University of Minnesota
EE 2301 Introduction to Logic Design Summer 2024

Homework 5

1. Determine the function of the following circuit.

$$PUN \quad f = (\overline{X_1} + \overline{X_2}) \cdot \overline{X_3} \cdot \overline{X_4}$$

$$PDN \quad f = \overline{X_1 X_2 + X_3 + X_4}$$

$$= (\overline{X_1} + \overline{X_2}) \cdot \overline{X_3} \cdot \overline{X_4}$$

$$f = (\overline{X_1} + \overline{X_2}) \cdot \overline{X_3} \cdot \overline{X_4}$$
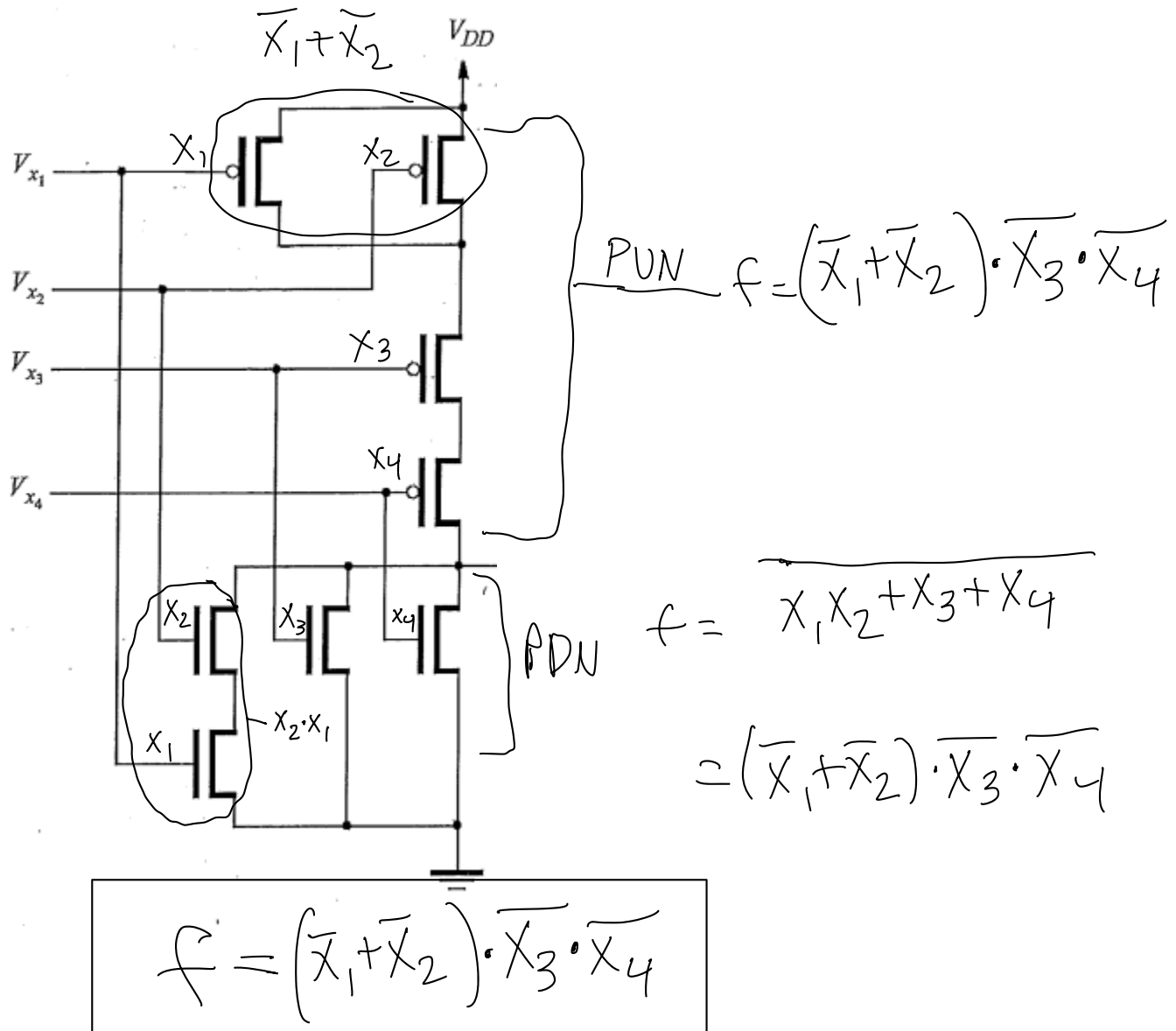
2. Sketch a CMOS circuit to implement the function f=(AB+CDE)'.

$$f = \overline{AB + CDE}$$

$$f = (\overline{A} + \overline{B}) \cdot (\overline{C} + \overline{D} + \overline{E})$$
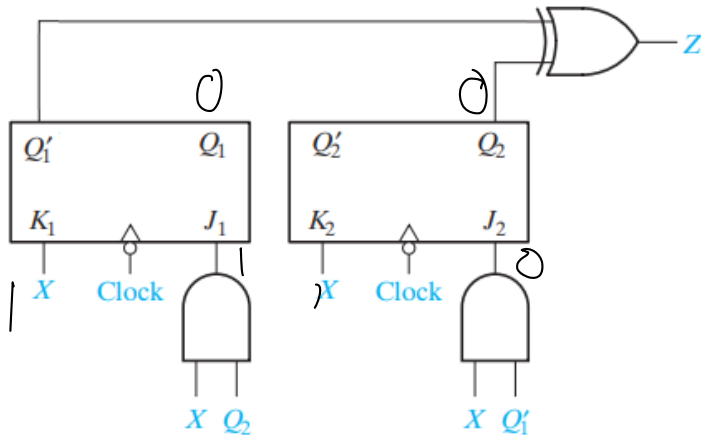

$$f = (\overline{A} + \overline{B}) \cdot (\overline{C} + \overline{D} + \overline{E})$$

$$f = \overline{AB + CDE}$$

3.
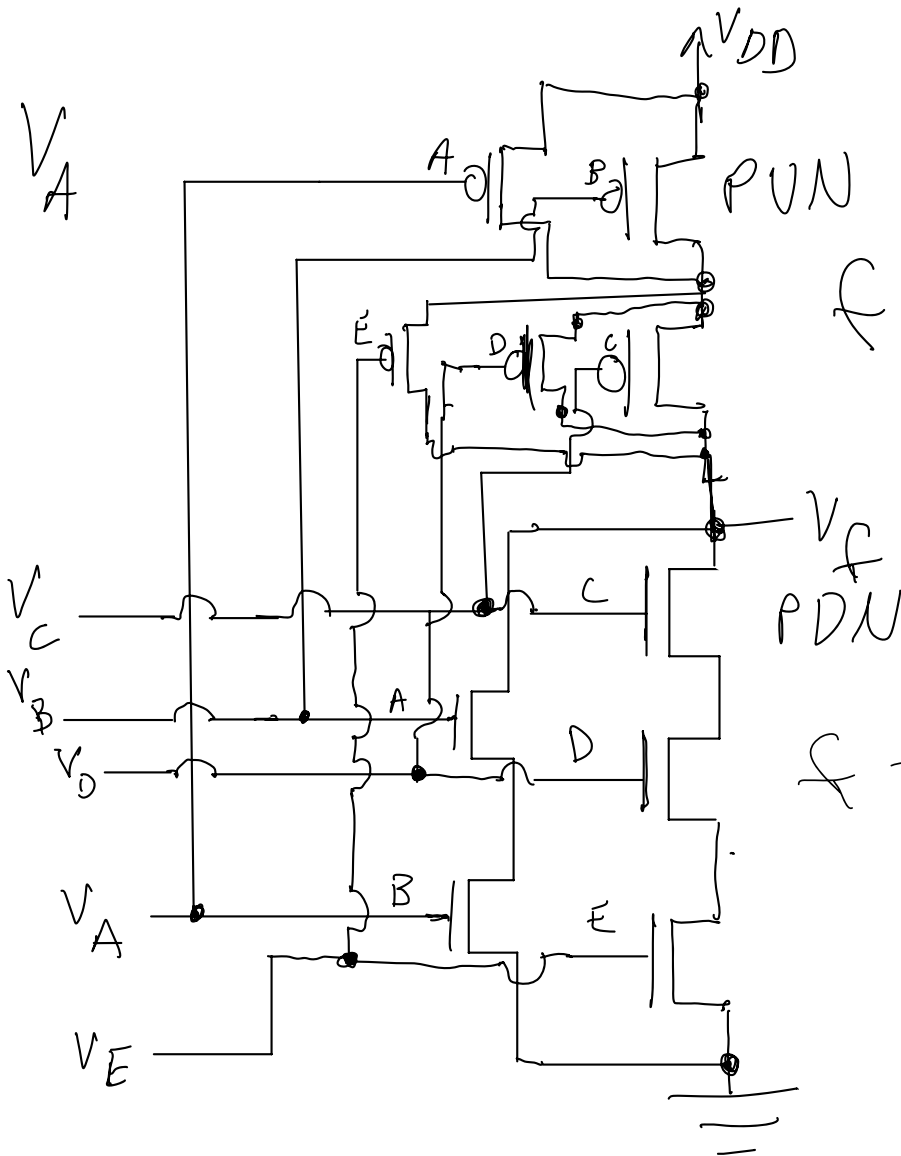
    a) Analyze the Moore Sequential Circuit to obtain the Next State Table.

    b) List values of Q_1, Q_2, and the output Z for an input sequence X = 1011. Initially, $Q_1 = Q_2 = 0$.
       Note: You don't need to sketch any graph.

4. Using the Quine-McCluskey, method find all prime implicants of

$$f(A, B, C, D) = \Sigma\, m(0, 2, 6, 7, 11) + \Sigma\, d(4, 10, 13)$$

Identify all essential prime implicants and find a minimum sum-of-products expression.

③

a) $J_1 = X Q_2$ $J_2 = X \overline{Q_1}$ $Z = \widetilde{\overline{Q_1} \oplus Q_2}$

$K_1 = X$ $K_2 = X$

NEXT STATE

Present state $Q_1 Q_2$	$x=0$		$x=1$		OUT Z
	$J_1 K_1 Q_1^+$	$J_2 K_2 Q_2^+$	$J_1 K_1 Q_1^+$	$J_2 K_2 Q_2^+$	
0 0	0 0 0	0 0 0	0 1 0	1 1 1	1
0 1	0 0 0	0 0 1	1 1 1	1 1 0	0
1 0	0 0 1	0 0 0	0 1 0	0 1 0	0
1 1	0 0 1	0 0 1	1 1 0	0 1 0	1

3

b)

CLK Negative edge	X	Q_1	Q_2	Z
0	1	0	0	r
1	0	0	1	0
2	1	0	1	0
3	1	1	0	0
4		0	0	1

(4) $\sum m(0,2,6,7,11) + \sum d(4,10,13)$

Group 0:

✓ 0   0 0 0 0 $(0,2) \to 00\_0$
                  $(0,4) \to 0\_00$ } $(0,4,2,6)$ ~~$0\_\_0$~~ $0\_\_0$

Group 1:

✓ 2   0 0 1 0 $(2,6) \to 0\_10$
✗ 4   0 1 0 0 $(2,10) \to \_010$
                  $(4,6) \to 01\_0$
                  $(4,10) \to can't$

Group 2:

6   0 1 1 0 $(6,7) \to 011\_$
                $(6,11) \to can't$
                $(6,13) \to can't$
✗ 10 1 0 1 0 $(10,7) \to can't$
                $(10,11) \to 101\_$
                $(10,13) \to can't$

Group 3:

7   0 1 1 1
11 1 0 1 1
13 1 1 0 1

	0	2	6	7	11
$(0,4,2,6)$ $0\_\_0$	⊗	✗	✗		
$(6,7)$ $011\_$			✗	⊗	
$(10,11)$ $10\_\_$					⊗
$(2,10)$ $\_010$		✗			

$$F = \overline{a}\,\overline{d} + \overline{a}\,b\,c + a\,\overline{b}\,c$$