SC1005 Digital Logic Tutorial 5

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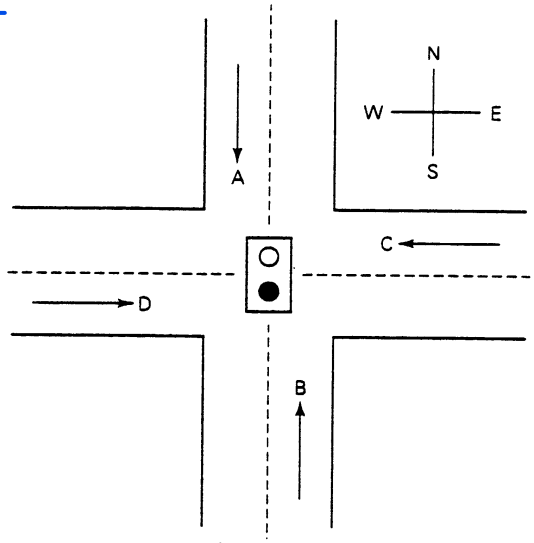
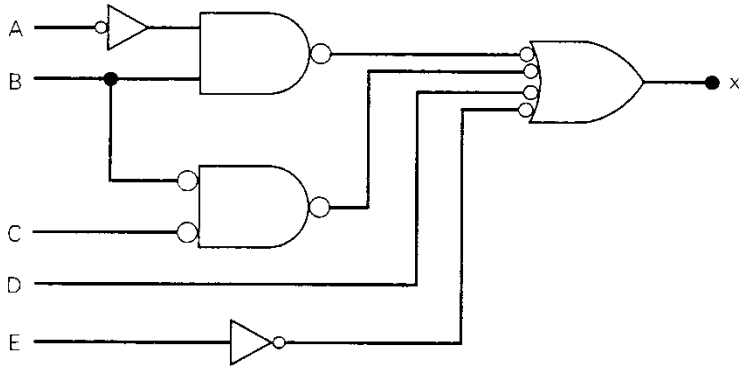
Figure 4-50 shows the intersection of a main highway with a secondary access road. Vehicle-detection sensors are placed along lanes *C* and *D* (main road) and lanes *A* and *B* (access road). These sensor outputs are LOW (0) when no vehicle is present and HIGH (1) when a vehicle is present. The intersection traffic light is to be controlled according to the following logic:

1. The east-west (E-W) traffic light will be green whenever *both* lanes *C* and *D* are occupied.
2. The E-W light will be green whenever *either C* or *D* is occupied but lanes *A* and *B* are not *both* occupied.
3. The north-south (N-S) light will be green whenever *both* lanes *A* and *B* are occupied but *C* and *D* are not *both* occupied.
4. The N-S light will also be green when *either A* or *B* is occupied while *C* and *D* are *both* vacant.
5. The E-W light will be green when *no* vehicles are present.

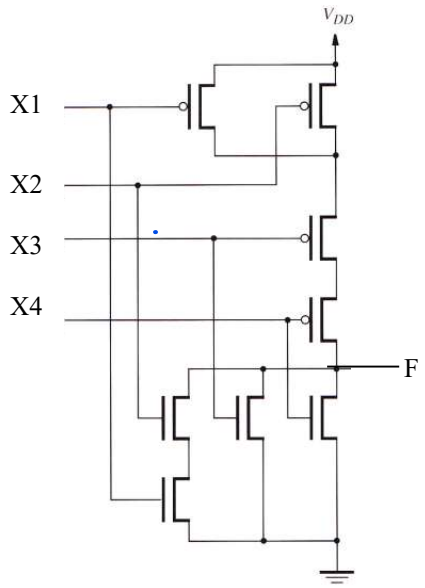
Using the sensor outputs *A*, *B*, *C*, and *D* as inputs, design a logic circuit to control the traffic light. There should be two outputs, N-S and E-W, that go HIGH when the corresponding light is to be *green*. Simplify the circuit as much as possible and show *all* steps.



2. From the diagram alone, determine the input conditions that will cause output X to go high. Note that the matched bubbles make the task easy.



3. Determine the truth table for the following CMOS logic circuit.



Answers

1. N/S = AC'D' + BC'D' + ABD' + ABC'

2. X = A'B + B'C' + D' + E

3. F (X1, X2, X3, X4) = ∑ m (0, 4, 8)