

**Cpr E 281 MINI
PROJECT**
ELECTRICAL AND COMPUTER
ENGINEERING
IOWA STATE UNIVERSITY

Mini Project Answer Sheet

053855830

Name and Student ID:

Devin Amdahl

Lab Section: 1

Date: 3/01/22

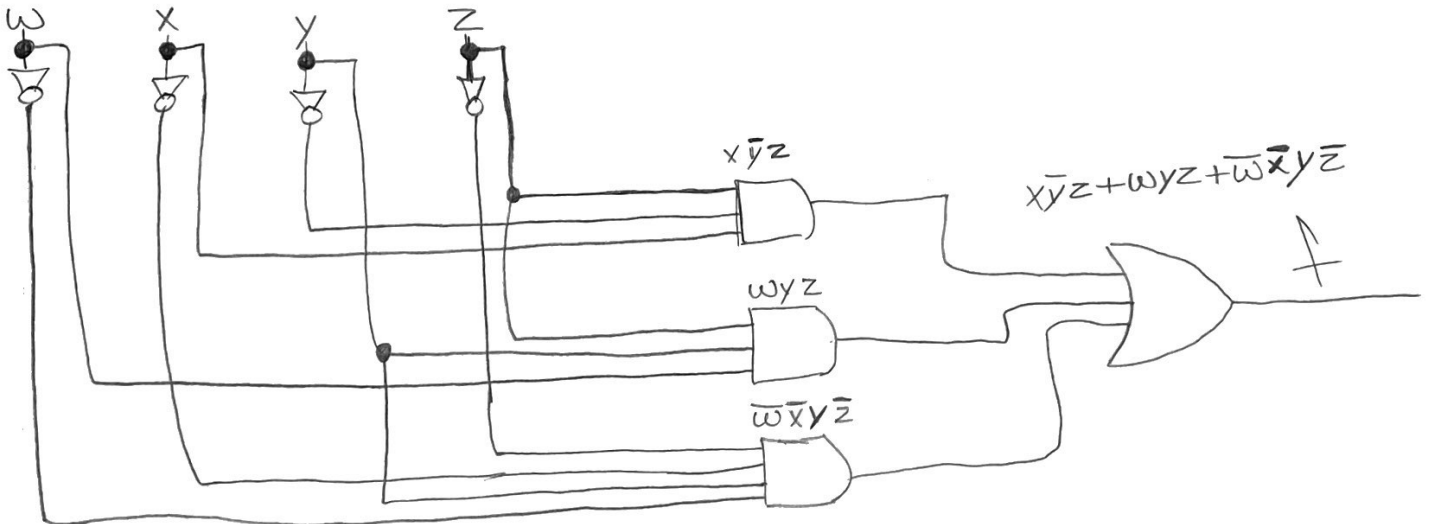
PRELAB:

Read the Mini-Project lab document and complete as much of this answer sheet as you can before lab.

TA Initials: _____

LAB:

4.0 Draw Uncle Bob's circuit below, using only AND, OR, and NOT gates. $NAND \rightarrow SOP$



● Bob's Circuit = $x̄ȳz + wyz + w̄x̄ȳz̄$

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5.0 Give the shorthand canonical SOP expression for Uncle Bob's circuit and then the Verilog code which implements this behavior:

$$B(W, X, Y, Z) = \underline{X\bar{Y}Z + WYZ + \bar{W}\bar{X}Y\bar{Z}}$$

Verilog:

```
module mProjStep1(F, W, X, Y, Z);  
    input W, X, Y, Z;  
    output F;  
    assign F = (X & ~Y & Z) | (W & Y & Z) | (~W & ~X & Y & ~Z);  
end module
```

Demonstration of Quartus Results:

M.K.S

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6.0 Truth table for Uncle Bob's function B and the 4-bit prime detector function P.

W	X	Y	Z	B	P
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	1	1
0	0	1	1	0	1
0	1	0	0	0	0
0	1	0	1	1	1
0	1	1	0	0	0
0	1	1	1	0	1
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	1	1
1	1	0	0	0	0
1	1	0	1	1	1
1	1	1	0	0	0
1	1	1	1	1	0

00 11
0 1 1 1
1 1 1 1

$$P = (y \cdot z) \cdot (\bar{w} \cdot x) + (x \cdot y)$$

P

wx

yz

00 01 11 10

	00	01	11	10
00	0	0	0	0
01	0	1	1	0
11	1	1	0	1
10	1	0	0	0

Simplified SOP Expression:

$$P(W, X, Y, Z) = \bar{w}xy + \bar{x}yz + \bar{w}xz + x\bar{y}z$$

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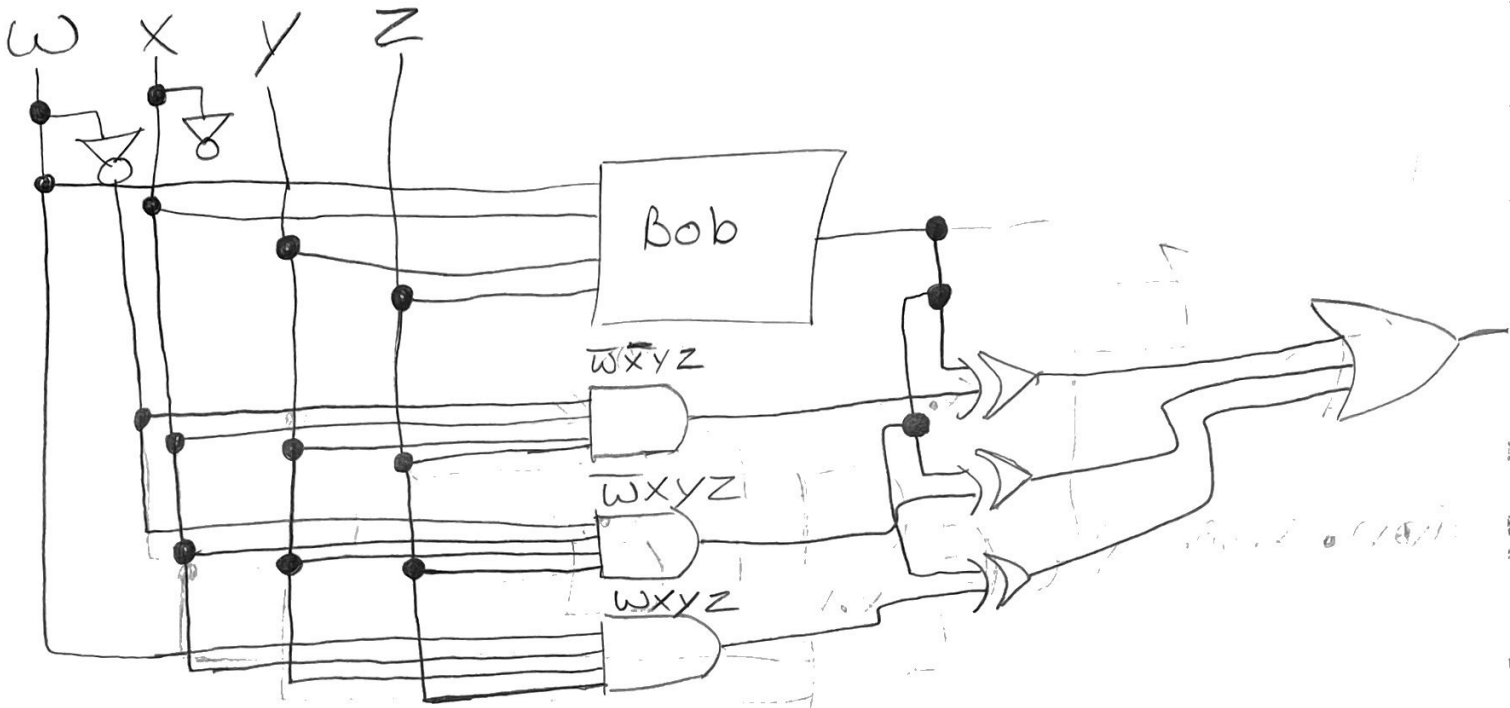
7.0 Give your implementation of the correct 4-bit prime detector circuit (P) below as either Verilog or a schematic (your choice). Then demonstrate the results:

```
module mProjStep2(F,W,X,Y,Z);  
    input W,X,Y,Z;  
    output F;  
    assign F = (~W & ~X & Y) | (~X & Y & Z) | (~W & X & Z) | (X & ~Y & Z);  
endmodule
```

Demonstration of ModelSim Results: M.K.S.

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8.0 Design and implement a circuit that uses Uncle Bob's circuit but fixes his mistakes.
Draw it below and demonstrate the results:



Demonstration of ModelSim Results: 19.10.5