Regular Expression :-

Any expression expressed in algebraic fashion

Four rules :-

① Any terminal symbol is a regular expression

$(\emptyset, \Sigma, \varepsilon, a, b, c)$

② The union of 2 regular expression is also a regular expression

$(R_1 + R_2)$

③ The concatenation of 2 regular expression also a regular expression $(R_1 . R_2)$

④ The closure of a Regular expression is also a Regular expression

① Represent the following in Regular expression :-

(i) $\{0, 1, 2\}$ $\Rightarrow$ RE = 0+1+2

(ii) $\{\wedge, ab\}$ $\Rightarrow$ RE = $\wedge . ab$

(iii) $\{aaa, a, b, bba\}$ $\Rightarrow$ RE = aaa+a+b+bba

(iv) $\{\wedge, 0, 00, 000, \ldots\}$ $\Rightarrow$ RE = 0^*

(v) $\{1, 11, 111, 1111, \ldots\}$ $\Rightarrow$ RE = 1^+

② Design a regular expression for following cases over $\Sigma = \{a, b\}$

(i) String length is exactly 2

(ii) The string length is atleast 2

(iii) The string length is atmost 2

(i) $RE = (a+b)(a+b)$

(ii) $RE = (a+b)(a+b)(a+b)^*$ (or) $(a+b)(a+b)^+$

(iii) $RE = (\varepsilon+a+b)(\varepsilon+a+b)$

③ Design the regular expression over $\Sigma = \{a, b\}$

(i) Even length String

(ii) odd length String

(i) $RE = ((a+b)(a+b))^*$

(ii) $RE = (a+b)((a+b)(a+b))^*$

④ Write a regular expression for strings that either start (or) end with 01

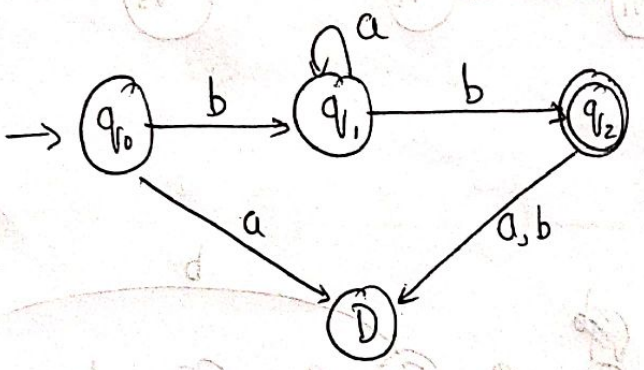
$$RE = [(01(0+1)^*) + ((0+1)^*01)]$$

⑤ Write a regular expression that have two consecutive '0's atleast
(or) 1's

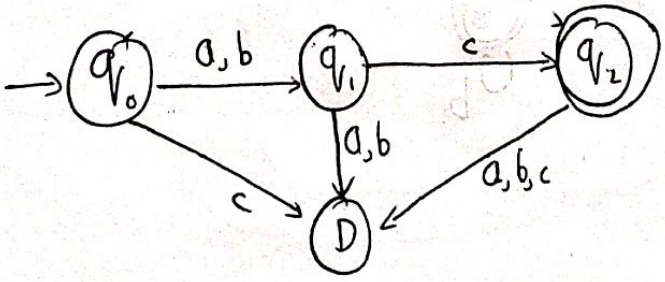
$$RE = [((0+1)^*00(0+1)^*) + ((0+1)^*11(0+1)^*)]$$

① Convert the regular expression into DFA.

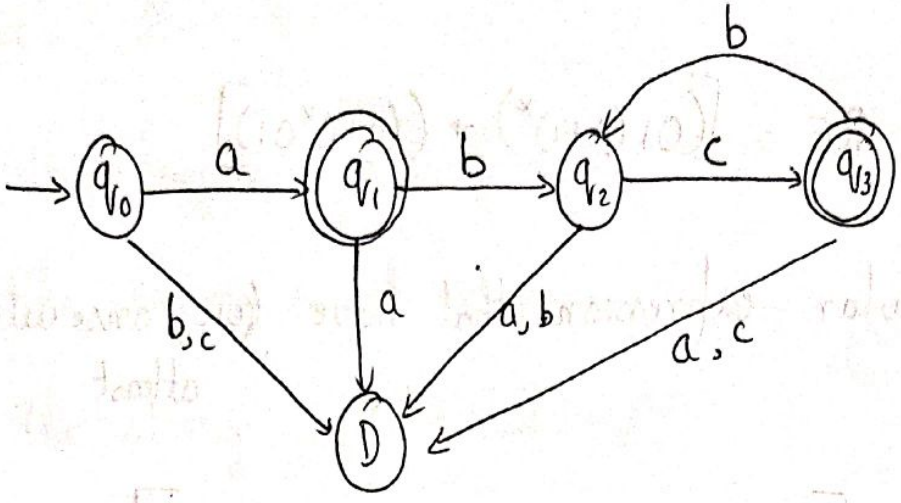
(i) ba^*b



(ii) $(a+b)c$

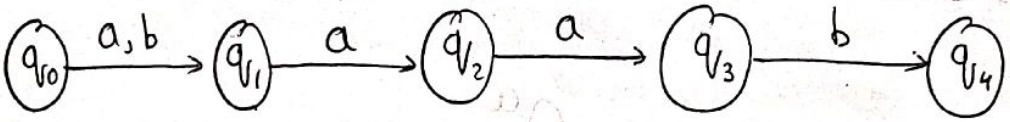


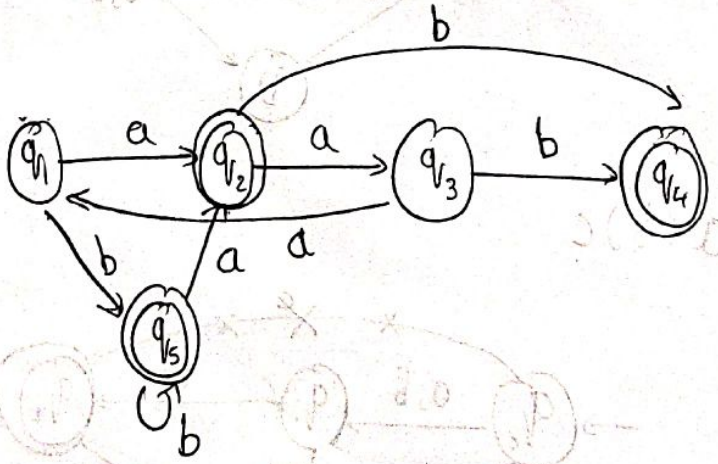
(iii) $a(bc)^*$



(iv) $(a|b)^*(aab|a+b)$

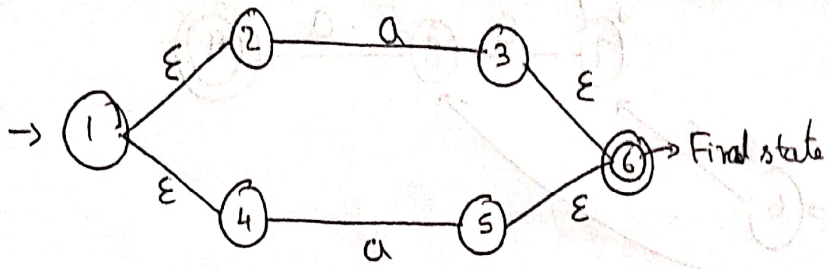
$\Rightarrow (a+b)^*((aab)+(a+b)) \Rightarrow$ aa, aaab, aaa



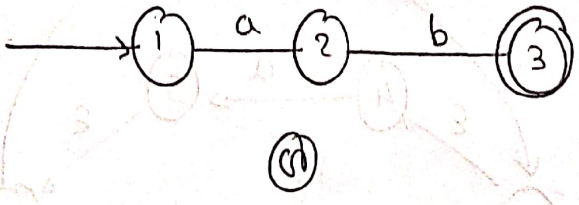


⇒ Conversion of RE to ε-NFA using Thompson Construction Method :-

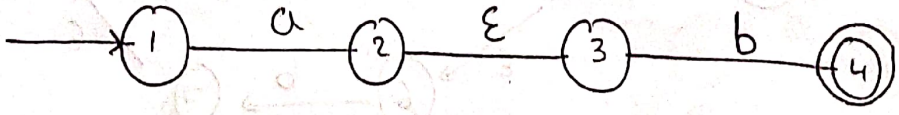
→ For union Expressions (a+b) :-



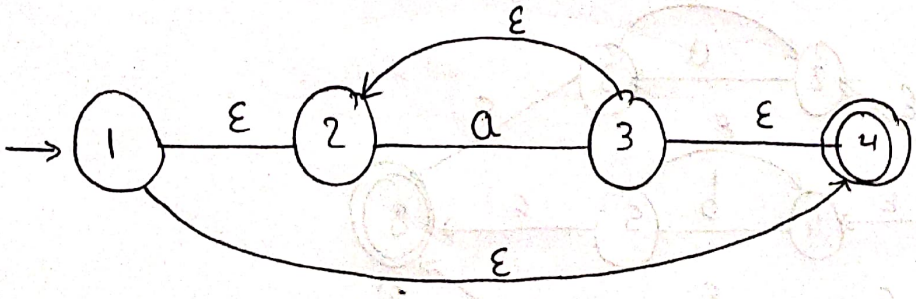
⇒ For Concatenation expressions :- (a.b)



(or)



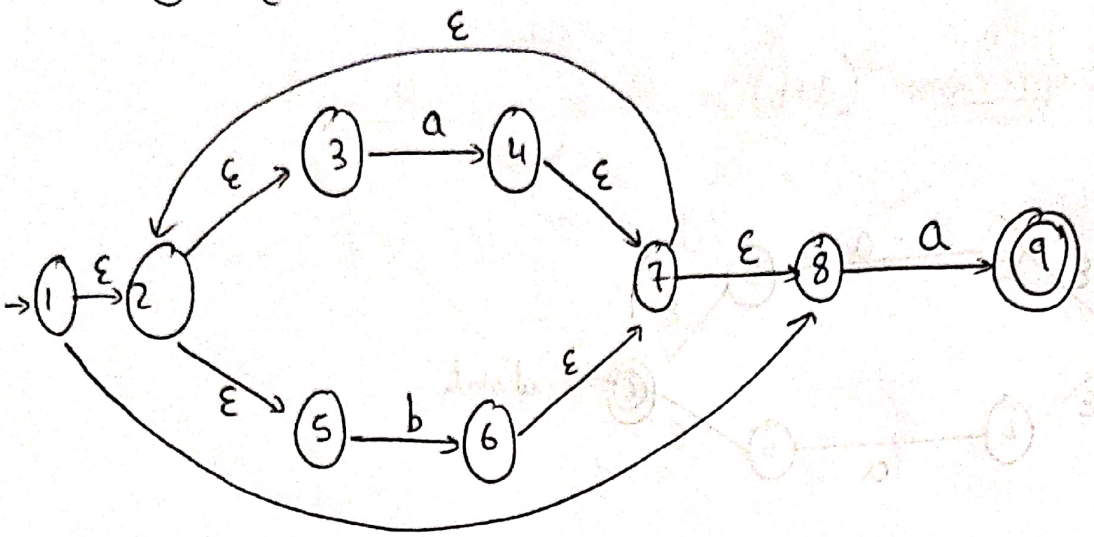
⇒ For Closure expressions :- (a*)



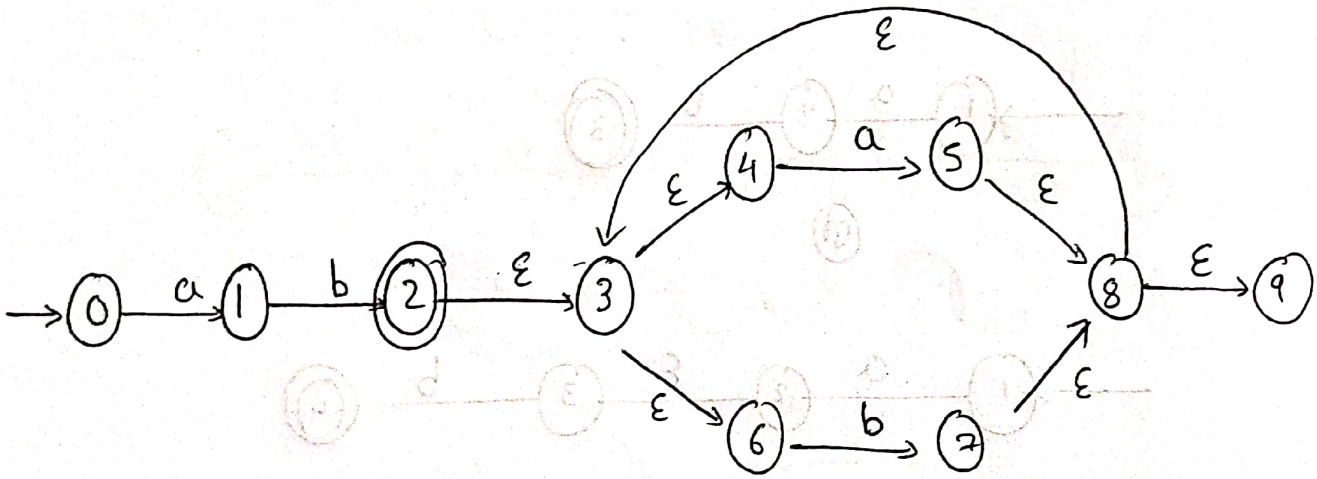
Priority :- ( ) > * > . > +

① Convert Regular Expression to ε-NFA :-

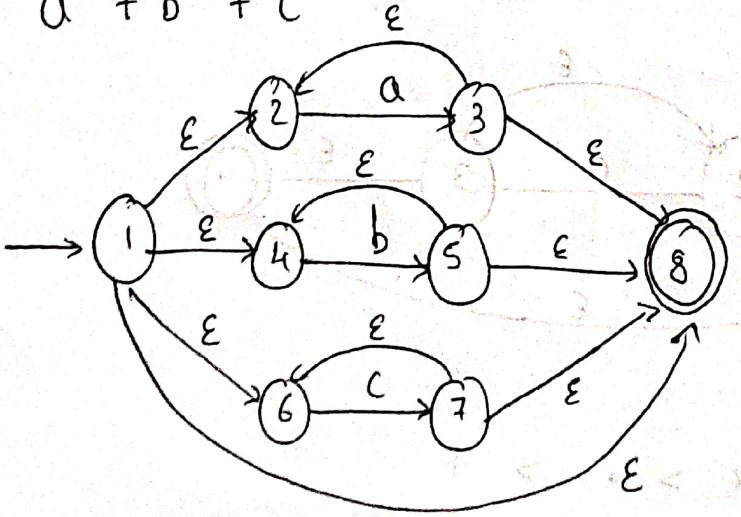
(i) $(a+b)^* a$

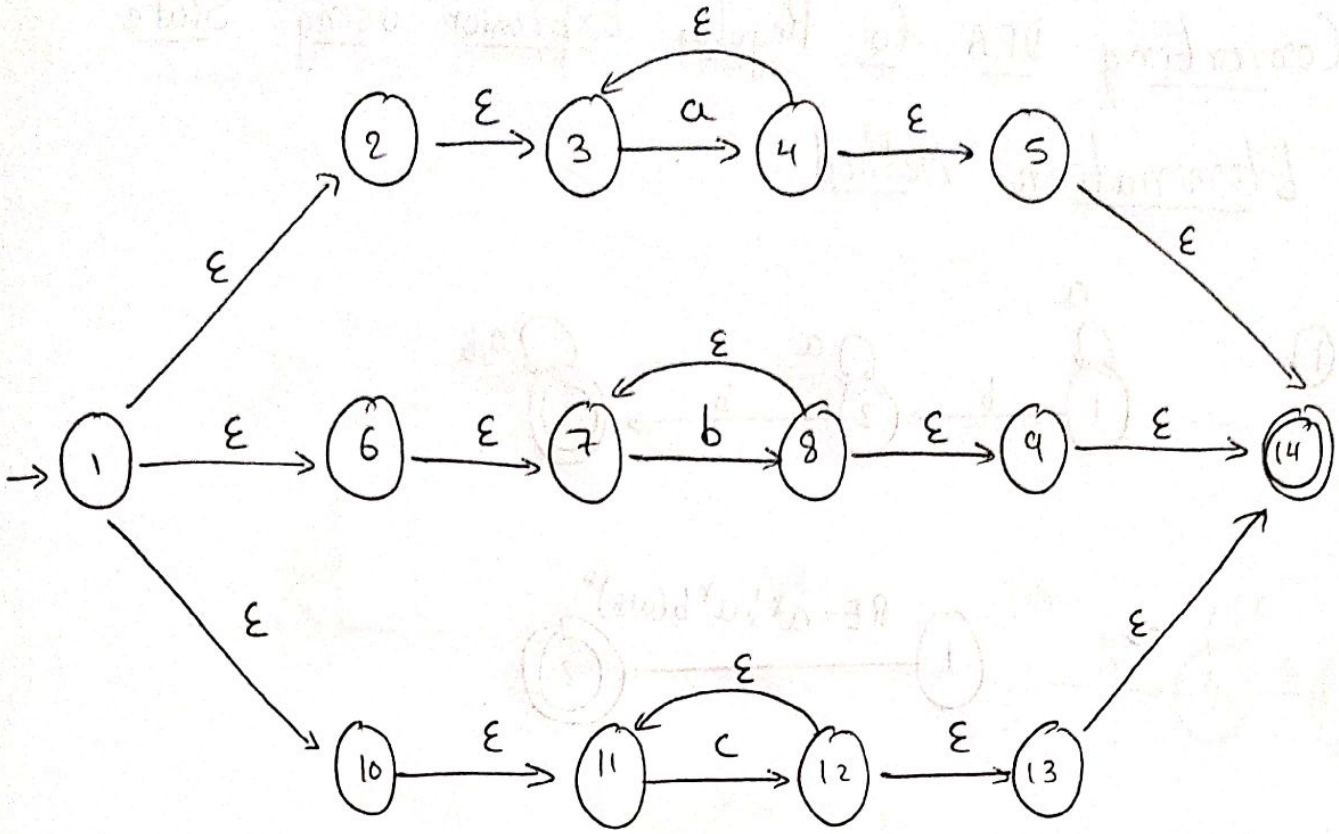


(ii) $ab(a+b)^*$



(iii) $a^* + b^* + c^*$




ε
ε
a
ε
ε
ε
ε
b
ε
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ε
ε
ε
c
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ε
1
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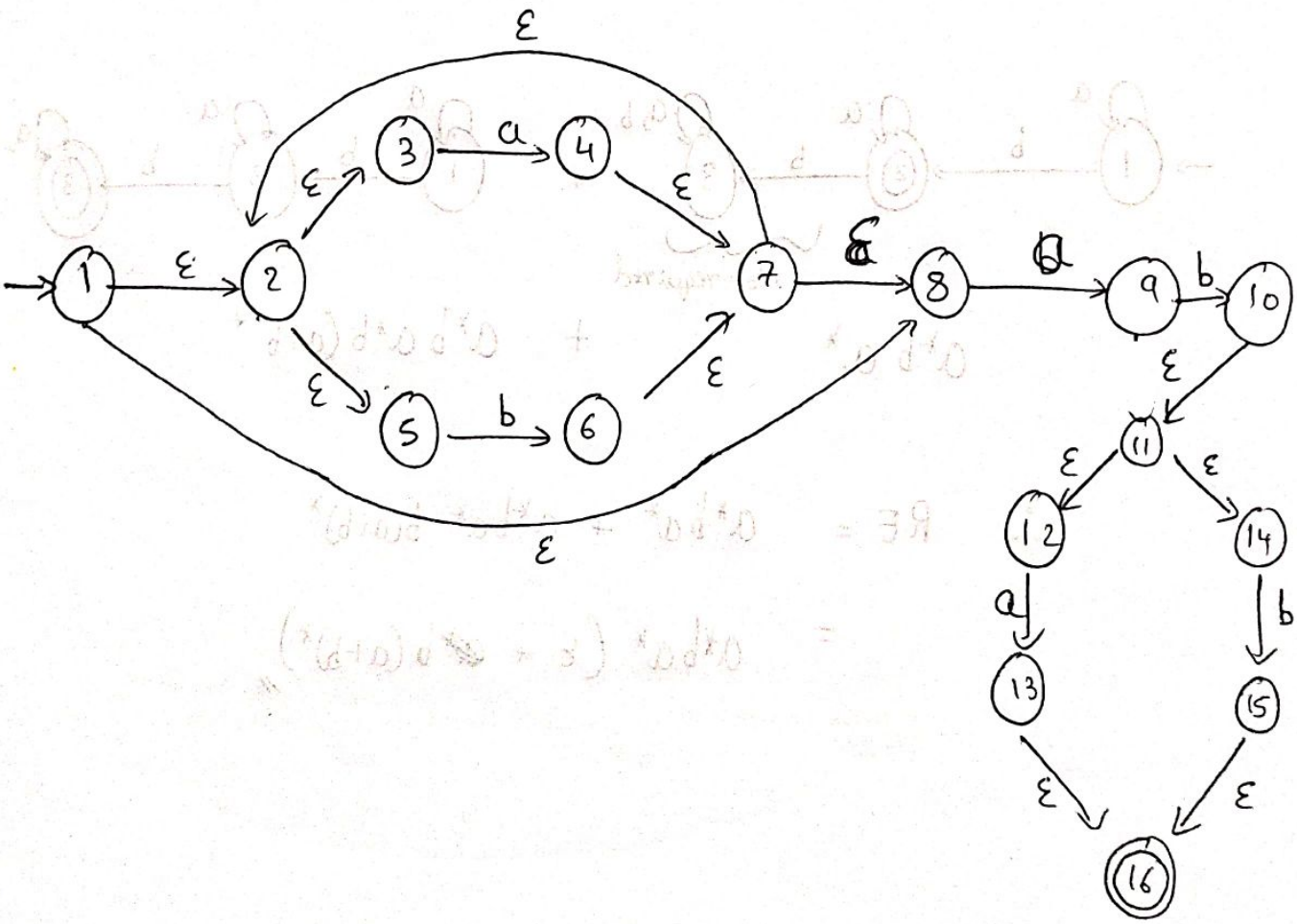
14

(iv) $(a+b)^* ab\,(a+b)$


ε
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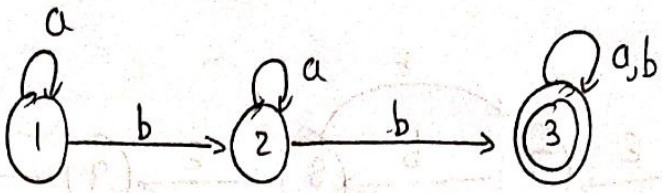
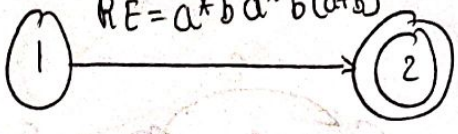
⇒ Converting DFA to Regular Expression using State Elimination Method :-

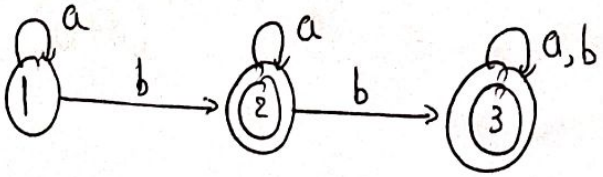
(1)

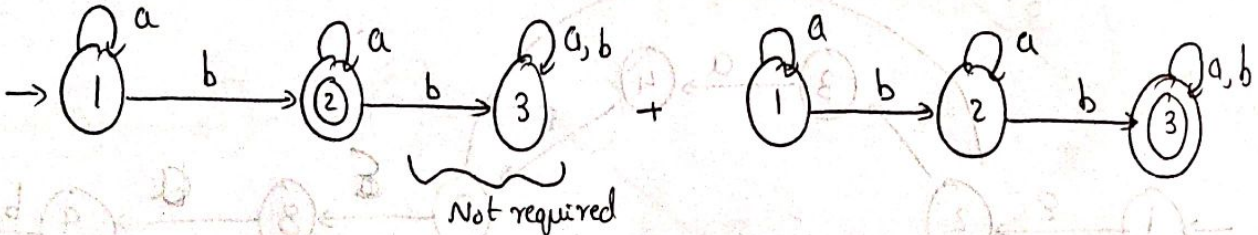


⇒



(2)



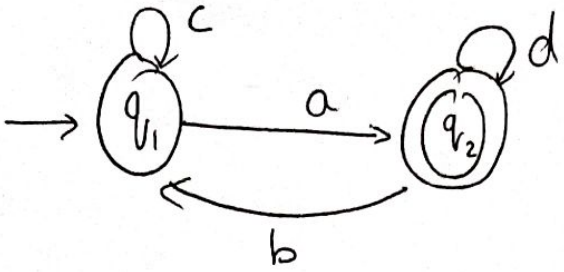


$a^*b\,a^*$ + $a^*b\,a^*b\,(a+b)^*$

$\therefore$ RE = $a^*ba^* + a^*ba^*\,b(a+b)^*$

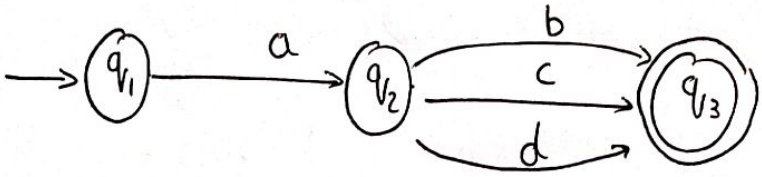
$= a^*ba^*\,(\varepsilon + b(a+b)^*)$ //

(3)

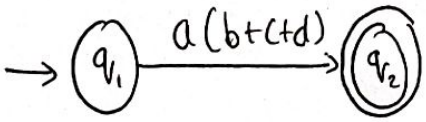


$$RE = c^* a (d + b c^* a)^*$$

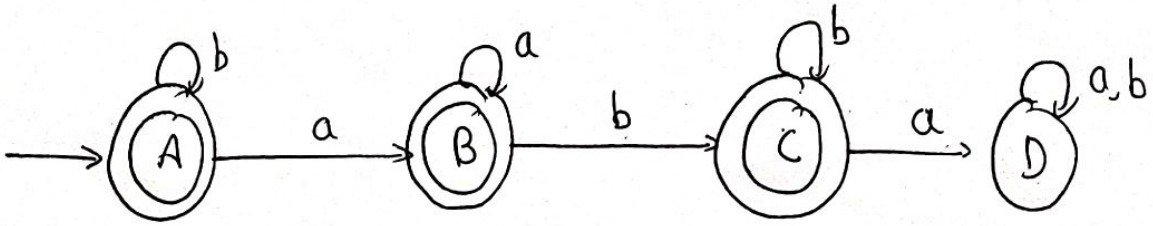
(4)



$$a(b+c+d)$$



(5)



$$\varepsilon + b^* a + b^* a a^* b b^*$$