CE 211
Digital Systems

Homework # 4

Note: To get the full mark, you need to show all the steps in details (Final answers are not acceptable).

Part 1: Seven-Segment Indicator

The seven-segment indicator (see Figure 1) can be used to display any one of the decimal digits 0 through 9. For example, "1" is displayed by lighting segments 2 and 3, "2" is displayed by lighting segments 1, 2, 7, 5, and 4, "8" is displayed by lighting all the seven segments. A segment is lighted when a logic 1 is applied to the corresponding input on the display module.

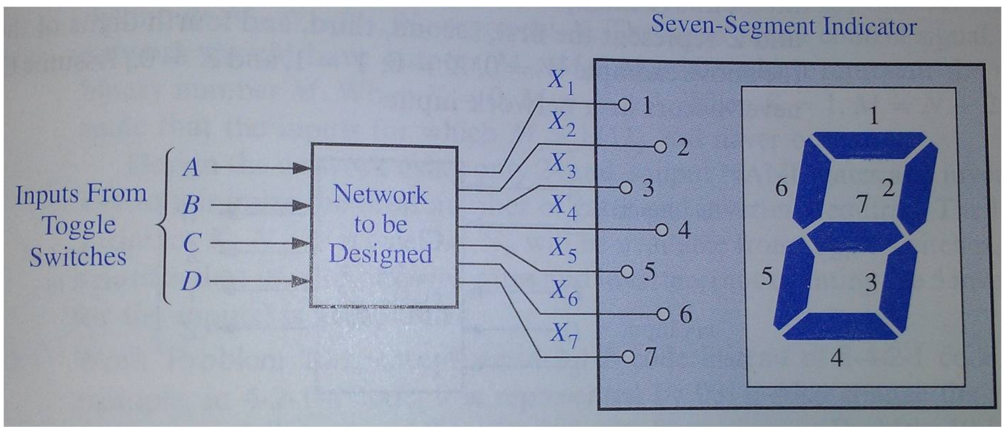

Figure 1: Network driving seven-segment display module.

Question 1: Design an $8-4-2-1$ BCD code convertor to drive the seven-segment indicator in Fig. 1. The four inputs to the convertor network (A, B, C, D in Fig. 1) represent an $8-4-2-1$ binary-coded decimal digit. Assume that only the combinations representing the digits 0 through 9 can occur as inputs, so the combinations $(1010)_2$ through $(1111)_2$ are don't cares. Furthermore, use the configuration provided in Fig. 2 to represent "6" and "9" on the seven-segment indicator.

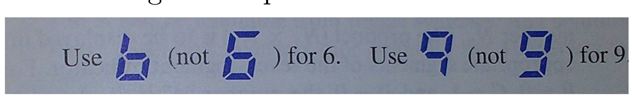

Figure 2: Configuration of the seven-segment display module for "6" and "9".

(a) Build the truth table of your seven-segment display module.

(b) Using K-maps, find the minimum SOP expression for $X_1, X_2, X_3, X_4, X_5, X_6$, and X_7 shown in Fig. 1.

(c) Plot the logic circuit of your seven-segment display module.

Part 2:

Question 1: A half adder (HA) takes 2-inputs A and B, and computes the sum bit S and the carry bit C from them. Show how a full adder (FA) can be constructed from HAs (provide a logic diagram for your solution).

Question 2: Design a half subtracter (HS) that has two input bits X and Y, and two output bits D and B. Where D is the difference between X and Y, and B is the borrow signal.

(a) Provide a truth table of the half subtracter.

(b) Provide a Boolean expression for each output, and use Karnaugh maps to simplify each output.

(c) Draw the logic diagram to implement this circuit.

Part 3:

The problems below are from Chapter 4 in the Textbook (5^{th} edition, International edition):

Question 1. Problem 4.2 use k-maps to simplify
Question 2. Problem 4.4 (b)
Question 3. Problem 4.16
Question 4. Problem 4.28(a)
Question 5. Problem 4.32 (a)
Question 6. Problem 4.33