1.1 FEEDBACK CONCEPTS:

- Definition: The amplifier in which a part of output is sampled and fed back to the input of the amplifier is called feedback amplifier
- Feedback is used to make the operating point of a transistor insensitive to both manufacturing variations in as well as temperature.

TYPES:

- **Positive feedback**: the input and part of the output which fed back to the input are in phase, the feedback is called positive feedback.

  If the net effect of the feedback is to increase the magnitude of the input signal,it is called as Positive.
- **Negative feedback**: both the signals are out of phase, the feedback is called negative feedback.

ADVATAGES OF NEGATIVE FEEDBACK:

- Stabilization of Gain
- Reduction in Distortion
- Reduction in Noise
- Increase in Input Impedance
- Decrease in Output Impedance
- Increases the range of Uniform Amplification.

COMPARISON OF POSITIVE AND NEGATIVE FEEDBACK:

S.No	Parameter	Positive feedback	Negative feedback
1	Phase shift b/w f/b signal and input signal	0 or 360	180
2	F/B signal and I/P signal	In phase	Out of phase
3	I/P Voltage	Increases	Decreases
4	O/P Voltage	Increases	Decreases
5	Voltage Gain	Increases	Decreases

6	Distortion	Increases	Decreases
7	Stability	Decreases	Increases
8	Application	Oscillator & Schmitt trigger	Amplifiers

1.1.1 GENERAL FEEDBACK STRUCTURE

The general feedback structure of feedback amplifier is shown in figure 1.1.1. The basic feedback amplifier consists of five basic elements. These are: Input & Output signals, Basic Amplifier, Sampling Network, Comparison or Summing Network and feedback network.

Input Signal:

- The signal source is modeled either by a voltage source V_s in series with a resistance R_s, or by a current source I_s in parallel with a resistance R_s.

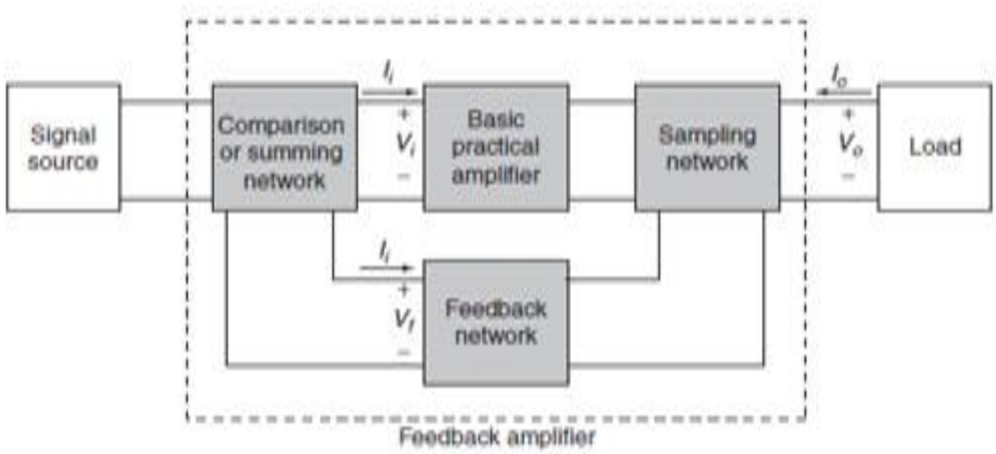

Fig1.1.1.Block diagram of a basic feedback amplifier

(Source: Microelectronics by J. Millman and A. Grabel, , 2nd ed., Page-203)

Output Signal:

- The output can either be the voltage across the load resistance R_L or the current through it. It is the output signal that is desired to be independent of the load and insensitive to parameter variations in the basic amplifier.

Sampling Network:

- There are two ways to sample the output, according to the sampling parameter, either voltage or current.

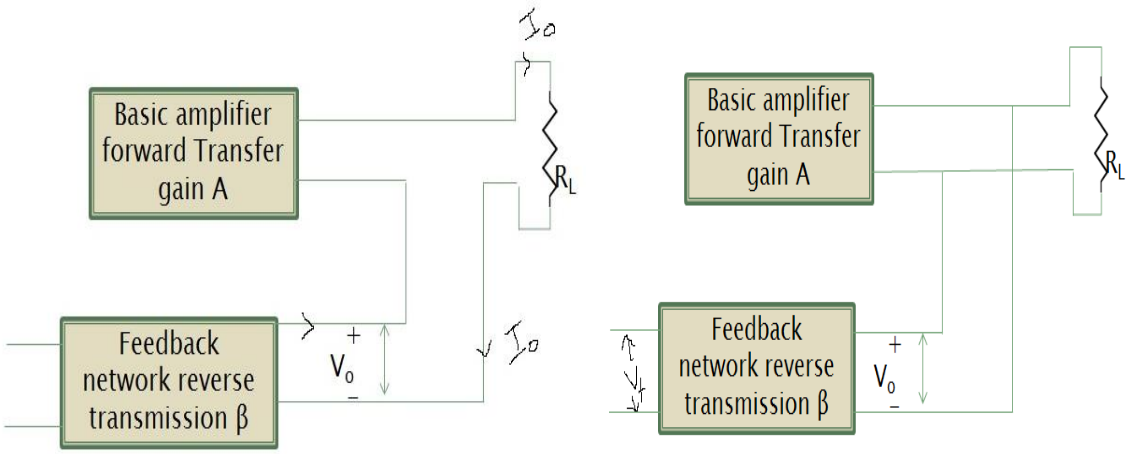

Fig1.1.2. (a) voltage (node) & (b) Current (loop) sampling

(Source: Microelectronics by J. Millman and A. Grabel, , 2nd ed., Page-203)

- The output voltage is sampled by connecting the feedback network in shunt across the output, as shown in 1.1.2 (a). This type of connection is referred to as voltage sampling.
- The output current is sampled by connecting the feedback network in series with the output, as shown in 1.1.2 (b). This type of connection is referred to as current sampling.

Feedback network:

- It may consists of resistor, Capacitors, inductors (resistive configuration)
- Provides reduced portion of the output as feedback signal to the input mixer network. $V_f = \beta V_o$
- β feedback factor or feedback ratio (lies b/w 0 to 1)

Mixer Network:

- There are two ways of mixing feedback signal with the input signal
- Series input mixing in fig 1.1.3 (a) shunt input mixing in fig 1.1.3 (b)

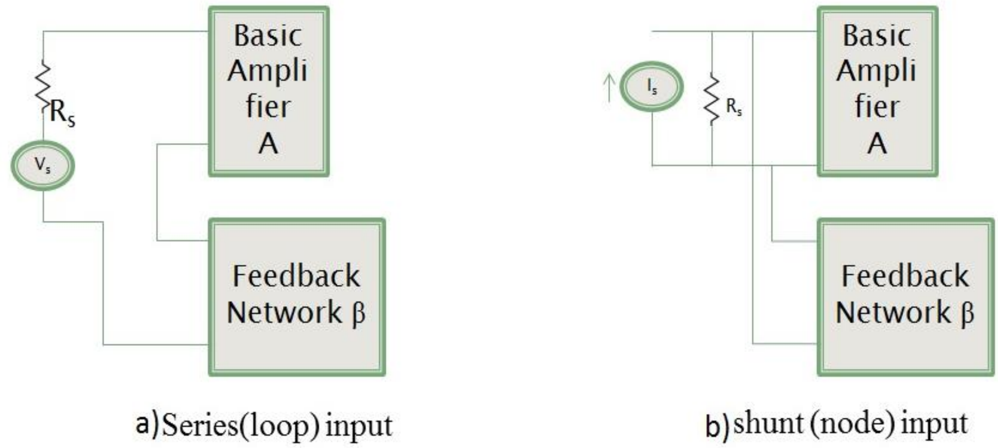

Fig.1.1.3. (a) series & (b) shunt mixing

(Source: Microelectronics by J. Millman and A. Grabel, , 2nd ed., Page-203)

TRANSFER RATIO OR GAIN

- the ratio of the output signal to the input signal of the basic amplifier is represented by the symbol A

$\frac{V}{V_i} = A_v$ = Voltage gain $\qquad \frac{V_o}{V_s} = A_{vf}$ = Voltage gain with feedback

$\frac{I}{I_i} = A_i$ = Current gain $\qquad \frac{I_o}{I_s} = A_{if}$ = Current gain with feedback

$\frac{I}{V_i} = G_m$ = Transconductance $\qquad \frac{I_o}{V_s} = G_{Mf}$ = Transconductance with feedback

$\frac{V}{I_i} = R_m$ = Transresistance $\qquad \frac{V_o}{I_s} = R_{Mf}$ = Transresistance with feedback

- The four quantities A_v, A_i, G_m, and R_m are referred to as a transfer gain of the basic amplifier without feedback
- The four quantities A_{vf}, A_{if}, G_{Mf}, and R_{Mf} are referred to as a transfer gain of the basic amplifier with feedback

1.2 GAIN WITH FEEDBACK

- Gain without feedback (A) is always greater than gain with feedback {A / (1 + β A)] and it decreases with increases in β

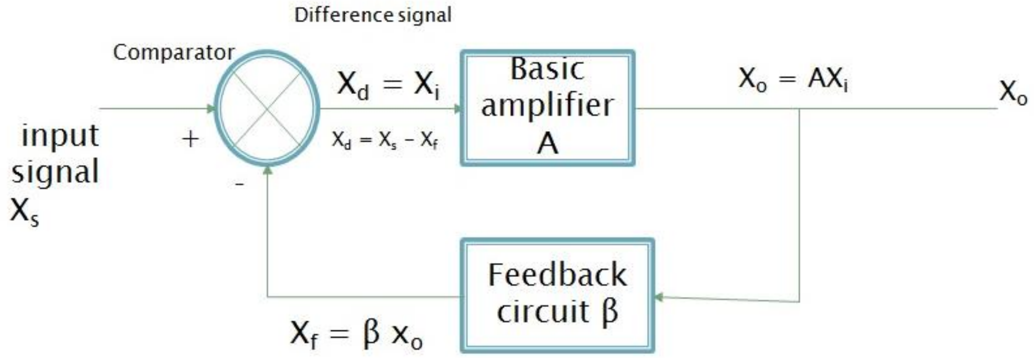

Fig.1.2.1. schematic representation of negative feedback amplifier

(Source: Microelectronics by J. Millman and A. Grabel, , 2nd ed., Page-204)

$$A_f = \frac{A}{1 + \beta A}$$

For voltage amplifier, gain with negative feedback is given by,

$$A_{vf} = \frac{A_v}{1 + \beta A_v}$$

A_V = open loop gain

β = feedback factor

LOOP GAIN

- In fig 1.2.1 The difference signal, X_d is multiplied by A in passing through the amplifier, is multiplied by β in transmission through the feedback network , and is multiplied by -1 in the mixing or difference network.
- The gain of this loop is the product -A β .This gain is known as loop gain or return ration