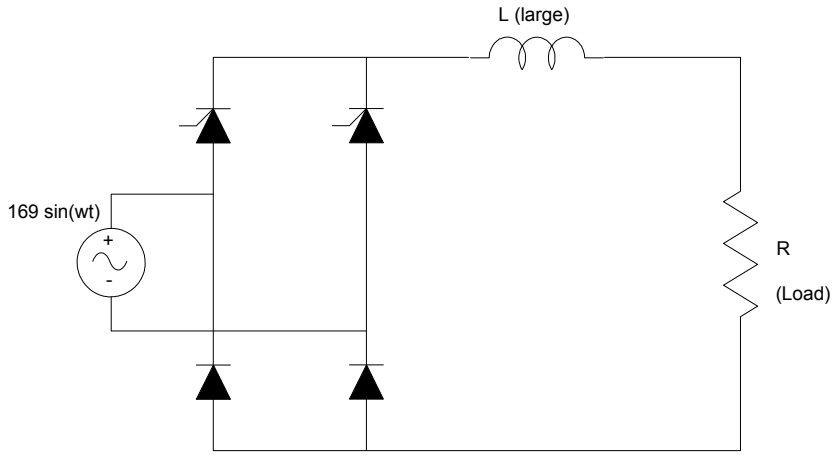
ECE 320 - Homework #6

SCR - Boolean Logic - DTL Logic Due Monday, March 2nd

SCR AC to DC Converter:

1) Assume a full-wave rectifier using SCR's and 120VAC (169V peak). Compute and plot in MATLAB (or like program) the DC voltage vs. firing angle

Assume an inductive load (planning ahead for problem #2)



The effective voltage applied to the load is then

$$V_{in} = 169\sin(\omega t + \phi)$$

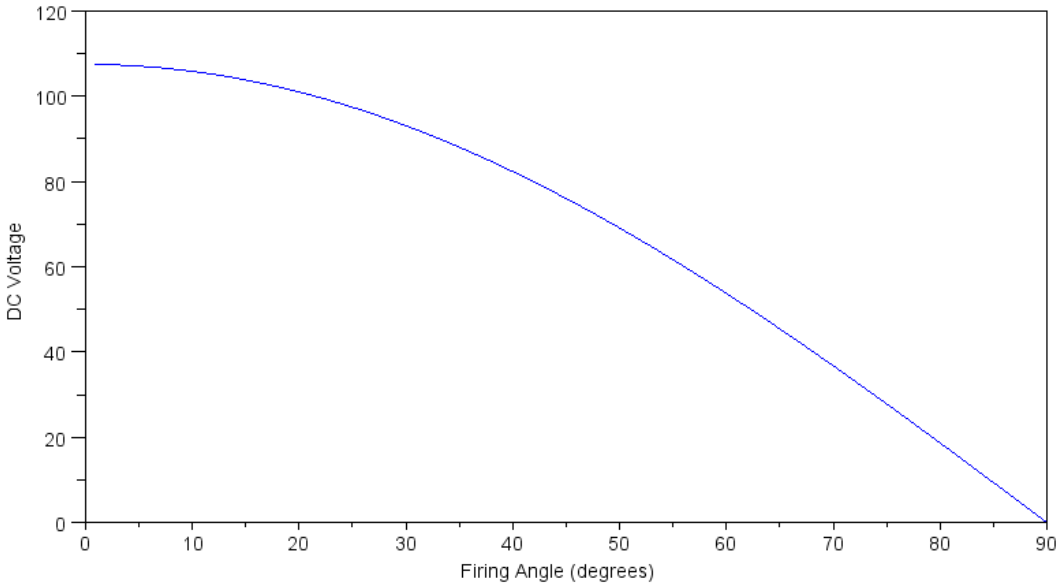
for a firing angle of 0 to 90 degrees. The mean voltage (DC level) is what gets through the inductor if it's large. So,

$$V_{DC} = mean(V_{in})$$

$$V_{DC} = \frac{1}{\pi}\int_0^{\pi} 169\sin(t+\phi)dt \qquad 0 < \phi < \frac{\pi}{2}$$

In MATLAB:

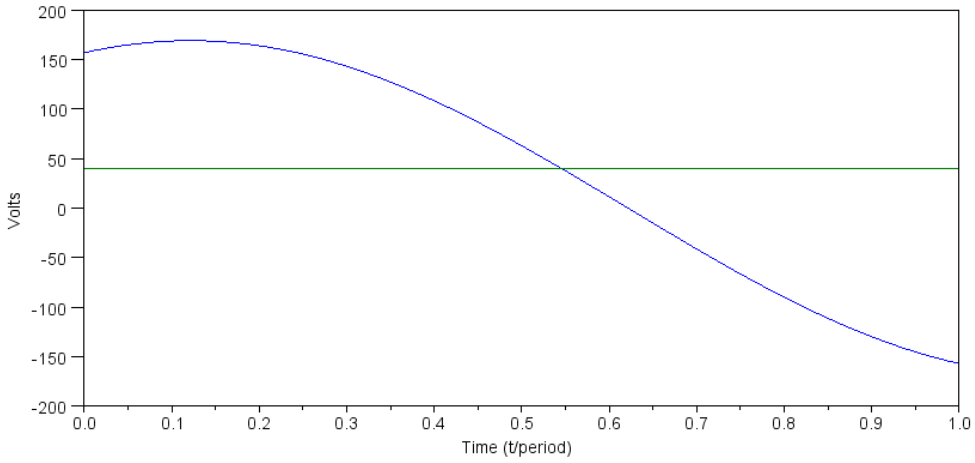
```
-->t = [0:0.001:1]';

-->for i=1:100
-->   p(i) = 0.5 * i/100;
-->   Vin = 169*sin(%pi*(t + p(i)));
-->   DC(i) = mean(Vin);
-->   end

-->plot(p*180,DC)
-->xlabel('Firing Angle (degrees)');
-->ylabel('DC Voltage')
```



2) Assume a SCR is used to convert 120VAC to 40VDC to drive a 40V DC motor at 1A. Design a filter (i.e. inductor and capacitor) so that the ripple voltage is 1Vpp.

From problem #1, 40V corresponds to a firing angle of 68.15 degrees (1.189 radians)

```
-->p = 68.15 * %pi/180

    1.1894419

-->   Vin = 169*sin(%pi*t + p);

-->mean(Vin)

    40.002122

-->plot(t,Vin,t,mean(Vin))
-->xlabel('Time (t/period)');
-->ylabel('Volts');
```



The ripple has a peak-to-peak voltage of

```
-->Vpp = max(Vin) - min(Vin)
 Vpp  =

    325.85915
```

For this to be 1Vpp,

$$1V_{pp} = \left(\frac{R}{R+j\omega L}\right)325.89V_{pp}$$

R = 40 Ohms (1A @ 40V)

$$\left|R + j\omega L\right| = \frac{325.89V}{1V}40\Omega$$

$$\omega L = 13035\Omega$$

Since this is a full-wave rectifier, f = 120Hz ($\omega = 240\pi$ rad/sec)

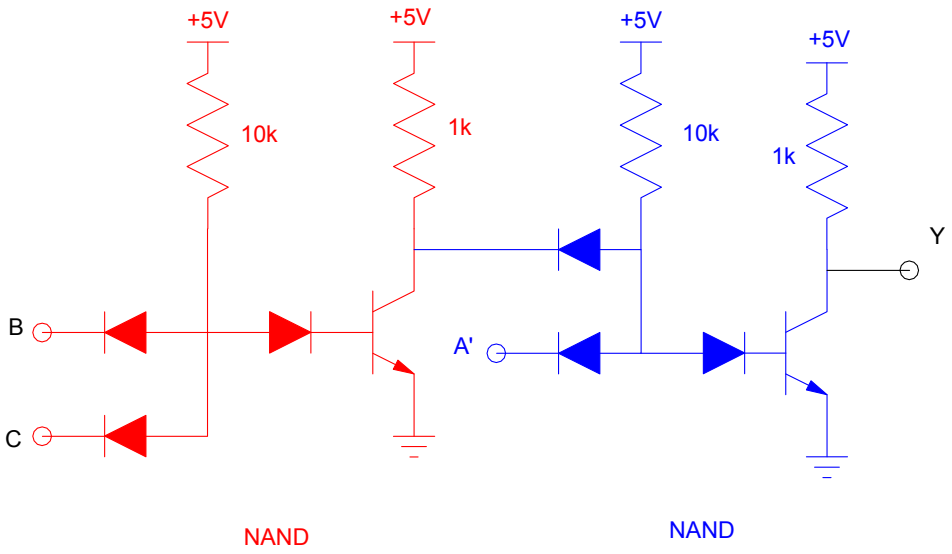
$$L = \frac{13{,}035\Omega}{2\pi \cdot 120Hz} = 17.29H$$

DTL Logic (Lab)

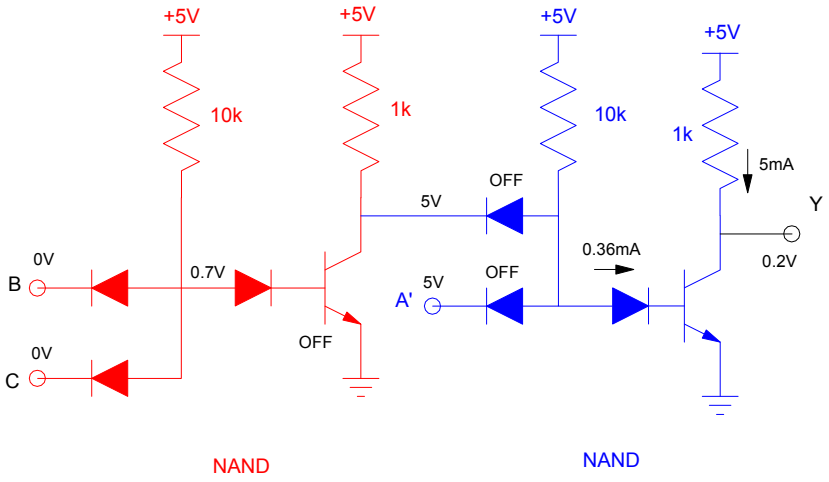
3) Specify a logic function, such as

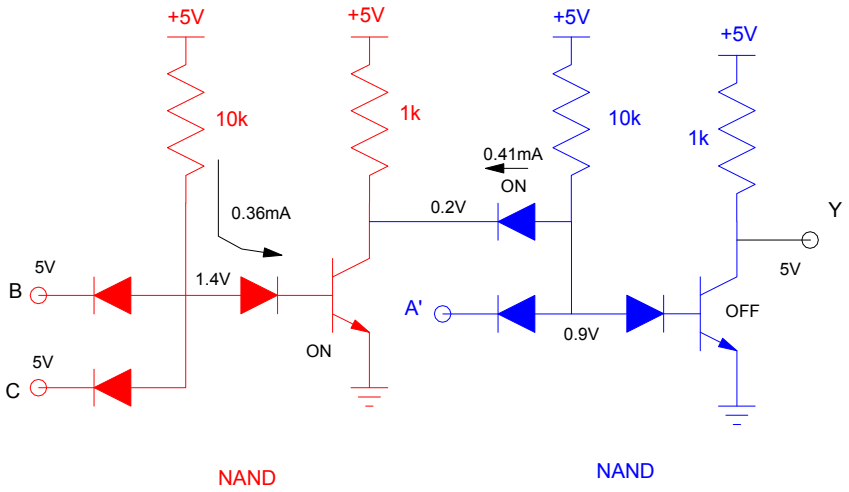
$$Y = \overline{A} + BC$$

4) Design a circuit using DTL logic to implement this function

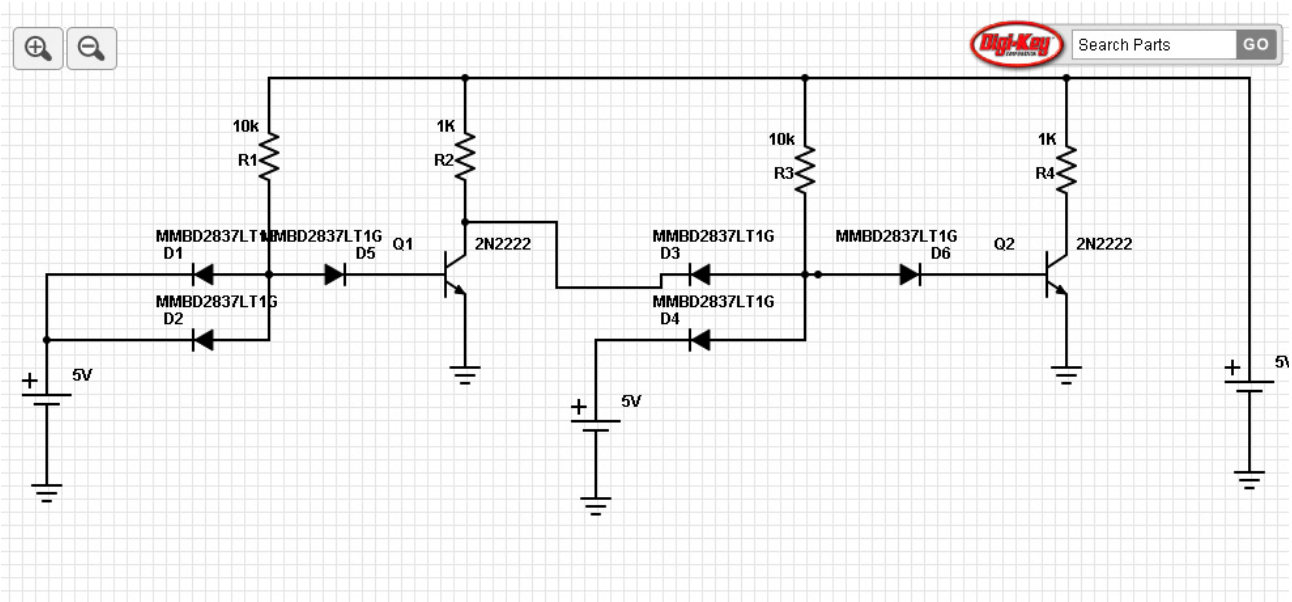


Analysis: Check some combinations of A, B, C





5) Test your design in simulation



6) Build and test your circuit in lab.

ECE 320 Term Project

The term project for ECE 320 must include

- At least one transistor,
- At least one diode, and
- Have two or more sections

7) Overall Project Requirements: Specify the inputs / output of your overall design and what it is supposed to do (i.e. how the inputs affect the outputs).

8) Project Breakdown: Specify at least two sections for your project For each, specify their inputs, outputs, and how they relate.

Example: Drive an 8-Ohm speaker with an iPhone.

- Input: 3.3V sine wave from the iPhone at 500Hz.
    - note: itmakes it easier to test if you constrain the voltage and frequency
- Output: 8 Ohm Speaker
- Relationship:
    - When the input is more than 2.2V, +5V is applied to the speaker
    - When the input is less than 2.2V, 0V is applied to the speaker
    - Tolerances: All voltages are +/- 100mV.

Sections: Two circuits connected in series

- Circuit 1: Converts 0..3.3V to 0V / 5V TTL signal and implements the logic function Vin > 2.2V
- Circuit 2: Takes the output from circuit 1 and drives an 8-Ohm speaker at 0V / 5V (625mA)