1. **Given the function:** \( F(a,b,c) = (ab) (b' + c) \)
   a. Draw the circuit for \( F(a,b,c) \) using AND, OR and NOT gates
   b. Convert the circuit using only NAND gates (INV are ok)
   c. Convert the circuit using only NOR gates (INV are ok)

2. a. Use DeMorgan’s Law to find the **inverse** of the following equation:
    \( F = abc + a'b. \)
    Reduce to minimal **sum-of-products** form (minimal number of product-terms).
    Hint: Start with \( F' = (abc + a'b)' \).
   
   b. Use DeMorgan's Law to find the **inverse** of the following equation:
    \( F = a'c+a'b'd+cd'. \)
    Reduce to minimal **product-of-sums** form.

3. Given the following function: \( F = (A'. B'. C')'. C + (A'. B'. C')' + D \)
   Using Boolean Algebra, prove that the logic equation above can be implemented by a 4-input OR gate: \( F = A + B + C + D \)
   Show ALL the steps of your proof AND state the name of the axiom or theorem used in each step. Apply only one axiom/theorem at each step.

4. A museum has three rooms each with a motion sensor (m0, m1, and m2) that outputs 1 when motion is detected. At night, the only person in the museum is one security guard who walks from room to room. Create a function that sounds an alarm (by setting an output A to 1) if motion is detected in more than one room at a time( i.e in two or three rooms), meaning that there must be one or more intruders in the museum.
   a. Specify the truth table
   b. Formulate the canonical sum of products implementation for A
   c. Minimize A using K-map and write the minimum implementation of A
   d. Draw the circuit for the minimum implementation shown in part c.