Shown in Fig. 1 is the Colpitts oscillator circuit with an open feedback loop. The Colpitts oscillator is widely used in communications systems. Some advantages of this circuit are: good frequency selectivity, higher oscillation frequency, and self-limiting behavior.

**PRE-LAB**

**Biasing:** Select values of $R_1$, $R_2$, and $R_e$ such that $I_C$ equals 1 mA dc. (Hint: Use low values of resistance and make $I_{R1} = 4 I_B$.)

**RF:** Using available inductors and capacitors, select $L$ & $C$ so that the oscillation frequency is close 0.5 MHz. Use $V_{cc} = 12$ volts. The selection of the unspecified components is left as a design problem.

**MultiSim:** Simulate both the open-loop and closed-loop circuits using Multisim. Verify the biasing. Measure the open-loop circuit gain (loop-gain) and phase at frequencies near the calculated oscillation frequency. It may be helpful to simulate the closed loop (oscillator) first to get an accurate estimate of the frequencies around which you should measure open-loop gain and phase.

**IN-LAB**

Construct the open-loop circuit and verify the biasing. Next, connect a function generator to node $v_i$ through a 1 μF capacitor and display $v_0$ and $v_i$ on your scope. Measure and plot the loop-gain magnitude and phase over the frequency range 100 kHz < $f$ < 1 MHz and confirm that self oscillation will occur, i.e., that the gain from input to output is greater than 1 where the phase shift is 0 degrees. (Note that the output must be in phase with the input for oscillation.)

Close the loop through the 1 μF input capacitor (remove the function generator and connect $v_O$ to $v_I$ through the capacitor) and display $v_B$ and $v_C$ on the scope. Record the waveforms and discuss their shape. Compare the experimental oscillation frequency with the calculated one. Now reduce $R_2$ until $I_C = 0.1$ mA and display and graph $v_B$ and $v_C$. How far can you reduce $R_2$ before oscillations are extinguished?

**Very Important:** To design the circuit, first choose one of the available values for $L$ given below and then calculate the value of capacitance $C$ to be used in the Colpitts oscillator. One of the inductors will serve as the “RF Choke.” ($RFC$) The $RFC$ should have a reactance that is much higher than the impedance of the frequency-determining elements in the circuit ($L$ and $C$).

**Available Inductors:** 68 μH, 100 μH, 1 mH, 10 mH, 100 mH

**Available Capacitors:** 470 pF, 1 nF, 2.2 nF, 4.7 nF (among others).