(1)

TOPIC:- FEEDBACK AMPLIFIERS

UG-III

When output of an electric network is connected to its input, transfer of energy takes place. This process is known as feedback. If the electric network is a transistor then it is called feed back amplifier.

There are two types of feedback, a negative feed back and a positive feed-back depending upon reduction and increase in the magnitude of input signal due to feedback signal.

A block diagram of a feedback amplifier is shown in fig (1). It consists of a basic or internal amplifier and a feedback network. The symbol A in this figure represents the ratio of the output voltage V_0 to the input voltage V_i and is called the transfer gain of the amplifier without feedback

i.e. $A = \frac{v_0}{v_i}$

$\therefore v_0 = A v_i \longrightarrow (1)$

And A_f, the transfer gain with feedback which is defined as

$$A_f = \frac{v_0}{v_s} \longrightarrow (2)$$

The feedback network in fig (1) and contains passive element such as resistors, capacitors or inductors. It may also contain active element such as transistor.

(2)

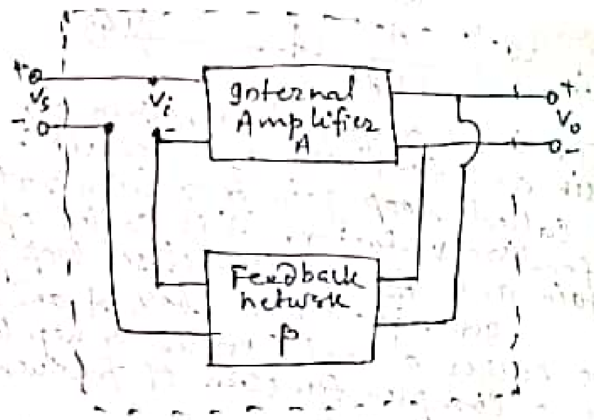


Fig (1)

The feedback network extracts a portion $V_f = \beta V_0$ from the output voltage V_0 of the amplifier which is added to or subtracted from the externally applied signal voltage V_s depending upon whether the feedback is positive or negative.

i.e. $V_i = V_s \pm V_f \longrightarrow (3)$

For negative feed back,

$$V_i = V_s - V_f$$

or $AV_i = AV_s - AV_f$

$= AV_s - A\beta V_0$ from (1)

or V_0

or $(1 + A\beta) V_0 = AV_s$

$$\therefore \frac{v_o}{v_s} = \frac{A}{1+A\beta} = A_f \longrightarrow (4)$$

This is the required expression for overall gain with feedback A_f in which $(-A\beta)$ is called loop gain or return ratio or feedback factor. 'A' is called open-loop gain and A_f is called closed loop gain.

In equation (4), both A and β may be either a real (positive or negative) or a complex function of frequency. In either case,

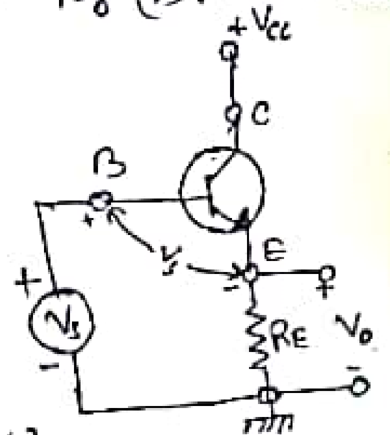
(i) if $|1+A\beta| > 1$, i.e the magnitude of return difference $[1-(-A\beta)]$ is greater than 1, then $|A_f| < |A|$ and the feedback is negative

(ii) if $|1+A\beta| < 1$ i.e the magnitude of difference between unit & loop gain i.e $(1+A\beta)$ is less than unity, then $|A_f| > |A|$ and the feedback is positive

(iii) if $|1+A\beta| = 0$, $|A_f| = \infty$, the amplifier is then capable of sustaining an output even though its input is zero, i.e, the amplifier becomes an oscillator.

EXAMPLE OF NEGATIVE FEEDBACK

The emitter follower circuit is an example of negative feedback. It is shown in fig (2). Here the output voltage V_o is developed across the load resistance R_L connected to the emitter. The whole of this voltage is returned to its input, so



$$\beta = 1. \quad (\because V_f = V_o)$$

$$\therefore A_f = \frac{A}{1+A} \longrightarrow (5)$$

The value of A can be calculated by transforming R_L from the emitter to collector. In this case

$$A \simeq \frac{h_{fe} R_L}{h_{ie}} \longrightarrow (6)$$

from eq^n (5) & (6), we obtain

$$A_f = \frac{h_{fe} R_L}{h_{ie} + h_{fe} R_L} \longrightarrow (7)$$

Thus the voltage gain is less than unity. Hence emitter follower circuit is an example of negative feedback.