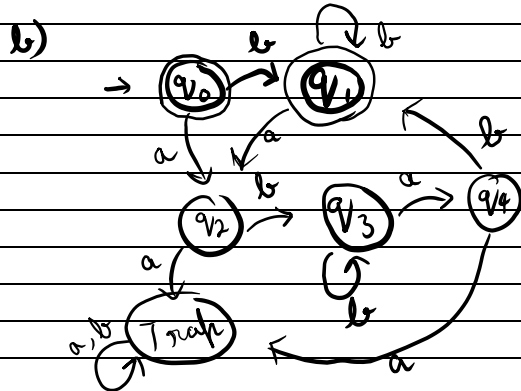
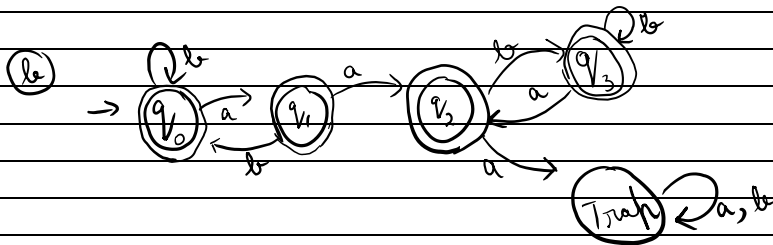


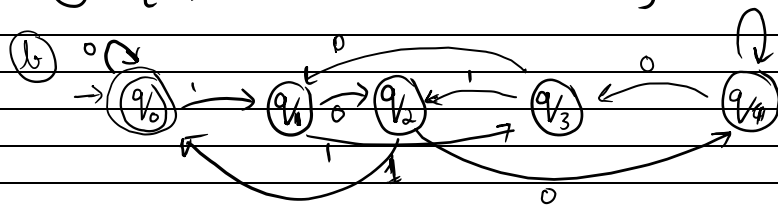
Q1) $L_1 = \{ b, ababbb, abababab, \dots \}$



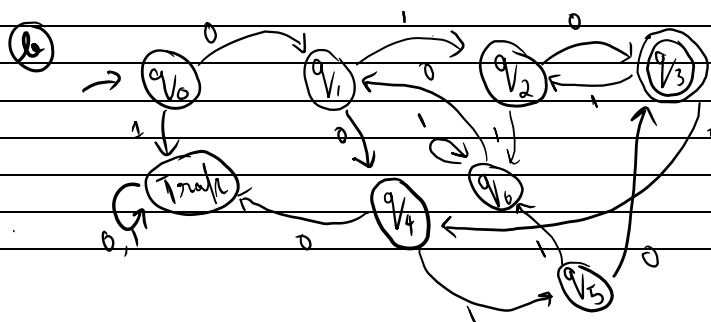
L4 $@ = \{ bbaab, bbaabbb, aab, aabbb, \dots \}$



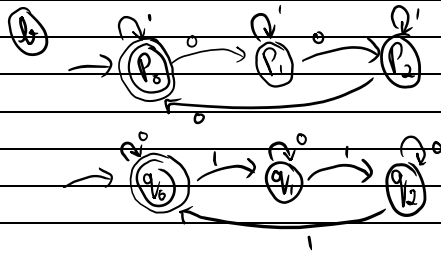
Q2a) $L_1 @ = \{ 0, 101, 1010, 1111, 10100, \dots \}$



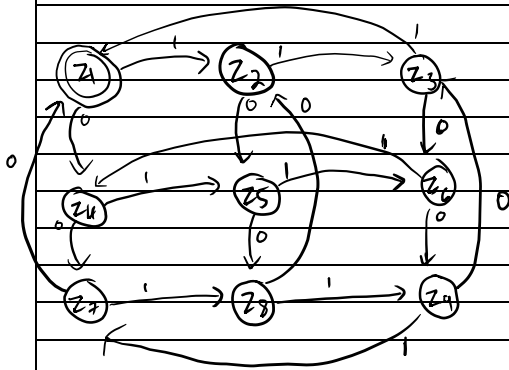
L2 $@ = \{ 010, 0010, 01010, 011010, \dots \}$



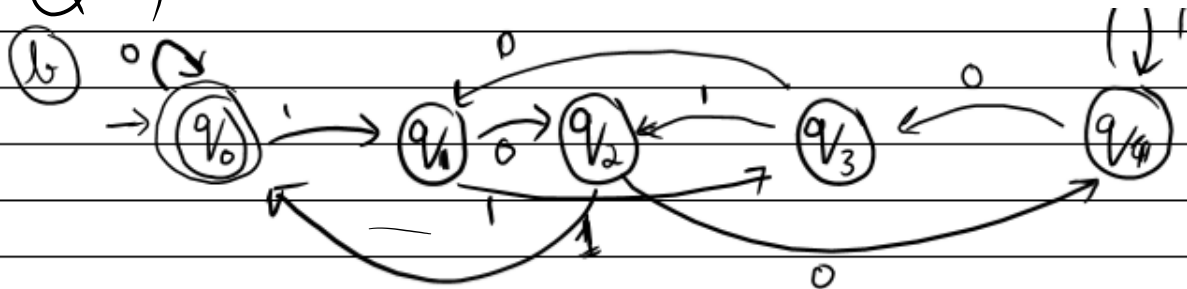
$$L_4 \quad @ = \{ \emptyset, 000, 111, 000111, 010101, \dots \}$$



| Old State | 0 | 1 |
|-----------------|-----------------|-----------------|
| $p_0 q_0 = z_1$ | $p_1 q_0 = z_4$ | $p_0 q_1 = z_2$ |
| $p_0 q_1 = z_2$ | $p_1 q_1 = z_5$ | $p_0 q_2 = z_3$ |
| $p_0 q_2 = z_3$ | $p_1 q_2 = z_6$ | $p_0 q_0 = z_1$ |
| $p_1 q_0 = z_4$ | $p_2 q_0 = z_7$ | $p_1 q_1 = z_5$ |
| $p_1 q_1 = z_5$ | $p_2 q_1 = z_8$ | $p_1 q_2 = z_6$ |
| $p_1 q_2 = z_6$ | $p_2 q_2 = z_9$ | $p_1 q_0 = z_4$ |
| $p_2 q_0 = z_7$ | $p_0 q_0 = z_1$ | $p_2 q_1 = z_8$ |
| $p_2 q_1 = z_8$ | $p_0 q_1 = z_2$ | $p_2 q_2 = z_9$ |
| $p_2 q_2 = z_9$ | $p_0 q_2 = z_3$ | $p_2 q_0 = z_7$ |



Q2b)



$$\begin{aligned}
 & i, f(q_0, 000111) \\
 & = f(f^*(q_0, 00011), 1) \\
 & = f(f(f^*(q_0, 0001), 1), 1) \\
 & = f(f(f(f^*(q_0, 000), 1), 1), 1) \\
 & = f(f(f(f(f^*(q_0, 00), 0), 1), 1), 1) \\
 & = f(f(f(f(f(f^*(q_0, 0), 0), 0), 1), 1), 1) \\
 & = f(f(f(f(f(f(f^*(q_0, \wedge), 0), 0), 0), 1), 1), 1)
 \end{aligned}$$

$$\begin{aligned}
 & f^*(q, \wedge) \rightarrow q \\
 & f^*(q, x\alpha) \rightarrow f(f^*(q, x), \alpha) \\
 & f^*(q, xy) \rightarrow f^*(f^*(q, x), y)
 \end{aligned}$$

$$\begin{aligned}
&= f(f(f(f(f(f(q_0, 0), 0), 0), 1), 1), 1)) \\
&= f(f(f(f(f(q_0, 0), 0), 1), 1), 1) \\
&= f(f(f(f(q_0, 0), 1), 1), 1) \\
&= f(f(f(q_0, 1), 1), 1) \\
&= f(f(q_1, 1), 1) \\
&= f(q_3, 1) \Rightarrow q_2
\end{aligned}$$

Hence, Rejected

$$ii) \quad {}^*f(q_0, 101000)$$

$$\begin{aligned}
&= f({}^*f(q_0, 10100), 0) \\
&= f(f({}^*f(q_0, 1010), 0), 0) \\
&= f(f(f({}^*f(q_0, 101), 0), 0), 0) \\
&= f(f(f(f({}^*f(q_0, 10), 1), 0), 0), 0), 0) \\
&= f(f(f(f(f({}^*f(q_0, 1), 0), 1), 0), 0), 0), 0) \\
&= f(f(f(f(f(f({}^*f(q_0, 1), 1), 0), 1), 0), 0), 0), 0) \\
&= f(f(f(f(f(f(q_0, 1), 0), 1), 0), 0), 0) \\
&= f(f(f(f(f(q_1, 0), 1), 0), 0), 0) \\
&= f(f(f(f(q_2, 1), 0), 0), 0) \\
&= f(f(f(q_0, 0), 0), 0) \\
&= f(f(q_0, 0), 0) \\
&= f(q_0, 0) \Rightarrow q_0
\end{aligned}$$

Hence, Accepted

$$\begin{aligned}
 & \text{iii) } {}^*f(q_0, 10110100) \\
 &= {}^*f({}^*f(q_0, 101), 10100) \text{ From (1)} \\
 &= {}^*f(q_0, 10100) \\
 &= {}^*f({}^*f(q_0, 101), 00) \\
 &= {}^*f(q_0, 00) \\
 &= f({}^*f(q_0, 0), 0) \\
 &= f(f({}^*f(q_0, 1), 0), 0) \\
 &= f(f(q_0, 0), 0) \\
 &= f(q_0, 0) \Rightarrow q_0
 \end{aligned}$$

Hence, Accepted

$$\begin{aligned}
 & \text{iv) } {}^*f(q_0, 0000100000) \\
 &= {}^*f({}^*f(q_0, 000), 010000) \text{ From (2)} \\
 &= {}^*f(q_0, 010000)
 \end{aligned}$$

$$\begin{aligned}
 &= f({}^*f(q_0, 01000), 0) \\
 &= f(f({}^*f(q_0, 0100), 0), 0) \\
 &= f(f(f({}^*f(q_0, 010), 0), 0), 0) \\
 &= f(f(f(f({}^*f(q_0, 01), 0), 0), 0), 0) \\
 &= f(f(f(f(f({}^*f(q_0, 0), 1), 0), 0), 0), 0) \\
 &= f(f(f(f(f(f({}^*f(q_0, 1), 0), 1), 0), 0), 0), 0)
 \end{aligned}$$

$$\begin{aligned}
 & {}^*f(q_0, 101) \\
 &= f({}^*f(q_0, 10), 1) \\
 &= f(f({}^*f(q_0, 1), 0), 1) \\
 &= f(f(f({}^*f(q_0, 1), 1), 0), 1) \\
 &= f(f(f(q_0, 1), 0), 1) \\
 &= f(f(q_1, 0), 1) \\
 &= f(q_2, 1) = q_0 \text{ --- (1)} \\
 & {}^*f(q_0, 101) = q_0
 \end{aligned}$$

$$\begin{aligned}
 & {}^*f(q_0, 0000) \\
 &= f({}^*f(q_0, 00), 0) \\
 &= f(f({}^*f(q_0, 0), 0), 0) \\
 &= f(f(f({}^*f(q_0, 1), 0), 0), 0) \text{ (2)} \\
 &= f(f(f(q_0, 0), 0), 0) \\
 &= f(f(f(q_0, 0), 0), 0) \Rightarrow q_0 \\
 &= f(q_0, 0)
 \end{aligned}$$

$$\begin{aligned}
 &= f(f(f(f(f(f(q_0, 0), 1), 0), 0), 0), 0), 0) \\
 &= f(f(f(f(f(q_0, 1), 0), 0), 0), 0) \\
 &= f(f(f(f(q_1, 0), 0), 0), 0) \\
 &= f(f(f(q_2, 0), 0), 0) \\
 &= f(f(q_4, 0), 0) \\
 &= f(q_3, 0) \Rightarrow q_1
 \end{aligned}$$

Hence, rejected