

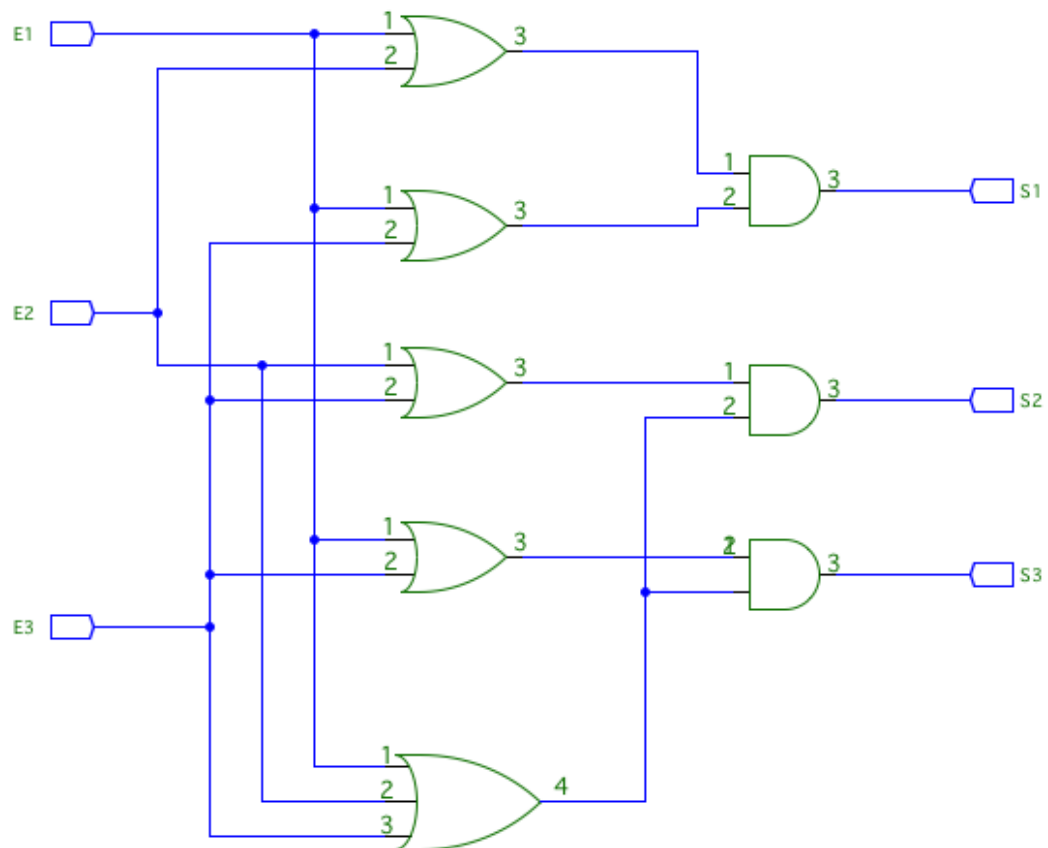
ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2020 SESSION

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

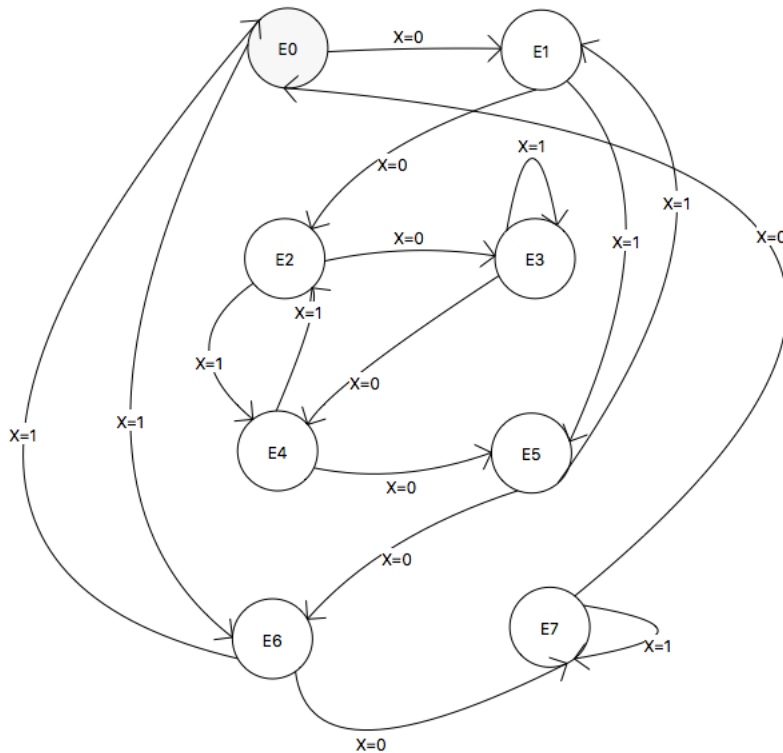
16-EL-A4 Digital System and Computers

- 1) We consider a combinational circuit with three inputs E_1 , E_2 and E_3 and three outputs S_1 , S_2 and S_3 with the following schematic:



- Give the true table for this circuit (**10 points**)
- Draw K Maps of the outputs (**10 points**)
- Give the equation of the outputs (**5 points**)
- Is the proposed circuit optimal? Give a simplified version of the same circuit (**5 points**)

2) Consider a synchronous circuit with the following state diagram:



The circuit have eight states named E0 to E7 and one input variable X.

- Give the transition table of this circuit **(10 points)**
 - Observing the transition table, deduce the operation performed on the binary representation of the state number during the transition from one state to another as a function of the variable X **(10 points)**
 - Propose an implementation of this circuit from standard components following the results arising from the previous question **(10 points)**
- 3) We consider the representation in 2-complement of 16-bit binary numbers. Indicate which are the minimum and maximum values which can be represented for signed and unsigned numbers, and place them in a table by giving the corresponding hexadecimal values **(10 points)**. Give an example where an addition will give for the same binary numbers a result without overflow for unsigned values and a result with overflow for signed values. **(10 points)**
- 4) Explain in short sentences the differences between the two following properties for assembly code: position independent code and reentrant code **(10 points)**. Give the conditions that the code written in assembler must meet for each of these properties. **(10 points)**