

Bipolar Junction Transistor (BJT)

characteristics & applications

AIM:-

1. To study the BJT characteristics in CE mode
2. To design and construct an amplifier using BJT
3. To design and construct an oscillator using BJT

APPARATUS:-

Bread boards, dc and ac power supply, connecting wires, DMM, oscilloscope, transistors

THEORY:-

Introduction

BJT is a 3 layer semiconductor device consisting of 2 n and 1 p type layers (npn BJT with, 2 junctions n-p, p-n) or 2 p and 1 n type (pnp BJT with 2 junctions p-n, n-p) layers.

One p-n junction of a transistor is reverse-biased, whereas the other is forward-biased.

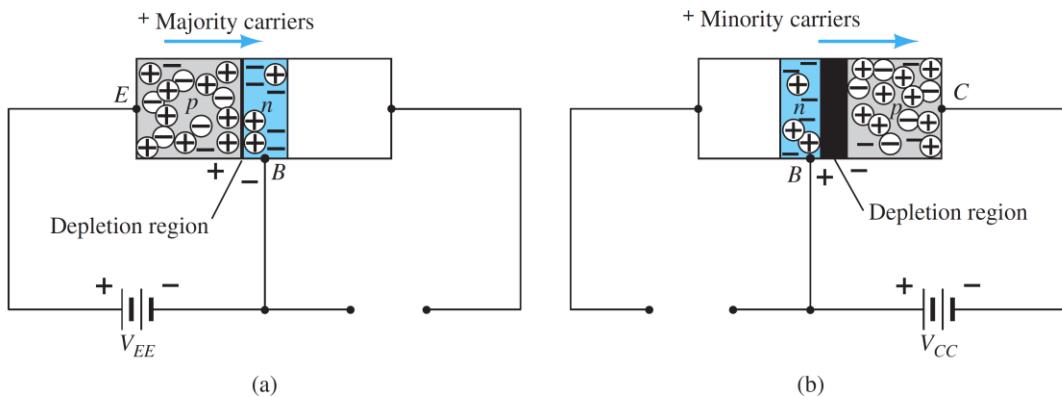


FIG. 3.4

Biasing a transistor: (a) forward-bias; (b) reverse-bias.

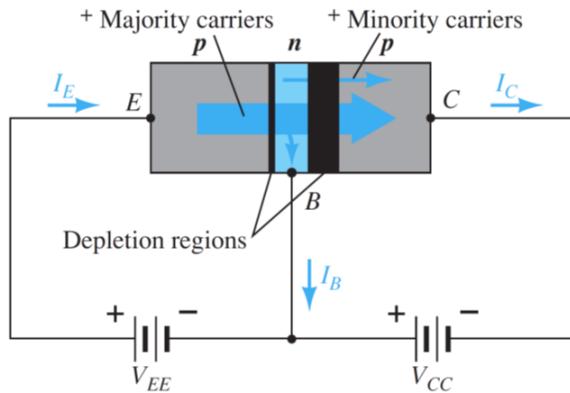


FIG. 3.5

Majority and minority carrier flow of a pnp transistor.

Applying Kirchhoff's current law to the transistor of Fig. 3.5 as if it were a single node, we obtain

$$I_E = I_C + I_B \quad (3.1)$$

Transistor testing with DMM

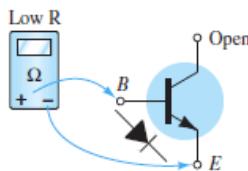


FIG. 3.27

Checking the forward-biased base-to-emitter junction of an npn transistor.

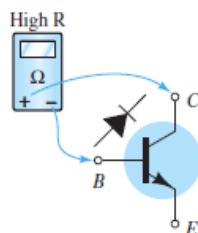


FIG. 3.28

Checking the reverse-biased base-to-collector junction of an npn transistor.

Transfer characteristics in CE mode

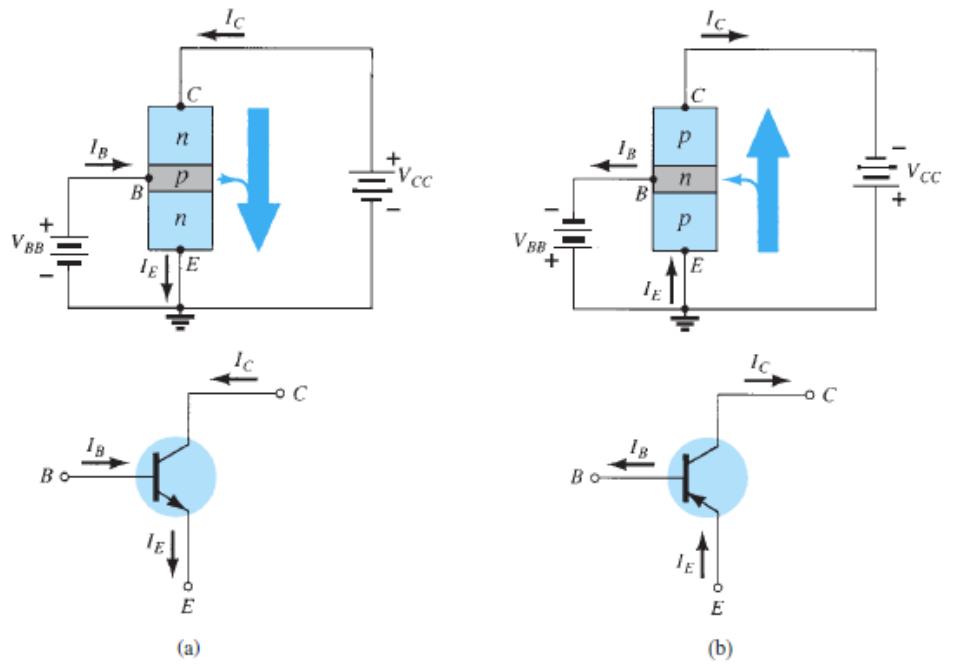


FIG. 3.12
Notation and symbols used with the common-emitter configuration: (a) npn transistor;
(b) pnp transistor.

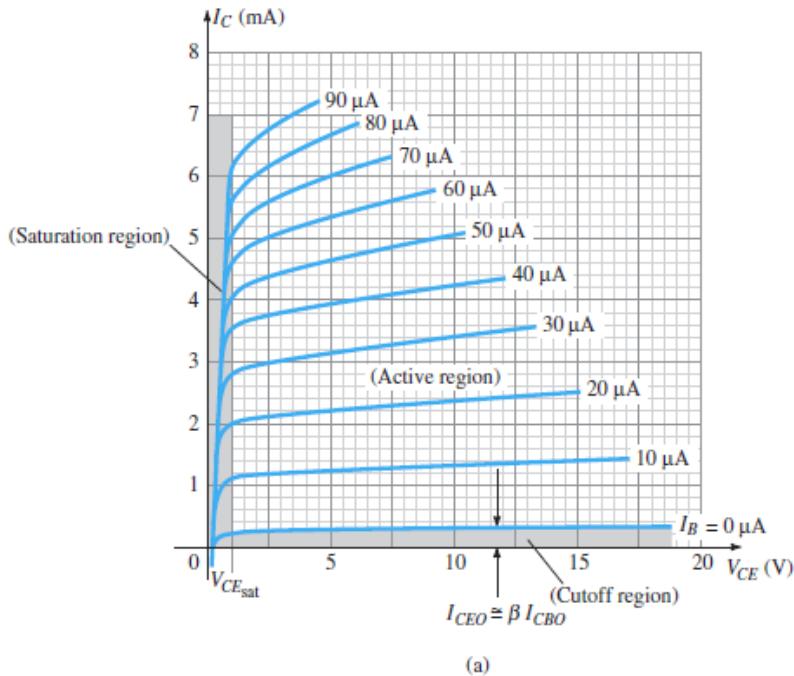
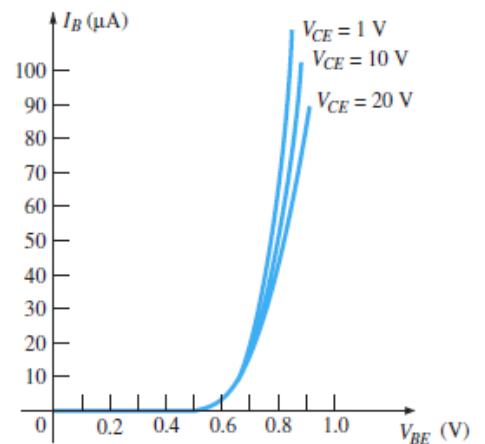


FIG. 3.13

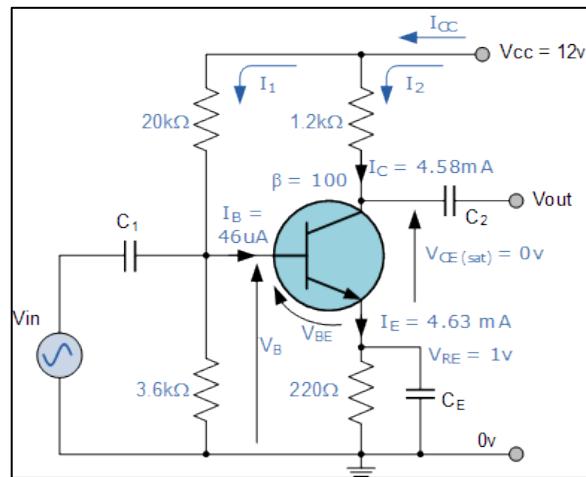
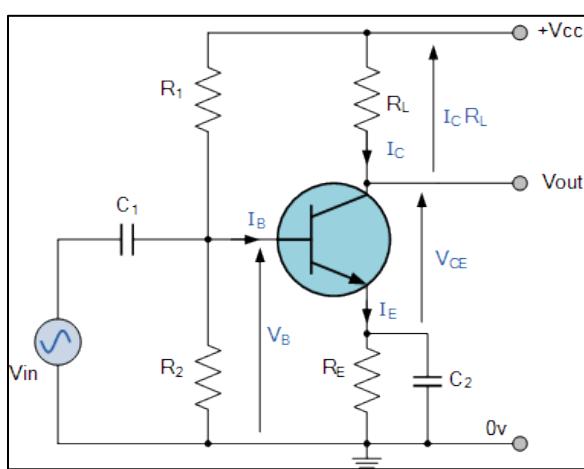
Characteristics of a silicon transistor in the common-emitter configuration: (a) collector characteristics; (b) base characteristics.



PROCEDURE:-

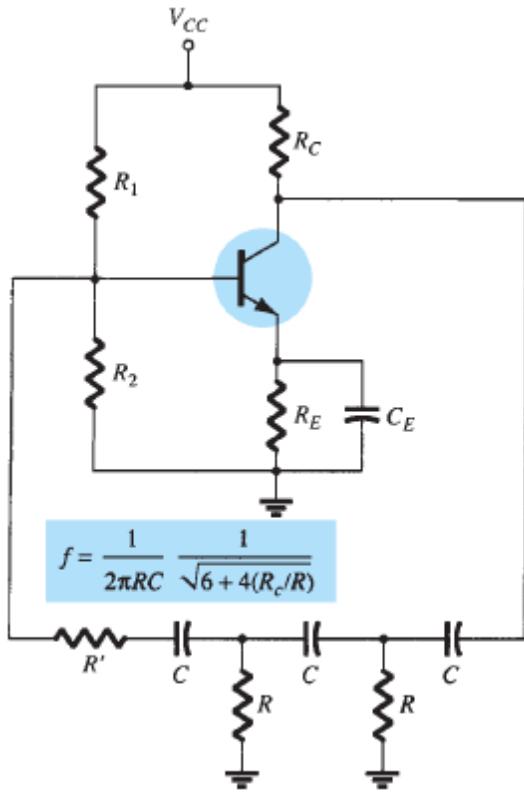
1. For transistor characteristics

- Test the transistor using the DMM as mentioned above
- Connect the transistor in CE mode as per the following circuit-



- current gain $\beta_{dc} = \frac{\Delta I_C}{\Delta I_B}$
- voltage gain $= \frac{V_{out}}{V_{in}} = \frac{\Delta V_L}{\Delta V_B} = -\frac{R_L}{R_E}$
- To test the input characteristics plot input current (I_B) versus the input voltage (V_{BE}) for a range of output voltage V_{CE}
- To test the output characteristics plot the output current (I_c) versus the output voltage (V_{CE}) for different values of input current I_B

2. For phase shift oscillator



- Use the above circuit to construct a phase-shift oscillator.
- For 1 kHz operation choose R and C for the RC network and proceed with the circuit design. You can use the circuit from the previous section for the transistor part.

REFERENCES:-

1. Boylestad & Nashelsky, 11th edition
2. http://www.electronics-tutorials.ws/amplifier/amp_2.html