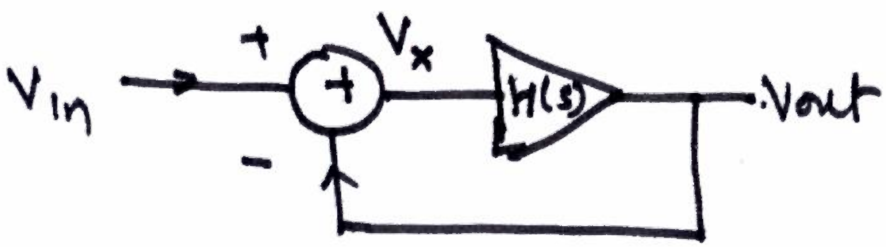
OSCILLATORS

$$A_{CL}(s) = \frac{H(s)}{1 + H(s)}$$ Unity Gain feedback

If $s = j\omega_0$ and $H(j\omega_0) = -1$

then $A_{CL}(j\omega_0) = \infty$ at $\omega = \omega_0$

This condn is essentially condition for oscillations.



A typical Negative feedback system is shown here. Here

$$V_x = V_{out} + |H(j\omega_0)|V_{out} + |H(j\omega_0)|^2 V_{out} + \cdots$$
(Geometric Series)

If $|H(j\omega_0)| > 1$, then V_x is having a Diverging series.

while $|H(j\omega_0)| < 1$, then V_x has converging series representation, and its magnitude is Finite.

We write

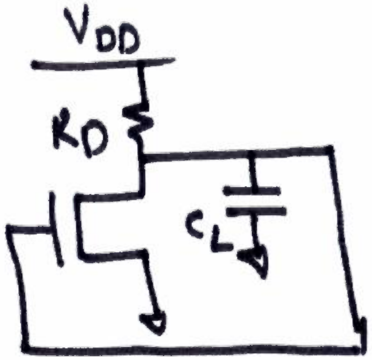
$$V_x = \frac{V_{out}}{1 - |H(j\omega_0)|} = \text{Finite} \left\{ \text{if } |H(j\omega_0)| < 1 \right\}$$

Barkhausen Criteria :

In a Negative feedback System, if Two conditions → $|H(j\omega_0)| \geq 1$ & $\angle H(j\omega_0) = 180^\circ$ are satisfied then the system will Oscillate

Ring Oscillator

1.

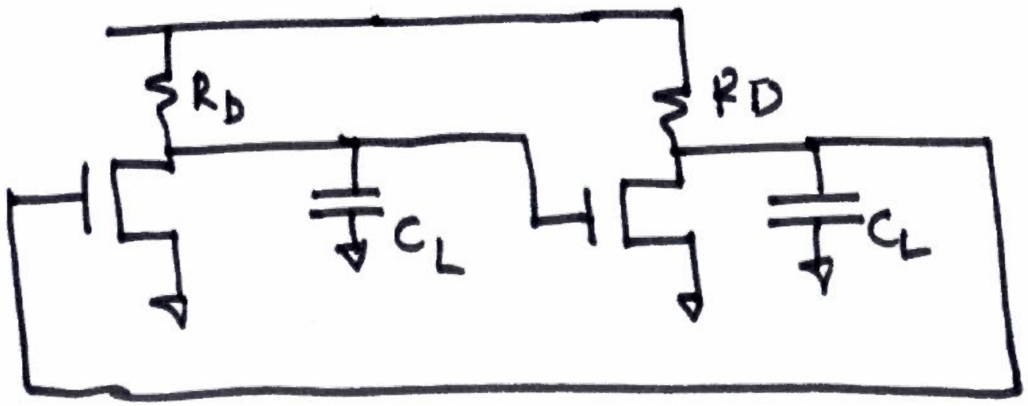


Pole $p_1 = \frac{1}{R_D C_L}$

Phase shift at Pole is 45° & total Phase shift is 90°, plus 180° from Transistor $= 270^\circ$

Hence Loop does not sustain oscillation.

2

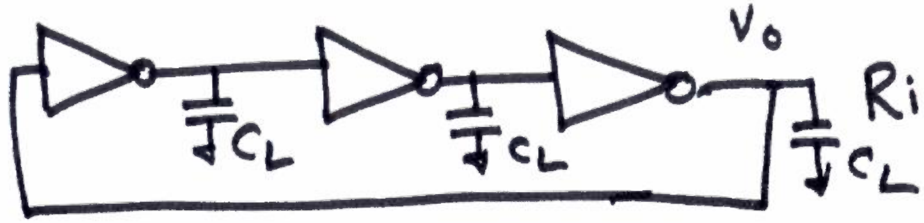


2 Poles will give total Phase shift of $180^\circ + 180^\circ = 360^\circ$. This satisfies Oscillation Cond^n!

However one does not observe Oscillations here.

The Feedback satisfies Barkhausan Criterion only at $\omega_0 = 0$. The circuit therefore exhibits Latch Action.

3.



Ring Oscillator.

$\omega_0 = \frac{1}{R_D C_L}$ and transfer function show Triple pole at ω_0.

or $$H(s) = \frac{-A_{V0}^3}{\left[1+\left(\frac{s}{\omega_0}\right)\right]^3}$$

We can see that for Oscillation to sustain

$A_{V0} = 2$ and $\omega_{osc} = \sqrt{3}\,\omega_0$

It means that each stage must contribute 60° from one RC combination