2 = 7.95uF (exact - numerical solution)



$$V_1(DC) = 19.3V - \frac{1}{2}V_1(AC) = 16.8V$$

$$I = \left(\frac{16.8V}{1314 + 300} \right) = 10.42mA$$

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

$$10.42mA = C_1 \cdot \frac{5V_{pp}}{1/60s}$$

$$C_1 = 34.7\mu F$$

Assume C2 = 0

$$V_2(AC) = \left(\frac{1314}{(1314) + (300 + j1885)} \right) \cdot 5V_{pp}$$

$$|V_2(AC)| = 2.648V_{pp}$$

To bring this down to 1V_{pp}

$$Z_2 = \left| \frac{1}{j\omega C_2} \right| = \left(\frac{1V}{2.648V} \right) 1314\Omega = 496\Omega$$

$$C_2 = 5.34\mu F$$

