Prob. 1) The D Latch as shown in Fig. 1 below can be constructed with only 4 NAND gates. This can be done by removing the inverter and connecting the output of the upper NAND gate to the input of the lower gate. Use conventional or computer-based logic simulation to show that the new circuit is functionally the same as the older one.

Fig. 1. A D-latch

Prob. 2) A sequential circuit with two $D$ flip-flops $A$ and $B$, two inputs $X$ and $Y$, and one output $Z$ is specified by the following input equations:

$$\overline{D_A} = XY + XA \quad \overline{D_B} = XB + XA \quad Z = XB$$

a) Draw the logic diagram of the circuit  
b) Derive the state table  
c) Derive the state diagram

Prob. 5) Design a sequential circuit with two $D$ flip-flops $A$ and $B$ and one input $X$. When $X = 0$, the state of the circuit remains the same. When $X = 1$, the circuit goes through the state transitions from 00 to 10 to 11 to 01, back to 00, and then repeats.

Prob. 6) A sequential circuit has two flip-flops $A$ and $B$, one input $X$ and one output $Y$. The state diagram is shown in Fig. 4. Design the circuit with D flip-flops.

Figure 4