Experiment 11

AC Analysis of Common Emitter and Common Base Amplifier

OBJECTIVE:

1. To measure AC and DC voltages in a common-emitter amplifier and common-base amplifier
2. To obtain measured values of amplified voltages (Av), input impedance (Zi), and Output impedance (Zo), for load and unloaded operation

Introduction:

Amplification is the process of increasing the strength of signal. Amplifier are the devices that provide amplification without appreciably altering the original signal. BJTs are frequently used as amplifier. It is a current amplifier having three terminals. Base Emitter and collector. The small current into base controls the large current flows collector to Emitter this makes it possible to obtain a large amplification of voltages by taking output from arrestor in parallel with collector.

Common Emitter configuration:

In this arrangement the output taken collector to Emitter and input is applied between base and emitter. Common Emitter amplifier with large voltage divider circuit consist of three capacitor one at input one at output and one act as the coupling capacitor with emitter resistor as shown in Figure 13.1. Input signal is applied at base and output is given at collector terminal.

Operation of Common Emitter Amplifier

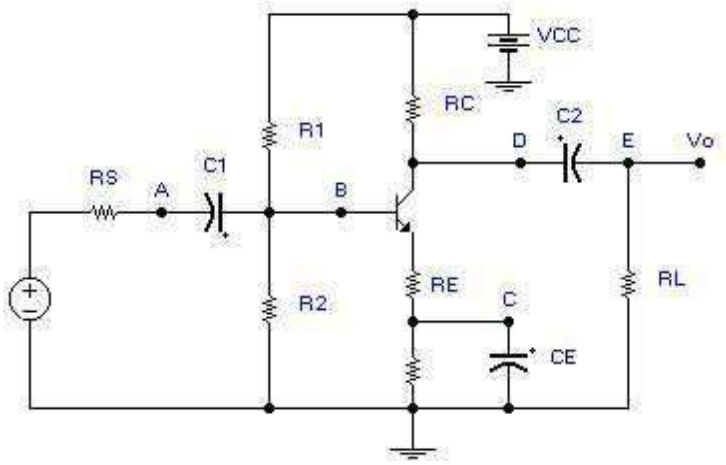


Figure 13.1 Common Emitter amplifier

First of all transistor is properly biased. The purpose of biasing is to obtain certain DC collector current and collector voltages. These values are called operating points. The most common biasing circuit is voltage divider. In this method two resistances R1 and R2 are connected across supply voltage Vcc. The voltage drops across R2 forward biased emitter junction this cause base current and hence collector current flows in zero signal condition. Resistance Re provide stabilization.

DC analysis

For amplification, a transistor must be in active region. For common Emitter configuration we have

1. Emitter base junction must be in forward biased
2. Collector base junction must be in reversed biased

DC analysis is done to find out DC parameters like Vc, VCE, VB, VBE, IC, IB and IE. It is also used to find the Q point of transistor.

For DC analysis the coupling capacitor and bypass capacitor are open circuited. To find DC parameters,

To find DC parameters,

$$V_B = \left(\frac{R_2}{R_1+R_2}\right) V_{cc} \qquad (13.1)$$

$$V_E = V_B - V_{BE} \qquad (13.2)$$

$$V_c = V_{CC} - I_C R_C \qquad (13.3)$$

$$I_E = \frac{V_E}{R_E} \qquad (13.4)$$

$$I_C = I_E \qquad (13.5)$$

$$V_{CE} = V_C - V_E \qquad (13.6)$$

AC analysis

To analyze the AC values first draw AC equivalent circuit. To draw AC equivalent circuit, follow these steps.

1. Capacitor C1 C2 C3 are replaced by effective short circuit
2. The DC source is replaced by a ground

In AC analysis we measure Zin, ZO output voltages and voltage gain.

Zin (Input Impedance)

Resistance connected to input.

$$Z_{in} = R_{in}\,(tot) = R_1 \parallel R_2 \parallel R_{in(base)} \quad (13.7)$$

Where,

$$R_{in}\,(base) = \beta r_e \quad (13.8)$$

Zo (Output Impedance)

Resistance connected at output. It can be R_c or $R_c \parallel R_L$

$$Z_{out} = R_{out} = R_C \parallel r_c \quad (13.9)$$

$Z_{out} = R_C \parallel R_L$ if R_L is connected

Voltage gain

$$A_v = {}^{Vc}/_{Vb} = {}^{Rc}/_{re} \quad (13.10)$$

Output voltages

$$V_c = A_v V_b \quad (13.11)$$

Lab Task:

Task: 1

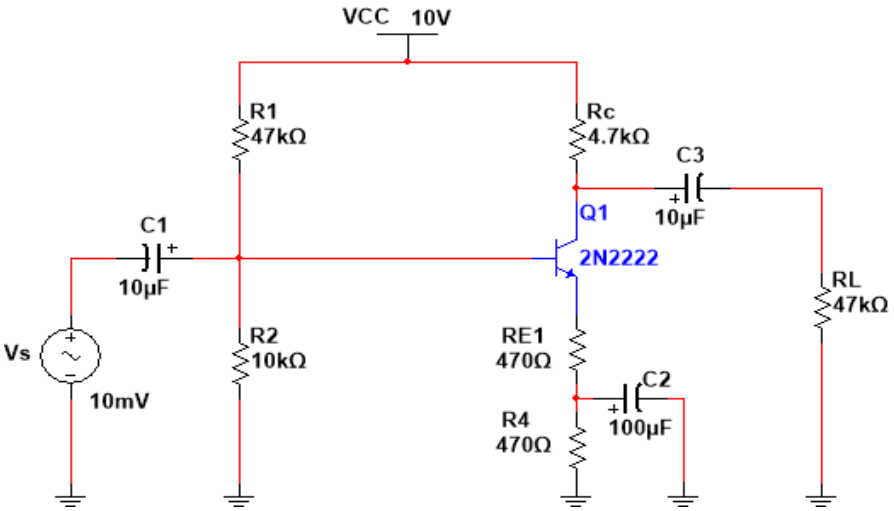


Figure 13.2 Common Emitter Amplifier

Task: 2

Draw AC signal model of Common Emitter Amplifier as shown in fig 13.2.

Task: 3

Compute and measure values of VB, VE, VC, IE using DC analysis

Calculated:

VB=

VE=

VC=

IE=

Calculated re=

Measured:

VB=

VE=

VC=

IE=

re = IE/RE

Task: 4

Compute value of Av, Zi and Zo

Av=

Zi=

Zo=

Task: 5

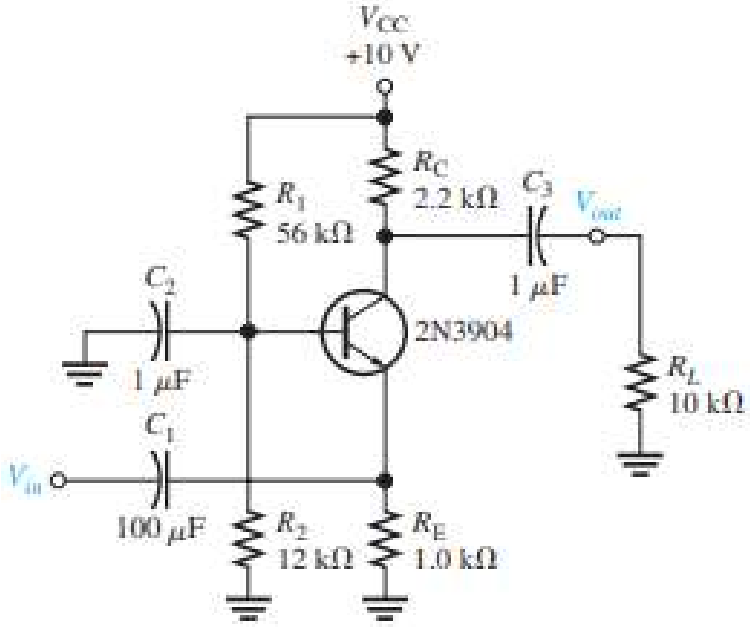
Apply an AC input signal, Vsig=50mV, rms at f=1kHz. Observe the output waveform on the scope and record the result below and compute Av= Vo/Vsig:

Measured Vo=

Calculated Av=

Task: 6

Calculate and measure DC bias values for the circuit shown below:



Calculated:

VB=

VE=

VC=

IE=

Calculated re=

Measured:

VB=

VE=

VC=

IE=

re = IE/RE

Task: 7

Draw Ac signal model of circuit given above:

Compute values of Av, Zi and Zo

Av=

Zi=

Zo=

Task: 8

Apply an AC input signal, Vsig=50mV, rms at f=1kHz. Observe the output waveform on the scope and record the result below and compute Av= Vo/Vsig:

Measured Vo=

Calculated Av=

Lab Exercise and Summary

Summary should cover Introduction, Procedure, Data Analysis and Evaluation.



Student's Signature: _____ **Date: _____**

LABORATORY SKILLS ASSESMENT (Psychomotor)

Total Marks: 100

Criteria (Max Marks)	Level 1 0% ≤ S < 50%	Level 2 50% ≤ S< 70%	Level 3 70% ≤ S< 90%	Level 4 90%≤ S ≤100%	Score (S)
Procedural Awareness (20)	Selects inappropriate skills and/or strategies required by the task	Selects and applies appropriate skills and/or strategies required by the task with some errors	Selects and applies the appropriate strategies and/or skills specific to the task without significant errors	Selects and applies appropriate strategies and/or skills specific to the task without any error	
Practical Implementation (30)	Makes several critical errors in applying procedural knowledge related to AC Analysis of Common Emitter and Common Base Amplifier	Makes few critical errors in applying procedural knowledge related to AC Analysis of Common Emitter and Common Base Amplifier	Makes some non-critical errors in applying procedural knowledge related to AC Analysis of Common Emitter and Common Base Amplifier	Applies the procedural knowledge in perfect ways related to AC Analysis of Common Emitter and Common Base Amplifier	
Safety (10)	Requires constant reminders to follow safety procedures	Requires some reminders to follow safety procedures	Follows safety procedures with only minimal reminders	Routinely follows safety procedures	
Use of Tool/Equipment (20)	Uses tools, equipment and materials with limited competence	Uses tools, equipment and materials with some competence	Uses tools, equipment and materials with considerable competence	Uses tools, equipment and materials with a high degree of competence	
Participation to Achieve Group Goals (10)	Shows little commitment to group goals and fails to perform assigned roles	Demonstrates commitment to group goals, but has difficulty performing assigned roles	Demonstrates commitment to group goals and carries out assigned roles effectively	Actively helps to identify group goals and works effectively to meet them in all roles assumed	
Interpersonal Skills in Group Work (10)	Rarely interacts positively within a group, even with prompting	Interacts with other group members if prompted	Interacts with all group members spontaneously	Interacts positively with all group members and encourages such interaction in others	
				Marks Obtained	

Instructor's Signature: _____ **Date: _____**

LABORATORY SKILLS ASSESMENT (Affective)

Total Marks: 40

Criteria (Max. Marks)	Level 1 0% ≤ S < 50%	Level 2 50% ≤ S < 70%	Level 3 70% ≤ S < 90%	Level 4 90% ≤ S ≤ 100%	Score (S)
Introduction (5)	Very little background information provided or information is incorrect	Introduction is brief with some minor mistakes	Introduction is nearly complete, missing some minor points	Introduction complete and well-written; provides all necessary background principles for the experiment	
Procedure (5)	Many stages of the procedure are not entered on the lab report.	Many stages of the procedure are entered on the lab report.	The procedure could be more efficiently designed but most stages of the procedure are entered on the lab report.	The procedure is well designed and all stages of the procedure are entered on the lab report.	
Data Record (10)	Data is brief and missing significant pieces of information.	Data provides some significant information and has few critical mistakes.	Data is almost complete but has some minor mistakes.	Data is complete and relevant. Tables with units are provided. Graphs are labeled. All questions are answered correctly.	
Data Analysis (10)	Data is presented in very unclear manner. Error analysis is not included.	Data is presented in ways (charts, tables, graphs) that are not clear enough. Error analysis is included.	Data is presented in ways (charts, tables, graphs) that can be understood and interpreted. Error analysis is included.	Data are presented in ways (charts, tables, graphs) that best facilitate understanding and interpretation. Error analysis is included.	
Report Quality (10)	Report contains many errors.	Report is somewhat organized with some spelling or grammatical errors.	Report is well organized and cohesive but contains some grammatical errors.	Report is well organized and cohesive and contains no grammatical errors. Presentation seems polished.	
				Marks Obtained	

LABORATORY SKILLS ASSESSMENT (Cognitive)

Total Marks: 10

(If any) **Marks Obtained**	

Instructor's Signature: _____ **Date: _____**