ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2018 SESSION

Open-book examination
Calculators : only authorized models
Duration : 3 hours

14-IF-A2 Digital System Design

1) Design a combinational circuit with 3-bit input, A, B and C and 1 output X with the following true table:

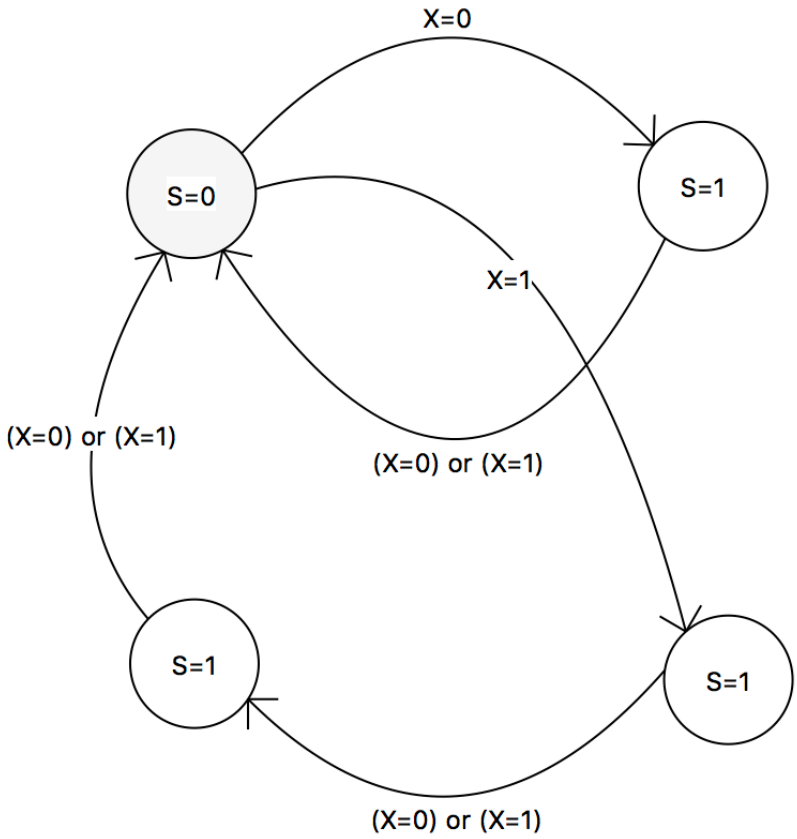
A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

a) Draw K Maps of the output X **(10 points)**

b) Give the output as a SOP (sum of products) expression of inputs **(10 points)**

c) Give the output as a POS (product of sums) of inputs **(10 points)**

2) Consider a <u>synchronous</u> circuit with one input X and one output S and a behavior represented by the following state diagram:



a) Plot a time sequence diagram of the behavior of this circuit **(10 points)**
b) Describe with one sentence what this circuit does **(10 points)**
c) Draw the transition table fort this circuit **(10 points)**
d) Design the circuit with D flip-flop(s) **(15 points)**

3) Describe the universal asynchronous receive and transmit (UART) protocol used to establish communication between microcomputer systems. Show the signals involved in the data exchange process and briefly explain their roles. Give a sample of the timing diagram for the transmission of a character. How the receiver synchronized with the clock of the transmitter? **(15 points)**

4) Explain the difference between a single cycle RISC (reduced instruction set computer) processor and a multi-cycle microprogrammed processor. **(10 points)**