

IQRA NATIONAL UNIVERSITY

THEORY OF AUTOMATA

FINAL TERM EXAM

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DATE

24TH JUNE 2020

Q1) Parse the given RE into its Individual / Atomic Symbols and then design an NFA.

$(a/b)^*(ab/ba)$

1) $(a/b)^*(ab/ba)$

→ Parse them;

→ NFA for a;

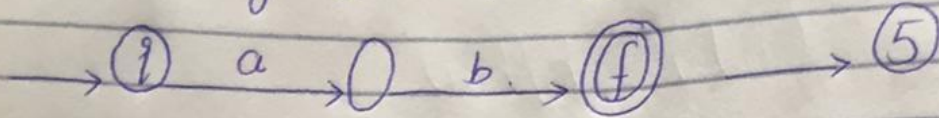
→ NFA for b;

→ NFA for (a/b);

→ NFA for $(a/b)^*$;

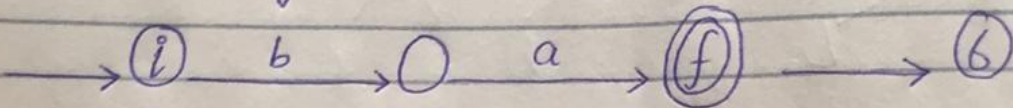
→ NFA for ab ;

↳ combining ① ϵ ②;



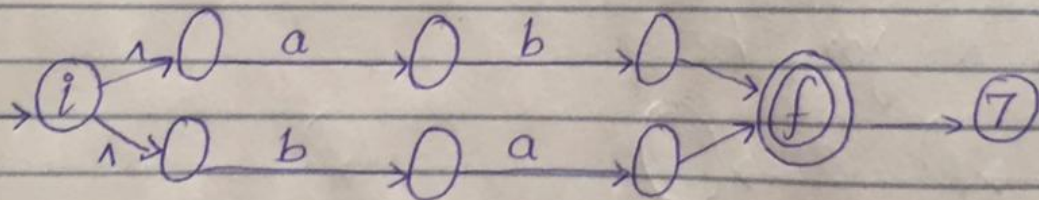
→ NFA for ba ;

↳ combining ② ϵ ①;

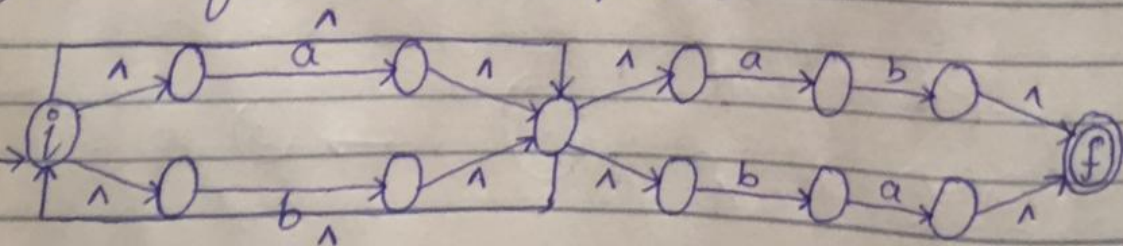


→ NFA for (ab/ba) ;

↳ combining ⑤ ϵ ⑥;



→ NFA for $(a/b)^*(ab/ba)$;

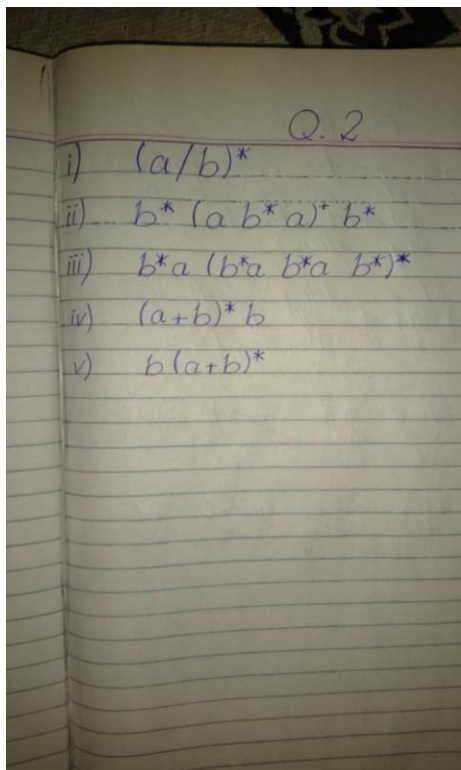


$(a/b)^*$

(ab/ba)

Q2) Design RE for each of the following.

- i. RE for all the optional words over $\{a \ b\}$.
- ii. RE for all the optional words over $\{a \ b\}$ with an Even Number of "a".
- iii. RE for all the optional words over $\{a \ b\}$ with an Odd Number of "a".
- iv. RE for all the optional words over $\{a \ b\}$ where Last symbol must be "b"
- v. RE for all the optional words over $\{a \ b\}$ where First symbol must be b



Q3). (a). Prove that

$$(a/b)^* \neq a^*b^*$$

$$3(a) \quad a^*b^* \neq (a/b)^*$$

$$\Rightarrow \text{L.H.S.} = a^*b^*;$$

$$\begin{aligned} \text{For, } a^0b^0 &= 1 \Rightarrow \Lambda \\ a^1b^0 &= a \\ a^1b^1 &= ab \\ a^0b^1 &= b \end{aligned}$$

So,

$$a^*b^* = \{ \Lambda, a, ab, b, ba, \dots \} \rightarrow \textcircled{1}$$

$$\Rightarrow \text{R.H.S.} = (a/b)^*$$

$$\begin{aligned} \text{For, } (a/b)^0 &= \Lambda \\ (a/b)^1 &= a, b \\ (a/b)^2 &= aa, ab, ba, bb \end{aligned}$$

So,

$$(a/b)^* = \{ \Lambda, a, b, aa, ab, \dots \} \rightarrow \textcircled{2}$$

$$\therefore \textcircled{1} \neq \textcircled{2} \\ a^*b^* \neq (a/b)^*$$

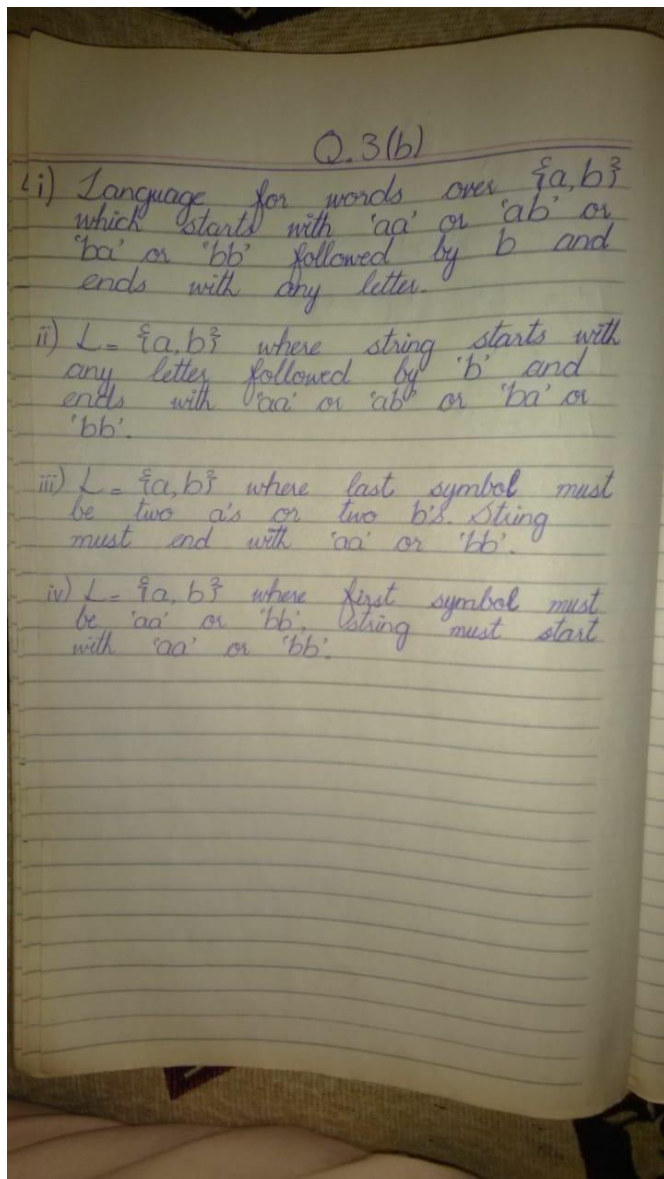
(b). Derive language descriptions (statements) for the following RE.

i. $(a / b) (a / b) b (a / b)^*$

ii. $(a / b)^* b (a / b) (a / b)$

iii. $(a / b)^* (aa / bb)$

iv. $(aa / bb) (a / b)^*$



Q4. Design NFA for the following without Parsing.

i. $(+ / -) d^+$

ii. $(a / b)^* (aaa / bbb) (a / b)^*$

