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**Class Group: COMP1DY**

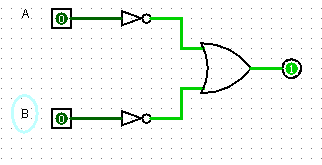
**Lab 5 – De Morgan’s Theorem and Basic Circuits**

1. Prove the following theorems of De Morgan by completing the following tables. Verify this theorem in Logisim using appropriate circuits:



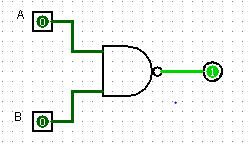
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| A | B |  |  |  |  |  |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 |

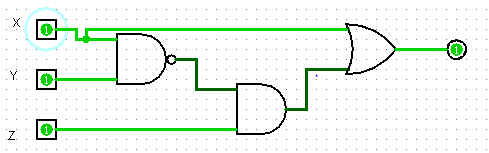
### Circuit:



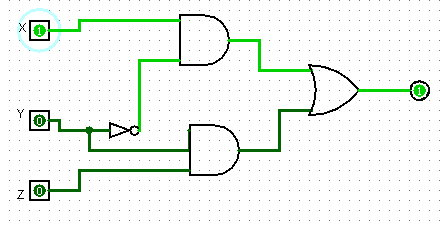
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| A | B |  |  |  |  |  |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 |

**Circuit**:

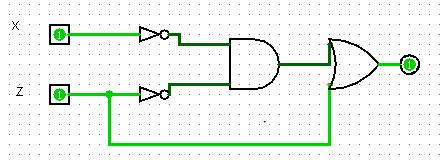
2. Draw  circuits for the Boolean expressions outlined below. Complete the truth tables for these expressions and verify the truth tables using your circuits,



|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| X | Y | Z | X.Y | NOT X.Y | NOT X | NOT X.Y.Z | NOT X.Y.Z +NOT X |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| X | Y | Z | NOT Y | X. NOT Y | Y.Z | X.NOT Y+Y.Z |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 |



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x | z | Not x | Not z | Not x. not z | Z + not x. y not |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 |

3. Using the Sum of Products technique, design a circuit which implements the following truth table. The inputs are A, B, and C. The output is X

**Truth Table:**

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **C** | **X** |
| 0 | 0 | 0 | **1** |
| 0 | 0 | 1 | **1** |
| 0 | 1 | 0 | **0** |
| 0 | 1 | 1 | **0** |
| 1 | 0 | 0 | **1** |
| 1 | 0 | 1 | **1** |
| 1 | 1 | 0 | **0** |
| 1 | 1 | 1 | **0** |

**Circuit:**

