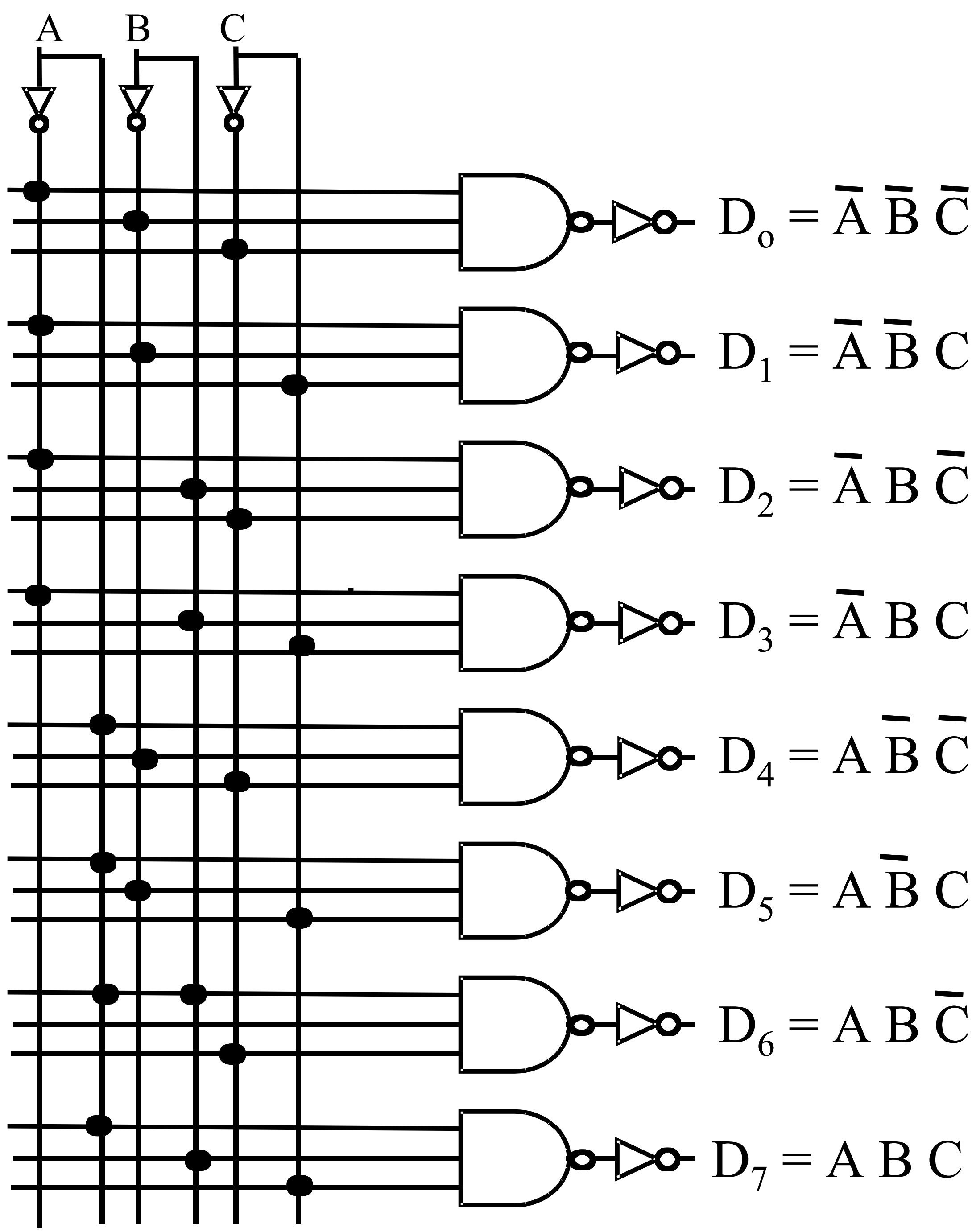
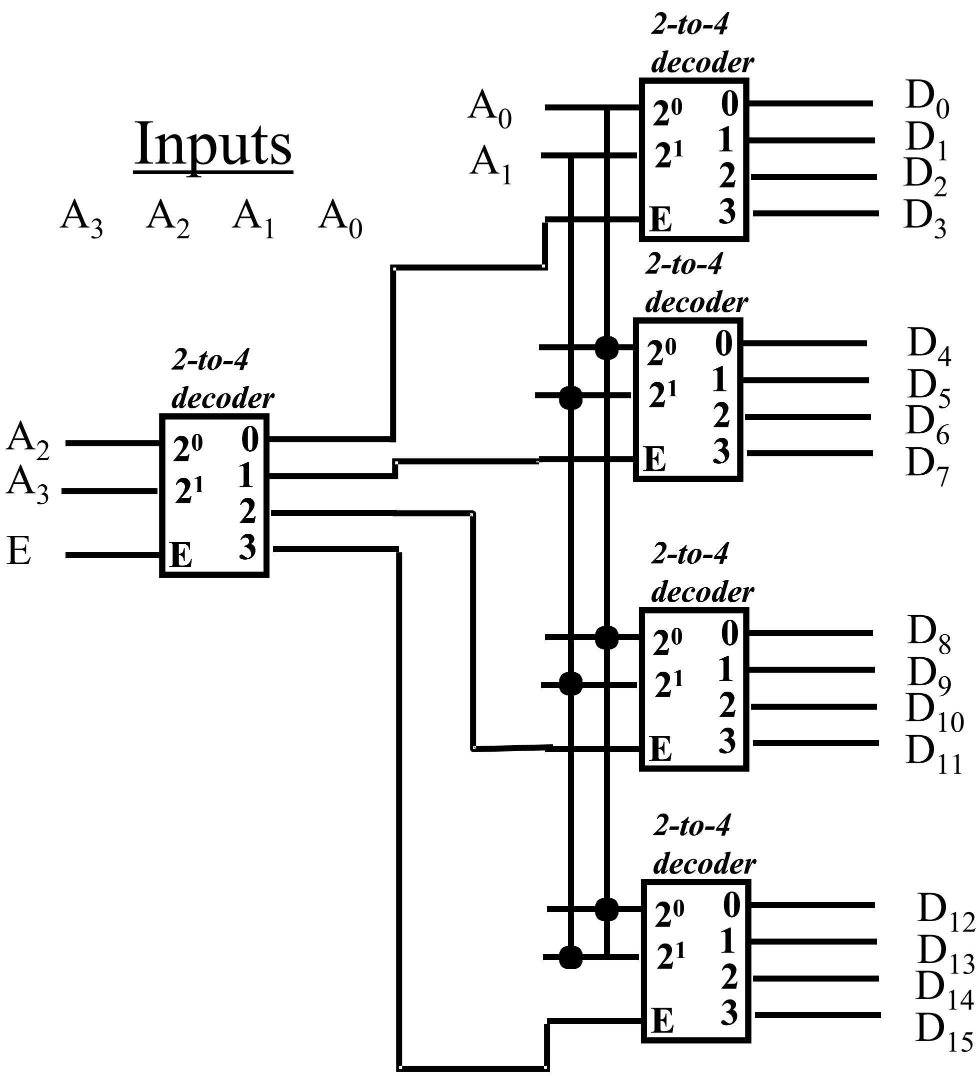
Homework 3 Solution

1.

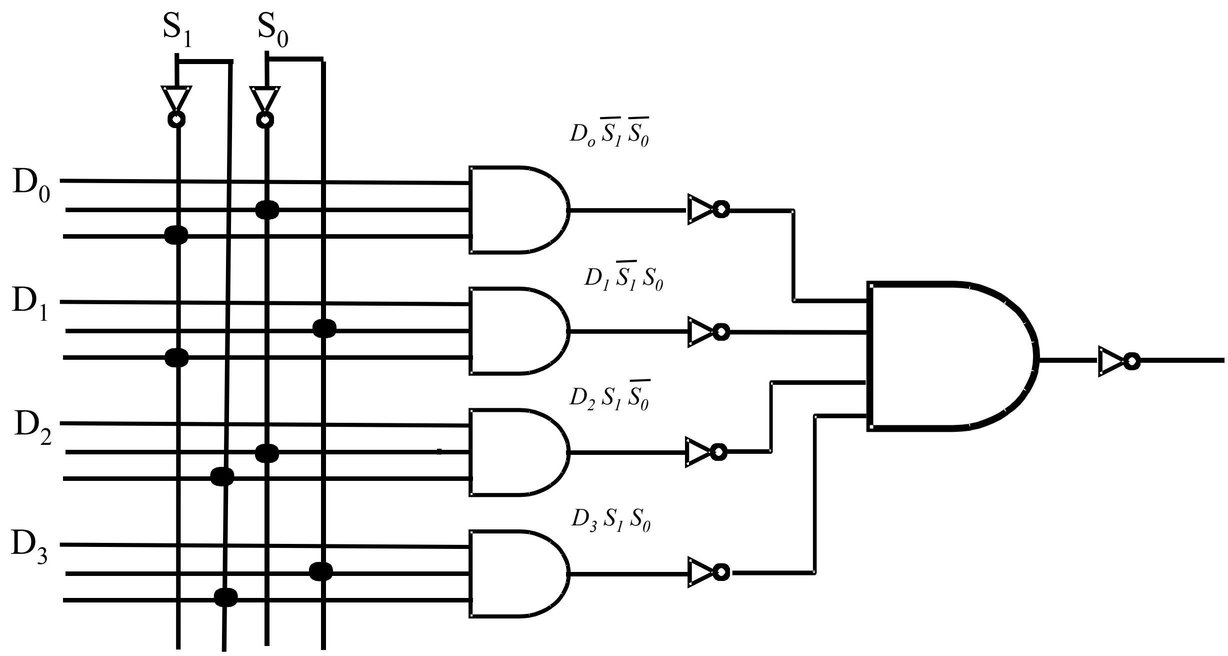


2.



Inputs
A3 A2 A1 A0
2-to-4 decoder
A2
A3
E
2^0
2^1
E
0
1
2
3
A0
A1
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15

3.



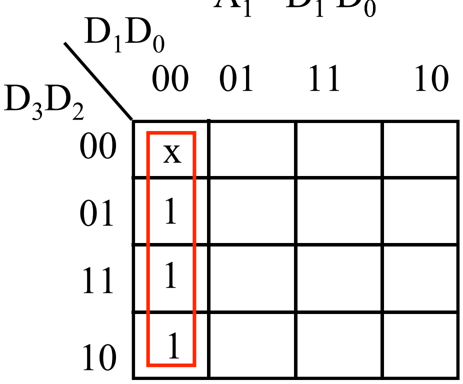
S_1
S_0
D_0
D_1
D_2
D_3
$D_o \overline{S_1}\,\overline{S_0}$
$D_1 \overline{S_1} S_0$
$D_2 S_1 \overline{S_0}$
$D_3 S_1 S_0$

4.

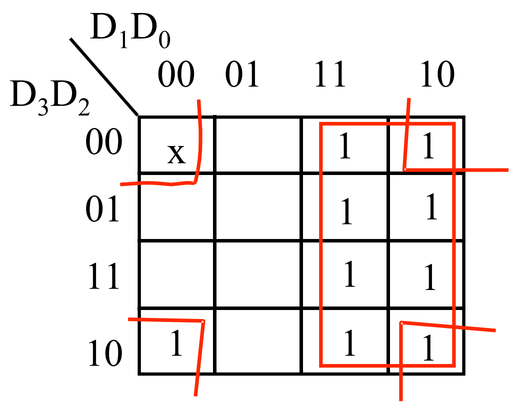
Truth Table describing Priority Encoder with D1>D0>D2>D3

D_3	D_2	D_1	D_0	A_1	A_0	V
0	0	0	0	x	x	0
x	x	1	x	0	1	1
x	x	0	1	0	0	1
x	1	0	0	1	0	1
1	0	0	0	1	1	1

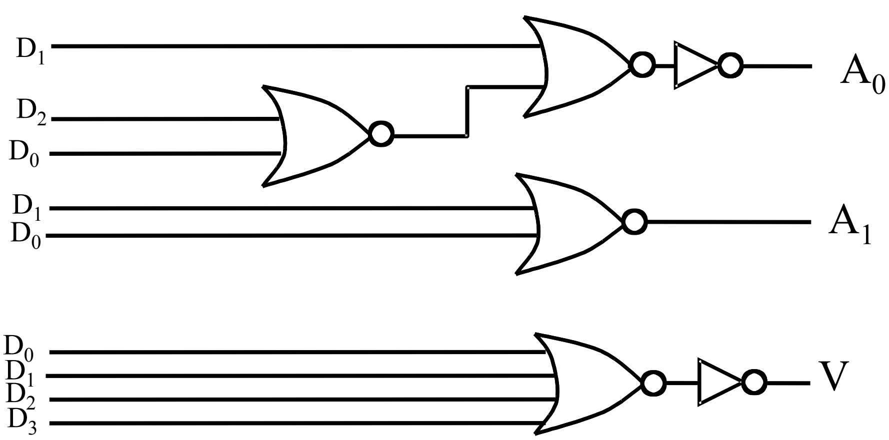
$A_1 = \overline{D}_1\,\overline{D}_0$



$A_0 = D_1 + \overline{D}_2\,\overline{D}_0$



$$A_0 = D_1 + \overline{D}_2\,\overline{D}_0$$
$$A_1 = \overline{D}_1\,\overline{D}_0$$
$$V = D_0 + D_1 + D_2 + D_3$$

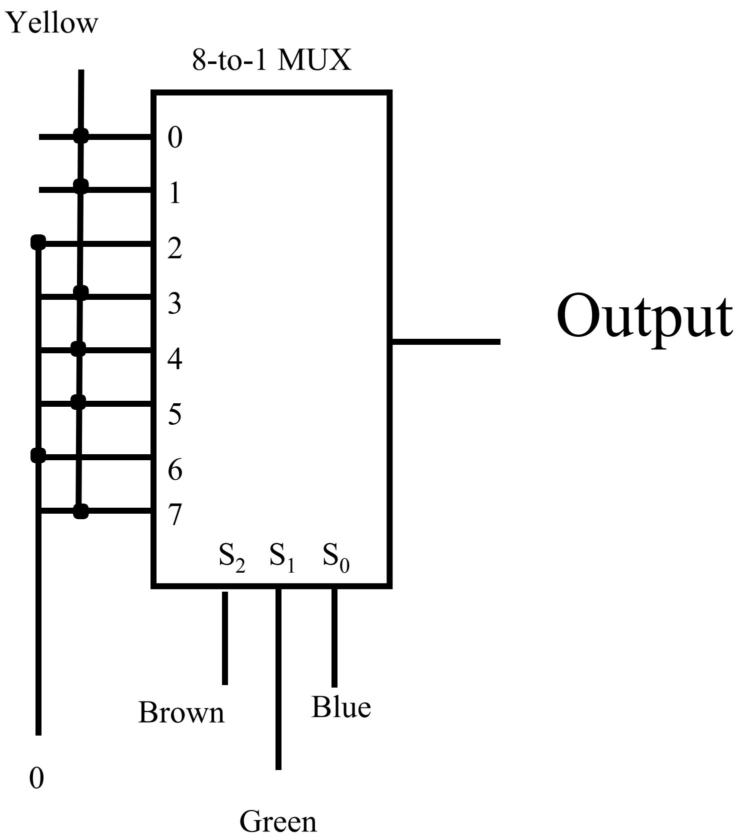


5.

At first glance, you might consider the problem and say, "I will quickly put in an 8-to-1 MUX to implement the function implemented by the decoder and the OR gate." You could draw up the truth table that looks something like this:

Brown	Green	Blue	Yellow	Output	
0	0	0	0	0	Output = Yellow
0	0	0	1	1	
0	0	1	0	0	Output = Yellow
0	0	1	1	1	
0	1	0	0	0	Output = 0
0	1	0	1	0	
0	1	1	0	0	Output = Yellow
0	1	1	1	1	
1	0	0	0	0	Output = Yellow
1	0	0	1	1	
1	0	1	0	0	Output = Yellow
1	0	1	1	1	
1	1	0	0	0	Output = 0
1	1	0	1	0	
1	1	1	0	0	Output = Yellow
1	1	1	1	1	

From the truth table, you could hook up an 8-to-1 MUX according to the following schematic:



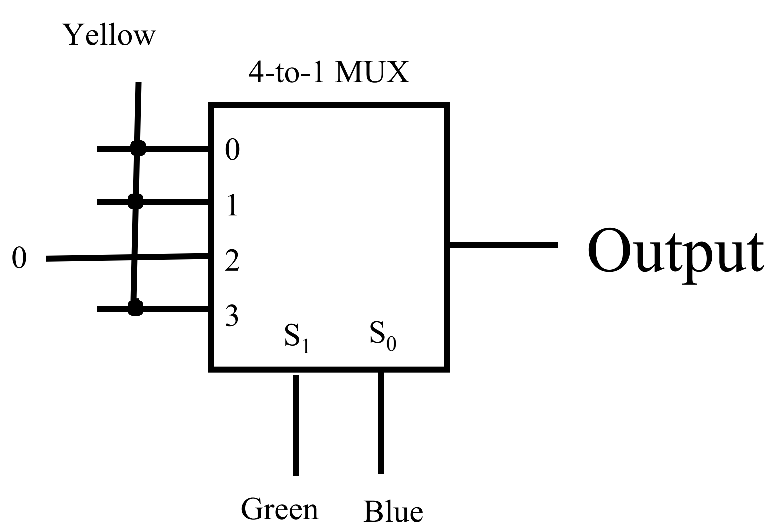
After a little more consideration, you might realize that the brown line is not actually needed. This can be verified by trying to simplify the output using a K-MAP as follows:

Br G \ Bl Y	00	01	11	10
00	0	1	1	0
01	0	0	1	0
11	0	0	1	0
10	0	1	1	0

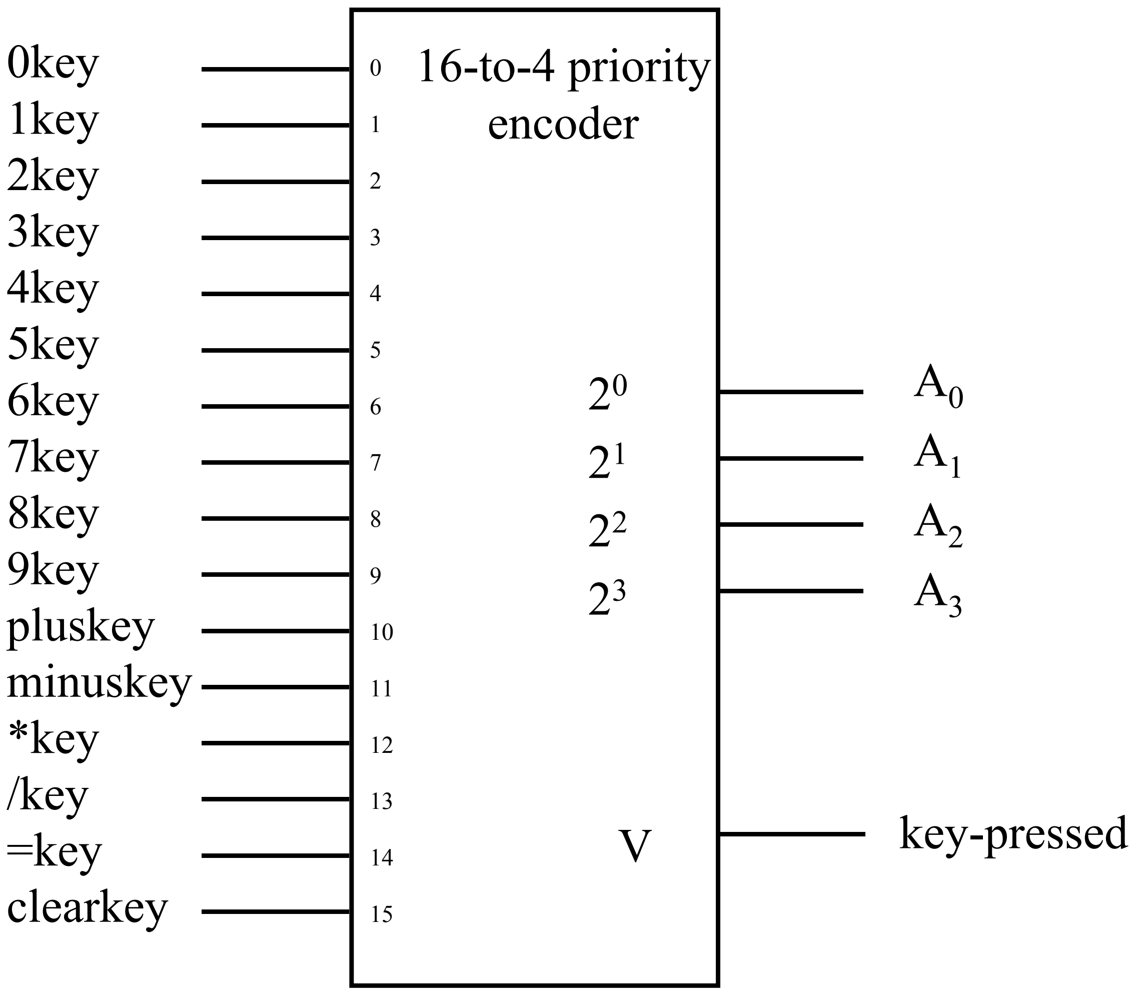
$$F = \text{Blue} \cdot \text{Yellow} + \overline{\text{Green}} \cdot \text{Yellow}$$

This K-map clearly shows that the brown line is not needed and reveals that the designer of the original control panel did not have an optimal design. Therefore, you decide to now use a 4-to-1 MUX to implement the function and save your 8-to-1 MUX for more complex tasks! The implementation with a 4-to-1 MUX is given by:

Green	Blue	Yellow	Output	
0	0	0	0	Output = Yellow
0	0	1	1	
0	1	0	0	Output = Yellow
0	1	1	1	
1	0	0	0	Output = 0
1	0	1	0	
1	1	0	0	Output = Yellow
1	1	1	1	



6.



A priority encoder is needed so that we can handle the condition when no key is selected in which V (which is labelled as key-pressed) will be a zero!!!