M.Sc. Sem III

MPHYCC-12

electronics II

OP-amp

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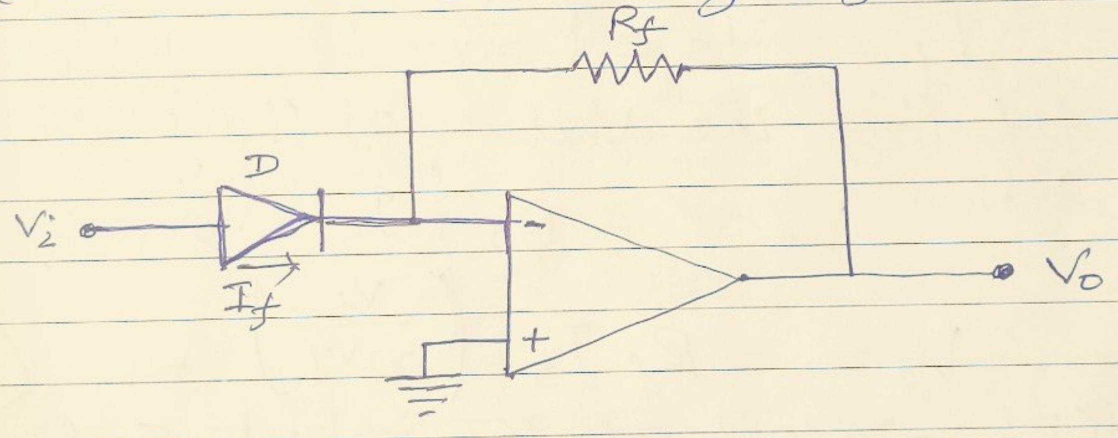
Anti Logarithmic (exponential) amplifier:-

An anti-logarithmic amplifier, or an anti-log amplifier, is an electronic circuit that produces an output that is proportional to the anti-logarithm of the applied input. This section discusses about the op-amp based anti-logarithmic amplifier in detail.

An op-amp based anti-logarithmic amplifier produces a voltage at the output, which is proportional to the anti-logarithm of the voltage i.e., applied to the diode connected to its inverting terminal.

The circuit diagram of an op-amp based anti-logarithmic amplifier is shown in the following figure —



In the circuit shown above, the non inverting input terminal of the op-amp is connected to ground. It means zero

Volts is applied to its non-inverting input terminal.

According to the Virtual Short Concept, the voltage at the inverting input terminal of op-amp will be equal to the voltage present at its non-inverting input terminal. So, the voltage at its inverting input terminal will be zero volts.

The Nodal equation at the inverting input terminal node is —

$$-I_f + \frac{0 - V_o}{R_f} = 0$$

$$\Rightarrow -\frac{V_o}{R_f} = I_f$$

$$\Rightarrow V_o = -R_f I_f \quad \text{---- (4)}$$

We know that the equation for the current flowing through a diode, when it is in forward bias, is as given below—

$$I_f = I_s e^{\left(\frac{V_f}{nV_T}\right)}$$

Substituting the value of I_f in eqn (4), we get

$$V_o = -R_f \left\{ I_s e^{\left(\frac{V_f}{nV_T}\right)} \right\}$$

$$V_o = -R_f I_s e^{\left(\frac{V_f}{nV_T}\right)} \quad \text{—— (5)}$$

The KVL eqn at the input side of the inverting terminal of the op-amp will be

$$V_i - V_f = 0$$

$$V_f = V_i$$

No.

Substituting, the value of in the equⁿ (5) we get ——

$$V_o = -R_f I_s e^{\left(\frac{V_i}{nV_T}\right)}$$

Note that, in the above equⁿ the parameters n, V_T and I_s are constants. So, the output voltage V_o will be proportional to the anti natural logarithm (exponential) of the input voltage V_i for a fixed value of feedback resistance R_f.

Therefore, the op-amp based anti-logarithmic amplifier circuit discussed above will produce an output, which is proportional to the anti-natural (exponential) of the input voltage V_i when $R_f I_s = 1V$.

Observe that the output voltage V_o is having a negative sign, which indicates that there exists a 180° phase difference between the input and the output.
