# 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 $V_o$ to the input voltage $V_i$ and is called the transfer gain of the amplifier without feedback

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

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

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

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

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



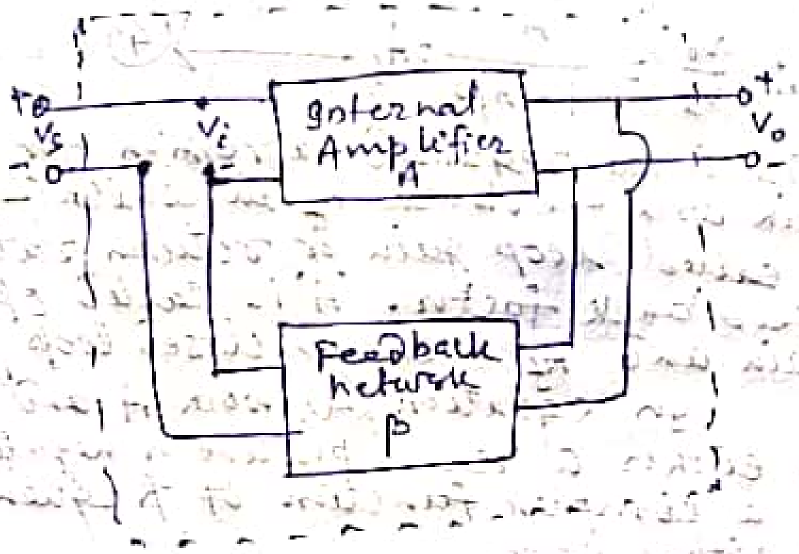



Fig (1)

The feedback network extracts a portion $V_f = \beta V_o$ of the output voltage $V_o$ 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 $AV_i = AV_s - AV_f$

or $V_o = AV_s - A\beta V_o$ from (1)

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

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

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 $\beta$ 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

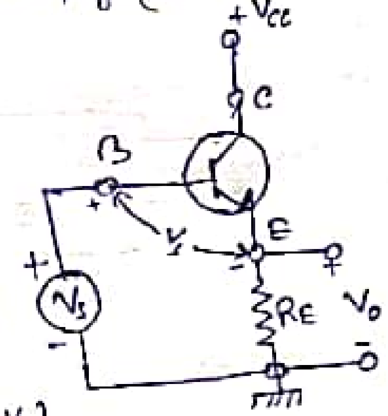
(ii) if $|1+A\beta| < 1$ i.e the magnitude of difference between unit & loop gain i.e $(1+A\beta)$ is less than unity, then $|A_f| > |A|$ and the feedback is positive

(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




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

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

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.