Comments on Lab #5 (and some general thoughts on design) **V23.1**

Regarding the Schmitt trigger: Please see the appropriate document in Canvas modules. The Schmitt trigger is tricky, and take some thought to interface with both its input and its output. The input resistance of the Schmitt trigger is extremely low, and the input current will increase abruptly when the Schmitt trigger output goes high.

Remember that input stages should generally have low collector current (1 to 20 mA or so), while later stages will tend to have higher collector current -in this way impedance levels will drop through successive stages leading to higher power output at the final stage.

In a multistage amplifier, the signal swing necessary in an early stage is often quite small, because it will eventually be amplified to provide the greater swing required at the output stage. You can sometimes use this fact to your advantage; if you don't need a lot of signal swing, you don't necessarily have to have the collector biased around half the supply; therefore, direct coupling might be possible.

The values you select for the DC gain are, of course, somewhat arbitrary, but you typically want the DC gain to be relatively low so that bias point stability is good. However, the lower the DC gain, the lower the available signal swing. Interesting. Why is this?

Don't forget the stage-to stage loading. Many of you will find that when your circuit is ultimately built, you do not get the composite gain that you are expecting. If a stage with the output resistance of, say 1 K, drives a second amplifier within input resistance of 10K, the resulting gain will only be one- half of the product of the gains.

Changes in beta will not produce large changes in the bias point if you use low resistance values for the base voltage-divider resistors (less loading of the voltage divider will occur). Unfortunately, low resistor values at the voltage divider will lower your input resistance. You just can't win.

Don't forget that the frequency switching points must be independent of the amplitude of the input.

Remember to use at least one PNP transistor.

An emitter- follower might come in handy somewhere in the amplifier chain.

Be sure you take into account the lamp characteristics, and the fact that you must drive it at very close to the full supply voltage.

The sharper your filter, the better your circuit will perform; it usually works out that way. Keep in mind that you can't reliably compare a voltage to a reference threshold if the voltage has a slope approaching horizontal; the voltage should be changing fairly quickly as it crosses the threshold; otherwise, there will be uncertainty at the switching point. This means that you will require a sharp, hi-Q bandpass filter. I suggest that at the frequency switching points your amplitude should change by at least 25% from the maximum or minimum -and hopefully more.

Pay attention to the series resistance that you select to drive an LC resonant circuit:

Comment on component values when designing a resonant LC filter:
When designing a resonant circuit, you can theoretically choose any pair of values for L and C; resonance will occur at the frequency where the reactances are equal. However, if you use a large value of L and a small value of C, their reactance at resonance will be high and the amount of current circulating in the tank will be low. Conversely, with a low value of L and a high value of C, the amount of current circulating in the tank will be high. For typical small-signal circuits, you should select values such that the reactance of L and C at the resonant frequency is in the range of a few KΩ.

The value of the series resistor in a parallel resonant circuit will typically be several larger than the reactance at resonance. Higher resistor values will produce a sharper response, but output impedance at resonance will increase, and the output voltage at resonance will decrease. The series resistance of the inductor may have significant effect on optimum component values, especially on the value of Q.

Generally speaking, use parallel resonant circuits instead of series resonant circuits when operating at frequencies below RF; series circuits usually involve low impedances that are problematic with the inductors typically used at lower frequencies.

When you select an inductor value for Lab #5, Part 3, make sure you can find that value in the lab. You might consider using the 47 mH inductor that was used in lab #1.

Finally, in all of your design work, please be aware of "Death by Potentiometer". Pots are to be used only for the final calibration of things like references and gain, and for adjustments that must be made by a user. Pots are **NOT** to be used during the design phase; otherwise, you will spend your time tweaking, then isolating and measuring the pot, and going back and forth. You are to first calculate or intelligently estimate component values and use fixed resistors. If necessary, during design you may use one of the resistor or capacitor substitution boxes that are in the lab on the front bench.