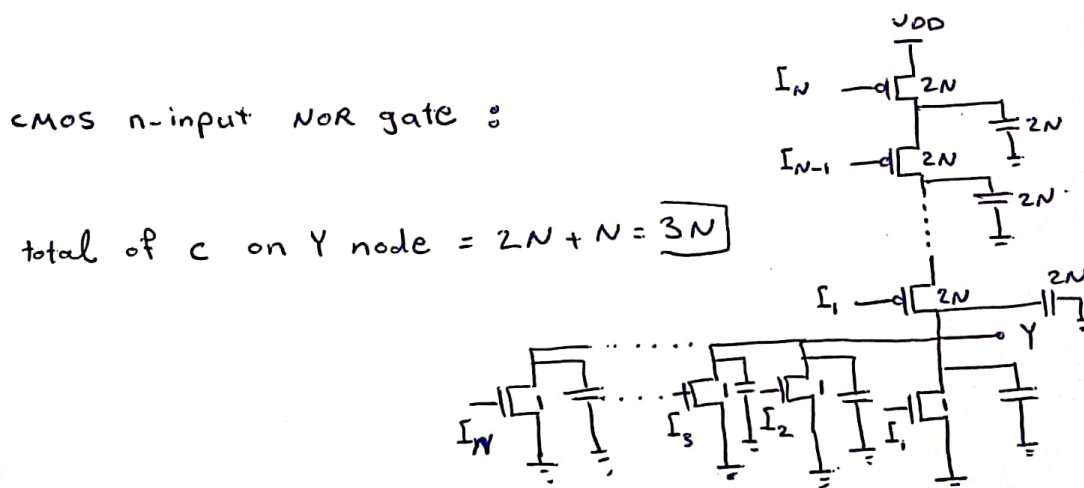
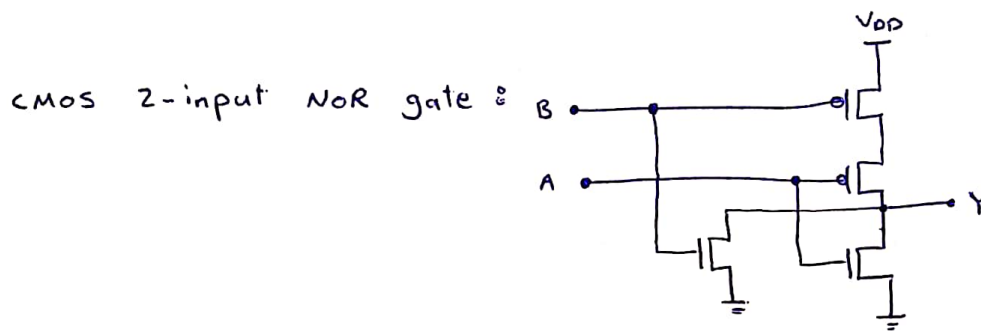
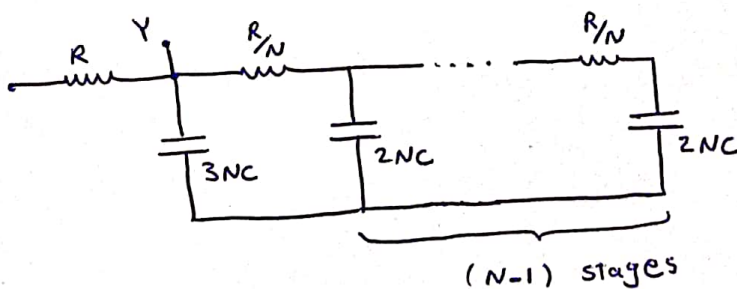


4.4 : Find the worst-case Elmore parasitic delay of an n-input NOR gate



worst case for Fall-Time : I_1, \dots, I_{N-1} all at 0 and I_N goes from 0 to 1



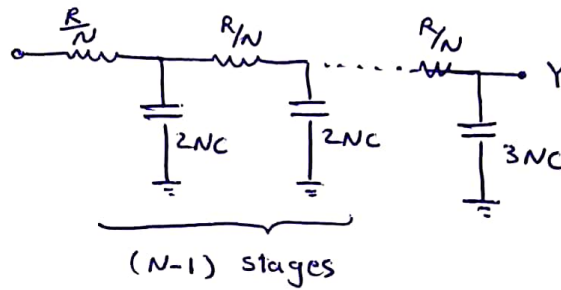
Elmore model delay :

$$R \times \left[\sum_{i=1}^{N-1} 2NC + 3NC \right]$$

$$= R(2N^2C + NC) = RC(2N^2 + N)$$

Worst case for Rise time :

$I_1 - I_{n-1}$ at 0 and I_N goes from 1 to 0



$$\begin{aligned}
 & \frac{R}{N}(2NC) + \frac{2R}{N}(2NC) + \dots + \frac{(N-1)R}{N}(2NC) + R(3NC) \\
 &= RC(1 + \dots + N-1) + 3NCR \\
 &= RC\left(\frac{(N-1)N}{2}\right) + 3NRC \\
 &= RC(N^2 - N) + 3NRC \\
 &= \boxed{RC(N^2 + 2N)} \quad \text{so fall time is the worst case}
 \end{aligned}$$