## ECE 320 - Homework \#5

555 Timers, Transistors used as a Switch, Schmitt Triggers. Due Monday, February 14th Assume a 3904 transistor (NPN) and 3906 (PNP) (\$0.04 each)

$$
\beta=100 \quad \min \left(\left|V_{c e}\right|\right)=0.2 \mathrm{~V} \quad \max \left(I_{c}\right)=200 \mathrm{~mA}
$$

Assume a thermistor with

$$
R=1000 \exp \left(\frac{3905}{T+273}-\frac{3905}{298}\right) \Omega
$$

## 555 Timers

1) Determine the on and off times for the voltage at V 2 for following 555 -timer circuit
2) Simulate this circuit in CircuitLab and verify the on and off times

## Transistor Switch

3) Determine the voltages $\{\mathrm{Vb}, \mathrm{Vc}\}$ and currents $\{\mathrm{Ib}, \mathrm{Ic}\}$ when

- $\mathrm{V} 2=0 \mathrm{~V}$
- $\mathrm{V} 2=5 \mathrm{~V}$

4) Verify your calculations using CircuitLab


## Comparitor

Add an electronic switch to turn the speaker on and off
5) Design a comparitor (shown in blue - don't add the red resistors (they are for a Schmitt trigger) ) to

- Turn on the speaker $(\mathrm{V} 3=5 \mathrm{~V})$ when $\mathrm{T}>40 \mathrm{C}$, and
- Turn off the speaker $(\mathrm{V} 3=0 \mathrm{~V})$ when $\mathrm{T}<40 \mathrm{C}$

6) Simulate the comparitor in CircuitLab to verify the on / off temperature (or resitance or voltage)

- use a voltage source (V4) to simulate the voltage at the voltage divider)

7) Build this circuit and verify it's on and off temperature (or voltage or ressistance. Replace R with a potentiometer for test purposes)

## Schmitt Trigger

Add an electronic switch to turn the speaker on and off
8) Design a Schmitt Trigger (modify section in blue) to

- Turn on the speaker $(\mathrm{V} 3=5 \mathrm{~V})$ when $\mathrm{T}>45 \mathrm{C}$, and
- Turn off the speaker $(\mathrm{V} 3=0 \mathrm{~V})$ when $\mathrm{T}<40 \mathrm{C}$

9) Simulate the comaritor in CircuitLab to verify the on / off temperature (or ressitance or voltage)

- use a voltage source (V4) to simulate the voltage at the voltage divider)

10) Build this circuit and verify it's on and off temperature (or voltage or ressistance. Replace $R$ with a potentiometer for test purposes)

