ECEN202 Assignment 1 **2019** **Combinatorial Logic**

Due Monday 18 March by 5 pm.

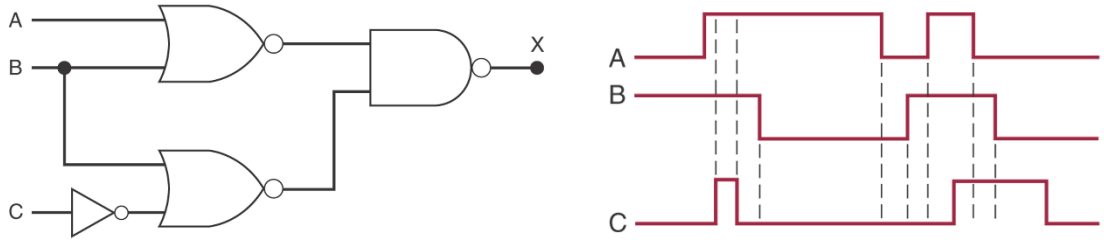
1. For each of the following expressions, construct the corresponding logic circuit using only AND and OR gates and INVERTERS.

(a) $z = \overline{A + B + \overline{C}.D.\overline{E} + \overline{B}.C.\overline{D}}$

(b) $x = \overline{W + P.\overline{Q}}$

(c) $x = (A + B)(\overline{A} + \overline{B})$

2. Write the expression for the output of the logic circuit below and use it to construct a complete truth table. Then apply the waveforms illustrated and sketch the resultant output waveform.



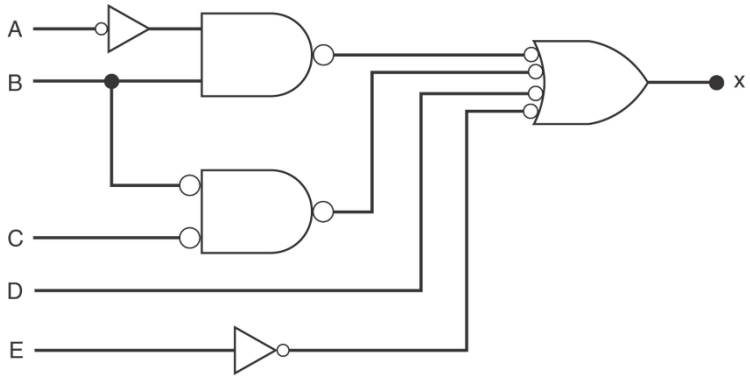
3. Simplify the following expressions using De Morgan's theorems:

(a) $\overline{A.B.\overline{C.D}}$

(b) $\overline{\overline{A} + \overline{C} + \overline{D}}$

(c) $\overline{(M + \overline{N})(\overline{M} + N)}$

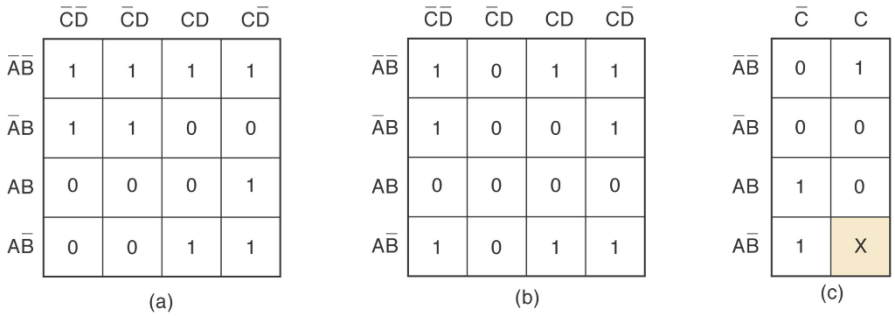
4. Determine the input conditions that will put the output of the logic circuit below in the active state. Draw up the truth table for this circuit.



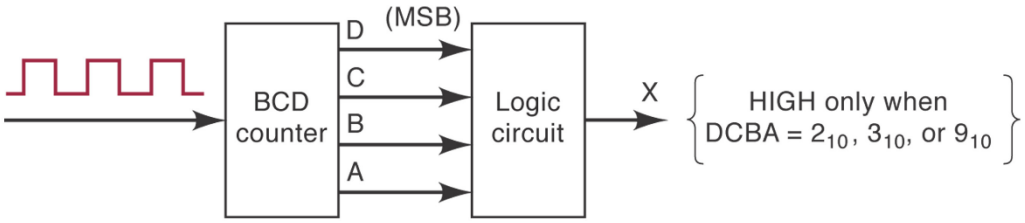
5. Use basic logic gates (AND, OR, NOT) to implement the truth table below:

A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

6. Determine the minimum expression for each of the K maps shown below:



7. The figure below shows a BCD counter that produces a 4-bit output representing the BCD code for the number of pulses that have been applied to the counter input. The counter resets on the tenth pulse and starts over again. The outputs will then never present a number > $1001_2 = 9_{10}$. Use K mapping to design a logic circuit that will produce a HI output whenever the count is 2,3 or 9.



8. The diagram below shows four switches that are part of the control circuitry in a photocopy machine. The switches are at various locations along the path of the copy paper. Each switch would be normally open and as the paper passes over a switch, the switch closes. It is impossible for switches SW1 and SW4 to be closed at the same time. You now need to design a logic circuit to produce a HI O/P whenever two or more switches are closed at the same time. Do this by:

(i) Drawing up a truth table that relates the O/P, X, to the state of the four switches.

(ii) Use a Karnaugh map to produce a simplified logic equation.
(iii) Sketch a logic diagram for a circuit to implement this function.