Question #1: Boolean Operators

Given the following values for X, Y, and Z, are the following Boolean expressions true or false?

**X = True, Y = True, Z = False**

|  |  |
| --- | --- |
| X OR Y AND Z | False |
| X AND X | True |
| (X NAND Z) AND Y | True |
| Y XOR Z | True |
| (X XOR Z) AND (Y XOR Z) | True |
| (Y OR Y) XOR Z | True |
| (Y NOR Z) AND (X OR Z) | False |
| NOT((Y NAND Z) OR Z) | False |
| ((NOT Y AND NOT Z) AND Z) NAND Y | True |
| (NOT X NOR Y) NAND (Z XOR NOT Y) OR Z | True |

Question #2: Simplifying Boolean Expressions

Simplify the given Boolean expression using the laws of Boolean logic. Show each simplification you make and please include the name of the law you used (e.g. complementation, idempotent, etc.) If you’re having trouble getting started, remember this is just like Algebra. Collect like terms and factor them out of the logical expression the exact same way you would an algebraic equation.

X’YZ + XYZ + XY’Z’+XYZ’ + XY’Z’ + X’Y’Z’ + WX’Y’Z’ + W’X’Y’Z’

Step1:factoring out items

X’(YZ+Y’Z’+WY’Z’+W’Y’Z’)+X(YZ+Y’Z’+YZ’+Y’Z’)

Step2: factoring out the first 4 inner components

X’(Y’(Z’+WZ’+W’Z’)+YZ)+X(YZ+Y’Z’+YZ’+Y’Z’)

Step3:factoring further

X’(Y’(Z’(W+W’+1))+YZ)+X(YZ+Y’Z’+YZ’+Y’Z’)

Step4: applying the Complementation Rule W+W’=1

X’(Y’(Z’(1+1))+YZ)+X(YZ+Y’Z’+YZ’+Y’Z’)

Step5: applying the Idempotent Rule 1+1=1

X’(Y’Z’+YZ)+ X(YZ+Y’Z’+YZ’+Y’Z’)

Step6: applying the Distributive Rule Y’\*Z’+Y= （Y+Y’）\*(Y+Z’)=(Y+Z’)

X’(Y+Z’+Z)+ X(YZ+Y’Z’+YZ’+Y’Z’)

Step7: applying Complementation Rule: Z+Z’=1 and Dominance Rule: Y+1=Y

X’Y+X(YZ+Y’Z’+YZ’+Y’Z’)

Step8: factoring out the second inner components

X’Y+X(Y(Z+Z’)+Y’Z(1+1))

Step9: applying the Complementation Rule and Idempotent Rule: Z+Z’=1, 1+1=1

X’Y+X(Y+Y’Z)

Step10: applying the Distributive Rule: Y+Y’\*Z=(Y+Y’)\*(Y+Z) and Complementation Rule: Y+Y’=1

X’Y+X(Y+Z)

Step11: exapand and factor

Y(X’+X)+ZX

Step12: applying the Complementation Rule: X+X’=1

Y+ZX

Step13: applying the Distributive Rule: Y+ZX=(Y+Z)\*(Y+X)

Question #3: Simplifying Boolean Expressions

Give both the simplified combinational Boolean expression and the truth table for the following circuit:

A picture containing diagram

Description automatically generated

|  |  |  |  |
| --- | --- | --- | --- |
| **Switch X** | **Switch Y** | **Switch Z** | **Output** |
| TRUE | TRUE | TRUE | FALSE |
| FALSE | TRUE | TRUE | FALSE |
| TRUE | FALSE | TRUE | FALSE |
| FALSE | FALSE | TRUE | FALSE |
| TRUE | TRUE | FALSE | FALSE |
| FALSE | TRUE | FALSE | FALSE |
| TRUE | FALSE | FALSE | TRUE |
| FALSE | FALSE | FALSE | FALSE |

**Simplified Boolean expression for the circuit above: X AND Y’ AND Z’**

Question #4: Creating a Digital Circuit

Draw a circuit that implements the following Boolean logic expression and provide the corresponding truth table.

## ¬(((W ˅ X) Ꚛ Y) ˄ Z)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| W | X | Y | Z | O1 |
| FALSE | FALSE | FALSE | FALSE | TRUE |
| FALSE | FALSE | FALSE | TRUE | TRUE |
| FALSE | FALSE | TRUE | FALSE | TRUE |
| FALSE | FALSE | TRUE | TRUE | FALSE |
| FALSE | TRUE | FALSE | FALSE | TRUE |
| FALSE | TRUE | FALSE | TRUE | FALSE |
| FALSE | TRUE | TRUE | FALSE | TRUE |
| FALSE | TRUE | TRUE | TRUE | TRUE |
| TRUE | FALSE | FALSE | FALSE | TRUE |
| TRUE | FALSE | FALSE | TRUE | FALSE |
| TRUE | FALSE | TRUE | FALSE | TRUE |
| TRUE | FALSE | TRUE | TRUE | TRUE |
| TRUE | TRUE | FALSE | FALSE | TRUE |
| TRUE | TRUE | FALSE | TRUE | FALSE |
| TRUE | TRUE | TRUE | FALSE | TRUE |
| TRUE | TRUE | TRUE | TRUE | TRUE |

**图表

描述已自动生成**

Deliverables

Please submit your assignment showing all work in a PDF named <Your JHEDID>\_module1.pdf using the Assignment link on Canvas.