DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING
BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY
COURSE NO.: EEE 208
EXPT. NO. 03

Name of the Experiment: Study of Common Emitter (CE) Amplifier

Objective

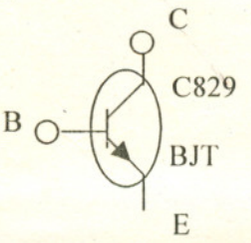
To know the effect of the frequency on the gain of a common emitter amplifier and also to measure the input impedance, output impedance and phase relationships of a CE amplifier.

Equipments Required

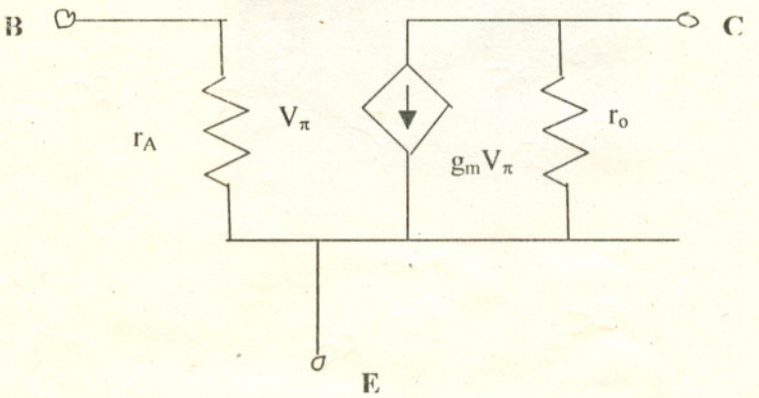
n-p-n transistor C828/C829	one piece
10k potentiometer	two piece
resistors	100Ω ,470Ω, 560Ω,5KΩ,33KΩ
capacitors	10μF,10μF,47μF
multimeter	one piece
bread board	one piece
power supply	one piece
signal generator	one piece
oscilloscope	one piece

Theory

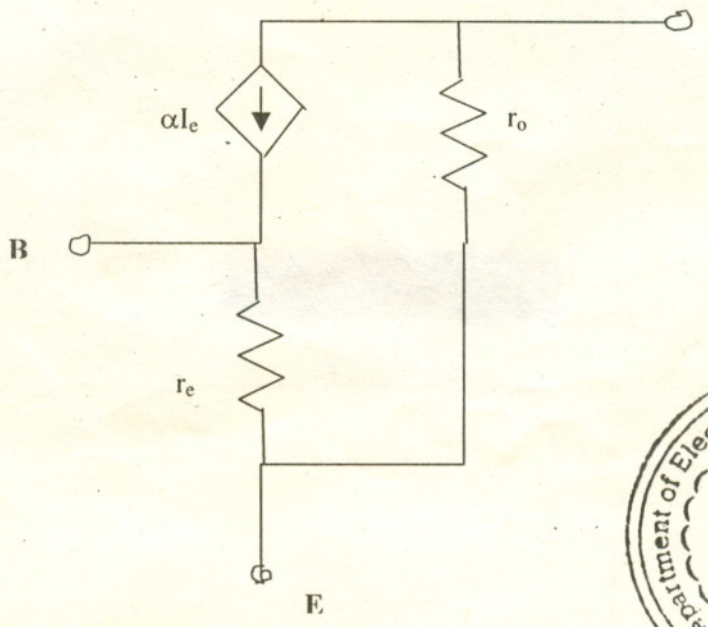
When a bipolar transistor operates in linear region, then principle of superposition can be applied. As a result, ac circuit can be separated from dc circuit. For small ac signal analysis, π or T model is used.



Small-signal π-model



Small-signal T-model



For π-model ,

$r_\pi = V_t/I_B$ and $g_m = \beta/r_\pi$ and $r_o = V_A/|I_C|$

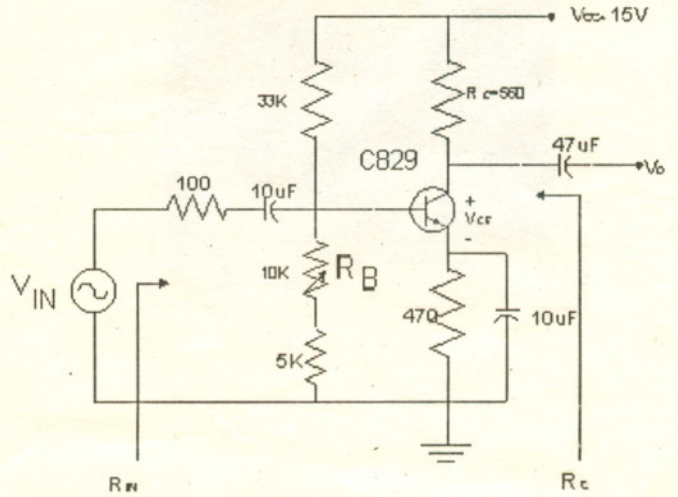
For T-model ,

$r_e = V_t / I_E$

V_A is the early voltage and $V_t = kT/q$ is thermal voltage.

We know that a p-n junction diode is associated with two types of capacitance, (i) junction capacitance and (ii) diffusion capacitance. A bipolar transistor consists of two junctions, emitter- base and collector-base junctions. At high frequency we cannot neglect the effect of capacitances on the performance of the transistor. At low and mid band frequencies, their effects can be neglected.

Circuit Diagram



CE Emitter Amplifier

Prelab (Home) Work

Students must perform the following Calculations before coming to the lab.

1. Draw the small signal equivalent Circuits of the CE Amplifier Circuit.
2. Obtain an expression for the voltage gain (V_0/V_{in}).
3. Remove $C_E = 10\mu F$ and obtain voltage gain.
4. Obtain an expression for output resistance R_0.

Procedures

1. Construct the circuit as shown in the circuit diagram for CE amplifier. Adjust 10K potentiometer until V_{CE} is approximately equal to $V_{CC}/2$ by multimeter.
2. Set the signal generator frequency at 5KHz. Ch.2 is connected to V_O. Apply and increase input signal until you see distorted output signal. Set V_{in} below this value 100mV. Connect V_{IN} to ch.1. Measure peak value of both V_{in} and V_O.
3. Set the oscilloscope in dual mode. Observe the phase relationship between input and output.
4. Connect the 10KΩ potentiometer from V_O to ground. Adjust the 10 KΩ potentiometer until V_O is half the open circuit value. Measure the output impedance from potentiometer.
5. Disconnect ch.2 and connect ch.1 across 100Ω and measure peak value.
6. Disconnect the bypass capacitor and observe the effect on gain.
7. Reconstruct the circuit as shown in Fig. 1. Set the signal frequency at 50 Hz. Measure the input and output.
8. Repeat step 7 for frequency 100Hz, 200Hz, 500Hz, 800Hz, 1KHz, 2KHz etc., until higher cut-off frequency is found ensuring constant input for all steps.
9. Observe the phase relationships between input and output below lower cutoff and higher cutoff frequency.

Reports

1. Plot the gain in dB as a function of frequency in a semi-log paper.
2. From the graph paper determine the lower cutoff frequency, higher cutoff frequency and mid-band gain for this common emitter amplifier.
3. What is the input impedance, output impedance and phase relationship between input and output for CE amplifier and comment on them?
4. What is the function of bypass capacitor and dc blocking capacitor?

5. What is the advantage and disadvantage of common emitter amplifier?

6. Using measured value of R_B, Calculate voltage gain from prelab expressions for $\beta = 75$. If value of g_m and r_π required, determine g_m and r_π from dc analysis for the circuit.

Updated by: Yeasir Arafat on 7th February, 2006