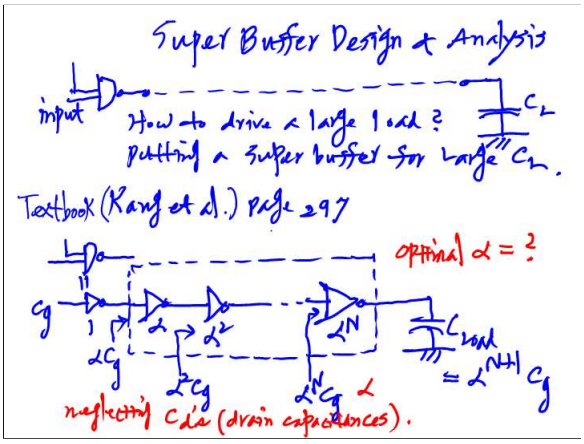
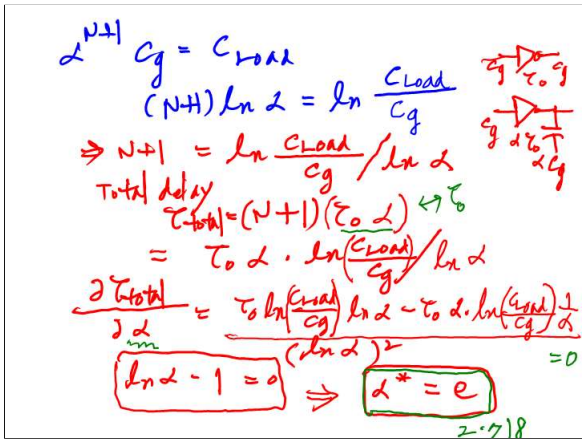
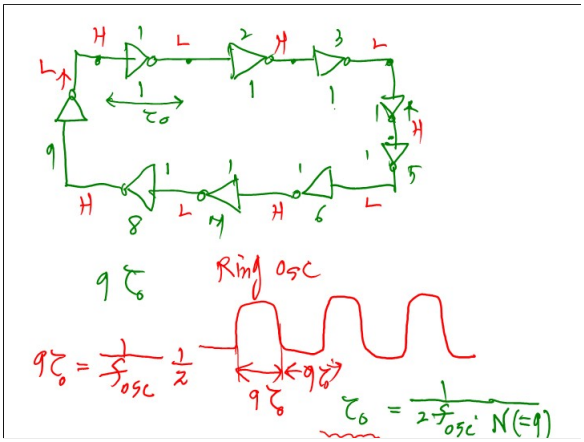
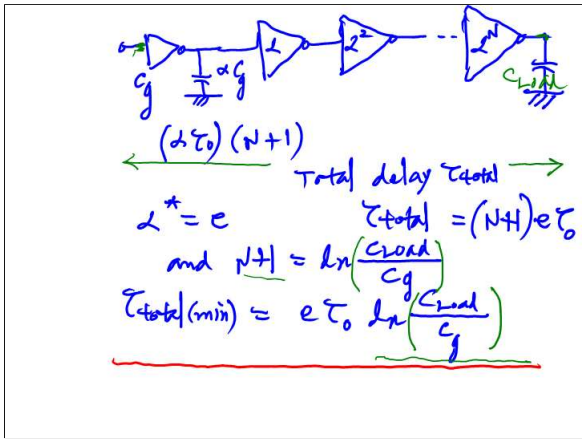

Super Buffer Design & Analysis
input
How to drive a large load?
putting a super buffer for large C_L.
Textbook (Rang et al.) page 297
optimal α = ?
C_g
αC_g
$\alpha^2 C_g$
$\alpha^N C_g$
$C_{load} = \alpha^{N+1} C_g$
neglecting C_{da} (drain capacitances).


$\alpha^{N+1} C_g = C_{load}$
$(N+1) \ln \alpha = \ln \frac{C_{load}}{C_g}$
$\Rightarrow N+1 = \ln \frac{C_{load}}{C_g} / \ln \alpha$
Total delay
$\tau_{total} = (N+1)(\tau_0 \alpha) \leftrightarrow \tau_0$
$= \tau_0 \alpha \cdot \ln\left(\frac{C_{load}}{C_g}\right) / \ln \alpha$
$\frac{\partial \tau_{total}}{\partial \alpha} = \tau_0 \ln\left(\frac{C_{load}}{C_g}\right) \ln \alpha - \tau_0 \alpha \cdot \ln\left(\frac{C_{load}}{C_g}\right) \frac{1}{\alpha}$
$(\ln \alpha)^2$
$= 0$
$\ln \alpha - 1 = 0 \Rightarrow \alpha^* = e$
2.718


H
L
1
2
3
4
5
6
7
8
9
τ_0
$9\tau_0$
Ring OSC
$9\tau_0 = \frac{1}{f_{osc}} \frac{1}{2}$
$\tau_0 = \frac{1}{2 f_{osc} \cdot N(=9)}$


C_g
αC_g
α^2
α^N
C_{load}
$(\alpha \tau_0)(N+1)$
Total delay τ_{total}
$\alpha^* = e$
$\tau_{total} = (N+1) e \tau_0$
and $N+1 = \ln\left(\frac{C_{load}}{C_g}\right)$
$\tau_{total(min)} \simeq e \tau_0 \ln\left(\frac{C_{load}}{C_g}\right)$