Homework 3

Due: Wednesday, December 28, 2022

- This homework is due on Wednesday, December 28, 2022.
- Hand in your completed handwritten homework to me during our Wednesday lecture.
- There is a 50% penalty per day for late submission.
- Copied homework will be awarded 0 marks.

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1. Design a 3-to-8 decoder using only NAND gates and inverters.

2. Construct a 4-to-16 decoder with an enable input using five 2-to-4 line decoders with enable inputs.

3. Design a 4-to-1 MUX using AND gates and inverters.

4. Design a 4-to-2 priority encoder with NOR gates and inverters such that the inputs D_0, D_1, D_2, and D_3 have the following priorities: $D_1 > D_0 > D_2 > D_3$.

5. Assume that you are a Telecom Engineer at ZTE Pakistan. You are responsible for BTS installation and commissioning. All of a sudden a power surge destroys a 4-to-16 decoder (implementing the function given in the table below) in one of your control panels. Due to cut backs in the budget, all you find in your inventory is a 4-to-1 MUX, an 8-to-1 MUX, and a 4-to-2 priority encoder. First, which of these devices (only use ONE of them) could you use to replace the decoder (and the OR gate) in the circuit such that the output performs the same function. Second, show the design with the new replacement device. (Assume that you also have as many inverters as you need).

Inputs				
Brown	**Green**	**Blue**	**Yellow**	**Output**
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

6. While designing a digital calculator, the first step is designing the keypad input. When a button on the keypad is pressed, a high voltage is sent along the corresponding wire to the digital circuit. Each keypad button provides an input into the digital circuit that you are going to design. Assume that each key type is encoded with a 4-bit code according to the following convention: '0 key'=0000; '1 key'=0001; '2 key'=0010, '3 key'=0011; '4 key'=0100; '5 key'=0101; '6 key'=0110; '7 key'=0111; '8 key'=1000; '9 key'=1001; '+ key'=1010; '- key'=1011; '* key'=1100; '/ key"=1101; '= key'=1110; 'clear key'=1111. Do you need a 4-to-1 MUX, a 16-to-1 MUX, a 1-to-16 DEMUX, a 3-to-8 decoder, a 16-to-4 encoder, a 4-to-16 decoder, a 16-to-4 priority encoder, or an 8-to-3 encoder to produce these codes from the basic keypad description? Once you pick one of these components, show how you would hook up the component to your keypad. Use the following names for the keypad signals: 1key, 2key, 3key, 4key, 5key, 6key, 7key, 8key, 9key, pluskey, minuskey, *key, /key, =key, and clearkey.