Question 1

(a) Latches and flip-flops are the basic elements for storing information. Describe the differences between latch and flip-flops.

(4 Marks)

(b) The master-slave flip-flops was developed to make the synchronous operation more predictable. Describe this master-slave flip-flops operation.

(5 Marks)

(c) With aid of appropriate register diagrams, draw the **FOUR (4)** modes of shift operation on a 3-bit shift register.

(4 Marks)

(d) Determine all the Q output waveforms for 4-bit shift register when the inputs are as shown in Figure 1. Assume that the register is initially LOW and negative triggered CLOCK input.

(5 Marks)

Question 2

Counters are flip-flop registers that can change their data values known as "binary states" or "states". Counters can either operate synchronously or asynchronously with a common clock pulse.

(a) Construct a modulus-11 asynchronous counter with a straight binary sequence from 0000 through 1010 using JK flip-flop.

(4 Marks)

(b) Determine the counter sequence in **Figure 2**. Assume that Q_2, Q_1 and Q_0 are initially at 0.

(6 Marks)

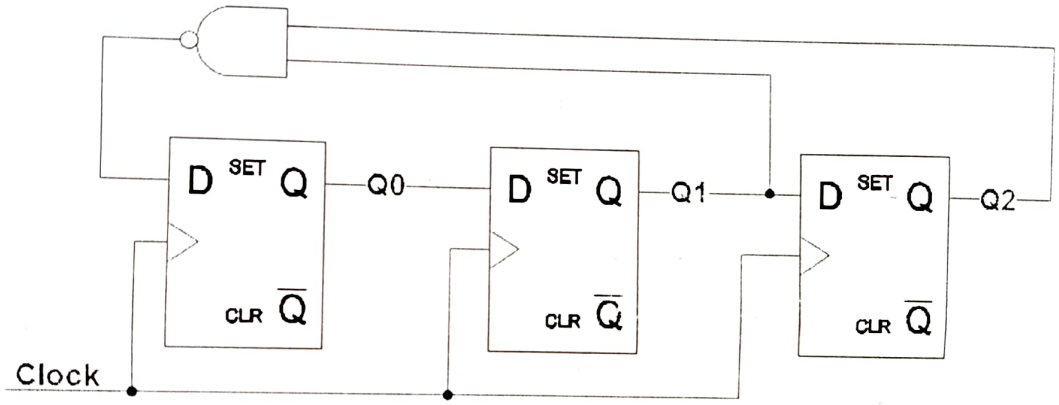

Figure 2

Question 3

Figure 3 shows a sequential circuit.

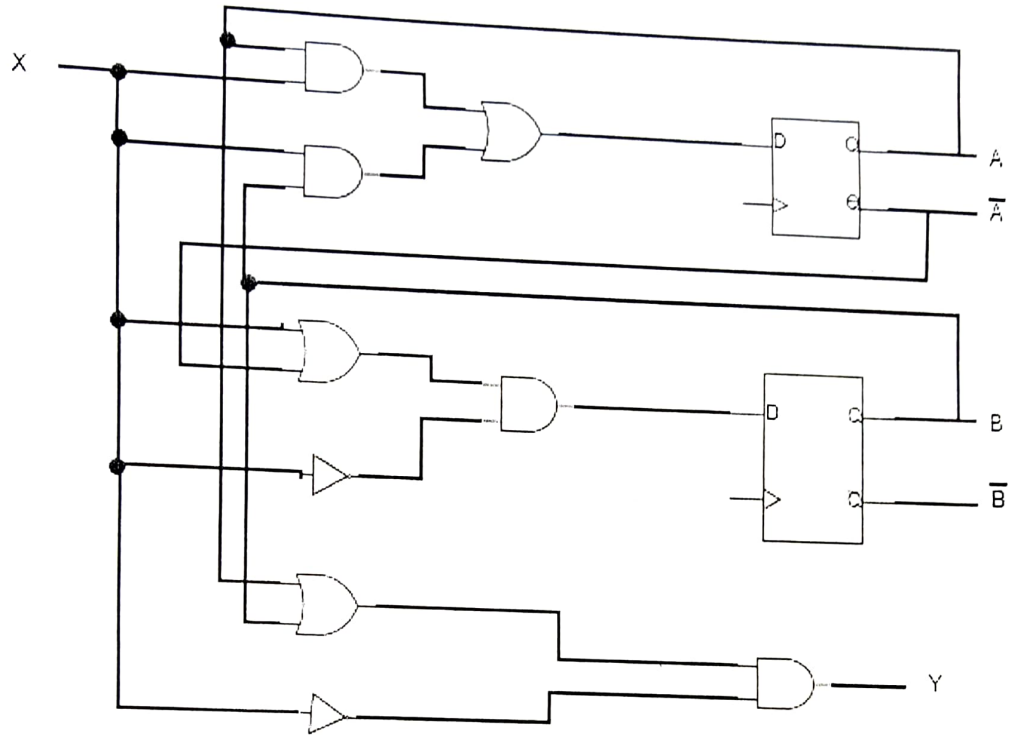

Figure 3

(a) Derive the state table which includes present state, input X, next state and output Y.

(8 Marks)

(b) Based on the state table derived in (i), draw the state machine model.

(4 Marks)