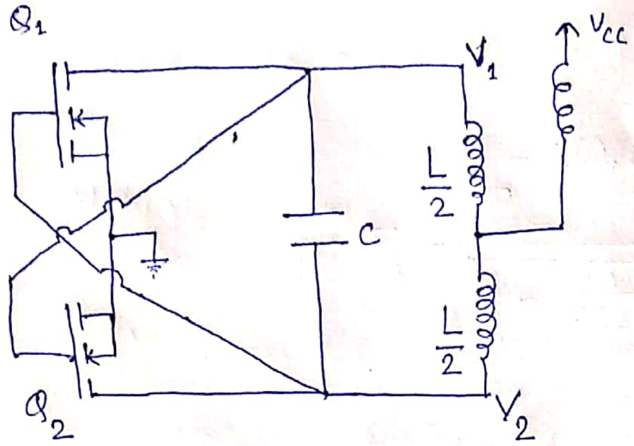
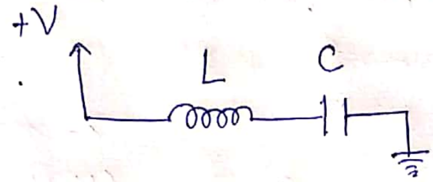
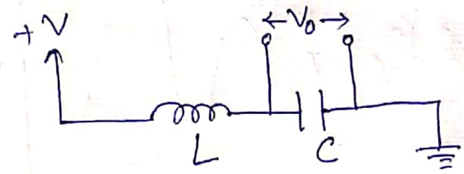


Analysing 'LC' oscillator circuit →

(a) Ideal case $(R=0)$ →



let's take output from Capacitor (C) →



& let input voltage $V = u(t)$. [unit step]

$$\frac{V_o(s)}{V_i(s)} = \frac{\frac{1}{Cs}}{Ls + \frac{1}{Cs}} = \frac{1}{LCs^2 + 1}.$$

$$V_i(t) = u(t) \Rightarrow V_i(s) = \frac{1}{s}.$$

$$\therefore V_o(s) = \frac{1}{s(LCs^2 + 1)}$$

$$V_o(s) = \frac{\left(\frac{1}{\sqrt{LC}}\right)^2}{s\left(s^2 + \left(\frac{1}{\sqrt{LC}}\right)^2\right)}$$

$$V_o(s) = \frac{\omega_n^2}{s(s^2 + \omega_n^2)}, \quad \omega_n = \frac{1}{\sqrt{LC}}$$

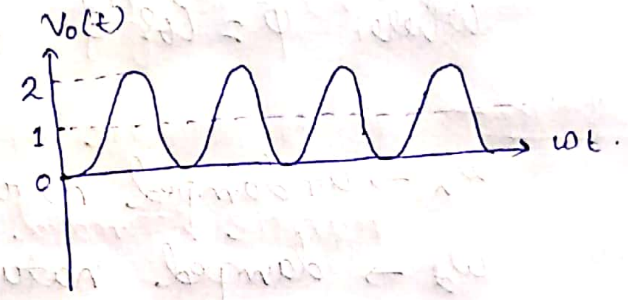
$$V_o(S) = \frac{1}{S} - \frac{S}{S^2+\omega_n^2}$$

$$V_o(t) = (1 - \cos\omega_n t).$$

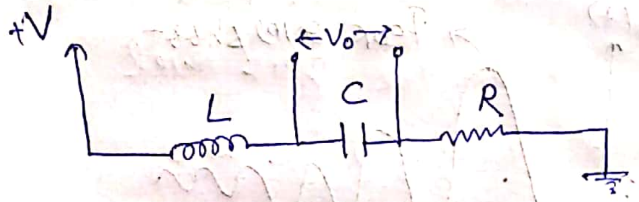
Output voltage as a function of time

$$V_o(t) = (1 - \cos\omega_n t)$$

waveform →



(b) Non-ideal case $(R \neq 0)$ →



output from C → V_o

input voltage = $U(t)$.

$$\frac{V_o(S)}{V_i(S)} = \frac{\frac{1}{CS}}{LS + \frac{1}{CS} + R} = \frac{1}{LCS^2 + 1 + RCS}$$

$$\frac{V_o(S)}{V_i(S)} = \frac{\frac{1}{LC}}{S^2 + \frac{1}{LC} + \frac{R}{L}S}.$$

$$V_i(t) = U(t) \Rightarrow V_i(S) = \frac{1}{S}.$$

$$V_o(S) = \frac{\left(\frac{1}{\sqrt{LC}}\right)^2}{S\left[S^2 + 2 \times \frac{1}{\sqrt{LC}} \times \frac{R}{2}\sqrt{\frac{C}{L}} + \left(\frac{1}{\sqrt{LC}}\right)^2\right]}.$$

$$V_o(S) = \frac{\omega_n^2}{S(S^2 + 2\xi\omega_n S + \omega_n^2)}$$

where $\omega_n = \frac{1}{\sqrt{LC}}$, & (damping factor) $= \frac{R}{2}\sqrt{\frac{C}{L}}$.

Solving, we get,

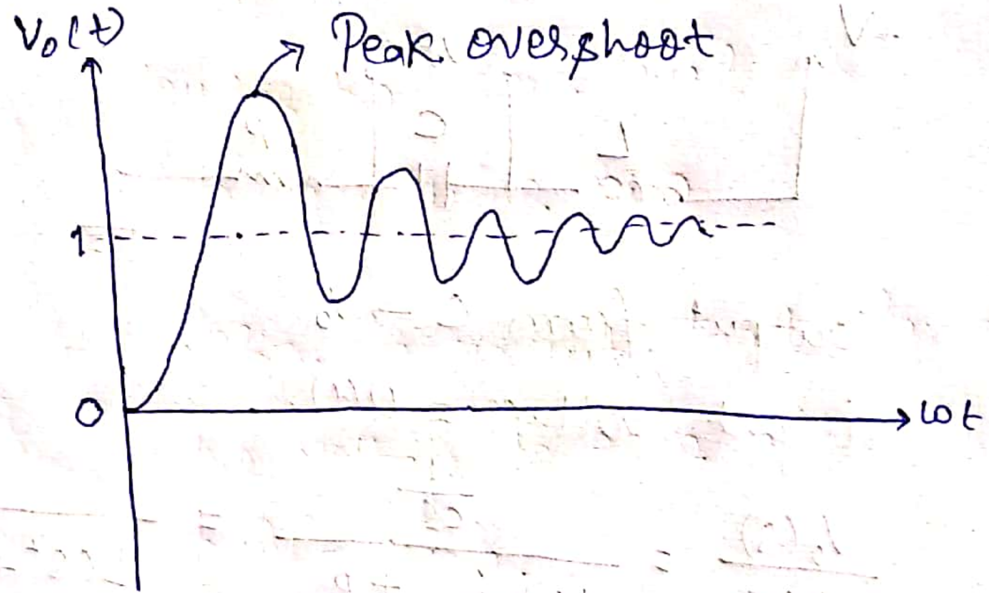
$$v_o(t) = \left[1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \sin(\omega_d t + \phi)\right]$$

where, $\phi = \cos^{-1}\xi$ and $\omega_d = \omega_n\sqrt{1-\xi^2}$.

$\omega_n \rightarrow$ undamped natural frequency.

$\omega_d \rightarrow$ damped natural frequency.

waveform $\rightarrow$

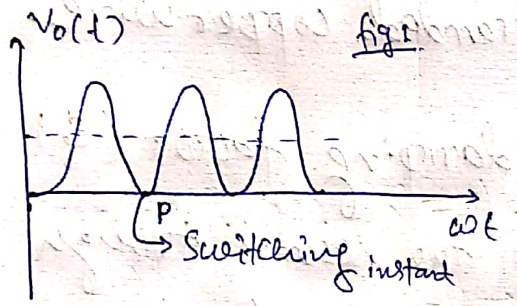


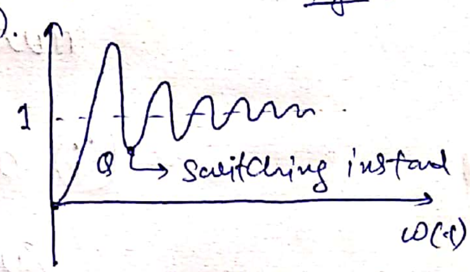
The main problem of suicide is non-zero switching that occurs due to resistive or non-ideal behaviour of oscillator.

This can be understood by compairing two waveforms in case (a) & case (b).

Case (a).
ideal oscillator

Case (b)
non-ideal oscillator
$(0 < \xi < 1)$ fig 2.





$V_o(t) = (1 - \cos\omega_n t)$

$$V_o(t) = 1 - \frac{e^{-\xi\omega_n t}}{\sqrt{1-\xi^2}} \sin(\omega_d t + \phi)$$

If oscillator is ideal then switching takes place at point 'p' (fig 1). i.e. at $V_o(t) = 0$. So as voltage drops to 0 V then switching occurs and MOSFETS turns off properly.

but in non-ideal oscillator switching occurs at point Q i.e. $V_o(t) \neq 0$.

So in this case, at switching instant, voltage does not drop to 0 V ~~but~~ so MOSFETS ~~does~~ don't turn off properly and the MOSFET that turned ON firstly robs all current and gets heated and burns.

Also, if we use ideal oscillator that runs at very high frequency, 'skin effect' comes into existence and introduces resistive nature in the circuit and oscillator behaves non-ideally.

Solution → (i) to decrease 'skin effect' use multiple stranded copper wire.

(ii) adjust damping factor (ξ) such that the second trough touches the zero level or 2nd trough value ≈ 0

(iii) design a circuit that clamps the voltage to zero after each half-cycle.