Dated : 16.03.2020

# UNIT 5

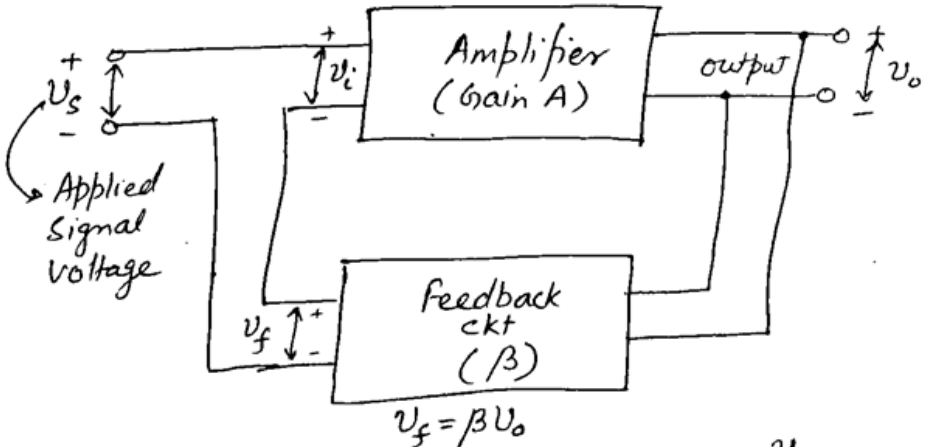


## FEEDBACK IN AMPLIFIERS

[4 Lectures]

⇒ An Amplifier circuit amplifies (increases) signal strength (Not only information but also noise)

### Principle of Feedback in Amplifier




$A$ = Gain of the Amplifier ckt $= \frac{v_o}{v_i}$

⇒ Feedback network provides a fraction of output as the feedback voltage to the input section of Amplifier ckt

So $v_f = \beta v_o$ , $\beta < 1$ (Called "Feedback Ratio/Fraction")

**Positive Feedback:** $v_i = v_s + v_f = v_s + \beta v_o$

**Negative Feedback:** $v_i = v_s - v_f = v_s - \beta v_o$

# How Gain (A) is affected in feedback ?

**Negative feedback:** The gain is given as The ratio of output voltage ($v_o$) to The input volt ($v_i$)

($A$ — Gain without feedback)

so $A_{neg} = \frac{v_o}{v_i} = \frac{v_o}{(v_s - \beta v_o)}$

$\Rightarrow A_{neg}(v_s - \beta v_o) = v_o$

$\Rightarrow A_{neg} v_s = v_o(1 + \beta A)$

$\Rightarrow \boxed{\frac{v_o}{v_s} = \frac{A}{(1+\beta A)}} = A_{fn}$ (overall gain with the Negative Feedback of Amplifier)

So $\boxed{A_{fn} = \text{Gain with Negative Feedback} = \frac{A}{(1+\beta A)}}$ & $\boxed{A_{fn} < A}$ $\because (1+\beta A) > 1$

(*) $\Rightarrow$ So Negative Feedback reduces / decreases the Gain of the Amplifier ckt.

**Positive Feedback:** Again $A = \frac{v_o}{v_i} = \frac{v_o}{(v_s + \beta v_o)}$

$\Rightarrow A(v_s + \beta v_o) = v_o \Rightarrow A v_s = v_o(1 - \beta A)$

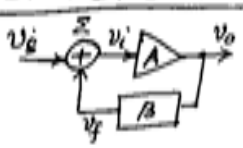
$\Rightarrow \boxed{\frac{v_o}{v_s} = \frac{A}{(1-\beta A)} = A_{fp}} =$ Gain with Positive Feedback

Since $(1 - \beta A) < 1$ so $\Rightarrow$ $\boxed{A_{fp} > A}$

i.e (*) $\Rightarrow$ Positive feedback Increases the Gain of the Amplifier ckt.

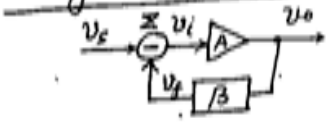
# Advantages/Disadvantages of Feedback

**Positive Feedback:** In this case the feedback, i.e the part of output signal (voltage or current), is in phase (360°) with the input signal and hence enhances/increases it.




- It "Increases" the Gain ($A_{fp}$) of the Amplifier.
- However, it also increases Distortion (Noise) in ckt.
- Increases Instability in the ckt.
- Used in 'Oscillator Circuits'.
- It is also called 'Regenerative Feedback'.

**Negative Feedback:** In this case the feedback part (voltage/current) is out of Phase (180° differena) with input signal & hence reduces/decreases it.




- It "Decreases" the Gain ($A_{fn}$) of the Amplifier, but Gain is Stabilized
- But "Distortion" is Reduced (Harmonic or Nonlinear) in all 4 types of feedback
- "Noise" is Reduced
- Input Impedance/Resistance Changes
- Output Impedance/Resistance Changes ] as given below in Table.
- Operating Point is Stabilized.
- Used in a wide range of applications:
  - Amplifiers, Regulated Power supply etc.
- It is also called 'Degenerative Feedback'.
- Bandwidth is increased/extended in all 4 types of feedback (Negative)

| Feedback | Volt. Series | Current Series | Volt. Shunt | Current Shunt |
|---|---|---|---|---|
| $R_{if}$ | $R_i(1+\beta A)\uparrow$ | $R_i(1+\beta_m A_m)\uparrow$ | $\frac{R_i}{(1+\beta A_m)}\downarrow$ | $\frac{R_i}{(1+\beta_m A)}\downarrow$ |
| $R_{of}$ | $\frac{R_o}{(1+\beta A)}\downarrow$ | $R_o(1+\beta_m A_m)\uparrow$ | $\frac{R_o}{(1+\beta_m A_m)}\downarrow$ | $R_o(1+\beta A)\uparrow$ |