Solutions to CSE3201 Assignment 1

1.

Solution in book.

2.

Solution in book.

3.

Solution in book.

4.

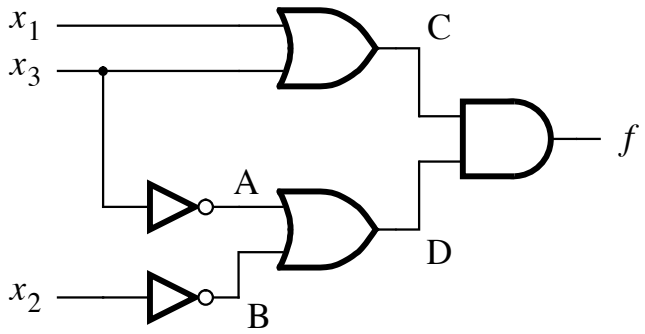
$$
\begin{aligned}
(x+y)\cdot(x+z) &= xx + xz + xy + yz \\
&= x + xz + xy + yz \\
&= x(1+z+y) + yz \\
&= x\cdot 1 + yz \\
&= x + yz
\end{aligned}
$$

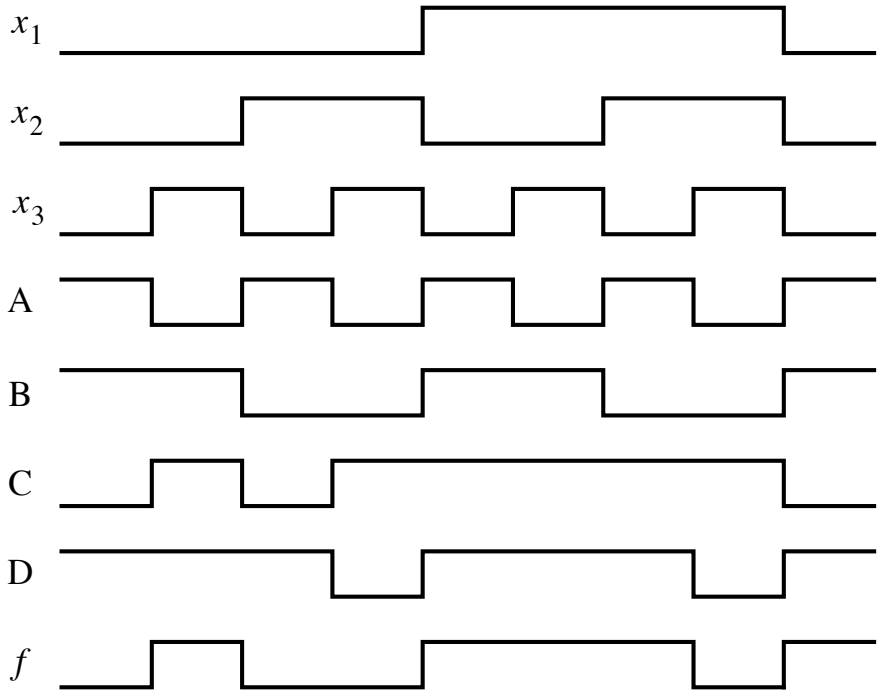
5.

Solution in book

6.

7.





8.

$$
\begin{aligned}
f &= x_1x_3 + x_1\overline{x}_2 + \overline{x}_1x_2x_3 + \overline{x}_1\overline{x}_2\overline{x}_3 \\
&= x_1(\overline{x}_2 + x_2)x_3 + x_1\overline{x}_2(\overline{x}_3 + x_3) + \overline{x}_1x_2x_3 + \overline{x}_1\overline{x}_2\overline{x}_3 \\
&= x_1\overline{x}_2x_3 + x_1x_2x_3 + x_1\overline{x}_2\overline{x}_3 + \overline{x}_1x_2x_3 + \overline{x}_1\overline{x}_2\overline{x}_3 \\
&= x_1x_3 + (x_1 + \overline{x}_1)x_2x_3 + (x_1 + \overline{x}_1)\overline{x}_2\overline{x}_3 \\
&= x_1x_3 + x_2x_3 + \overline{x}_2\overline{x}_3
\end{aligned}
$$

9. A CMOS inverter is composed of an NMOS transistor with an equivalent ON resistance of 1 kOhms and a PMOS transistor with an

ON resistance of 1.5 kOhms. The equivalent capacitance of the NMOS transistor at the output of the inverter in 2 fF and for the PMOS transistor it is 2.5 fF. On top of this, the capacitive load being driven by the inverter is 5 fF. What is the rise time delay of the inverter? What is its fall time delay?

10.

$$f(x_1, x_2, x_3) = \sum M(3,4,6,7)$$

$$= \bar{x}_1 x_2 x_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 + x_1 x_2 x_3$$

$$= (\bar{x}_1 + x_1) x_2 x_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 \bar{x}_3$$

$$= x_2 x_3 + x_1 \bar{x}_3 (\bar{x}_2 + x_2)$$

$$= x_2 x_3 + x_1 \bar{x}_3$$

11.

12.

$$f(x_1, x_2, x_3) = \pi M(0,1,5,7)$$

$$= (x_1 + x_2 + x_3)(x_1 + x_2 + \bar{x}_3)(\bar{x}_1 + x_2 + \bar{x}_3)(\bar{x}_1 + \bar{x}_2 + \bar{x}_3)$$

$$= (x_1 + x_2)(x_3 + \bar{x}_3)(x_1 + \bar{x}_3)(x_2 + \bar{x}_2)$$

$$= (x_1 + x_2)(x_1 + \bar{x}_3)$$

13.

14.

x_1	x_2	x_3	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

	00	01	11	10
0	0	1	1	1
1	1	0	1	0

$$f = (x_1 + x_2 + x_3)(\bar{x}_1 + x_2 + \bar{x}_3)(\bar{x}_1 + \bar{x}_2 + x_3)$$

15.

x_1	x_2	x_3	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

x_1 \ x_2x_3	00	01	11	10
0	0	1	1	1
1	1	0	1	0

$$x_1\bar{x}_2\bar{x}_3 + \bar{x}_1x_3 + \bar{x}_1\bar{x}_2 + x_2x_3 = f$$

$f = \bar{X}_1\bar{X}_2X_3 + \bar{X}_1X_2\bar{X}_3 + \bar{X}_1X_2X_3 + X_1\bar{X}_2\bar{X}_3 + X_1X_2X_3$

- identify which minterms share at least two literals
- and make duplicates of the one ~~that~~ that shares the most links

(remember) $a = a + a$

$= \bar{X}_1X_2X_3 + X_1X_2X_3 +$
$\bar{X}_1X_2\bar{X}_3 + \bar{X}_1X_2X_3 +$
$\bar{X}_1\bar{X}_2X_3 + \bar{X}_1X_2X_3 +$
$X_1\bar{X}_2\bar{X}_3$

$f = X_2X_3 +$
$\bar{X}_1X_2 +$
$\bar{X}_1X_3 +$ $X_1\bar{X}_2\bar{X}_3$

16.

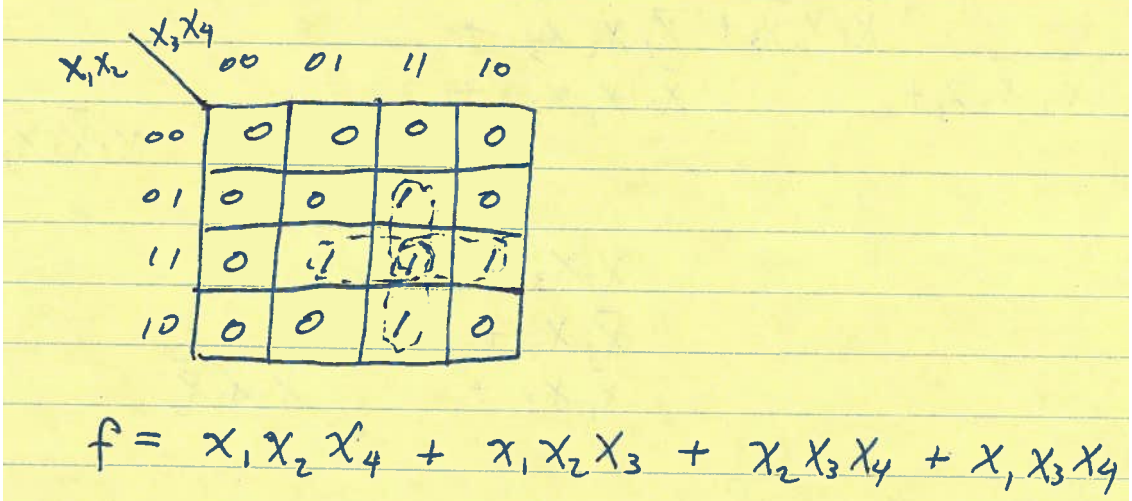
$f(X_1, X_2, X_3) = \sum m(1,4,7) + D(2,5)$

X_1 \ X_2X_3	00	01	11	10
0	0	1	0	d
1	1	d	1	0

SOP: $f = X_1\bar{X}_2 + X_1X_3 + \bar{X}_2X_3$

POS: $f = (X_1 + X_3)(X_1 + \bar{X}_2)(\bar{X}_2 + X_3)$

17.



18.

19.

```
module  prob2_46 (x1, x2, x3, f);
    input  x1, x2, x3;
    output  f;

    not (notx1, x1);
    not (notx2, x2);
    not (notx3, x3);
    and (a, notx1, notx2, x3);
    and (b, notx1, x2, notx3);
    and (c, x1, notx2, notx3);
    and (d, x1, x2, x3);
    or (f, a, b, c, d);

endmodule
```

20.