1. For the following function:

\[ f(a, b, c, d) = \prod M(0, 3, 6, 11, 13, 15).D(5, 8, 10, 14) \]

a. Draw the K-map
b. List all prime implicants
c. List all essential prime implicants
d. Simplify the function based on your K-map in product of sum format
2. Functions $f$ and $g$ are given as below, find out and simplify the function $F = f \cdot g$

\[
f(a, b, c, d) = abc' + c'd + a'cd' + b'cd'
\]

\[
g(a, b, c, d) = (a + b + c' + d')(b' + c' + d)(a' + c + d')
\]

a. Give K-map for $f$

b. Give K-map for $g$

c. Give K-map for $f \cdot g$

d. Simplify $F(a, b, c, d)$ as sum of products
3. Use K-Maps to reduce the circuit. Give the following:
   a. Truth Table
   b. Minimized output expression in SOP form for $F(A,B,C)$
   c. Draw the logic circuit for the equation given in b)
4. A farmer wants to automate watering his fields. He has three sensors to measure temperature (A), soil humidity (B), and light (C). The fields will be watered in the following cases:
   - The temperature is warm (A), the soil is dry (B'), and there is daylight (C)
   - The temperature is cool (A'), the soil is dry (B'), and there is daylight (C)
   - The temperature is warm (A), the soil is dry (B'), and it is dark (C')
   - The temperature is warm (A), the soil is wet(B), and there is daylight (C)

Use K-map reduction to express the output of the automated waterer in sum of products form.