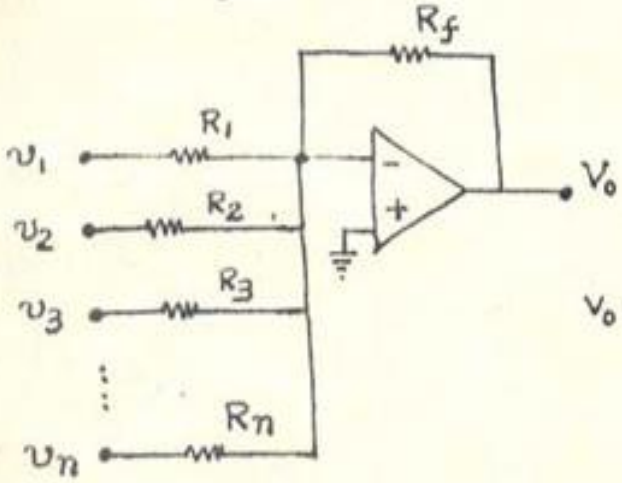
UNIT-5

(Lecture-8)

OP-AMP CIRCUITS

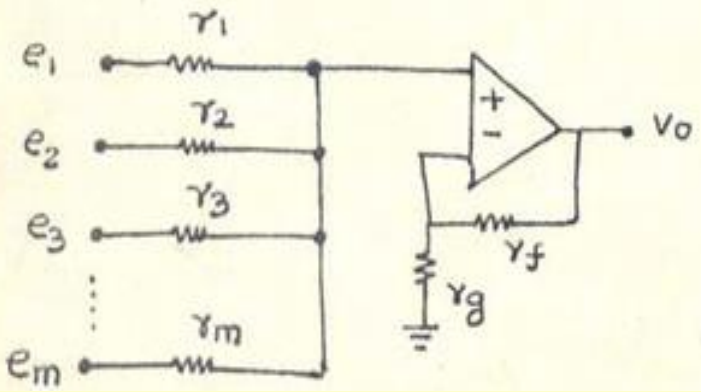
Weighted Summers : Active synthesis invariably requires circuits capable of performing summation of analog voltages . Realisations of inverting , noninverting and generalised summers are shown in Fig. 14 (a)-(c).

(a)



$$V_o = -\left(\frac{R_f}{R_1} v_1 + \frac{R_f}{R_2} v_2 + \cdots + \frac{R_f}{R_n} v_n \right)$$

(b)



(c)

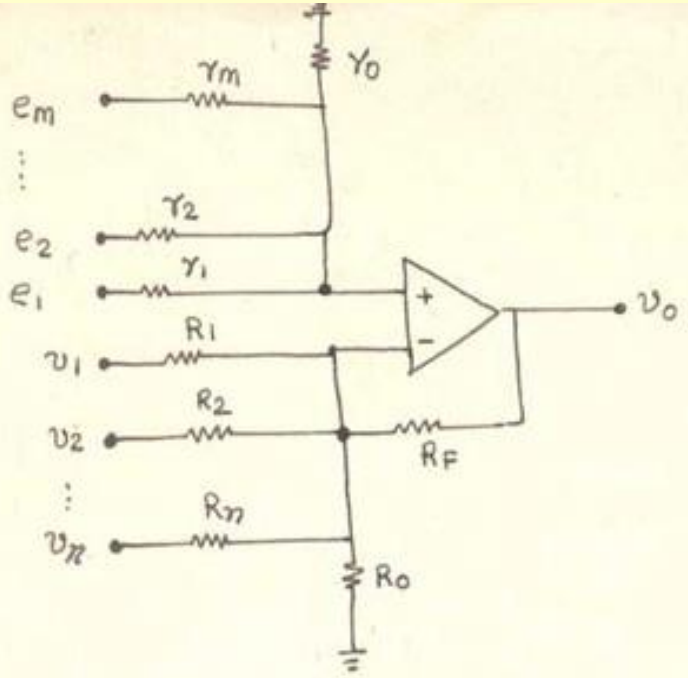


Fig. 14 Realisation of various summers (a) inverting summer (b) noninverting summer (c) generalised weighted summer.

3. Miscellaneous Circuits and Techniques :

In the following some interesting circuits and techniques are presented which can be understood and analysed on the basis of understanding of the building blocks discussed in the previous section.

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3.1 Capacitance multiplier :

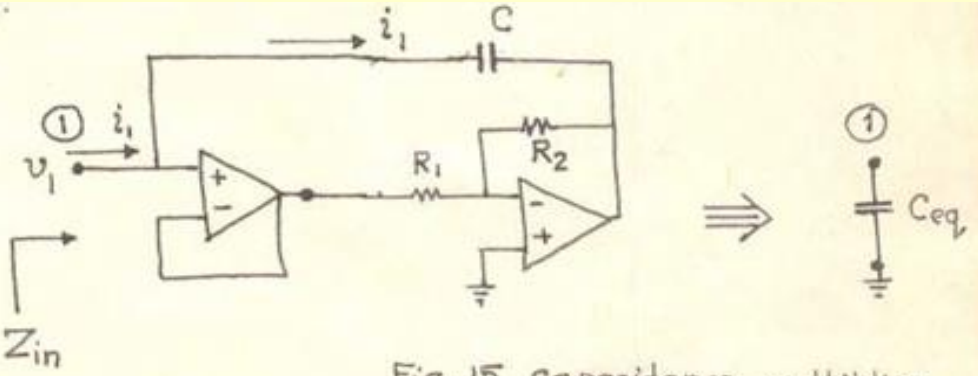

Fig. 15 capacitance multiplier

The given circuit has

$$Z_{in} = \frac{v_1}{i_1} = \frac{1}{sC\left(1+\frac{R_2}{R_1}\right)}$$

thus, behaving as an equivalent capacitance $C_{eq} = C\left(1+\frac{R_2}{R_1}\right)$

This circuit is useful in creating *artificially* large values of capacitances while using low-valued C which is normally available.

3.2 Inductance Simulator :

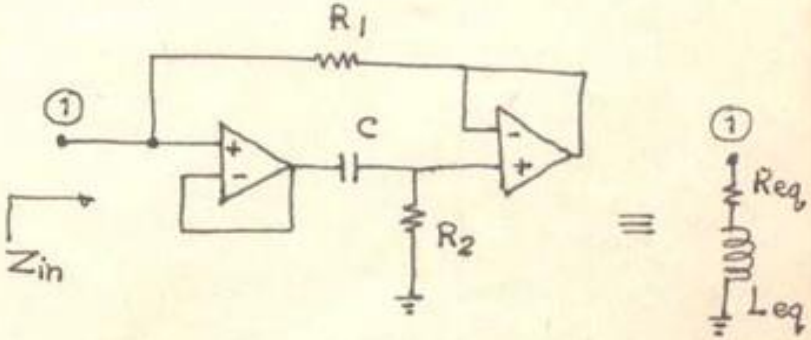

Fig. 16

The circuit has

$$Z_{in} = R_1 + sCR_1R_2$$

thus, representing an inductance

$L_{eq} = CR_1R_2$ Henries with quality factor equal to $Q_{eq} = \frac{\omega L_{eq}}{R_{eq}} = \omega C R_2$

3.3 Noninverting Integrator :

Although inverting integrator followed by an inverting amplifier gives noninverting integrator, this approach needs two op-amps. A circuit which does this job with just one op-amp is Deboo's integrator shown here. Analysis gives

$$V_o(t) = +\frac{2}{CR}\int V_{in}(t)\,dt \quad \text{or} \quad \frac{V_o(s)}{V_i(s)} = +\frac{2}{SCR}$$

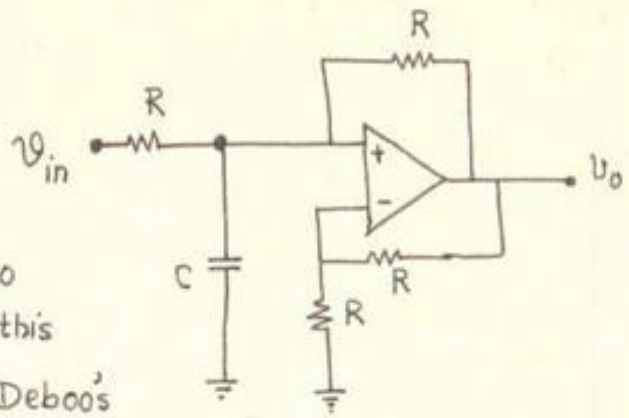

Fig. 17 Deboo's integrator

3.4 Noninverting Differentiator :

The accompanying circuit by proposed by Horrocks. Analysis shows

$$V_o(t) = \frac{CR}{2}\frac{dV_{in}(t)}{dt}$$

or equivalently

$$\frac{V_o(s)}{V_i(s)} = +\frac{SCR}{2}$$

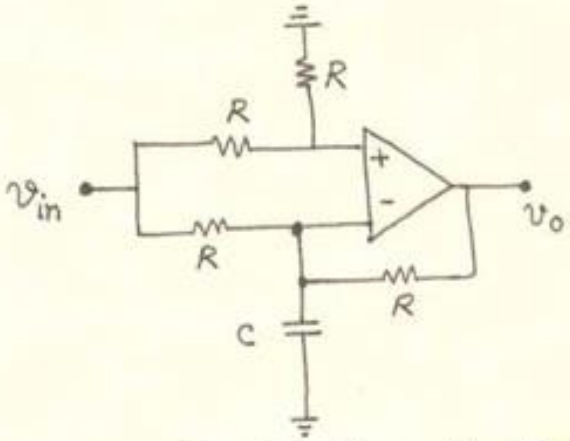

Fig. 18 Horrock's differentiator