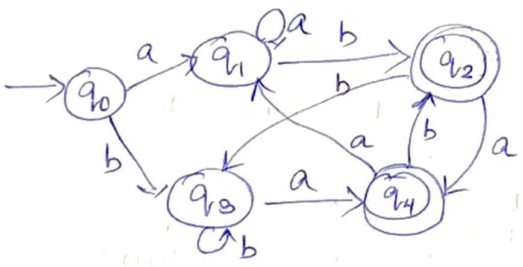
# TUTORIAL – 1 (DFA)

## ANSWER KEY

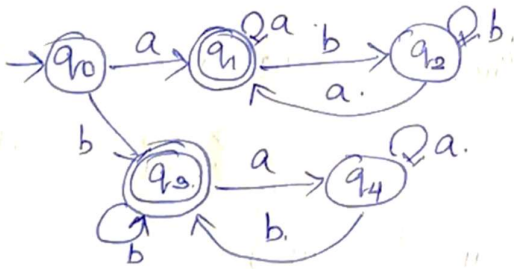
I. Recognize the languages accepted by the following DFAs

a)



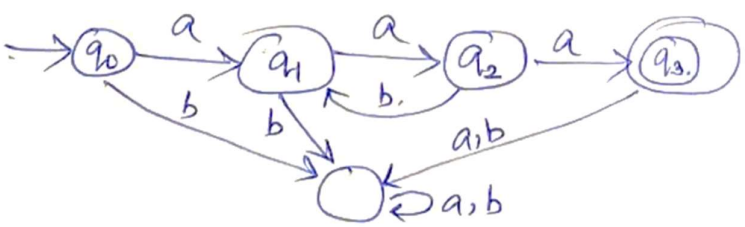

**L = {w | w ends with ab or ba}**

b)




**L = {w | w starts and ends with same letter}**

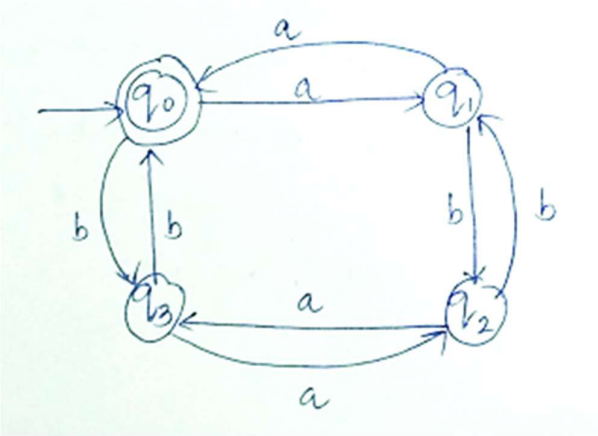
c)



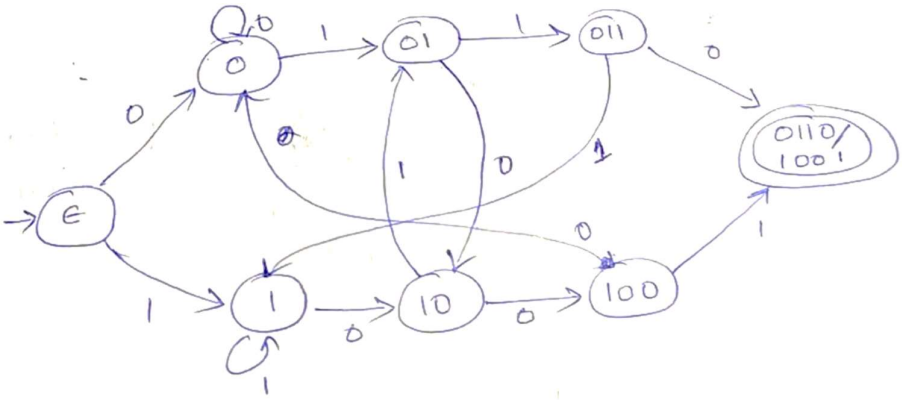

**L = {w | w is aa(ba)na , n≥0}**

II. Design DFA to recognize strings in the following language:

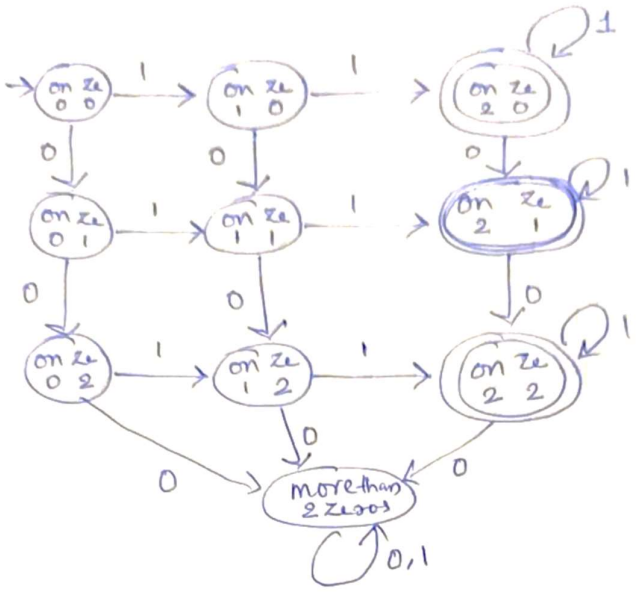
a) $L_1$ = {w | w contains even no of a's and even no: of b's, Σ = {a,b} }



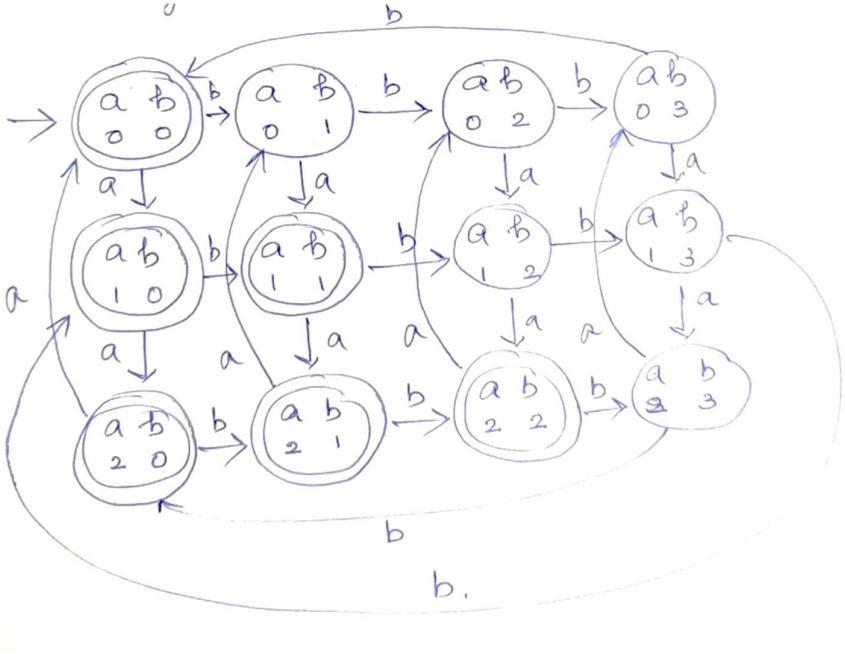

b) $L_2$ = {w | w contains 0110 or 1001, Σ = {0,1} }



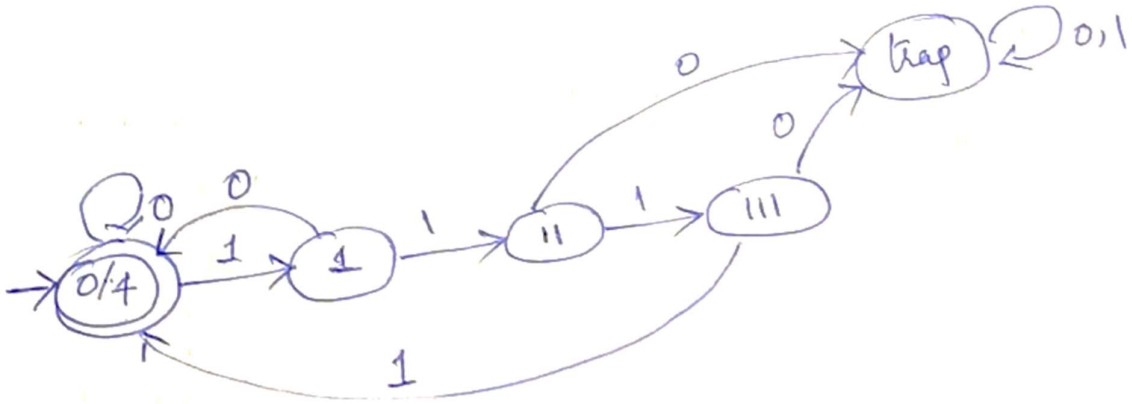

c) $L_3$ = {w | w is a binary string with atleast two ones and atmost two zeros, Σ = {0,1} }




d) $L_4$ = {w | w has $n_a(w)\%3 >= n_b(w)\%4$ , Σ = {a,b} }

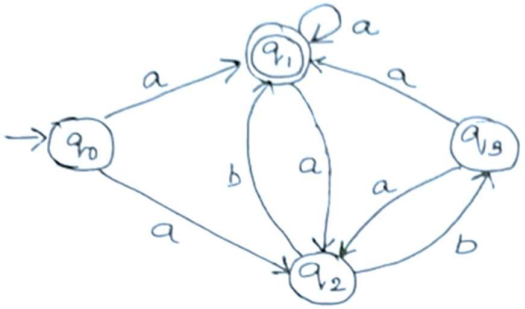



e) $L_5$ = {w | No of consecutive 1's in w is 0 or multiple of 4, Σ = {0,1}}




III. Convert the following NFA to DFA using Subset Construction method.

a)



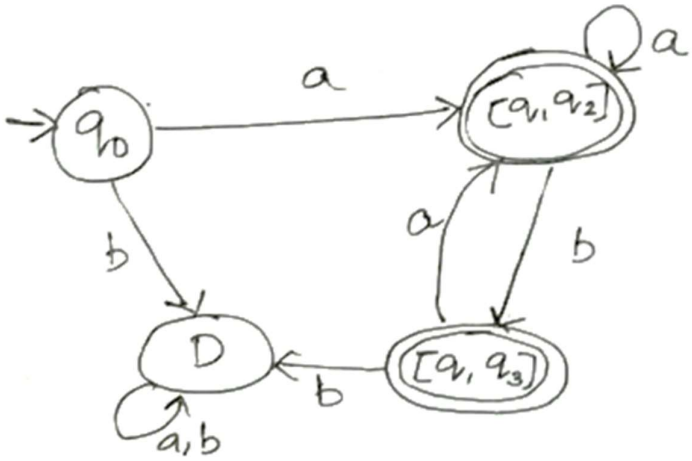

Ans:-

| NFA | a | b |
|---|---|---|
| → $q_0$ | $\{q_1, q_2\}$ | $\phi$ |
| * $q_1$ | $\{q_1, q_2\}$ | $\phi$ |
| $q_2$ | $\phi$ | $\{q_3, q_1\}$ |
| $q_3$ | $\{q_1, q_2\}$ | $\phi$ |

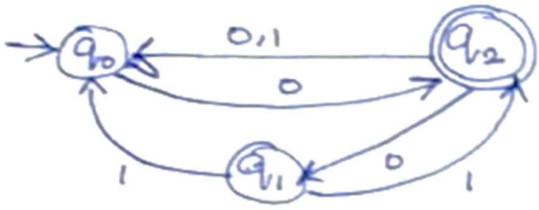
⇒ DFA transition table using Subset Construction method

| | a | b |
|---|---|---|
| → $q_0$ | $[q_1, q_2]$ | ~~$[q_1, q_2, q_3]$~~ D |
| * $[q_1, q_2]$ | $[q_1, q_2]$ | $[q_1, q_3]$ |
| * $[q_1, q_3]$ | $[q_1, q_2]$ | D |
| D | D | D |

DFA




b)




NFA txn table

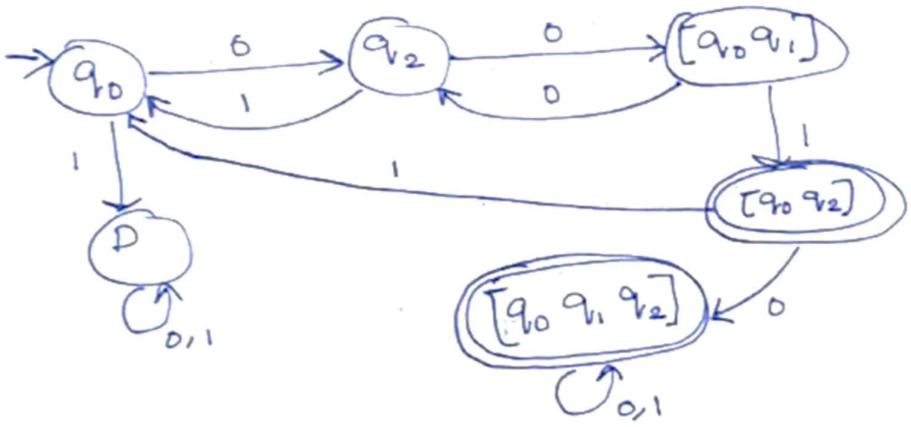
| | 0 | 1 |
|---|---|---|
| → $q_0$ | $q_2$ | $\phi$ |
| $q_1$ | $\phi$ | $\{q_0\ q_2\}$ |
| * $q_2$ | $\{q_0, q_1\}$ | $q_0$ |

DFA txn table

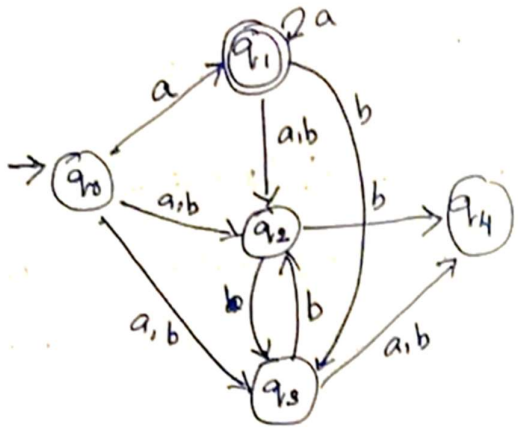
δ:

| | 0 | 1 |
|---|---|---|
| $\rightarrow q_0$ | $q_2$ | D |
| $* q_2$ | $[q_0 q_1]$ | $q_0$ |
| D | D | D |
| $[q_0 q_1]$ | $q_2$ | $[q_0 q_2]$ |
| $* [q_0 q_2]$ | $[q_0 q_1 q_2]$ | $q_0$ |
| $* [q_0 q_1 q_2]$ | $[q_0 q_1 q_2]$ | $[q_0 q_1 q_2]$ |

DFA.




c)

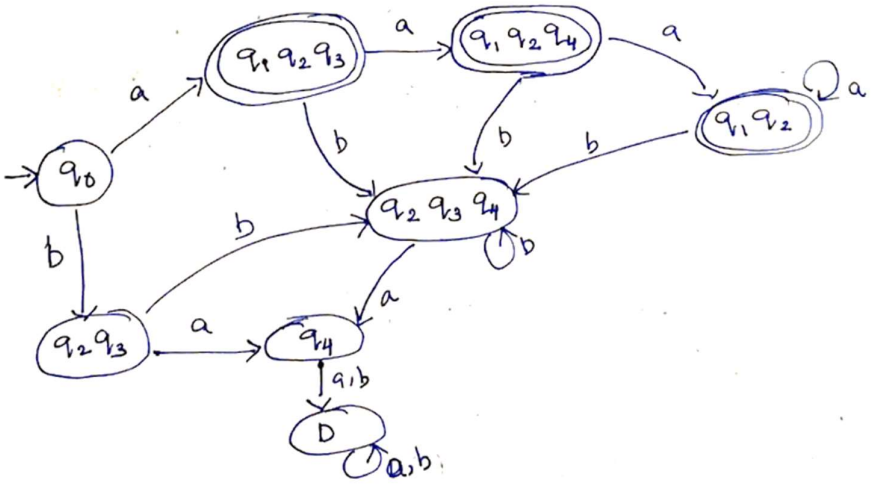



NFA

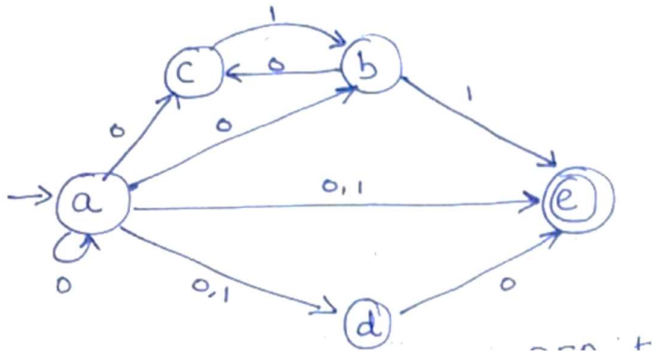
| δ | a | b |
|---|---|---|
| $q_0$ | $\{q_1, q_2, q_3\}$ | $\{q_2, q_3\}$ |
| $q_1$ | $\{q_1, q_2\}$ | $\{q_2, q_3\}$ |
| $q_2$ | $\phi$ | $\{q_3, q_4\}$ |
| $q_3$ | $q_4$ | $\{q_2, q_3, q_4\}$ |
| $q_4$ | $\phi$ | $\phi$ |

DFA

| δ | a | b |
|---|---|---|
| $\rightarrow q_0$ | $[q_1 q_2 q_3]$ | $[q_2 q_3]$ |
| $*[q_1 q_2 q_3]$ | $[q_1 q_2 q_4]$ | $[q_2 q_3 q_4]$ |
| $[q_2 q_3]$ | $q_4$ | $[q_2 q_3 q_4]$ |
| $*[q_1 q_2 q_4]$ | $[q_1 q_2]$ | $[q_2 q_3 q_4]$ |
| $[q_2 q_3 q_4]$ | $q_4$ | $[q_2 q_3 q_4]$ |
| $q_4$ | D | D |
| $*[q_1 q_2]$ | $[q_1 q_2]$ | $[q_2 q_3 q_4]$ |
| D | D | D |




d)




NFA txn table

| | 0 | 1 |
|---|---|---|
| → a | {a,b,c,d,e} | {e,d} |
| b | c | e |
| c | ϕ | b |
| d | ϕ e | ϕ |
| * e | ϕ | ϕ |

DFA txn table

| | 0 | 1 |
|---|---|---|
| → a | [abcde] | [ed] |
| *[abcde] | [abcde] | [bed] |
| *[ed] | e | Dead. |
| *[bde] | [ce] | e |
| *e | Dead | Dead |
| Dead | Dead | Dead. |
| *[ce] | Dead | b |
| *b | c | e |
| c | Dead. | b |