EE 231

Exam 2

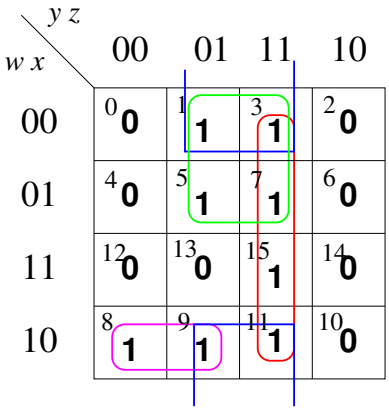
October 15, 2008

Name: _____

Show all work. Partial credit will be given. No credit will be given if an answer appears with no supporting work.

1. Conside the following Boolean function: $F(w,x,y,z) = \sum(1,3,5,7,8,9,11,15)$.

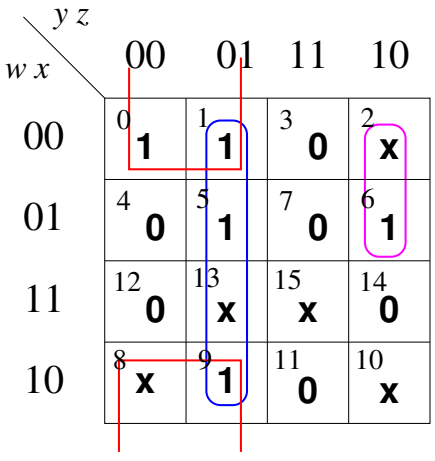
   (a) Find all the prime implicants of the function, and indicate which are essential.



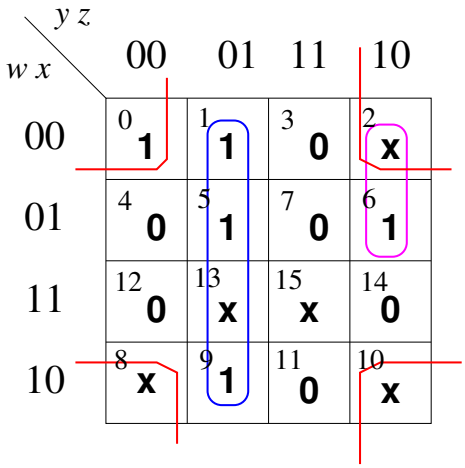
$F(w,x,y,z) = yz = \sum(3,7,11,15)$ (essential)
$F(w,x,y,z) = w'z = \sum(1,3,5,7)$ (essential)
$F(w,x,y,z) = wx'y' = \sum(8,9)$ (essential)
$F(w,x,y,z) = x'z = \sum(1,3,9,11)$ (not essential)

   (b) Use a Karnaugh map to simplify the function.
   $F(w,x,y,z) = yz + w'z + wx'y'$

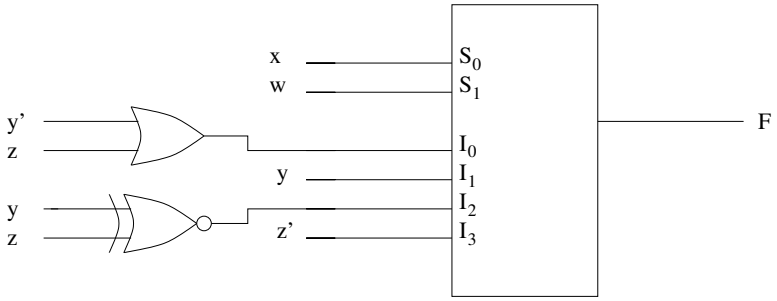
2. Simplify the Boolean function $F(w,x,y,z) = \sum(0,1,5,6,9)$ with the don't-care conditions $d(w,x,y,z) = \sum(2,8,10,13,15)$.



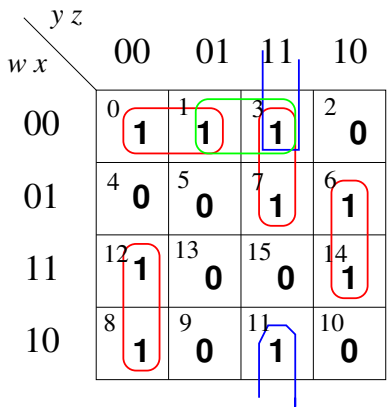
$F(w,x,y,z) = x'y' + y'z + w'yz'$ or $F(w,x,y,z) = x'z' + y'z + w'yz'$



3. Consider the following circuit constructed with a 4-to-1 multiplexor. Determine a Boolean expression for the output F.



w	x	y	z	F	
0	0	0	0	1	
0	0	0	1	1	$z + y'$
0	0	1	0	0	
0	0	1	1	1	
0	1	0	0	0	
0	1	0	1	0	
0	1	1	0	1	y
0	1	1	1	1	
1	0	0	0	1	
1	0	0	1	0	
1	0	1	0	0	$(y \oplus z)'$
1	0	1	1	1	
1	1	0	0	1	
1	1	0	1	0	
1	1	1	0	1	z'
1	1	1	1	0	



$F = w'x'y' + wy'z' + w'yz + xyz' + x'yz$ or $F = w'x'y' + wy'z' + w'yz + xyz' + w'x'z$

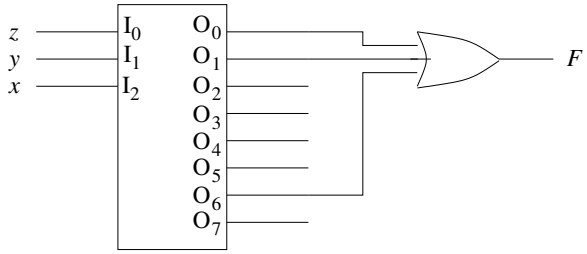
or

When w is low and x is low ($w'x'$), the output is I_0 ($y' + z$); when $w'x$ the output is I_1 (y), when wx' the output is I_2 ($(y \oplus z)'$); when wx the output is I_3 (z'), so

$F = w'x'(y' + z) + w'x(y) + wx'(y \oplus z)' + wx(z')$

4. Design a circuit which implements the function $F = x'y' + xyz'$ using a 3-to-8 decoder and some OR gates.

$F(x, y, z) = x'y'(z' + z) + xyz' = x'y'z' + x'y'z + xyz' = \sum(0, 1, 6)$

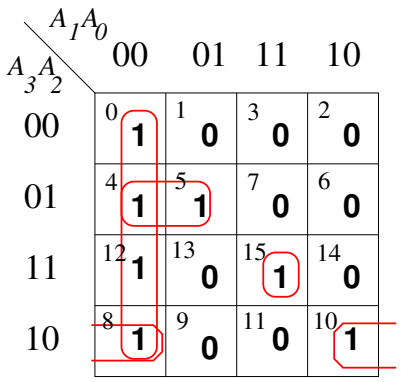


5. Design a division detector device that receives a 4-bit binary number $A_3A_2A_1A_0$ and outputs a 1 whenever the input is evenly divisible by either 4 or 5.

   (a) Find the truth table for the device

   (b) Use a Karnaugh map to find a reduced sum-of-products form for the device.

A_3	A_2	A_1	A_0	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1



$$F(A_3, A_2, A_1, A_0) = A_2'A_1' + A_3'A_2A_1' + A_3A_2'A_0' + A_3A_2A_1A_0$$