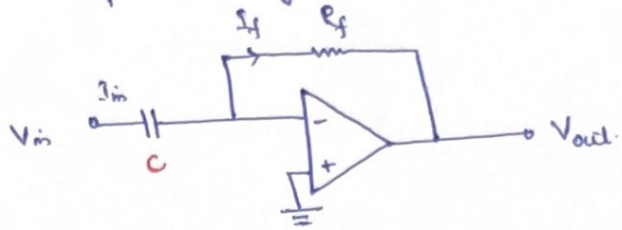
Differentiator Amplifier: (Ideal)

This operational amplifier circuit performs the mathematical operation of Differentiation.

i.e produces a voltage output which is directly proportional to the input voltage rate of change w.r.t time.



here, $I_{in} = I_f$

$$C \frac{dV_{in}}{dt} = -\frac{V_o}{R_f}$$

$$\therefore \boxed{V_{out} = -R_f C \frac{dV_{in}}{dt}}$$

Eg. If $V_{in} \rightarrow +ve$, slope $-ve$

$\rightarrow -ve$, slope $+ve$.

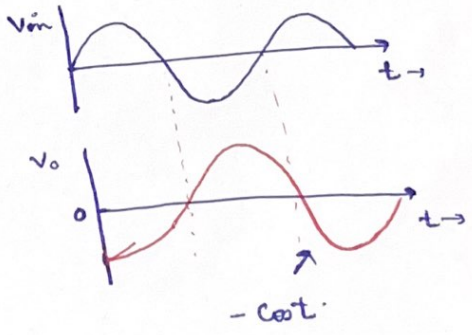
e.g. $V_{in} = \sin t$, Assume $R_f = 1M\Omega$, $C = 1\mu f$

$$V_o = -\frac{d}{dt} \sin t$$

$$V_o = -\cos t$$

↓

180° phase shift.



eg. $V_{in} \rightarrow$ Square $V_{out} \rightarrow$ Spike.