Digital Electronics

Consider the following state diagram

\[x=1\]
\[S_0\]
\[y=0\]
\[x=0\]
\[S_1\]
\[y=1\]
\[x=0\]
\[S_2\]
\[y=1\]
\[x=1\]
\[S_3\]
\[y=0\]
\[x=0\]
\[x=1\]

and the state assignment \(S_0 = 00, S_1 = 01, S_2 = 10\) and \(S_3 = 11\).

(a) Write down the state table and derive the minimised Boolean expressions for implementing the next-state and output functions. Assume the use of D-type flip-flops for the state registers. Note that state = \((Q_1, Q_0)\). [10 marks]

(b) An alternative is to use a 1-hot state machine with the following state assignment: \(S_0 = 0001, S_1 = 1000, S_2 = 0010\) and \(S_3 = 0100\). Determine Boolean expressions for implementing the next-state and output functions assuming the use of D-type flip-flops. Note that state = \((Q_3, Q_2, Q_1, Q_0)\). [7 marks]

(c) What problem may arise with the approach proposed in part (b)? Briefly describe two solutions to this problem. [3 marks]