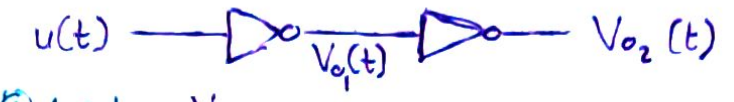
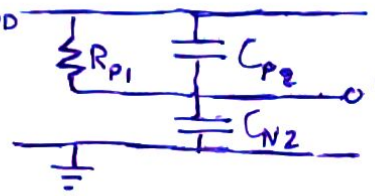
EECS 16B ##1.30 LECTURE 4

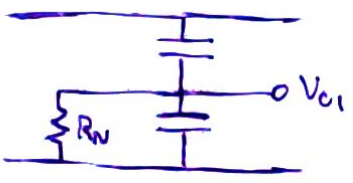


① $t < t_1$: V_{DD}
$V_{o1} = V_{DD}$
$t > t_2$:



$\tau_P = R_{P1}(C_{P2} + C_{N2})$

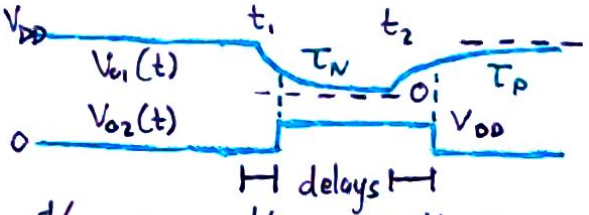
② $t_1 < t < t_2$: V_{DD}



$\tau_N = R_N(C_P + C_N)$

At ①, $\frac{d}{dt} V_{o1} = -(R_P(C_N + C_P))^{-1} \cdot V_{o1} + V_{DD}(R_P(C_N + C_P))^{-1}$

At ②, $\frac{d}{dt} V_{o1} = -(R_N(C_N + C_P))^{-1} \cdot V_{o1}$



$$V_{o2}(t) = \begin{cases} 0 & \text{otherwise} \\ V_{DD} & \text{if } V_{o1} < V_{DD}/2 \end{cases}$$ ← V_{TH}

$\frac{d}{dt} v = -\frac{1}{\tau} v + \frac{1}{\tau} \underbrace{V_{DD}}_{\text{external}}$ $\lambda = -\frac{1}{\tau}$

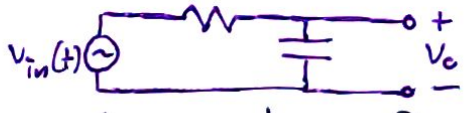
RULE: 1st order — only variable, only 1st derivative
— RHS has a constant external input

$v(t_0)$ is defined

$v = v_\infty + (v(t_0) - v_\infty) e^{-\frac{t - t_0}{\tau}}$

$v(t_0) = v_\infty + (v(t_0) - v_\infty) \cdot 1$

AUDIO AMP : RC CIRCUIT



$\frac{d}{dt} V_o = -\frac{1}{RC} V_o + \frac{1}{RC} V_{in}(t)$

$V_{in} = V_{in} \cdot e^{st}$ eigenfunction for I/O behavior

in a real amp, R would be a potentiometer/knob $V_o(t) = V_o \cdot e^{st}$

$s V_o e^{st} = -\frac{1}{RC} V_o e^{st} + \frac{1}{RC} V_{in} e^{st}$ $s V_o + \frac{1}{RC} V_o = \frac{1}{RC} V_{in}$

$V_o = \frac{1}{RC}(s + \frac{1}{RC})^{-1} \cdot V_{in} = (1 - s/\lambda)^{-1} \cdot V_{in}$

$v_o(t) = (1 - s/\lambda)^{-1} \cdot V_{in} \cdot e^{st}$