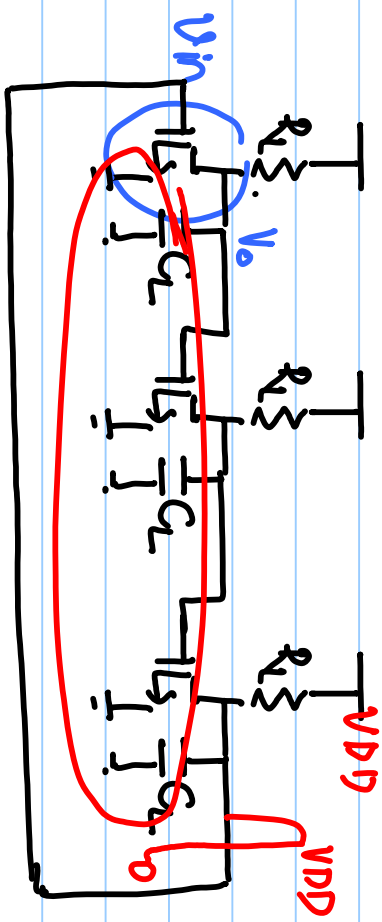


Lecture # 26

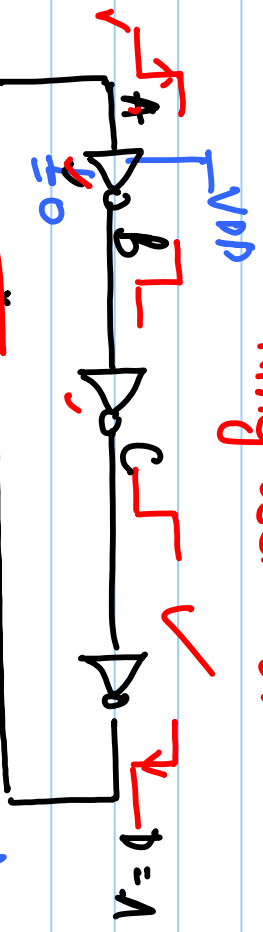
Limited Swing Osc.

$$k_{osc} = \frac{\sqrt{3}}{R_L C_L}$$

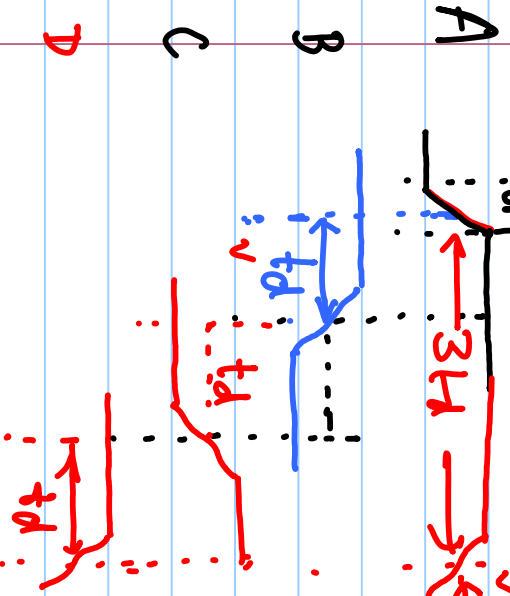
$$\frac{V_o}{V_i} \neq 1 \text{ (RS)}$$



Ring Oscillator



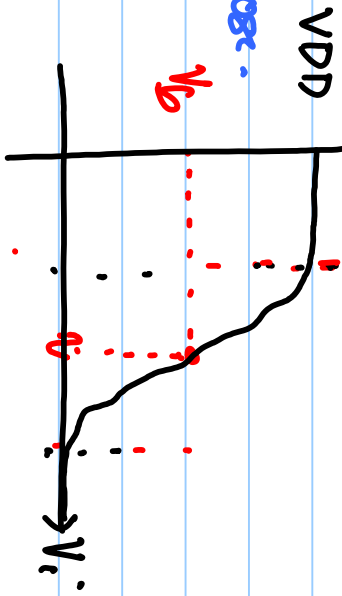
Large-swing Ring Osc.

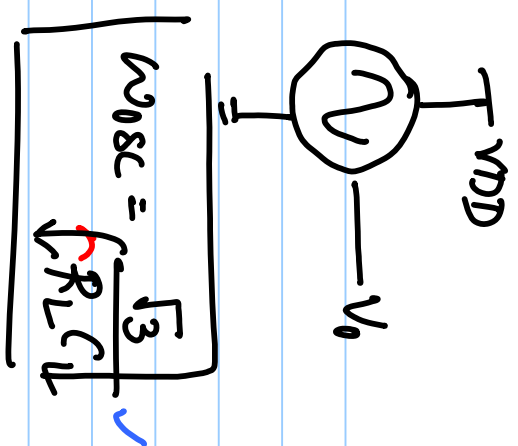
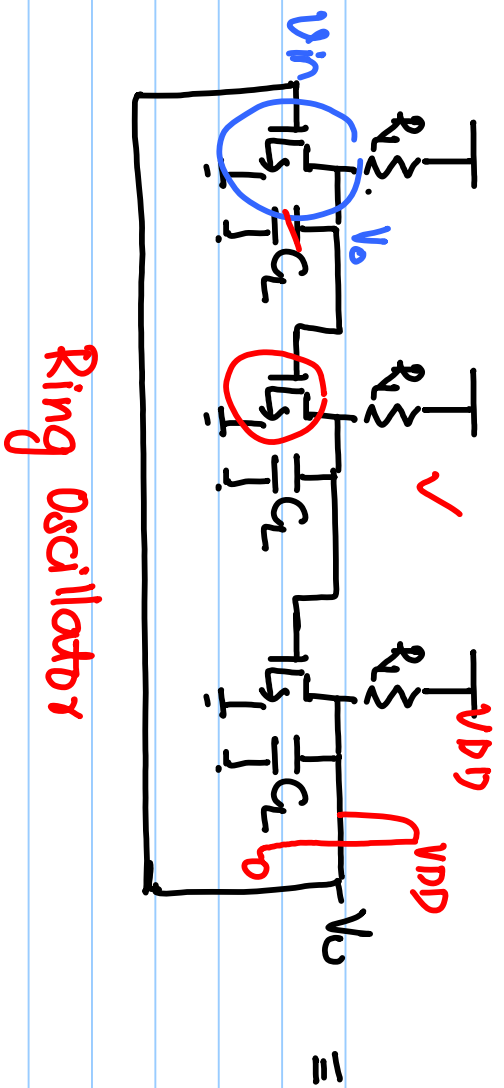


$$f = \frac{1}{6t_d}$$

$$T = 6t_d$$

$$v - 1 = \frac{1}{v_i} \int_{V_i}^{V_o} \frac{R_L}{C_L} dt$$

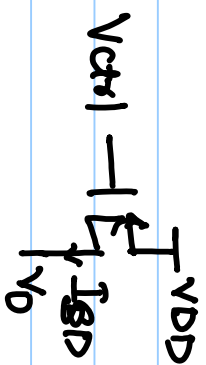
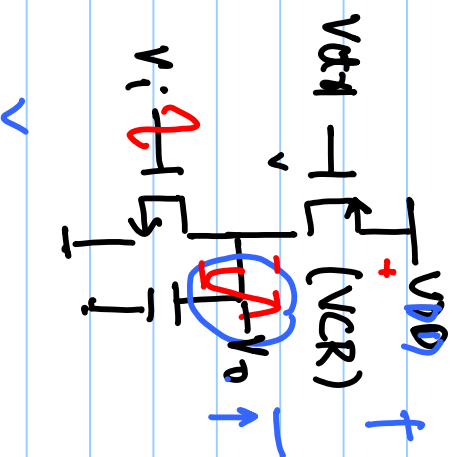
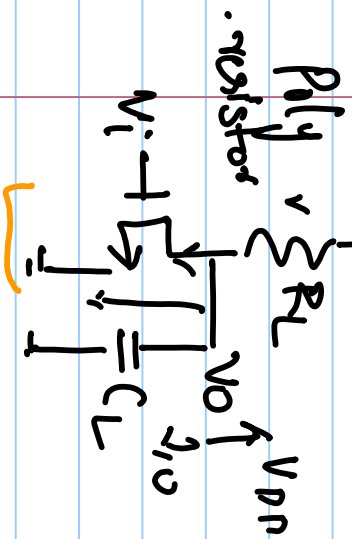




To vary freq.

- Vary R_L

- Vary C_L



For linear region ✓

$$I_{SD} = \mu_p C_{ox} \left(\frac{W}{L}\right)_p \left[(V_{DD} - V_{GS1} - |V_{TP}|) V_{SD} - \frac{V_{SD}^2}{2} \right]$$

$$\frac{dI_{SD}}{dV_{SD}} = \mu_p C_{ox} \left(\frac{W}{L}\right)_p \left[(V_{DD} - V_{GS1} - |V_{TP}|) - V_{SD} \right]$$

$$R = \frac{1}{\mu_p C_{ox} \left(\frac{W}{L}\right)_p \left[(V_{DD} - V_{GS1} - |V_{TP}|) - V_{SD} \right]}$$

$$= \frac{1}{\mu_p C_{ox} \left(\frac{W}{L}\right)_p \left[V_{DD} - V_{GS1} - |V_{TP}| \right]}$$

$$\omega_{osc} = \frac{\sqrt{3}}{R_L C_L} = \frac{\sqrt{3}}{C_L} \mu_{p\text{ Cox}} \left(\frac{W}{L} \right)_p \left[V_{DD} - V_{th1} - |V_{TP1}| - \underbrace{V_{SD}} \right]$$

$$\omega_{osc} \propto -V_{th1}$$

- Wide tuning range.

- Good linearity.

for linear region op.

$$V_{SD} < V_{th} - |V_{TP1}|$$

$$-V_0 < -V_{th1} - |V_{TP1}|$$

$$V_{th1} < \underbrace{V_0 - |V_{TP1}|}$$

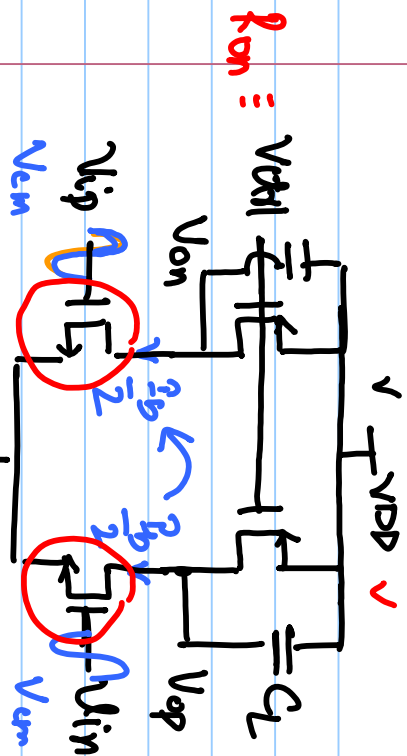
$$V_0 > V_{th1} - |V_{TP1}|$$

As freq. increases o/p swing reduces

$$\omega_{osc} = \alpha \left(V_{DD} - V_{th1} - |V_{TP1}| - \underbrace{(V_{DD} - V_0)} \right) \checkmark$$

$$\propto \alpha \left(\underbrace{V_0}_{\downarrow} - V_{th1} - |V_{TP1}| \right)$$

$$V_{DD}, V_{DD} - |V_{TP1}|$$



$$R_{on} = V_{TH1} \left(\frac{1}{\mu_n C_L} + \frac{1}{\mu_p C_L} \right)$$

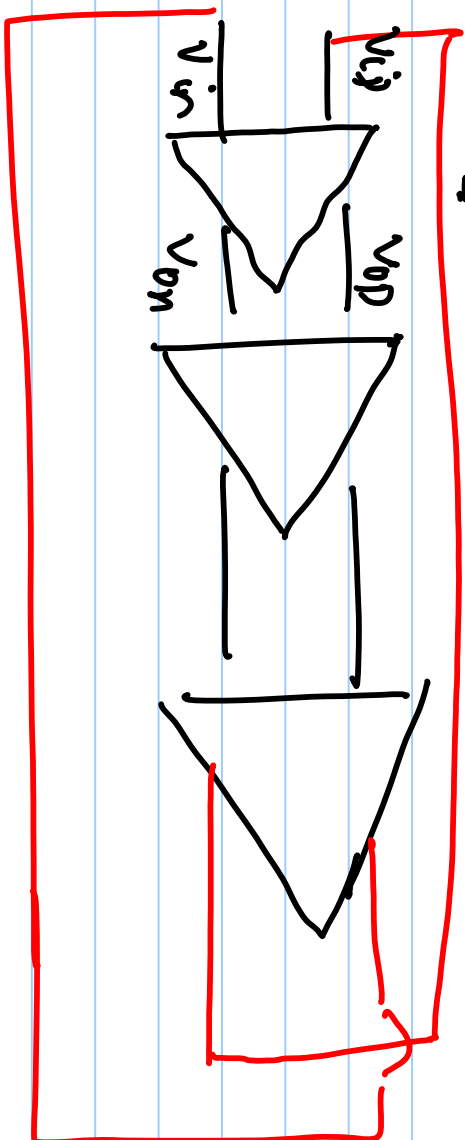
$$A_{DC} = \frac{V_{op} - V_{on}}{V_{ip} - V_{in}}$$

$$\omega_p = \frac{1}{R_L C_L}$$

$v_{ip} \uparrow, v_{in} \downarrow \Rightarrow V_{on} = V_{DD} - I_b \cdot R_L$

$$V_{op} = V_{DD}$$

$$V_{op} - V_{on} = I_b \cdot R_L$$



$$V_o = 2 I_b \cdot R_L \propto \frac{1}{\omega_{osc}}$$

$\omega_{osc} \uparrow \Rightarrow R_L \downarrow \Rightarrow V_o \downarrow$

