for $d$ to be non-negative, eqn (5) demands.

$$\left(1 + \frac{b}{c}\right) \geq k \quad \text{——— (6)}$$

Since for finite gain $1 \leq K < \infty$, eqn (4) and (5) imply,

$$C \neq 0,\ a \neq \infty,\ b \neq \infty;$$
$$b \neq 0,\ c \neq \infty,\ d \neq \infty \quad \text{——— (7)}$$

Out of many possibilities that satisfy eqn (4), (5) we consider the following which reduce one resistor.

Case A: $a = 0$, $R_2 = 0$ or $R_1 = \infty$
Case B: $d = 0$, $R_5 = 0$ or $R_6 = \infty$

$R_1 = \infty$ is not admissible, as it will reduce see eqn (5), $b = c = 0$, the undesireable condition in eqn (7). Also $R_5$ cannot be zero, when S is close (for negative gain) input will be shorted, However $R_5$ can be replaced by a switch $\bar{S}$, which open when S is closed and the viceversa.

Case A: $R_2 = 0$

# Unit — III

## Programmable Dual Polarity Gain Amplifier

### Programmable Amplifier Configuration —

The proposed Amplifier Configuration is Show.

Gain of the Amplifier is.

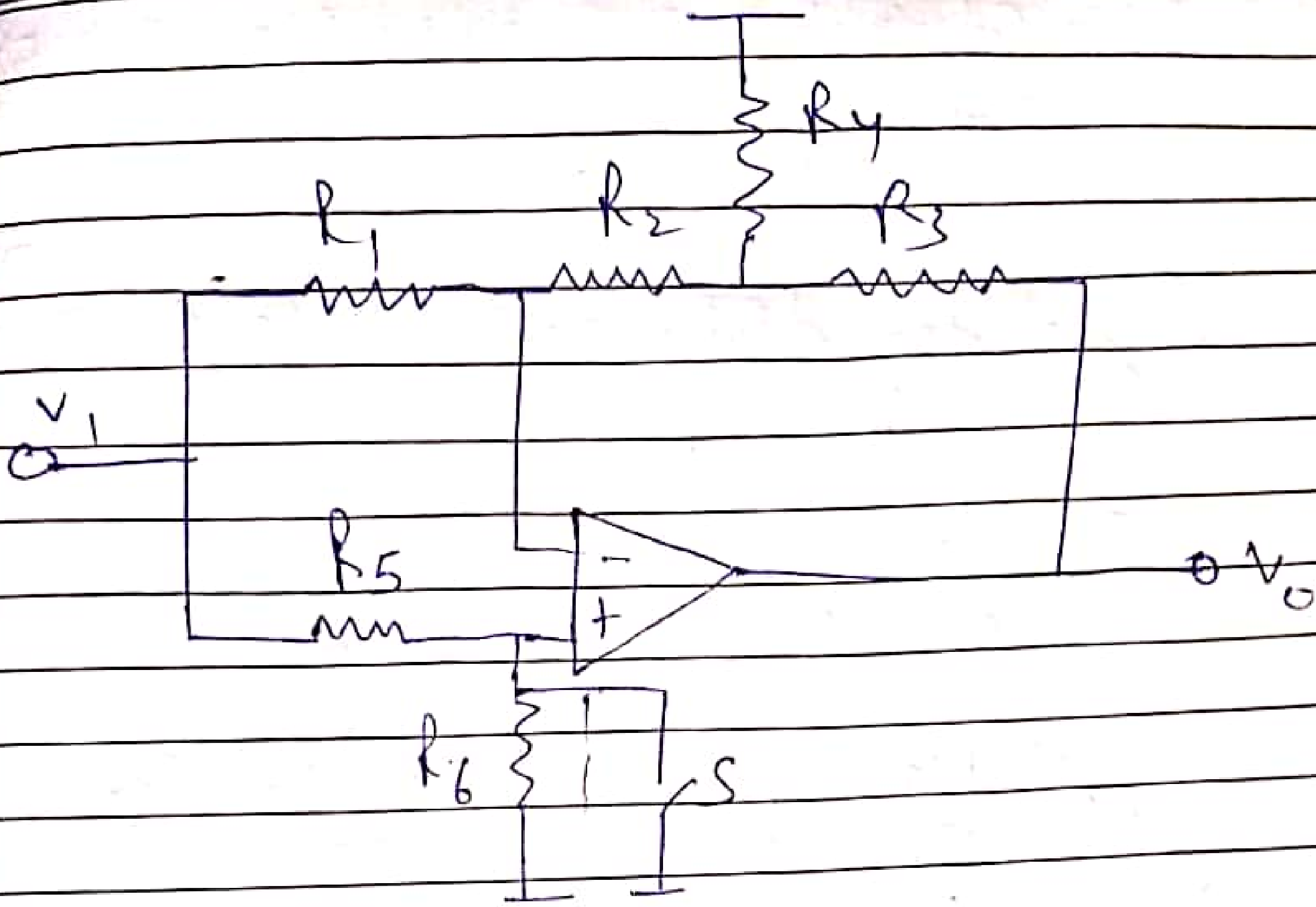
$$\frac{V_o}{V_i} = \begin{cases} K_- = -P & \text{When S closed} \quad \text{--- (1)} \\ K_+ = \frac{1+P+b/c}{1+d} - P & \text{When S open} \quad \text{--- (2)} \end{cases}$$

Where

$$P = a + b + \frac{ab}{c}$$

$$a = \frac{R_2}{R_1}, \quad b = \frac{R_3}{R_1}, \quad c = \frac{R_4}{R_1}, \quad d = \frac{R_5}{R_6}$$

— (3)




Proposed Amplifier Configuration

It is obivious from eq (1) and (2) that polarity of the gain can be controlled by the switch S. Condition for

$$K_- = -K_+ = K$$

Imposed by eq (1) and (2) are.

$$K = a + b + \frac{ab}{c} \quad \text{—— (4)}$$

and

$$d = \left(1 + \frac{b}{c} - K\right) / 2K \quad \text{—— (5)}$$

In this Case the circuit of fig 1 reduces to a circuit that has been studied in detail in Ref. 1. Out of the four cases Case (iv) in 1 restrict the gain $\leq 1$ being a case of an attenuator (and not an Amplifier) it will not be considered.

The total resistances for a Specific gain k for the three circuits are respectively.

$$R_{ta} = 6(1+k)R \quad k \geq 0 \quad — 8(a)$$

$$R_{tb} = 2\left(4 + \frac{2k^2}{2k-1}\right)R \quad k \geq \frac{1}{2} \quad — 8(b)$$

$$R_{tc} = \left(1 + \frac{k^2}{k-1}\right)R \quad k \geq 1 \quad — 8(c)$$

It can be verified that

$$R_{tb}, R_{tc} < R_{ta}, \quad \text{for all } k \quad — 9(a)$$

$$R_{tc} \leq R_{tb}, \quad k=1, \; k \geq 1.112 \quad — 9(b)$$

Case B: $R_6 = \infty$, $R_5$ replaced by