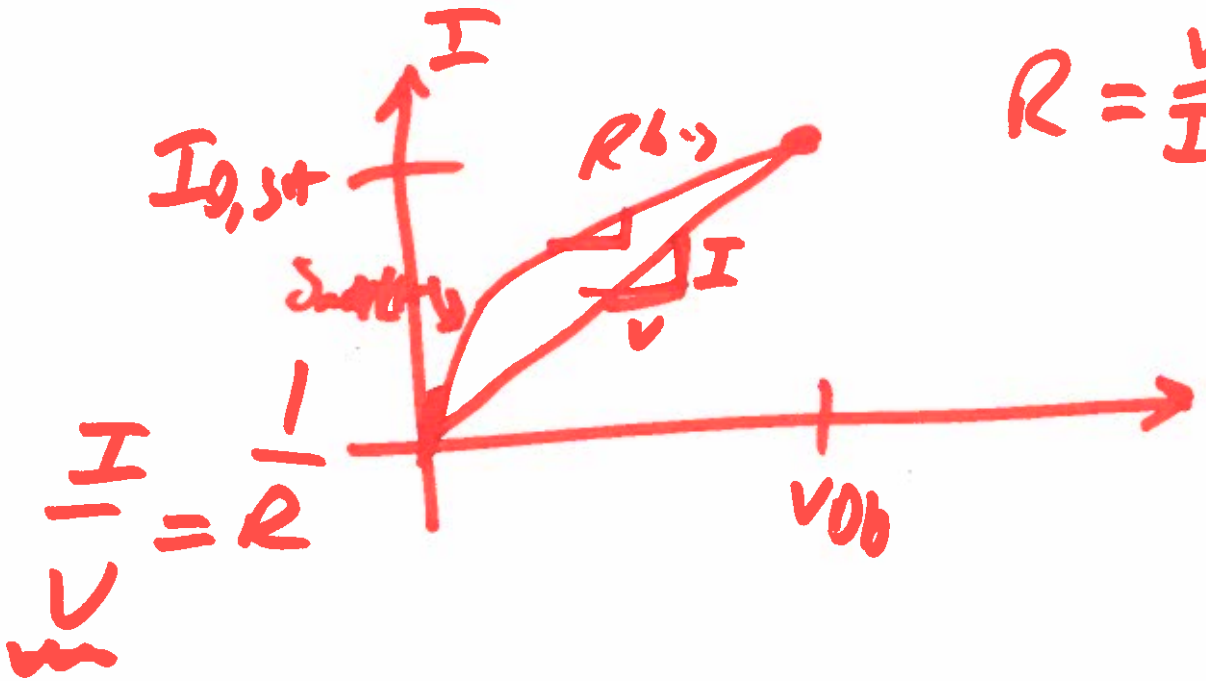
EE421 / ECG 621

Digital IC Design

Lecture 20

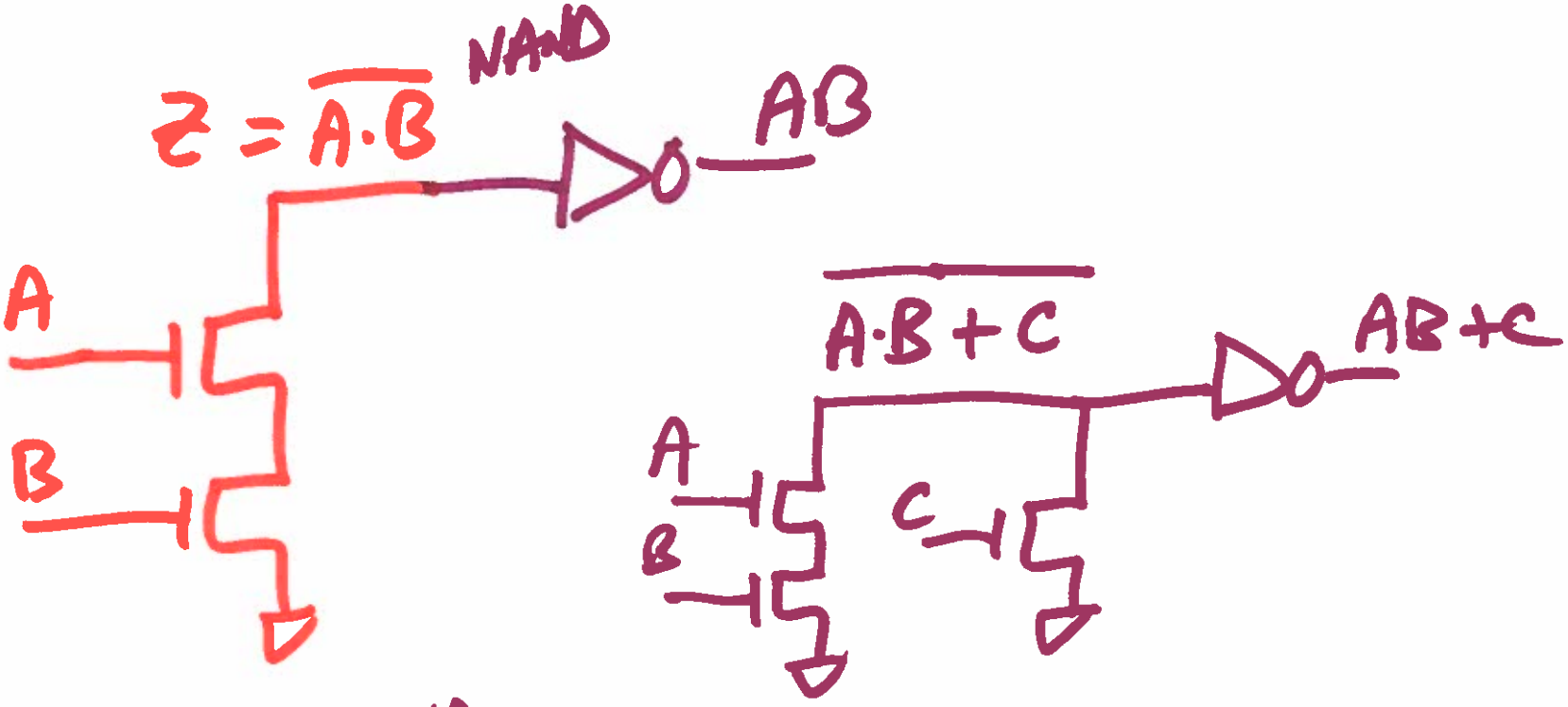
Nov. 6, 2019



$R = \frac{V}{I}$

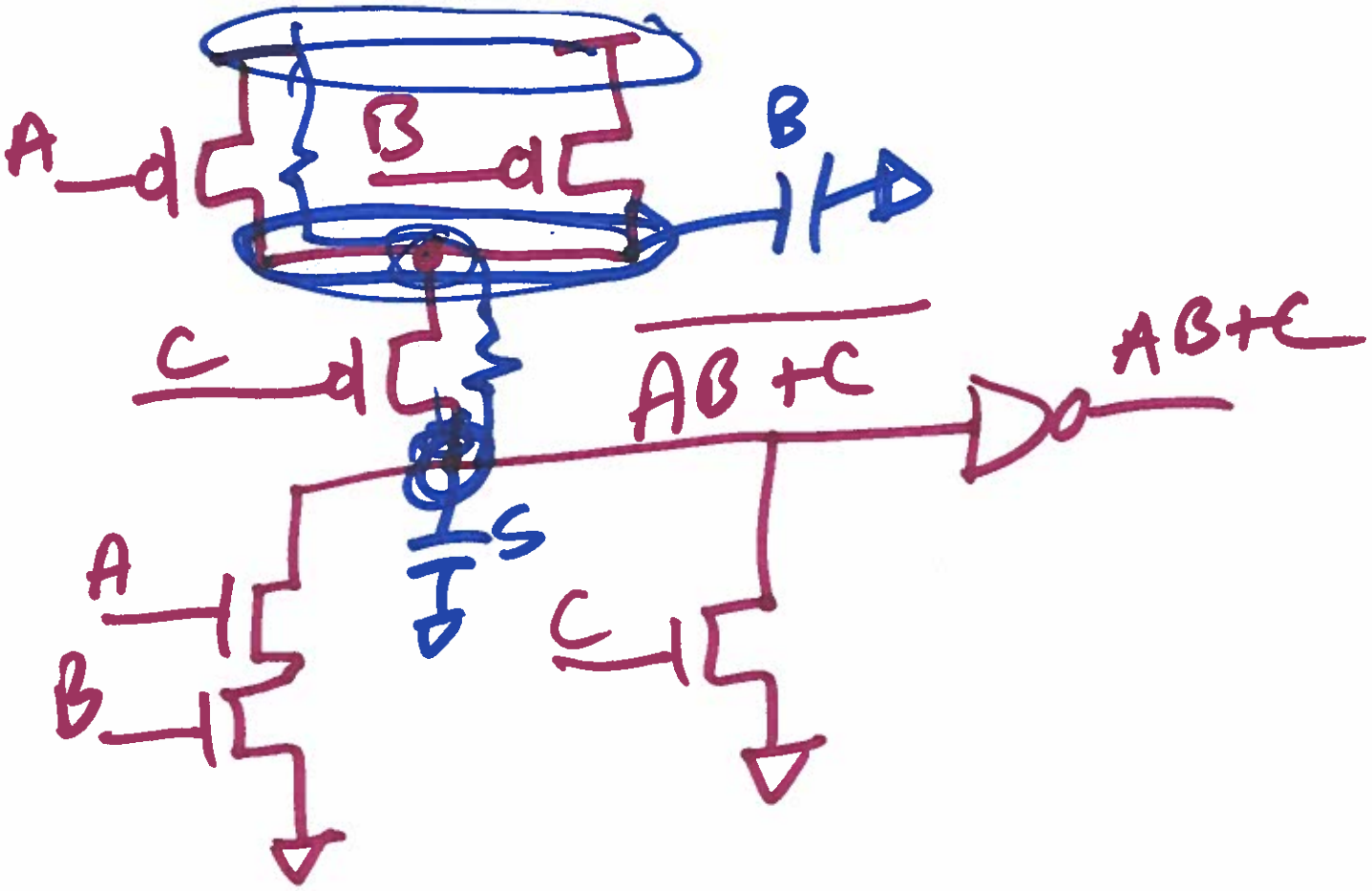
Complex CMOS logic

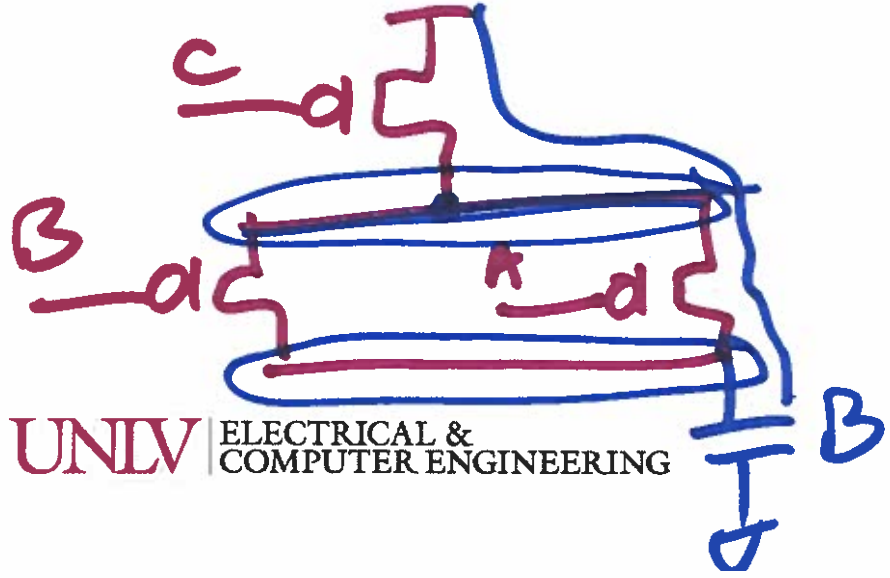
$Z = AB + C$



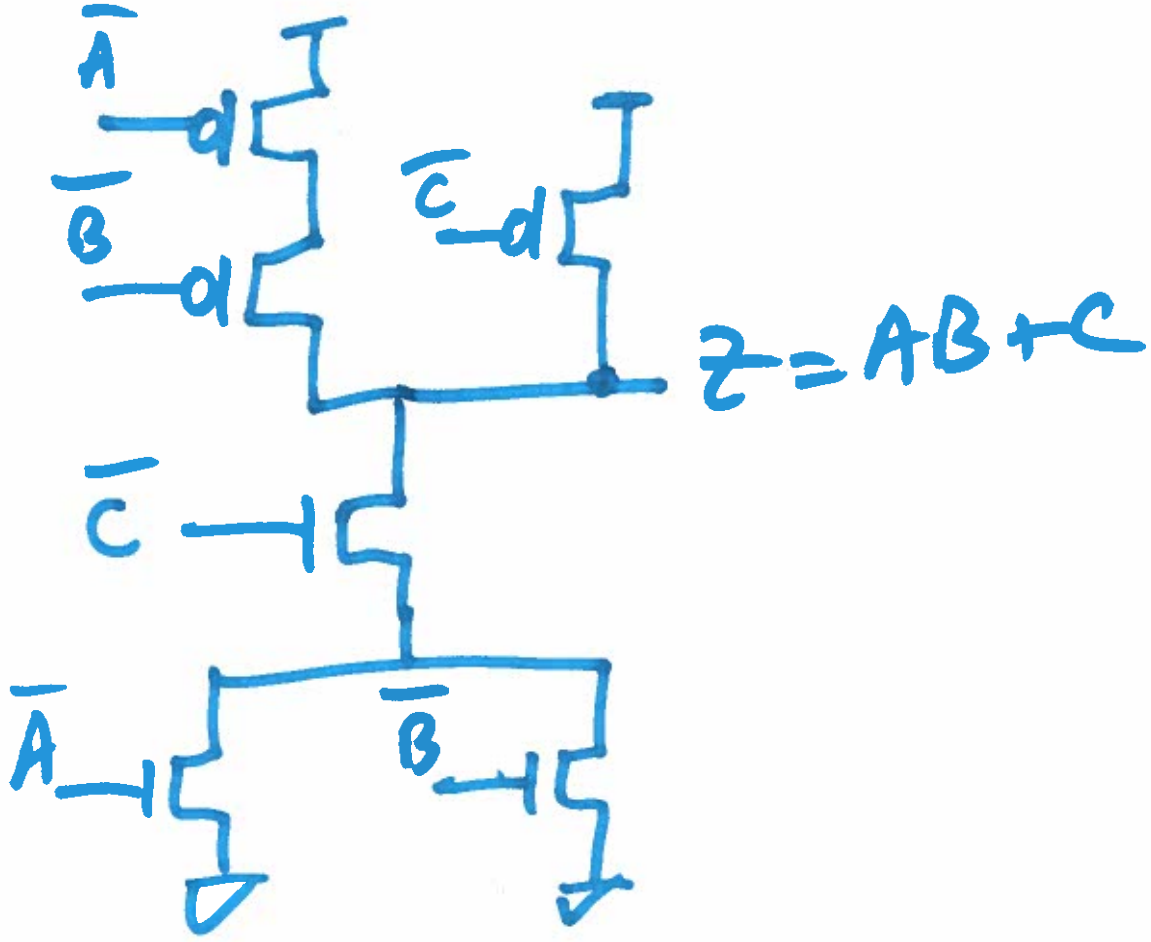
NAND

A	B	A NAND B	A AND B
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1


A
B
B
C
$\overline{AB+C}$
$AB+C$
S
A
B
C

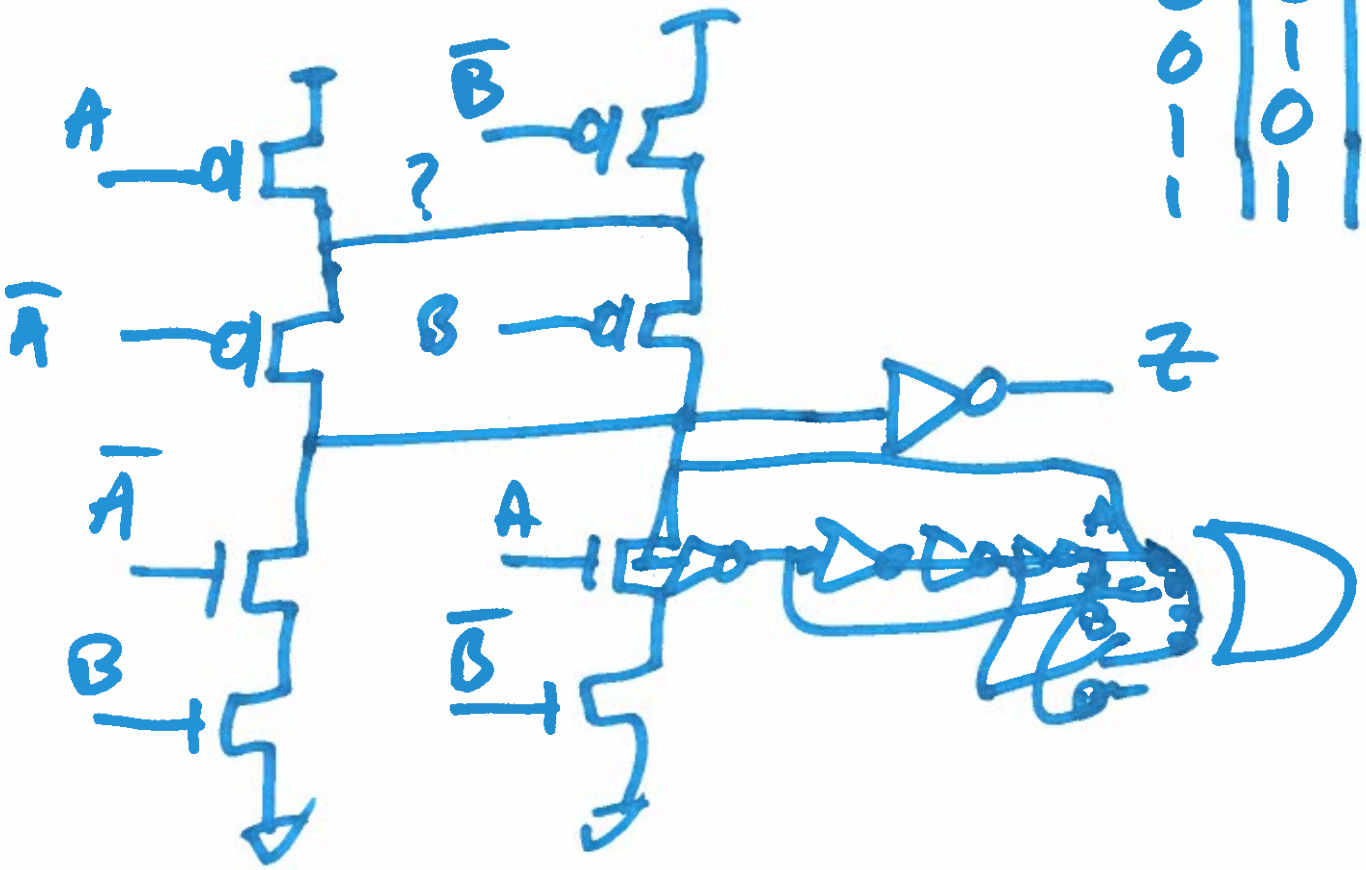

C
B
A
B

$$Z = AB + C = \overline{(\bar{A} + \bar{B}) \cdot \bar{C}}$$

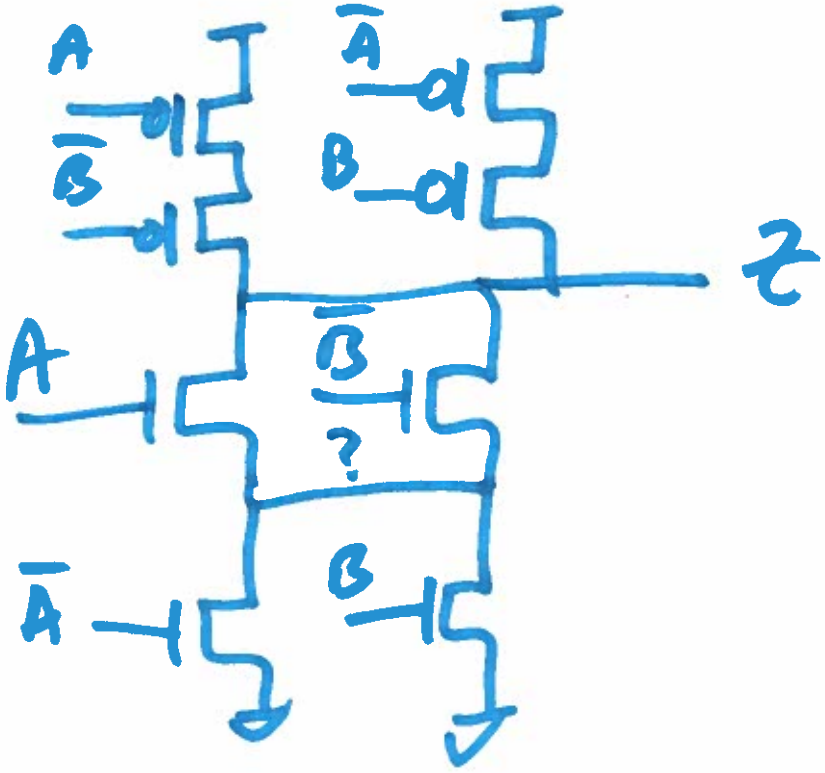


$$Z = \bar{A}B + A\bar{B}$$

A	B	A xor B
0	0	0
0	1	1
1	0	1
1	1	0

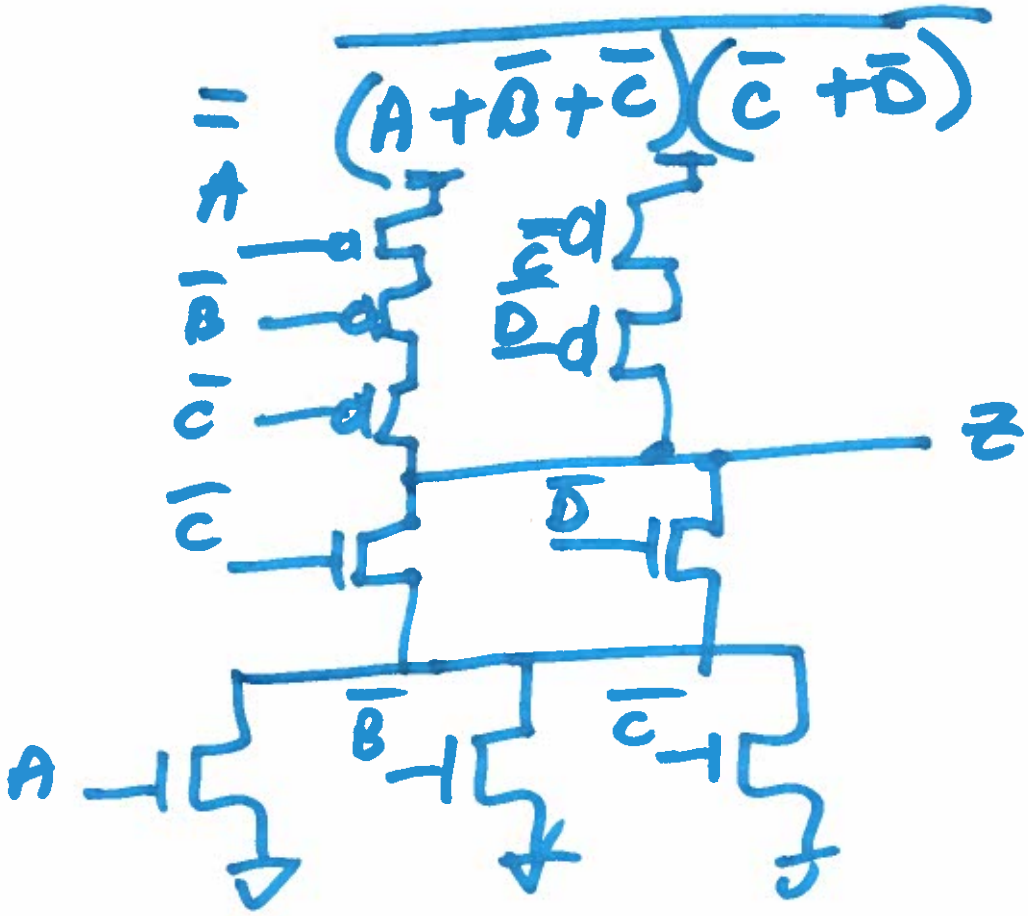


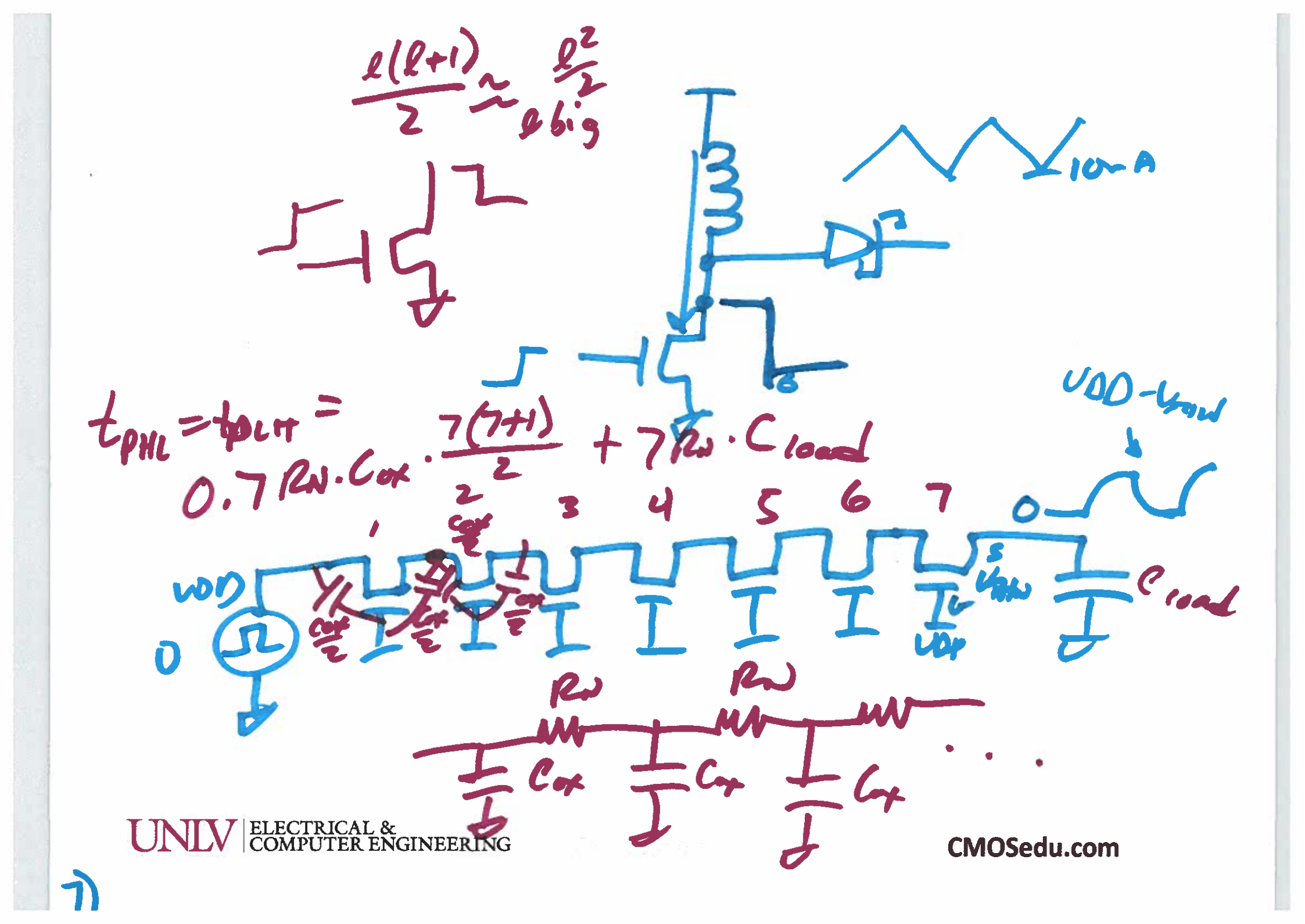
$$z = \bar{A}B + A\bar{B} = \overline{(A+\bar{B})(\bar{A}+B)}$$

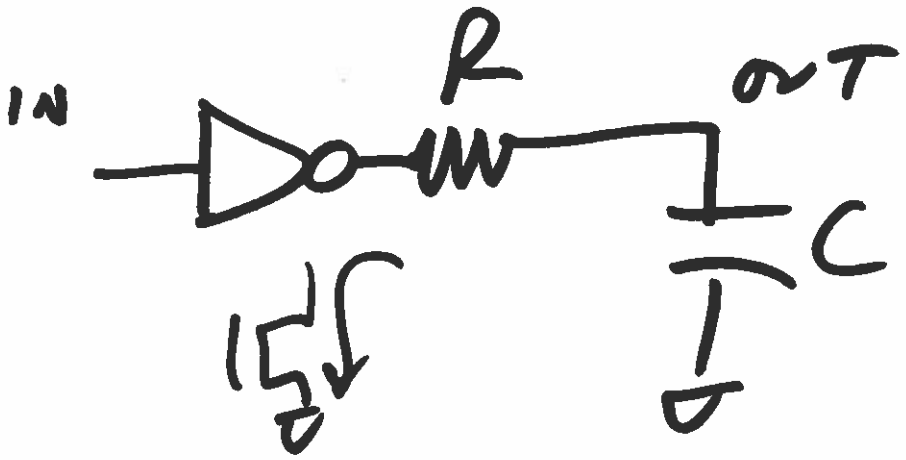


$$Z = \bar{A}BC + CD + \cancel{ABCA}$$

$$= \overline{(A+\bar{B}+\bar{C})(\bar{C}+\bar{D})}$$




$\frac{l(l+1)}{2} \simeq \frac{l^2}{2} \simeq l_{big}$
$t_{PHL} = t_{pLH} =$
$0.7 R_N \cdot C_{ox} \cdot \frac{7(7+1)}{2} + 7 R_N \cdot C_{load}$
V_{out-A}
$V_{DD-known}$
0
1
2
3
4
5
6
7
V_{DD}
C_{load}
R_N
R_N
C_{ox}
C_{ox}
C_{ox}



$$t_{pHL} = 0.7(R + R_N) \cdot C + 0.7 \cdot R_N \cdot (C_{oxp} + C_{oxN})$$

$$t_{pLH} = 0.7(R + R_P) \cdot C + 0.7 \cdot R_P (C_{oxp} + C_{oxN})$$

$$C_{oxN} = C'_{ox} \cdot W_N L_N$$

$$C_{oxp} = C'_{ox} \cdot W_P L_P$$