Lab 8

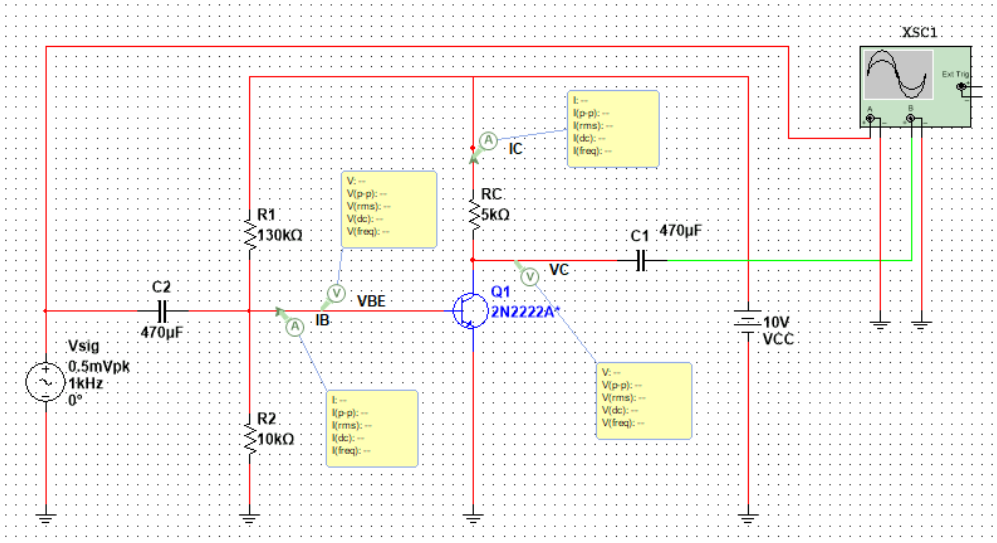
Common Emitter Amplifier

Learning outcomes

1) Studying the open-loop amplification characteristics of CE circuit
2) Studying the effect of load resistance R_L on amplification characteristics of CE circuit
3) Studying the effect of source internal resistance R_{sig} on amplification characteristics of CE circuit
4) Studying the effect of degenerate resistance R_E on amplification characteristics of CE circuit

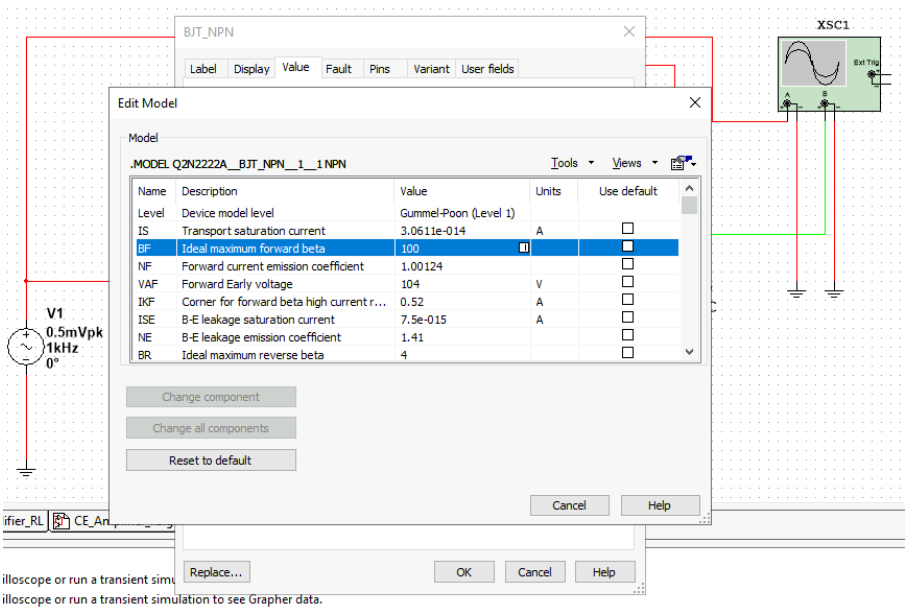
Experiment 1) Studying the open-loop amplification characteristics of CE circuit

A) Create a new Multisim project and construct the circuit shown



B) Double click on the BJT transistor then in the "Value" tap click "Edit package"

C) Change "Ideal maximum forward beta" to 100 (set β=100)



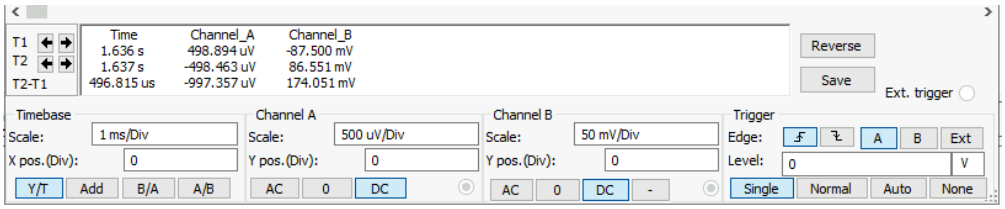
D) Run the simulation and record I_C, V_C, V_{BE} and calculate r_π

E) Calculate the theoretical values of I_C, I_B, V_C (note: use the V_{BE} measured in (D) not 0.7) then calculate r_π

F) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
I_B			
I_C			
V_C			
r_π	V_T/I_B = (25mV/9.57*10^{-3})		

G) Read $v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$ after setting both ChA and ChB as shown below



H) Take a screenshot of the outputs of the oscilloscope and put it in the following place holder

Put a screenshot of your output ($v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$) here and Plz make $v_{o\text{-}pp}$ in green and $v_{sig\text{-}pp}$ in red

I) Calculate open loop gain Avo= $v_{o\text{-}pp}$ / $v_{sig\text{-}pp}$

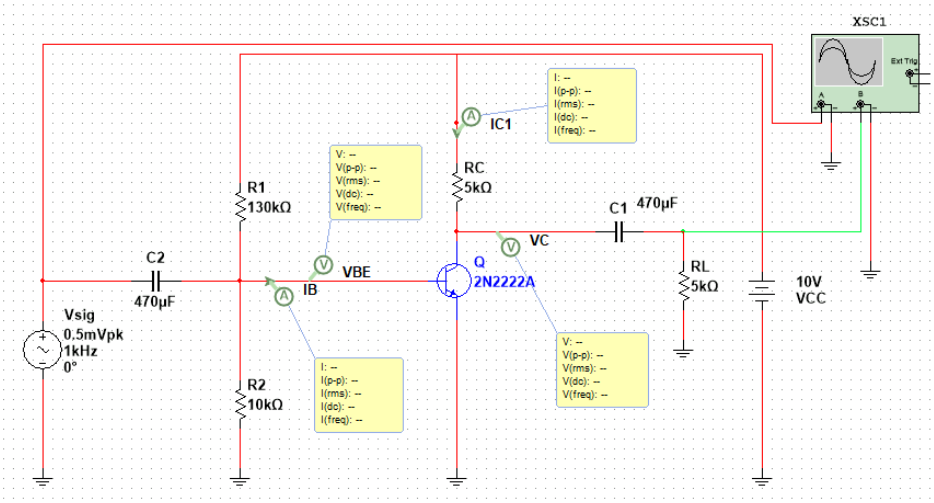
J) Calculate the theoretical values of Avo = $\frac{-\beta R_C}{r\pi}$

K) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Avo			

Experiment 2) Studying the effect of load resistance on the amplification characteristics of CE circuit

A) Create a new Multisim project and construct the circuit shown (note: copy and paste from exp 1 project but add the new resistance RL as a load)



B) Change "Ideal maximum forward beta" of the transistor to 100 (set β=100) as explained in exp 1

C) Run the simulation and record I_C, V_C, V_{BE} and calculate r_π

D) Calculate the theoretical values of I_C, I_B, V_C (note: use the V_{BE} measured in (D) not 0.7) then calculate r_π

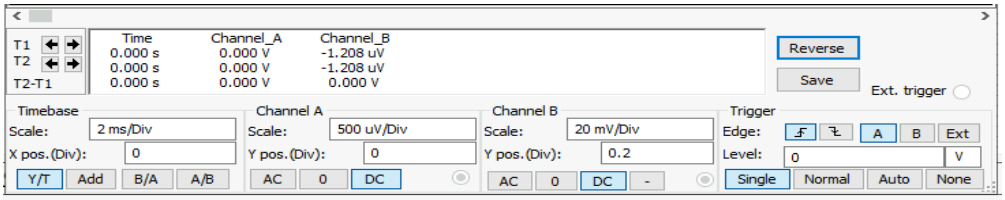
E) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
I_B			
I_C			
V_C			
r_π			

F) Do you notice any change in I_C, V_C, or V_{BE} from exp 1? Why or why not? Plz put you answer in the following placeholder

Answer (F) here! (Plz write your answer in red)

G) Read $v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$ after setting both ChA and ChB as shown below



H) Take a screenshot of the outputs of the oscilloscope and put it in the following place holder

Put a screenshot of your output ($v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$) here and Plz make $v_{o\text{-}pp}$ in green and $v_{sig\text{-}pp}$ in red

I) Calculate the voltage gain Av= $v_{o\text{-}pp}$ / $v_{sig\text{-}pp}$

J) Calculate the theoretical values of Av = $\frac{-\beta\ (R_C||R_L)}{r\pi}$

K) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Av			

L) Comparing Av to Avo in exp 1 which is greater and why?

Answer (L) here! (Plz write your answer in red)

M) Repeat the previous procedure at R_L=50Ω

N) Based on your measurements and calculations at R_L=50Ω fill the following table

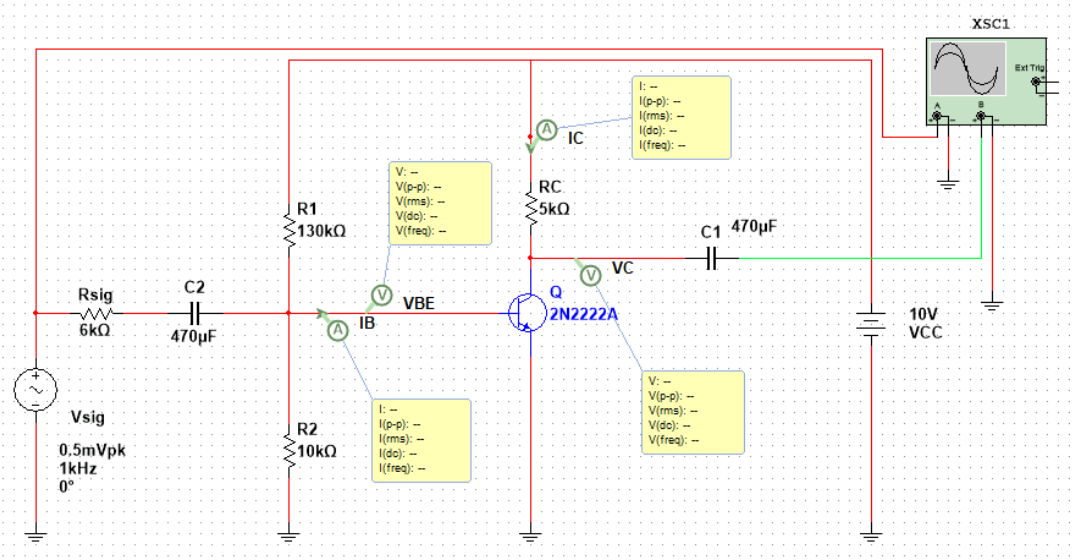
	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Av			

O) Comparing Av at R_L = 5K Ω to Av at R_L = 50 Ω which is greater and why?

Answer (O) here! (Plz write your answer in red)

Experiment 3) Studying the effect of internal resistance of source v_{sig} on the amplification characteristics of CE circuit

A) Create a new Multisim project and construct the circuit shown (note: copy and paste from exp 1 project but add the new resistance Rsig as an internal resistance of Vsig)



B) Change "Ideal maximum forward beta" of the transistor to 100 (set β=100) as explained in exp 1

C) Run the simulation and record I_C, V_C, V_{BE} and calculate r_π

D) Calculate the theoretical values of I_C, I_B, V_C (note: use the V_{BE} measured in (D) not 0.7) then calculate r_π

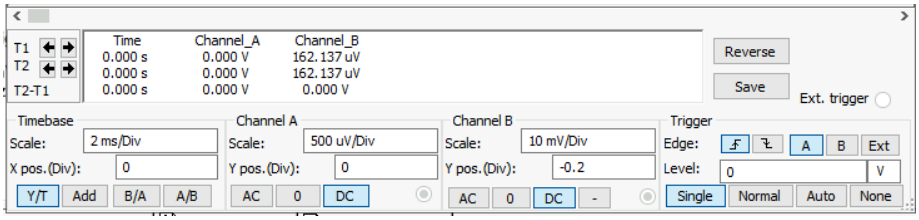
E) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
I_B			
I_C			
V_C			
r_π			

F) Do you notice any change in I_C, V_C, or V_{BE} from exp 1? Why or why not? Plz put you answer in the following placeholder

Answer (F) here! (Plz write your answer in red)

G) Read $V_{o\text{-}pp}$ and $V_{sig\text{-}pp}$ after setting both ChA and ChB as shown below



H) Take a screenshot of the outputs of the oscilloscope and put it in the following place holder

Put a screenshot of your output ($v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$) here and Plz make $v_{o\text{-}pp}$ in green and $v_{sig\text{-}pp}$ in red

I) Calculate the overall voltage gain $Gv=V_{o\text{-}pp}/V_{sig\text{-}pp}$

J) Calculate the theoretical values of Gv = Av $\frac{R_{in}}{R_{in}+R_{sig}}$, where Av = $\frac{-\beta\, R_C}{r\pi}$ and Rin= $R_1||R_2||r_\pi$

K) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Gv			

L) Comparing Gv to Avo in exp 1 which is greater and why?

Answer (L) here! (Plz write your answer in red)

M) Repeat the previous procedure at R_{Sig}=50Ω

N) Based on your measurements and calculations at R_{Sig}=50Ω fill the following table

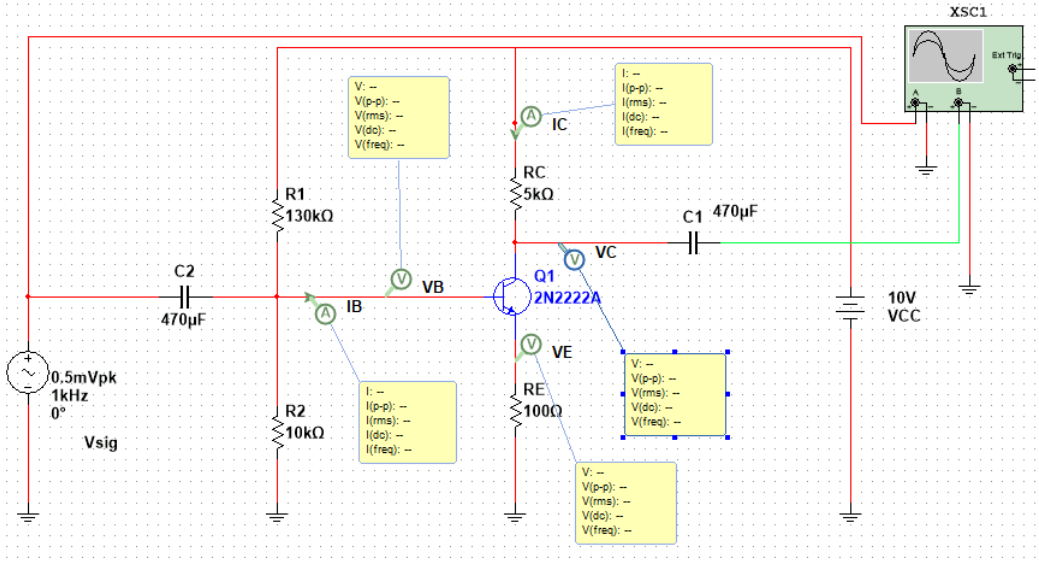
	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Gv			

O) Comparing Av at R_{Sig} = 6KΩ to Av at R_{Sig} = 50 Ω which is greater and why?

Answer (O) here! (Plz write your answer in red)

Experiment 4) Studying the effect of Emitter degenerate resistance on the amplification characteristics of CE circuit

A) Create a new Multisim project and construct the circuit shown (note: copy and paste from exp 1 project but add the new resistance R_E between Emitter and ground)



B) Change "Ideal maximum forward beta" of the transistor to 100 (set β=100) as explained in exp 1

C) Run the simulation and record I_C, V_C, V_B, V_E and calculate r_π

D) Calculate the theoretical values of I_C, I_B, V_C (note: use the $V_{BE}=V_B-V_E$ measured in (D) not 0.7) then calculate r_π

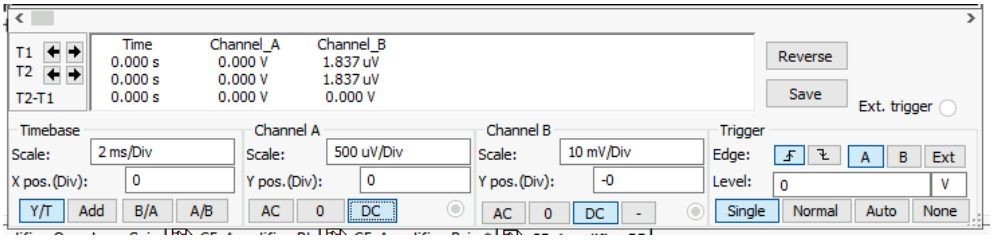
E) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
I_B			
I_C			
V_C			
r_π			

F) Do you notice any change in I_C, V_C, or V_{BE} from exp 1? Why or why not? Plz put you answer in the following placeholder

Answer G) here! (Plz write your answer in red)

G) Read Vopp and Vsigpp after setting both ChA and ChB as shown below



H) Take a screenshot of the outputs of the oscilloscope and put it in the following place holder

Put a screenshot of your output ($v_{o\text{-}pp}$ and $v_{sig\text{-}pp}$) here and Plz make $v_{o\text{-}pp}$ in green and $v_{sig\text{-}pp}$ in red

I) Calculate the overall voltage gain Av= $v_{o\text{-}pp}$ / $v_{sig\text{-}pp}$

J) Calculate the theoretical values of Av = $\frac{-\beta R_C}{r\pi+(\beta+1)R_E}$

K) Based on your measurements and calculations fill the following table

	Measured	Theoretical	Error = $\frac{\|Measured-Theortical\|}{Theortical}$ x 100
Av			

L) Comparing Av to Avo in exp 1 which is greater and why?

Answer (M) here! (Plz write your answer in red)