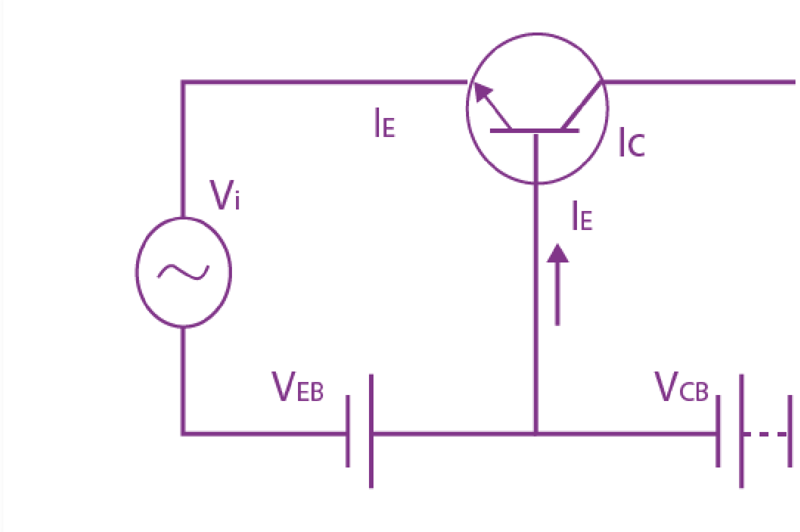
Transistor As Amplifier

One of the key characteristics of a transistor is that it can be use
Transistors can act as amplifiers while they are functioning in th
is correctly biased. The need for transistor as an amplifier arises
or amplify the input signal. A transistor can take in a very small v
base junction and release the amplified signal through the collec

Transistors amplifiers are used frequently in RF (radio frequency
communication), audio amplification, etc. In this lesson, we will l
transistor works as an amplifier.

Common-Emitter Configuration

For a transistor to work as an amplifier we usually use the common-emitter configuration. The figure below shows how the transistor is set up when it is connected in a circuit as an amplifier.

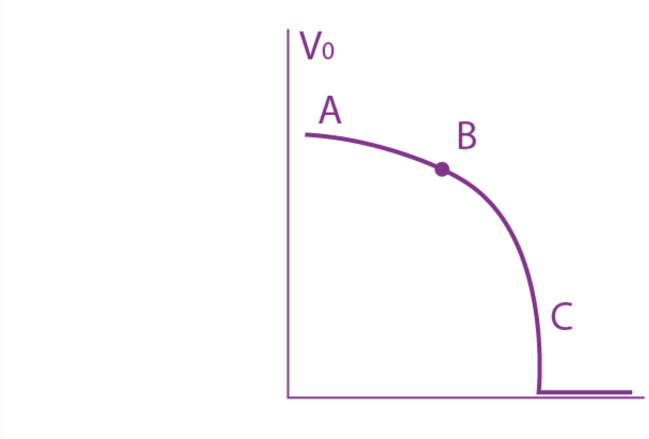


In the figure given above, the input is connected in forward-biase connected in reverse-biased. The input signal is applied on the b the output is taken through the load in emitter-collector junction. There is also an application of DC voltage in the input circuit for amplification. Besides, a small change in signal voltage results in the change of emitter current which is n resistance in the input circuit.

Also Read: Forward Bias

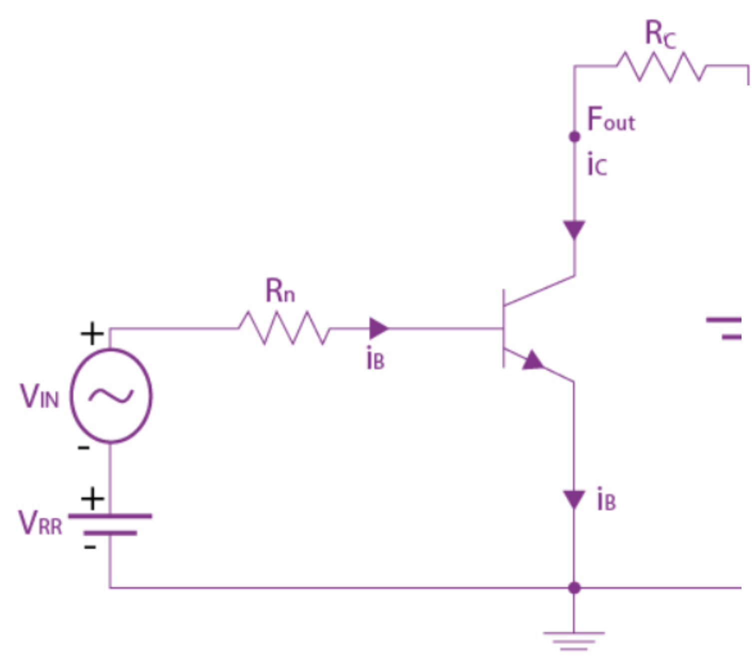
The output is taken across the load connected on the output sid combination of R, L or C. The load resistance is of high value wh drop. Overall, the weak signal is thus amplified in the collector ci

However, to work as an amplifier, the transistor has to work in th output voltage versus input voltage curve as seen in the figure b



In the above graph, we have AB as the cut-off region, BC as the a
we have a line parallel to X-axis, which is the saturation region.

Gain in Power, Current and Voltage



From the figure that is given above it is clear that on the output s
V_0 is the output voltage, I_c is the collector current, R_c is the load ı
voltage on the output side.

If we consider ΔV_0 and ΔV_i as small changes in output and input
$\Delta V_0 / \Delta V_i$ is called as the small-signal voltage gain, A_v of the amp

Therefore, $\Delta V_0 = 0 - R_c \Delta I_C$

The gain in terms of voltage when the changes in input and outp
called Voltage gain.

Similarly in input side,

$V_{in} = I_B R_B + V_{BE}$

Or

$\Delta V_{in} = \Delta I_B R_B + \Delta V_{BE} \sim \Delta V_{in} = \Delta I_B R_B \ (\Delta V_{BE} << \Delta I_B R_B)$

Or,

$A_v = \Delta V_0 / \Delta V_{in} = - R_c \Delta I_C / R_B \Delta I_B = -\beta_{ac} R_c / R_B$

where $\beta_{ac} = \Delta I_C / \Delta I_B$ is the AC current gain.

When there is gain in terms of current due to the changes in inpu
called current gain. β value can range between 20 to 500.

Power gain of an amplifier is defined as the product of the curre
the amplifier. It is also defined as the rate of change in output pc
power.

Mathematically, $A_p = \beta_{ac} \times A_v$

Use of Capacitors

We have a coupling capacitor that is used to couple the AC com
DC component contained in the input signal of the amplifier. At t
the DC component will be invariantly present due to the amplific

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being removed by the coupling capacitor at the output and henc
signal being supplied to the load connected at the output.

Also Read: Capacitor Types and Capacitance

Similarly, we do have an Emitter- bypass Capacitor C_E. When AC amplifier circuit, the variable current will flow through resistors c and emitter, i.e., R_C and R_E. This current in R_E will develop a varia and provides additional negative feedback to the emitter junctio

This will result in an overall reduction of voltage gain associated capacitor C_E connected across R_E provides a short circuit path f reduce the effect of additional negative feedback due to the AC reduction in voltage gain.

Role of Resistance

The resistors R_1 and R_2 form the voltage division circuit to suppl base of the transistor. The resistors R_C and R_E control the collector and emitter currents respectively. Proper selection of these resistors helps us to cont currents. These resistors provide the required junction voltages currents I_E, I_B and I_C to work the transistor in the active region of

The emitter resistor R_E produces the following changes in the pe

- It causes bias stabilization
- It causes current gain to remain essentially unaltered.
- Increases the input and output impedances.
- It stabilizes the voltage gain.

Also Read: Transformer

The Need for CE Configuration

We usually employ CE configuration for transistors as amplifiers values of current gain, voltage gain and power gain. Moreover, th

degrees between input and output. It implies the output signal w
version of the signal given in the input.

As we come to the end of the lesson, we have to know and reme
amplifier in order to function properly must have the following th

- High input impedance.
- High gain.
- High slew rate.
- High bandwidth.
- High efficiency.
- High stability.
- High linearity.

Solved Problems

1. Consider a CE- transistor made to work as an amplifier. The a across the collector resistance of 2 KΩ is 2 volts. Suppose the factor of the transistor is 100 and base resistance is 1 KΩ, dete voltage and base current?

Answer:

Given R_C = 2 KΩ = 2000 Ω; V_C= 2V; β_{ac} = 100; R_B = 1KΩ = 1000 Ω

Collector current, $I_c = V_c/R_c$ = 2/2000 = 1 mA

$I_B = V_B/R_B = V_B/1000 = V_B$ mA

$\beta_{ac} = 100 = I_C/I_B = 1/V_B$

V_B = 1/100 = 0.01 V

Therefore, $I_B = V_B$ m A = 0.01 / 1000 = 10 * 10^{-6} A = 10 μA.

2. 2 amplifiers are connected in a series (cascaded). The voltage gain of the first amplifier is 10 and the second has 20 voltage gain. The input signal is given as 0.01 V.

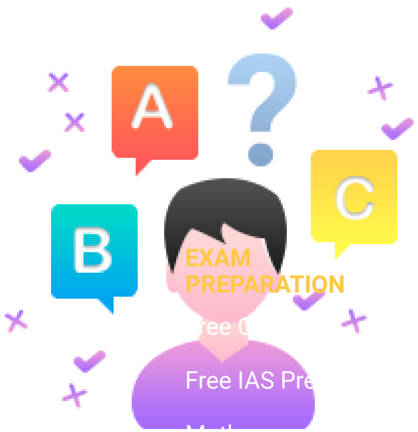
Calculate the output of the AC signal?

Answer:

Total voltage gain is $A_V = A_{V1} * A_{V2} = \Delta V_o / \Delta V_i$

$\Delta V_o = \Delta V_i * A_{V1} * A_{V2} = 0.01 * 10 * 20 = 2V$

Test Your Knowledge On Transistor As Amplifier!



Put your understanding of this concept to test by answering a few MCQs. Click 'Start Quiz' to begin!

Select the correct answer and click on the "Finish" button
Check your score and answers at the end of the quiz