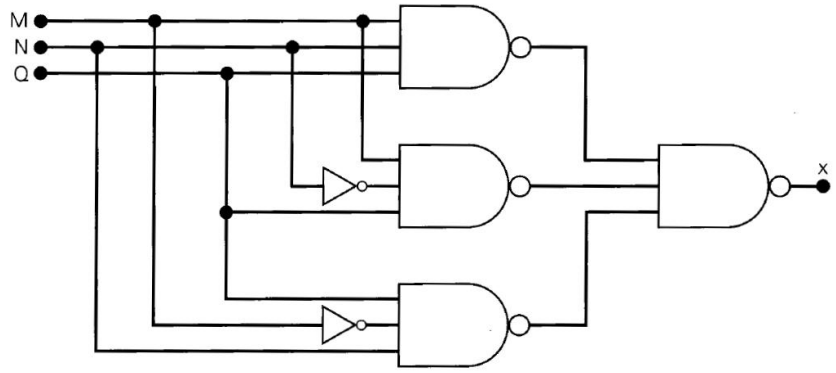
XMUT202 **Assignment 1**

Due Sunday 13 April 2025 before 7 pm.

1. Simplify the circuit below using Boolean algebra



2. Determine the minimum expression for each K map below.

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	1	1	1
$\bar{A}B$	1	1	0	0
AB	0	0	0	1
$A\bar{B}$	0	0	1	1

(a)

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	0	1	1
$\bar{A}B$	1	0	0	1
AB	0	0	0	0
$A\bar{B}$	1	0	1	1

(b)

	$\bar{C}$	C
$\bar{A}\bar{B}$	1	1
$\bar{A}B$	0	0
AB	1	0
$A\bar{B}$	1	X

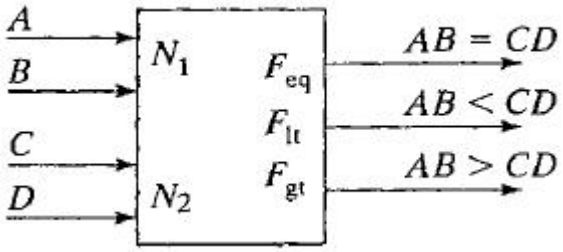
(c)

3. Simplify the following expressions using Boolean algebra

(a) $x = \bar{A}\bar{B}\bar{C} + \bar{A}BC + ABC + A\bar{B}\bar{C} + A\bar{B}C$

(b) $x = \overline{C + D} + \bar{A}C\bar{D} + A\bar{B}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$

4. You are to design a circuit that compares two 2-bit numbers, N1 and N2. Specifically, as shown, the circuit generates three outputs Feq, Flt and Fgt whose values are TRUE if N1 = N2, N1 < N2 and N1 > N2, respectively. The numbers N1 and N2 are denoted by single bit inputs A, B and C, D, respectively, where A and C are the most significant bits.



   (a) Find the Boolean expressions for each of the outputs Feq, Flt and Fgt. Use K-maps to simplify them (if possible).
   (b) Simplify Feq using Boolean algebra and express the final answer using XNOR operators.

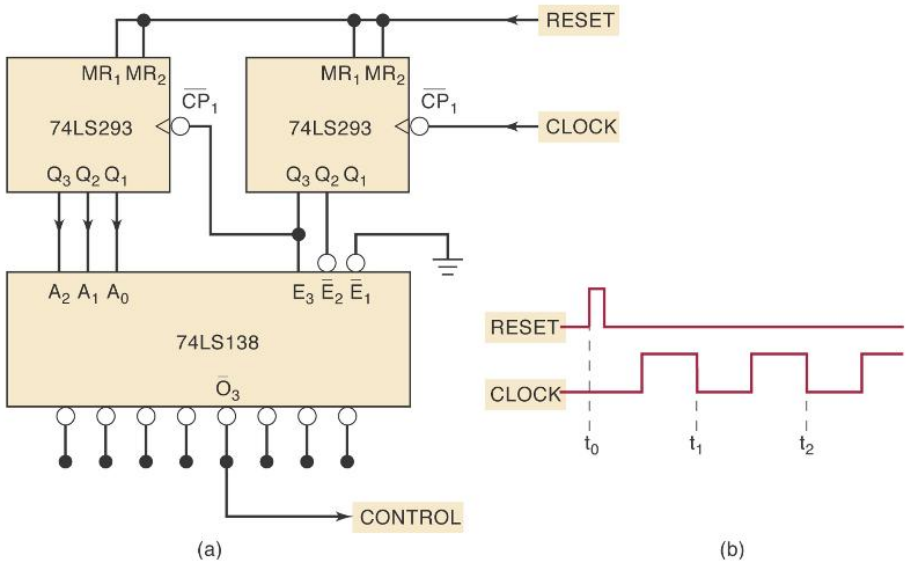
5. Use J-K flip flops to design a **synchronous** counter that will go through the following sequence: **000**, **010**, **101**, **110** and repeat. The undesired (unused) states must always go to 000 on the next clock pulse.

   Build the counter using the circuit simulator. Save your answer in a separate file. The file name should contain “Q5”.

6. Redesign the counter of (Q5) without any requirement on the unused states, so that their next state can be a don’t care state. Compare to the previous counter design.

   Build the counter using the circuit simulator. Save your answer in a separate file. The file name should contain “Q6”.

7. Examine the circuit below, identify each of the ICs used and explain the operation of the circuit: (i) What does 74LS293 do in this circuit? Please also explain in details what its inputs and outputs do. (ii) What does 74LS138 do in this circuit? Please also explain in details what its inputs and outputs do. (iii) What are the indices of t that activate O3'? Explain what inputs are required for O3' to be activated. (iv) Now modify the circuit so that it will produce a control signal that will remain LO from CLK t_{20} to t_{24}.



You need to submit a compressed file which contains 2 circuit diagrams (for Questions 5 and 6) and pdf file which contains your answers for all other Questions.