Name Answers

CE-1901-11 – Dr. Durant – Quiz 3
Fall 2016, Week 3

1. (1 point) **Explain** why a digital circuit might not operate properly if $V_{OH} < V_{IH}$.

The voltage of an output of 1 is guaranteed to be at least V_{OH}. Let it exactly equal V_{OH}. When received, the signal is interpreted as 1 if it is at least V_{IH}, which is $V_{OH} \geq V_{IH}$. But, we are given $V_{OH} < V_{IH}$, which is contradictory. Therefore, we did not receive a value of 1.

2. (2 points) ***State and explain why either*** a (relatively) positive or negative charge must present at the gate of an NMOS transistor (specifically, an n-channel enhancement mode MOSFET [metal-oxide-semiconductor field-effect transistor]) in order for current to ***flow*** between the drain and the source?

positive charge, attracts negative electrons into the channel, allowing electrical current to flow since this is an n-channel FET

3. (2 points) **Complete** a **truth table** for function that outputs 1 iff the 3-bit input, $a_2a_1a_0$ is a palindrome (it reads the same left-to-right as it does right-to-left).

a_2	a_1	a_0	r
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

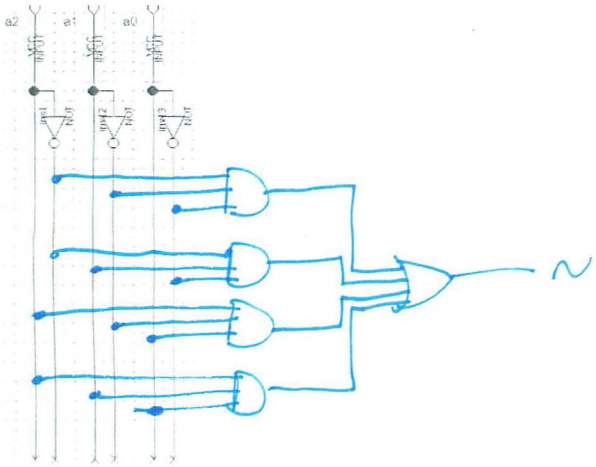
4. (1 point) **Write** the **canonical** sum-of-products (**SOP**) equation for your truth table.

$N = \bar{a}_2\bar{a}_1\bar{a}_0 + \bar{a}_2 a_1 \bar{a}_0 + a_2\bar{a}_1 a_0 + a_2 a_1 a_0$ $(= a_2 \odot a_0$, but this is not canonical)

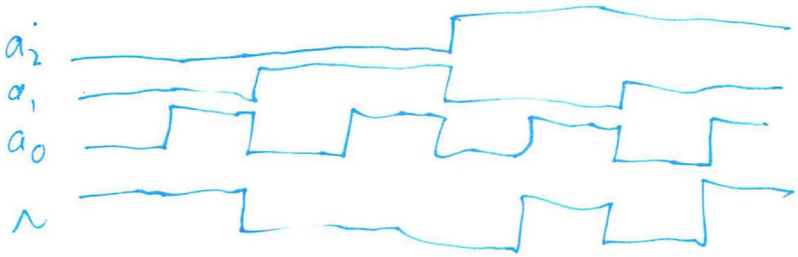
5. (1 point) Write the canonical SOP equation **in sum-of-minterms (Σ)** form.

$N(a_2 a_1 a_0) = \Sigma_m(0, 1, 5, 7)$

6. (1 point) Draw the **gate diagram** for your canonical SOP equation.



7. (2 points) Draw an **ideal timing diagram** (like Quartus simulation output) for your function with the input progressing through all possible values in a logical order.



Name Answers

CE-1901-12 – Dr. Durant – Quiz 3
Fall 2016, Week 3

1. (1 point) **Explain** why $V_{OL} < V_{IL}$ is a requirement for the proper operation of a digital circuit.

If this condition is violated then the transmitted voltage representing a 0 can be higher than the maximum acceptable valid (V_{IL}) for a receiver to interpret it as a 0, resulting in an incorrect interpretation.

2. (2 points) **Explain** what it means to say that transistors are **active** devices (as opposed to passive devices). Recalling the light switch example might be helpful.

They control a "switch" energy that can be greater than the input energy used for control. (Thus they require a separate power source from the controlling input.)

3. (2 points) **Complete** a **truth table** for function that outputs 1 iff the 3-bit unsigned number, $a_2a_1a_0$, is less than 4.

a_2	a_1	a_0	r
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

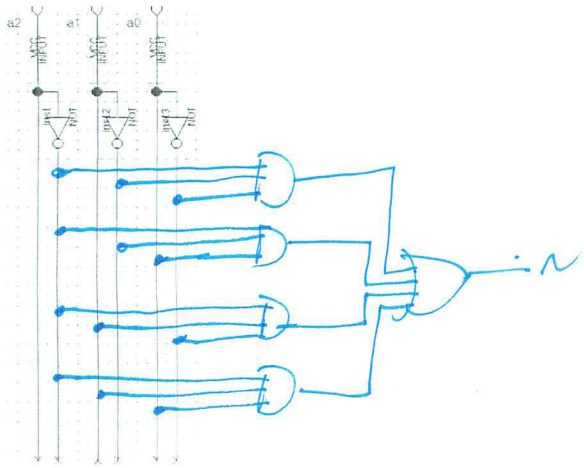
4. (1 point) **Write** the **canonical** sum-of-products (**SOP**) equation for your truth table.

$N = \bar{a}_2\bar{a}_1\bar{a}_0 + \bar{a}_2\bar{a}_1 a_0 + \bar{a}_2 a_1\bar{a}_0 + \bar{a}_2 a_1 a_0$ $(= \bar{a}_2$, but that's not canonical)

5. (1 point) Write the canonical SOP equation **in sum-of-minterms (Σ)** form.

$N(a_2, a_1, a_0) = \Sigma_M(0, 1, 2, 3)$

6. (1 point) Draw the **gate diagram** for your canonical SOP equation.



7. (2 points) Draw an **ideal timing diagram** (like Quartus simulation output) for your function with the input progressing through all possible values in a logical order.