$$V_o = -Z_f \sum_{i=1}^{n} \frac{V_i}{Z_i}$$

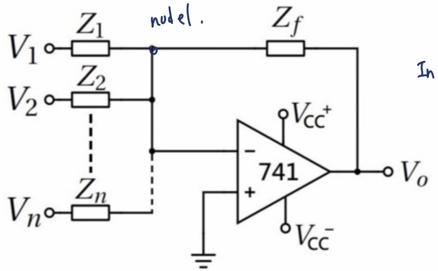

Figure 2.1: Summer Circuit

Let current I_1 be current from V_1

I_2 be current from V_2

and I_n be current from V_n

In node1,

$$I_n = I_1 + I_2 + \dots + I_n$$
$$= \left(\frac{V_1}{Z_1} + \frac{V_2}{Z_2} + \dots + \frac{V_n}{Z_n} \right)$$

By inverting amplifier,

$$V_{out} = (V_{in}) \left(\frac{-Z_f}{Z_{in}} \right) = \left(\frac{V_{in}}{R_{in}} \right)(-Z_f) = I_{in}(-Z_f)$$

$\therefore$ V_{out} in summing amplifier $= \sum_{i=1}^{n} \frac{V_i}{Z_i}(-Z_f)$ //

$$V_o = \frac{-1}{R_I C_f} \int V_I dt$$

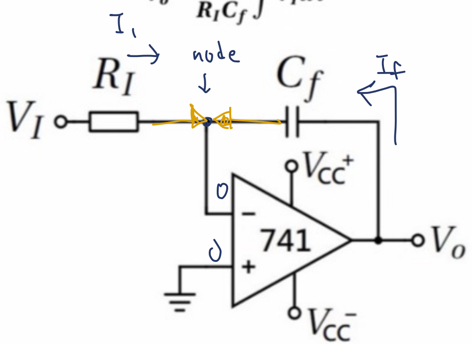

Figure 2.4: Integrator Circuit

In node1, since voltage in node is same as inverting input terminal which is zero, then voltage at node1 is also zero

$$I_{I} = \frac{V_I - 0}{R_I} = \frac{V_I}{R_I}$$

By Ohm law

$$I_f = C_f \cdot \frac{d V_{out}}{dt}$$

$$\therefore I_I = -I_f \qquad \therefore \frac{V_I}{R_I} = -C_f \frac{d V_o}{dt}$$

$$\therefore V_o = -\frac{1}{R_I C_f} \int V_I \, dt$$