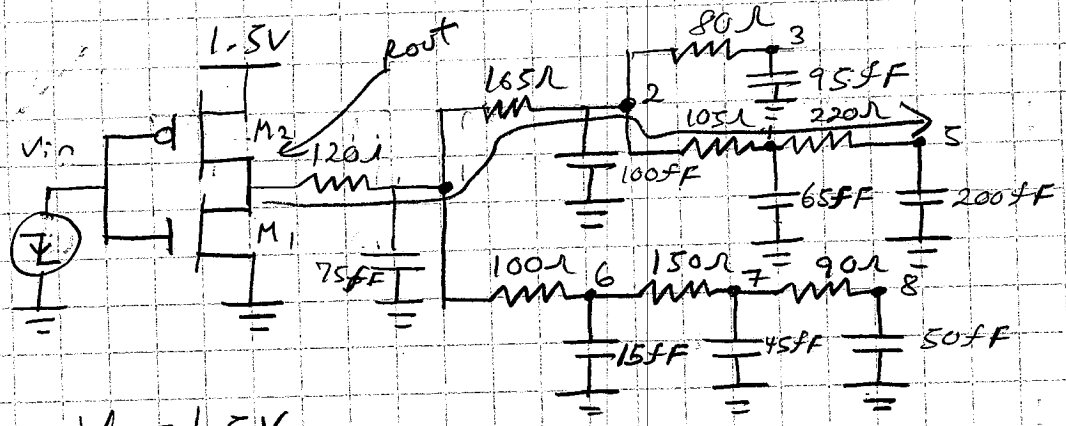
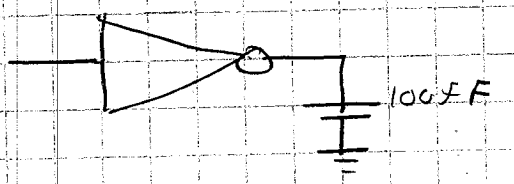
Anthony Mancuso
ECE321
HW-10
18 NOV 2012



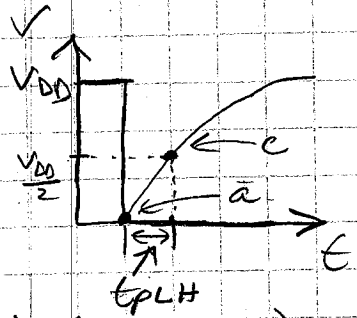
90

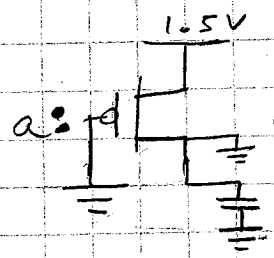
$V_{DD} = 1.5V$
$K'_n = 100\mu A/V^2$
$V_{tn} = 0.4V$
$\lambda_n = 0.1V^{-1}$
$(\frac{W}{L})_n = 10$
$K'_p = 60\mu A/V^2$
$V_{tp} = -0.4V$
$\lambda_p = 0.2V^{-1}$
$(\frac{W}{L})_p = 17$

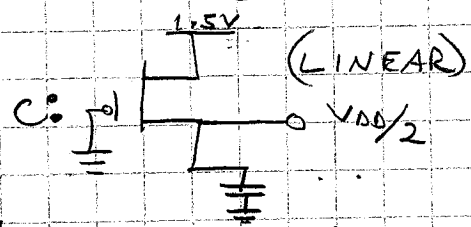
Connect 100fF cap to output:



$$t_{pLH} = \frac{C_L V_{DD}/2}{I_{ave}} \Rightarrow I_{ave} = \frac{I_a + I_c}{2}$$







$$I_a = \frac{K'_p}{2}(\frac{W}{L})_p (|V_{GS}| - |V_{tp}|)^2 (1 + \lambda_p |V_{DS}|)$$

$$= \frac{60\mu A/V^2}{2}(17)(1.5 - 0.4)^2 [1 + (0.2)(1.5)] = \underline{802.23\mu A}$$

$$I_c = K'_p (\frac{W}{L})_p \left[(V_{GS} - V_{tp})|V_{DD}/2| - \frac{(V_{DD}/2)^2}{2}\right]$$

$$= 60\mu A/V^2 (17)\left[(1.5 - 0.4)(0.75) - \frac{(1.5/2)^2}{2}\right] = \underline{554.6\mu A}$$

$$I_{ave} = \frac{I_a + I_c}{2} = \underline{678.43\mu A}$$

$$R_{out} = \frac{V_{DD}/2}{.69 I_{AVE}} = \frac{0.75}{(0.69)(786.01\mu A)} = \boxed{1.595\ k\Omega}\ \checkmark$$

(continued next page)

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$$\tau_{Di} = \sum_{k=1}^{N} R_{ki} C_k = \Omega$$

$$(1.595k\Omega + 120\Omega)(75fF + 15fF + 45fF + 50fF)$$
$$+ (1.595k\Omega + 120\Omega + 165\Omega)(100fF + 95fF)$$
$$+ (1.595k\Omega + 120\Omega + 165\Omega + 105\Omega)(65fF)$$
$$+ (1.595k\Omega + 120\Omega + 165\Omega + 105\Omega + 220\Omega)(200fF)$$
$$= 317.32ps + 366.65ps + 129.04ps + 441.05ps$$

$$\tau_{Di} = 1.254\ ns$$

$$t_{pLH} = (0.693)\tau = \boxed{869\ ps}$$ ✓