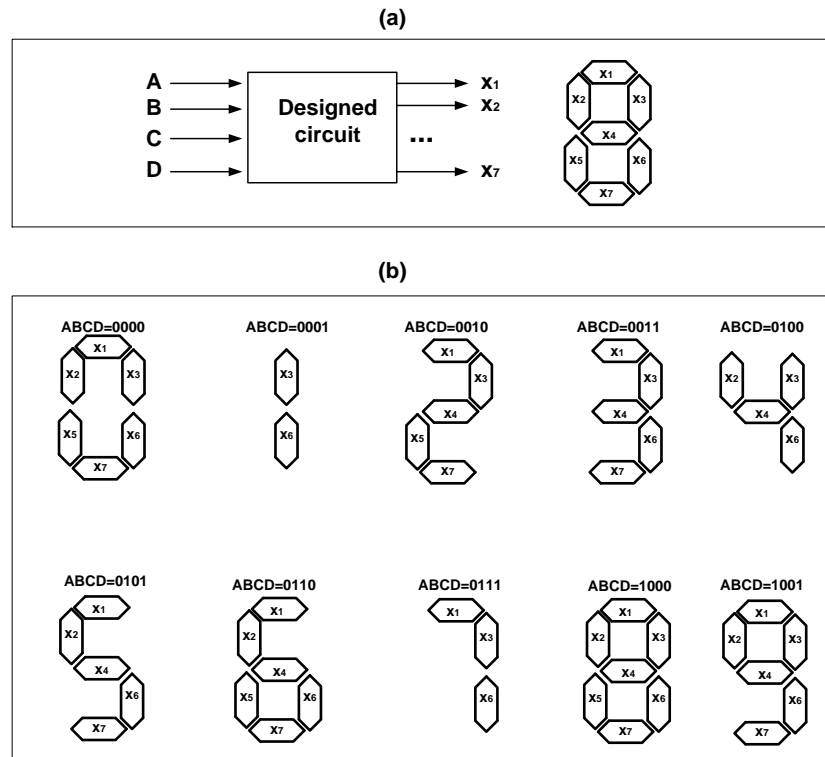
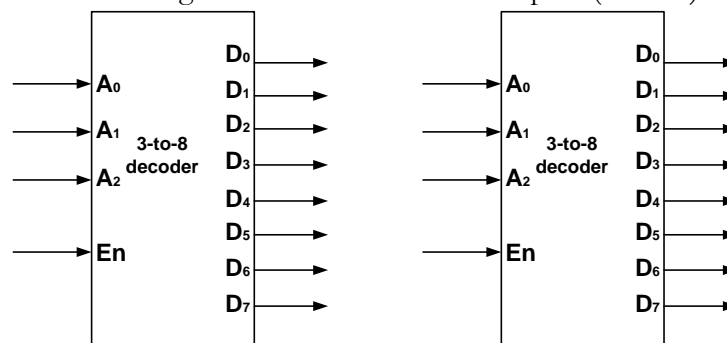


Problem 7 (20 points). Consider the 7-segment display in Fig. (a). This display has been discussed in the Midterm 2. We want to design a circuit to control the 7 display devices X_1, X_2, \dots, X_7 based on the binary inputs ($ABCD$). By controlling the on (denote as 1) and off (denoted as 0) states of each device, we can display the corresponding decimal number as shown in Fig. (b).



(a). (8 points) Two 3-to-8 decoders are shown below. Here En is an enable signal, and all outputs are 0 if $En=0$. Please use them to design a 4-to-16 decoder with inputs ($ABCD$) and outputs ($Q_0 \dots Q_{15}$).



(b). (12 points) Design a programmable ROM (read-only-memory) circuit to implement a control circuit for the 7-segment display. You should use your designed 4-to-16 decoder as a black box. **For simplicity, you only need to show the circuit for controlling X_1 and X_2 .**