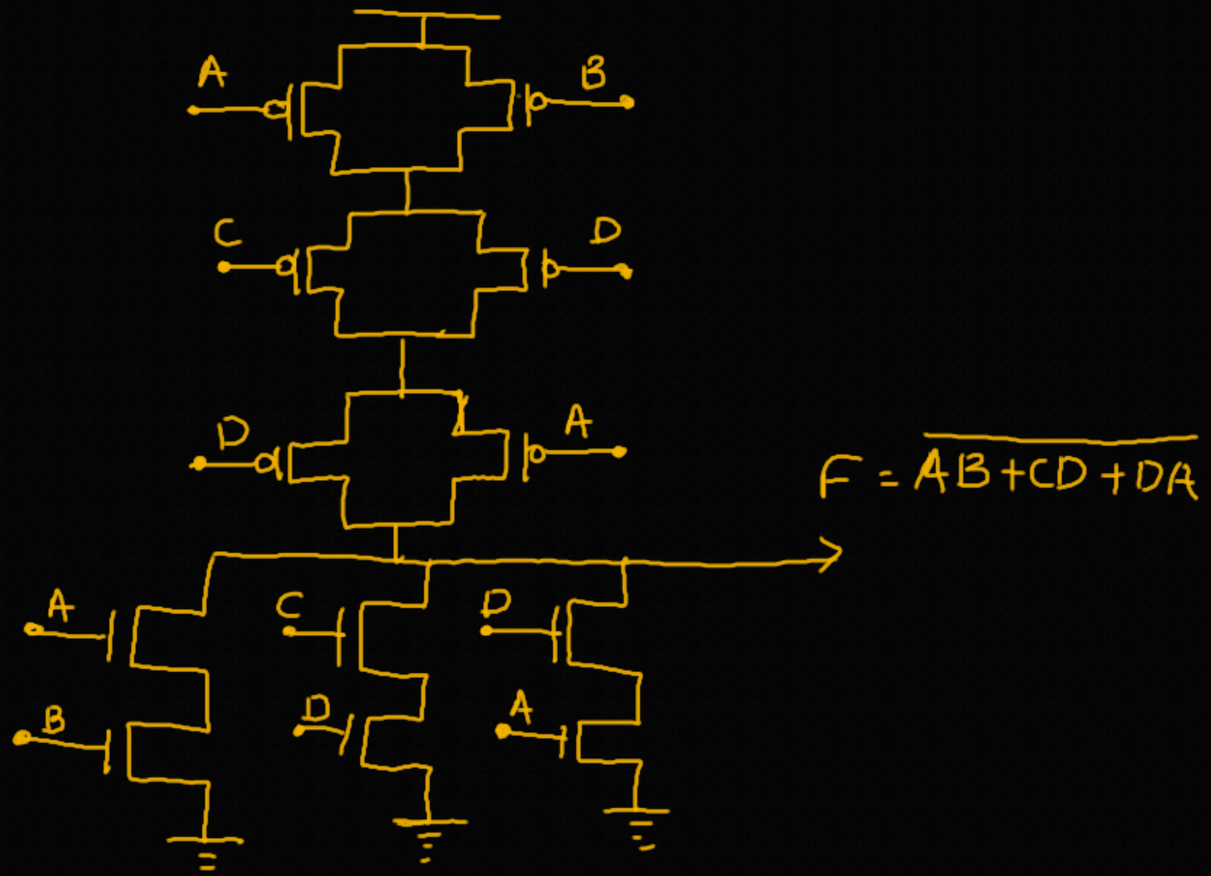
Assingment-5

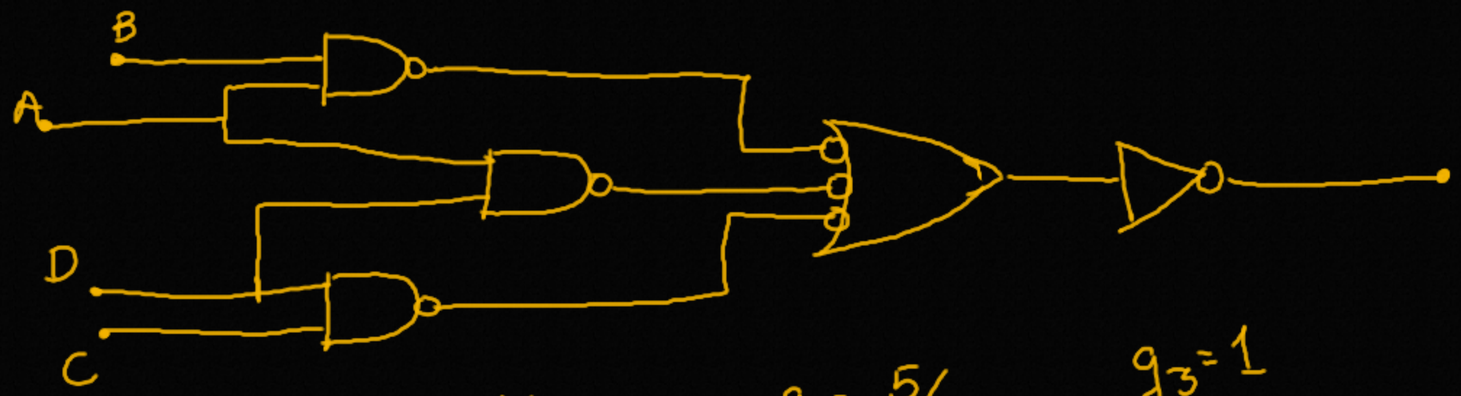
Implement the Boolean function bar (A.B + CD + DA) using CMOS logic family. Find the logical effort for each input. Approximate the delay using Elmore's delay method.

Solution

Boolean function $F = (AB + CD + DA)'$



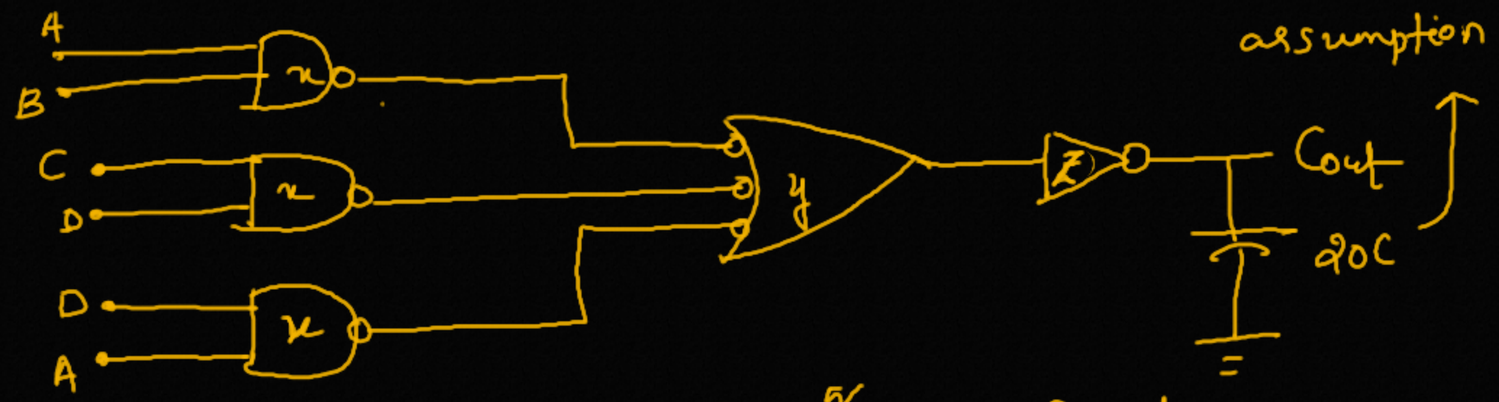
$F = \overline{AB + CD + DA}$



$g_1 = 4/3$ $\quad g_2 = 5/3$ $\quad g_3 = 1$

$$\text{logical effort} = \prod_{i=1}^{3} g_i = 4/3 \times 5/3 \times 1 = 20/3$$

$\therefore$ logical effort for each input will be $20/3$.



Logical effort :

$g_1 = 4/3$ $\quad g_2 = 5/3$ $\quad g_3 = 1$

$p_1 = 2$ $\quad p_2 = 3$ $\quad p_3 = 1$

$h_1 = y/x$ $\quad h_2 = z/y$ $\quad h_3 = 20/z$

as we know,

$A.P. \leq G.P.$

$\Rightarrow (a+b+c+d) \leq (abcd)^{1/4}$

$$\text{Delay} = p_1 + g_1h_1 + p_2 + g_2h_2 + p_3 + g_3h_3$$

$$= 2 + \frac{4}{3}\cdot\frac{y}{x} + 3 + \frac{5}{3}\cdot\frac{z}{y} + 1 + \frac{20}{z}\times 1$$

$$= 6 + \frac{4}{3}\left(\frac{y}{x}\right) + \frac{5}{3}\cdot\frac{z}{y} + \frac{20}{z}$$

So, the maximum delay will be,

$$\text{delay} = 6 + \frac{4}{3}\times\frac{y}{x}\times\frac{5}{3}\times\frac{z}{y}\times\frac{20}{z} = 6 + \frac{400}{9x}$$

assume $x = 10$

then delay $= 6 + \frac{40}{9}$

$= \frac{94}{9} = 10.44$

∴ The approximated delay will be 10.44.