Topic:- Logarithmic and Exponential Amplifier

P.G.(III)

The circuit of operational amplifier developing a logarithmic relation between input voltage and output voltage is called "Logarithmic Amplifier". A logarithmic Amplifier is formed by replacing feedback resistor R_f of an inverting amplifier by a diode or a transistor. The circuit of the logarithmic amplifier is shown in fig (1)

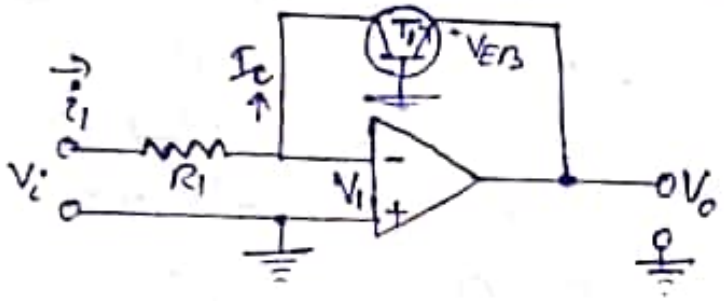

Fig (1)

A transistor T_1 is used in a common - base connection in the feedback loop. With $V_i = 0$ and the base at ground, then $V_{CB} = 0$ as well. The collector current is dependent on V_{EB} in the usual exponential relation

$$I_c = M e^{V_{EB}/(kT/e)} \longrightarrow (1)$$

where M depends on temperature for a given transistor. Taking the logarithm, we have

$$\log \frac{I_c}{M} = \frac{V_{EB}}{(kT/e)}$$

$$\therefore V_{EB} = \frac{kT}{e} \log \frac{I_C}{M} \longrightarrow (2)$$

The emitter of the transistor is connected to the output of the Op-AMP so that-

$$V_0 = V_{EB} \text{ and } I_C = i_1 = \frac{V_i}{R_1}$$

∴ The output voltage becomes

$$V_0 = \frac{kT}{e} \log \frac{V_i}{MR_1} \longrightarrow (3)$$

Thus the output voltage of the amplifier is proportional to the logarithm of the input voltage.

Anti logarithmic Amplifier

The Op-AMP is used for multiplication of variables. The variable voltages are converted to their logarithms, the logarithms are added in a summing amplifier, and the result is converted to numerical form through an anti-logarithmic amplifier.

The later circuit uses a common-base transistor or a diode as the input component in place of R_1 and a resistor as R as the feed back element.

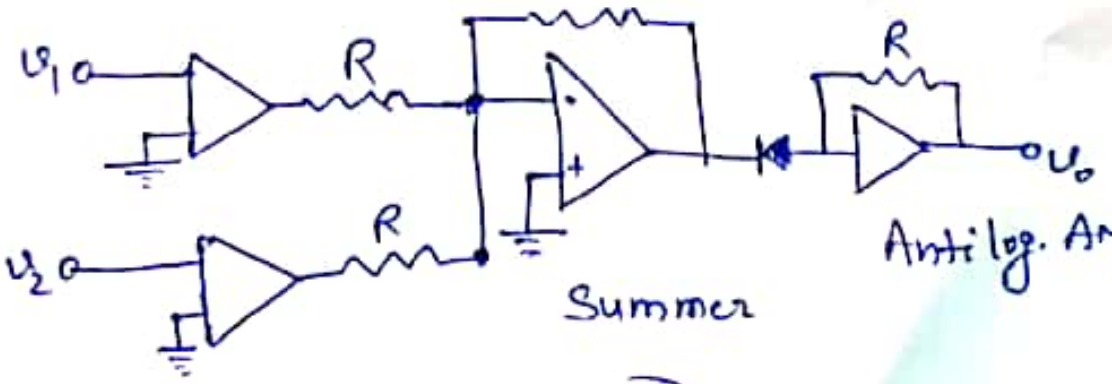

Fig (2)