(I) A state machine is described by the following state equations.

\[ Q_1(t + 1) = Q_0(t) \oplus x(t), \]
\[ Q_0(t + 1) = Q_1(t) x'(t) + Q_0(t) x(t), \]
\[ y(t) = Q'_1(t) + Q_0(t). \]

1. Write the state table.
2. Design the system with two T flip-flops and a minimal AND-OR-NOT network.
3. Design the system with two JK flip-flops and a minimal AND-OR-NOT network.

(II) (Decoders) Given three four-input Boolean functions

\[ f_1(a, b, c, d) = \sum m(1, 2, 4, 7) + \sum d(3), \]
\[ f_2(a, b, c, d) = \sum m(0, 3, 14) + \sum d(15), \]
\[ f_3(a, b, c, d) = \sum m(12, 15). \]

1. Implement the functions using a minimal network of 4:16 decoders and OR gates.
2. Implement the functions using a minimal network of 3:8 decoders and OR gates.
3. Implement the functions using a minimal network of 2:4 decoders and OR gates.

(III) (Multiplexers) Given a three-input Boolean function

\[ f(a, b, c) = \sum m(0, 3, 5, 7) + \sum d(6). \]

1. Implement the function using a minimal network of 8:1 multiplexers.
2. Implement the function using a minimal network of 4:1 multiplexers.
3. Implement the function using a minimal network of 2:1 multiplexers.

(IV) Given a three-input Boolean function \( f(a, b, c) = \sum m(0, 2, 4, 6, 7) + \sum d(1). \)

1. Implement the function using a minimal network of 2:4 decoders and OR gates.
2. Implement the function using a minimal network of 4:1 multiplexers.
3. Implement the function using a minimal network of 2:1 multiplexers.