Experiment #4- Part#2

Small Signal BJT Amplifier

Procedure

1. Connect the circuit shown in Fig.5 and measure the DC voltages V_B, V_E, and V_C. Try to measure the DC current gain of the BC337 transistor h_{FE} using a multi-meter. Tabulate your results as illustrated in Table-1.

Table-1: Measured Quantities for the DC Bias Circuit

Parameter	β	V_B	V_E	V_C	I_{CQ}	V_{CEQ}	V_{BEQ}	r_e
Value								

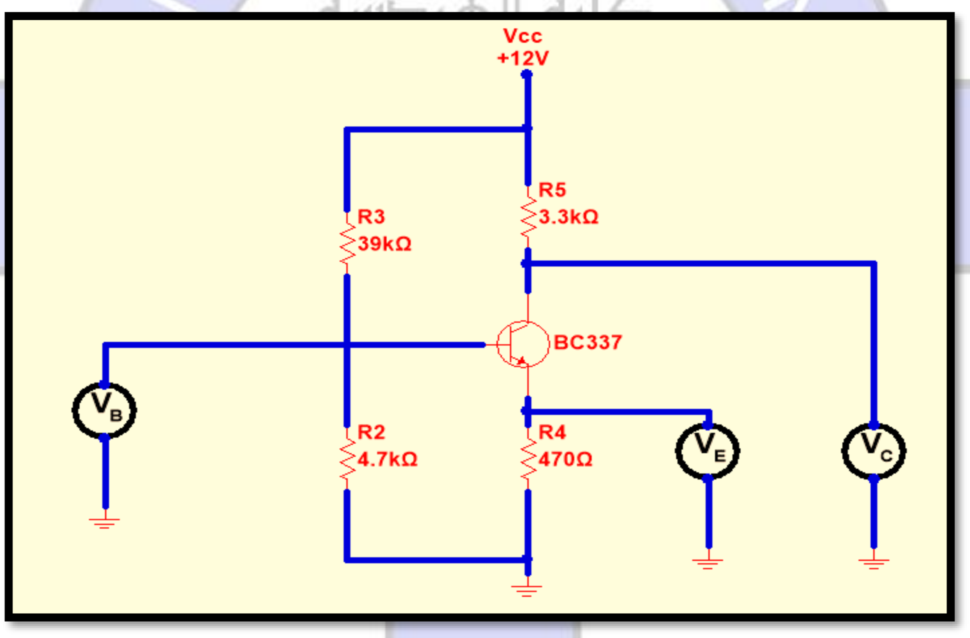

Figure 5: The DC Bias Circuit of the Common Emitter Amplifier

2. Connect the amplifier circuit shown in Fig.6, and apply a sinusoidal source signal with peak amplitude of 0.1V and frequency of 10 KHz. Display both the input (source) and output (load) signals on the oscilloscope. Try to measure the voltage gain Av, where Av = Vout/Vs.

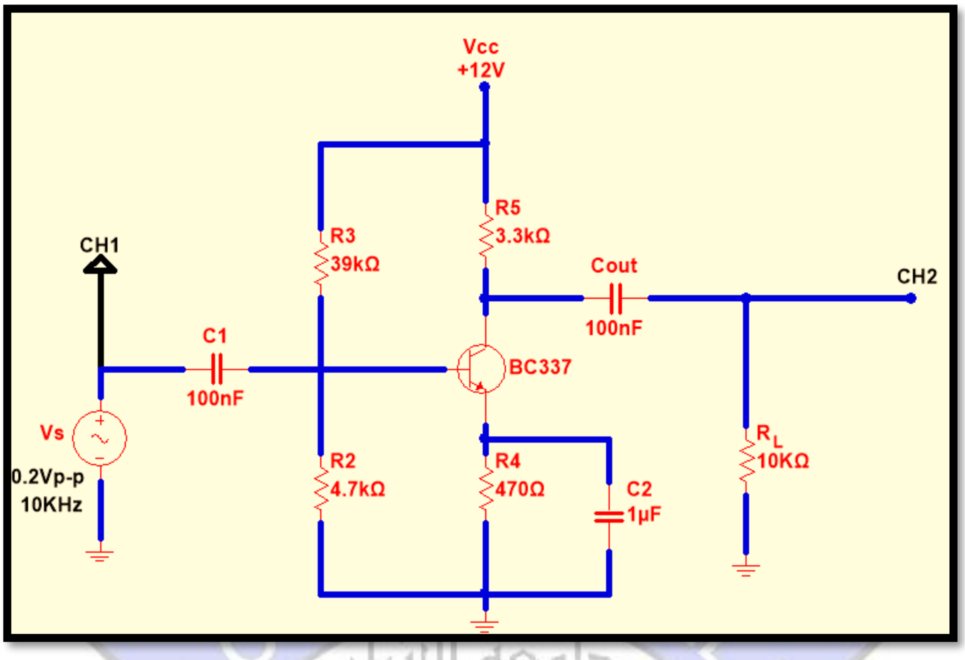

Figure 6: The Practical Common Emitter Amplifier Circuit

3. Remove load resistor R_L and re-measure the voltage gain.
4. Remove the bypass capacitor C_E and measure the voltage gain with the load resistor R_L connected at the output. Tabulate your results as shown in Table-2.

Table-2: Voltage Gain for Different Cases

Case	Voltage Gain
Normal (R_L=10KΩ)	
No-Load ($R_L = \infty$)	
No Bypass Capacitor	

5. Increase the amplitude of the source input signal gradually until clipping occurs in the output signal. Find the maximum peak amplitude for v_{out} and vs at the edge of clipping for the three cases illustrated in Table-3.

Table-3: Peak Input and Output Voltages before Clipping

Case	$V_{s(max)}$	$V_{out(max)}$
Normal		
No-Load		
No Bypass Capacitor		

6. Connect the circuit shown in Fig.7, where R_{test} is a variable resistor box. This circuit is used to measure the input impedance of the amplifier.

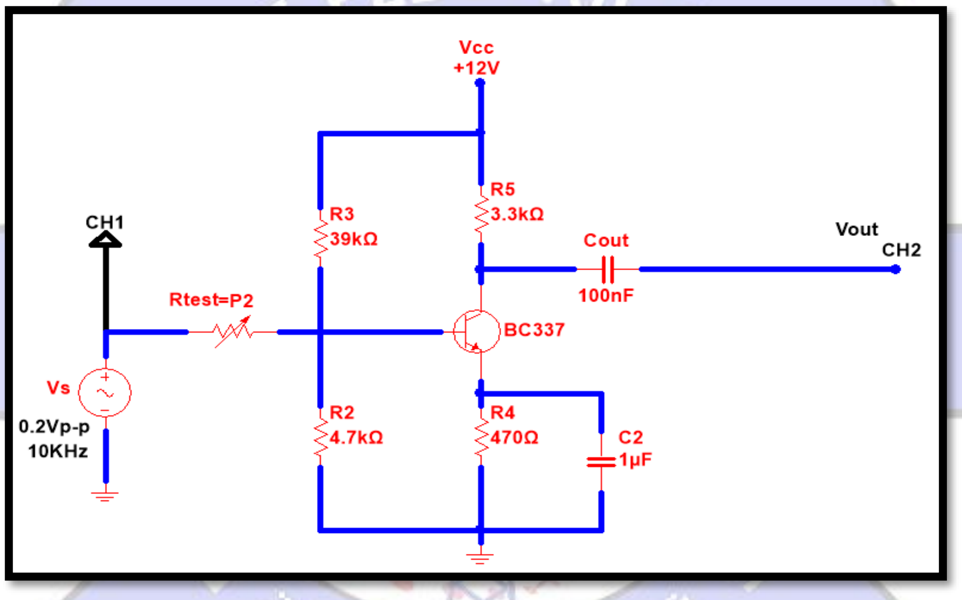

Figure 7: Test Circuit to Measure the Input Impedance of the Amplifier

7. Set R_{test} = 0 Ω initially, and measure the no-load voltage gain A_{vo}.
8. Increase R_{test} in steps until the voltage gain becomes equal to half the no-load gain. Record this value of R_{test} as Z_{in}.
9. Connect the circuit shown in Fig.8 to measure the output impedance of the amplifier. Resistor R_{test} is inserted at the output terminals instead of R_L.

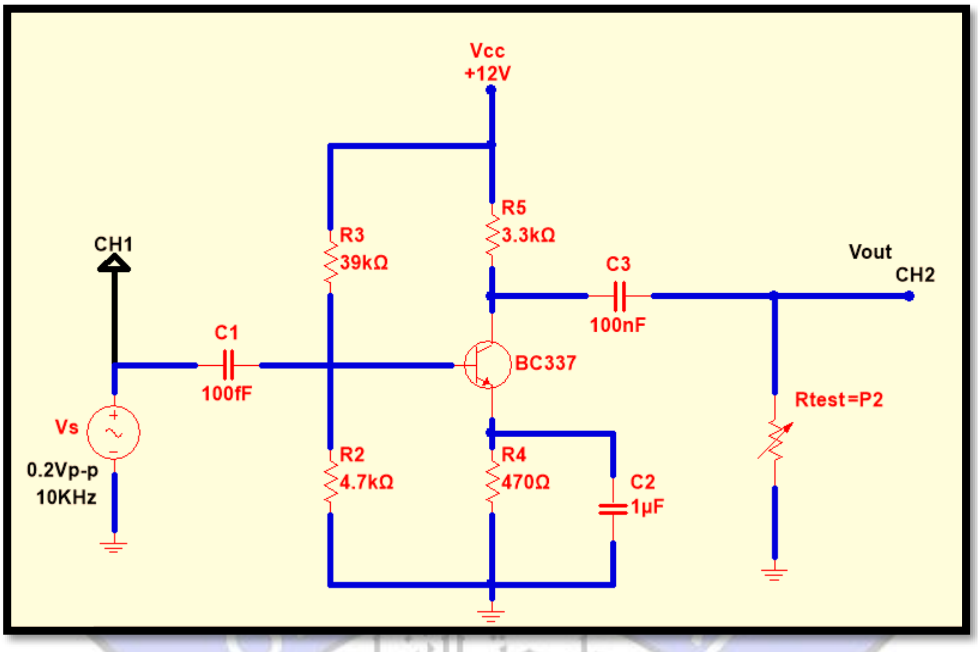

Figure 8: Test Circuit for Measuring the Output Impedance of the Amplifier

10. Vary R_{test} in steps until the voltage gain becomes equal to half the no-load gain. Record this value of R_{test} as Z_{out}.

Discussion

1. Calculate the theoretical DC voltages and currents for the transistor bias circuit and compare them with the practically measured values.
2. Calculate the theoretical values of the voltage gain for the three cases and compare them with the measured quantities.
3. Sketch the AC load line for the amplifier circuit and find the theoretical maximum symmetrical swing in collector voltage v_{ce} before clipping when $R_L = 10\ K\Omega$. Determine $V_{out(max)}$ before clipping and compare it with the measured value.
4. Determine the theoretical value of the input impedance and compare it with the measured value.
5. Calculate the theoretical value of the output impedance and compare it with the measured value.
6. If resistor R_2 is opened (or removed) in the circuit of Fig.5, what is its effect on the transistor circuit? Determine the collector current I_C and voltage V_{CE} in this case.
7. Calculate the current gain A_i of the amplifier circuit of Fig.6.