ECE 320 - Quiz #7 - Name _____

DC to AC, SCR, Boolean Logic

DC to AC Converter

1) Assume the Fourier transform for the output of a DC to AC converter driving a 1 Ohms reisistor is as follows:
   - note: units are Vp (peak voltage)
   - Energy = $\frac{1}{2}(a_n^2 + b_n^2)$ Watts (assuming a 1 Ohm resistor)

Harmonic	0 (DC)	1	2	3	4	5
an (cosine)	0	**5** birth month	5	3	0	0
bn (sine)	0	**14** Birth Date	0	0	2	0
$E = \frac{1}{2}(a^2 + b^2)$	0	110.5	12.5	4.5	2	0

Determine the following:

Total Energy in the signal	Energy in the 1st harmonic	Efficiency % of energy in the 1st harmonic
129.5W	**110.5W**	**85.3%**

DC to AC Converter: Differential equations for a Circuit

2) Determine the differential equations which describe the following circuit.

Assume

- R1 = 1..12 Ohms (your birth month)
- R2 = 1..31 Ohms (your birth date)

$$I_1 = C_1 \frac{dV_1}{dt} = 0.01 \cdot \quad \frac{dV_1}{dt} = \left(\frac{V_0 - V_1}{20}\right) - I_3$$

$$I_2 = C_2 \frac{dV_2}{dt} = 0.02 \cdot \quad \frac{dV_2}{dt} = I_3 - \frac{V_2}{14}$$

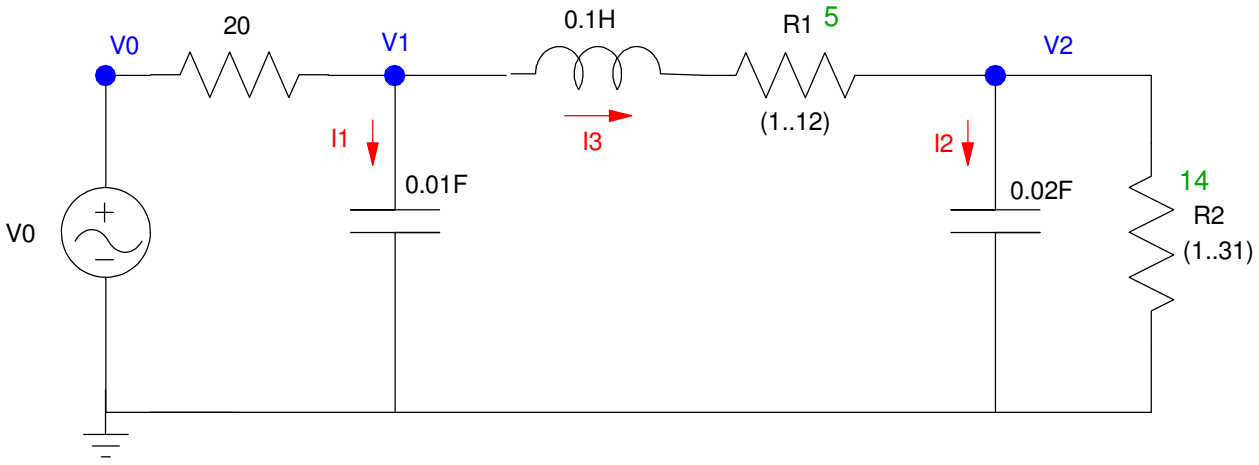
$$V_3 = L \frac{dI_3}{dt} = 0.1 \cdot \frac{dI_3}{dt} = V_1 - V_2 - 5I_3$$

solving

$$\frac{dV_1}{dt} = 5V_0 - 5V_1 - 100I_3$$

$$\frac{dV_2}{dt} = 50I_3 - 3.571V_2$$

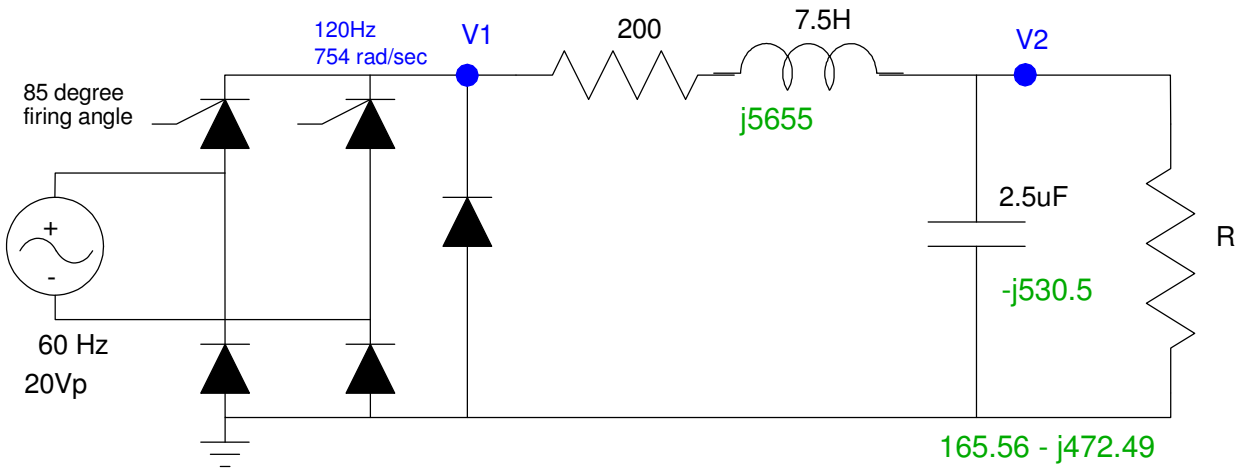
$$\frac{dI_3}{dt} = 10V_1 - 10V_2 - 50I_3$$



SCR (5 diode version)

3) SCR: Analysis. Determine the votlages at V1 and V2 (both DC). Assume a firing angle of 85 degrees.

R 1000 + 100*Mo + Day	V1		V2	
	DC	AC (V1pp)	DC	AC (V2pp)
1514	**5.979V**	**19.3Vpp**	**5.281V**	**1.860Vpp**



$$V_1(DC) = \left(\frac{18.6+0.7}{\pi}\right) \cdot (1 + \cos(85^0)) - 0.7 = 5.979V$$

$$V_2(DC) = \left(\frac{1514}{1514+200}\right) 5.979V = 5.281V$$

$$V_1(AC) = 19.3V_{pp}$$

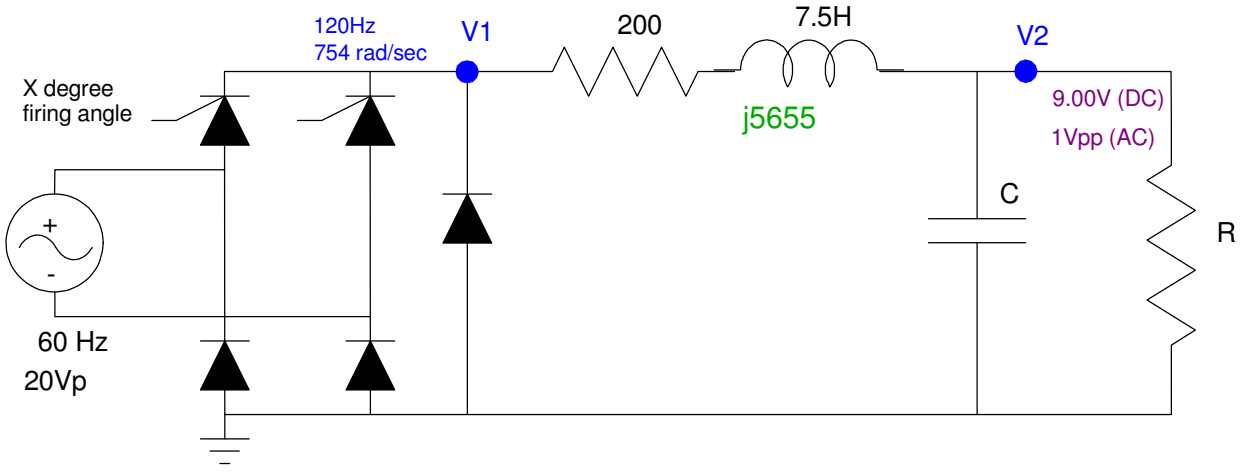
$$V_2(AC) = \left(\frac{(165.56 - j472.49)}{(165.56 - j472.49)+(200+j5655)}\right) 19.3V_{pp}$$

$$V_2(AC) = 1.860V_{pp}$$

4) SCR Design. Determine the firing angle and C so that

- V2(DC) = 9.00V
- V2(AC) = 1.00Vpp
- R = 1000 + 100*(Birth Month) + (Birth Day). May 14th would give R = 1514 Ohms.

V1(DC)	Firing Angle	C	R 1000 + 100*Mo + Day
10.189V	**39.42 deg**	**4.33uF**	**1514**



$$V_2 = 9.00V$$

$$V_1 = \left(\frac{1514+200}{1514}\right)9.00V = 10.189V$$

$$10.189V \approx \left(\frac{18.6+0.7}{\pi}\right)\cdot(1+\cos(\theta)) - 0.7$$

$$\theta = 39.425^0$$

If C = 0

$$V_2 = \left(\frac{1514}{(1514)+(200+j5655)}\right)19.3V_{pp}$$

$$V_2 = 4.945V_{pp}$$

For V2 = 1Vpp

$$\left|\frac{1}{j\omega C}\right| = \left(\frac{1V_{pp}}{4.945V_{pp}}\right)1514\Omega = 306\Omega$$

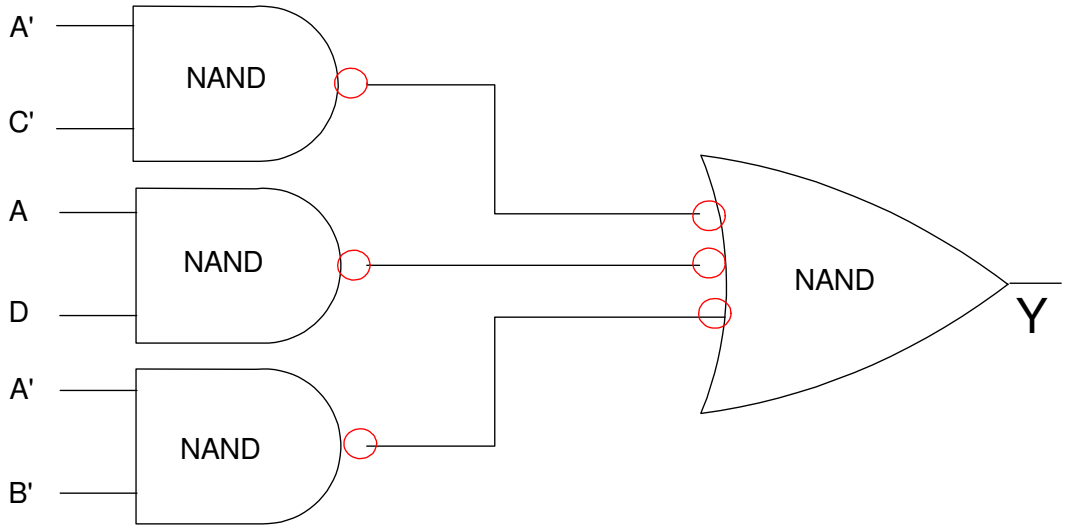
$$C = 4.33\mu F$$

5) Design a circuit using NAND gates to implement the following logic

- hint: Circle the ones

f(A,B,C,D)		CD			
		00	01	11	10
AB	00	x	1	x	0
	01	1	x	0	0
	11	0	1	1	0
	10	1	x	x	x

$$Y = \overline{A}\,\overline{C} + AD + A\overline{B}$$



6) Design a circuit using NOR gates to implement the following logic

- hint: Circle the zeros

f(A,B,C,D)		CD			
		00	01	11	10
AB	00	x	1	x	0
	01	1	x	0	0
	11	0	1	1	0
	10	1	x	x	x

$$\overline{Y} = \overline{A}C + AB\overline{D}$$

$$Y = \left(A + \overline{C}\right)\left(\overline{A} + \overline{B} + D\right)$$