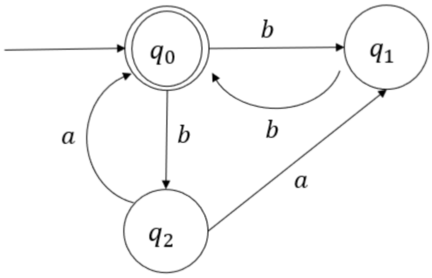
UNIT-II

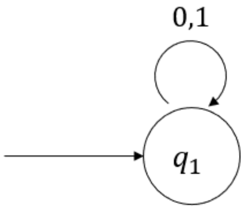
PRACTICE QUESTIONS

1. Describe the following sets by regular expressions :
   a. L is the set of all string of 0's and 1's ending with 00.
   b. L is the set of all string of 0's and 1's beginning with 0 and ending with 1.
   c. L = $\{\epsilon, 11, 1111, 111111, \ldots \ldots\}$ }
2. Find a regular expression corresponding to each of the following subsets of $\{a, b\}$
   a. The set of all strings containing exactly 2 a's
   b. The set of all strings containing atleast 2 a's
   c. The set of all strings containing atmost 2 a's
   d. The set of all strings containing the substring aa.
3. Find regular expressions representing the following sets :
   a. The set of strings over $\{0,1\}$ which have at most one pair of 0's or at most one pair of 1's.
   b. The set of strings over $\{a, b\}$ in which the number of occurrences of a is divisible by 3.
   c. The set of strings over $\{a, b\}$ in which there are at most two occurrences of b between any two occurrences of a.
   d. The set of strings over $\{a, b\}$ with three consecutive b's.
   e. The set of strings over $\{0,1\}$ beginning with $\{0,0\}$.
   f. The set of strings over $\{0,1\}$ ending with 00 and beginning with 1.
4. Find a regular expression consisting of all strings over $\{a, b\}$ starting with any number of $a's$, followed by one or more $b's$, followed by one or more $a's$, followed by a single b, followed by any number of $a's$, followed by b and ending in any string of $a's$ and $b's$.
5. Find the regular expression representing the set of all strings of the form
   a. $a^m b^n c^p$ where $m, n, p \geq 1$
   b. $a^m b^{2n} c^{3p}$ where $m, n, p \geq 1$
   c. $a^n b a^{2m} b^2$ where $m \geq 0, n \geq 1$
6. Find all strings of length 5 or less in the regular set represented by the following regular expressions :
   a. $(ab + a)^*(aa + b)$
   b. $(a^*b + b^*a)^*a$
   c. $a^* + (ab + a)^*$
   d. $a(a + b) * ab$
   e. $a^*b + b * a$
   f. $(aa + b) * (bb + a) *$

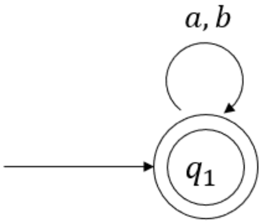
7. Covert the following NFA to DFA



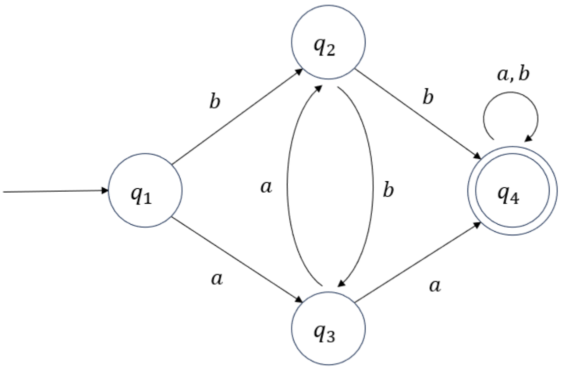
8. Find the set of strings over $\Sigma = \{a, b\}$ recognized by the transition systems given below :



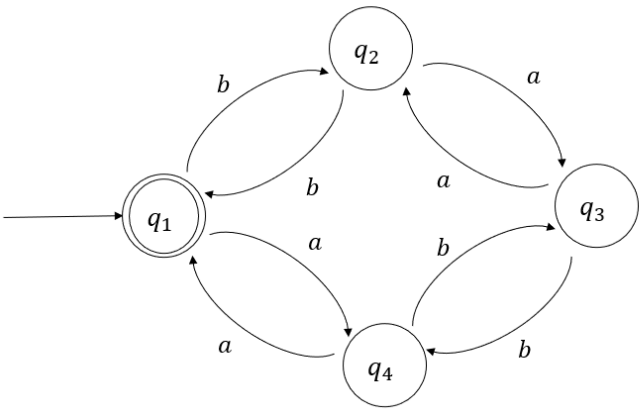
a.



b.

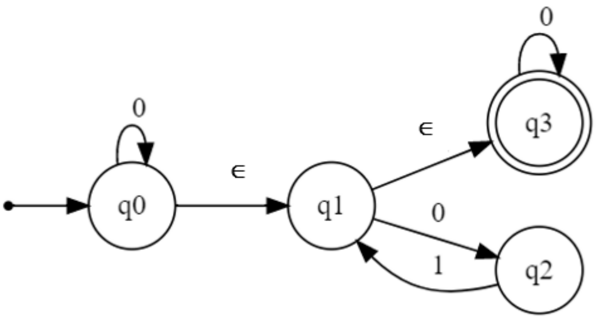


c.



d.

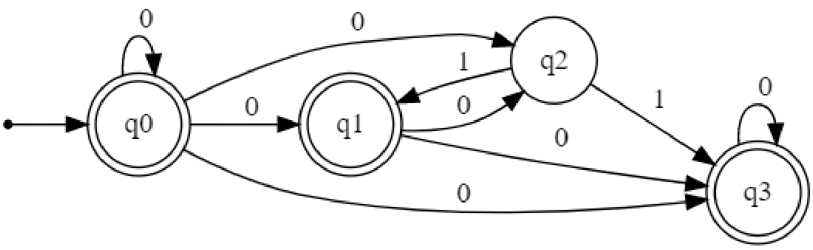
9. Convert the following $\epsilon - NFA$ to its equivalent NFA.



Answer :

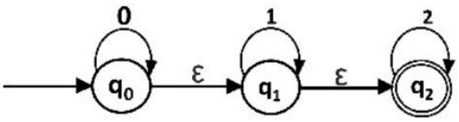
Transitions

state	0	1
q0	{q0, q1, q2, q3}	-
q1	{q2, q3}	-
q2	-	{q1, q3}
q3	{q3}	-

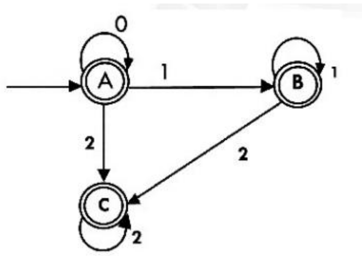


NFA

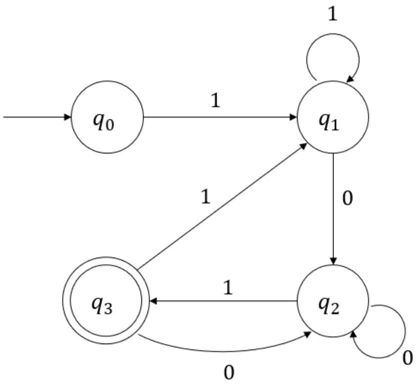
10. Convert the following $\epsilon - NFA$ to its equivalent NFA.

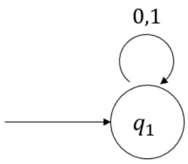


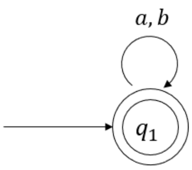
Answer :

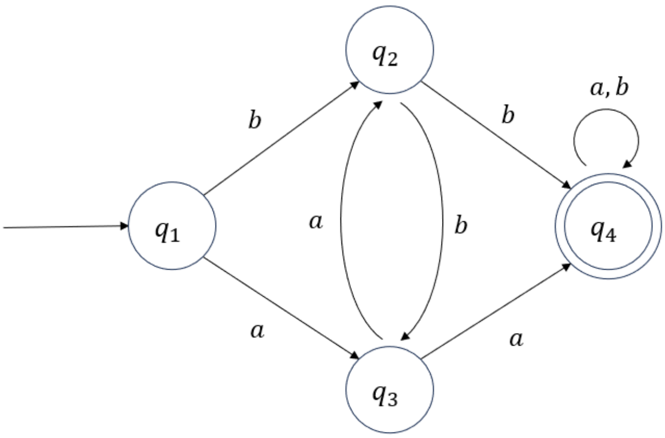


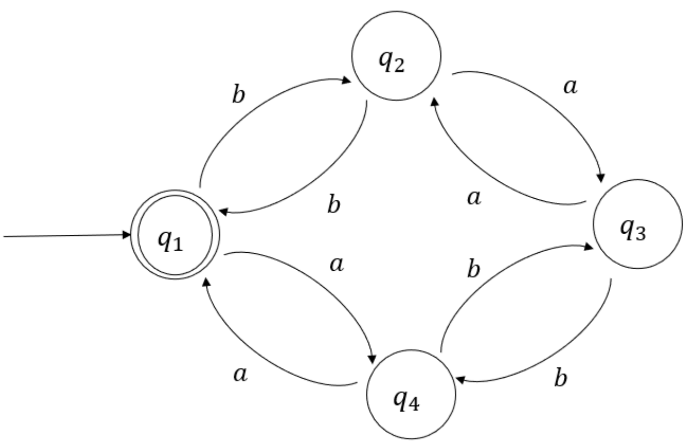
11. Find the regular expression corresponding to the automaton given below :

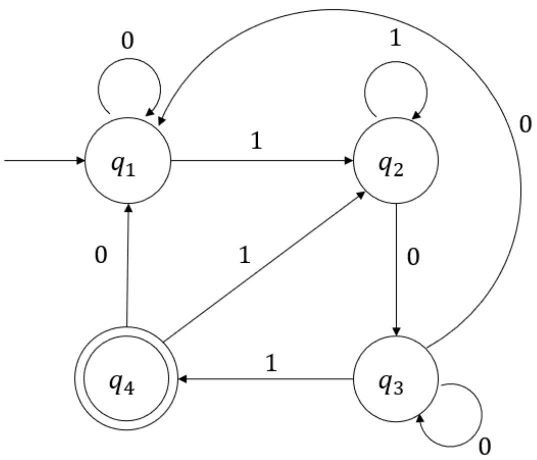
a. 

b. 

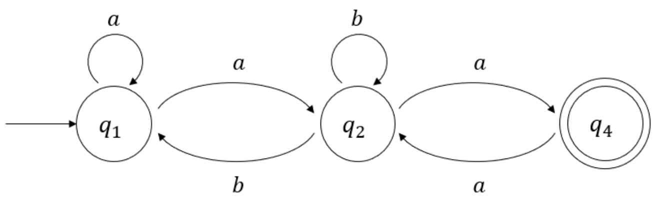
c. 

d. 

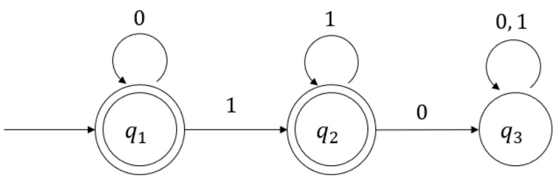
e. 


0
1
1
0
q_1
q_2
0
1
0
q_4
1
q_3
0

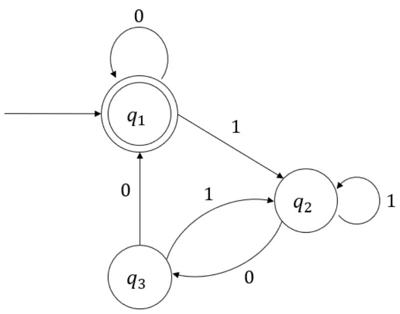
f.


a
b
a
a
q_1
q_2
q_4
b
a

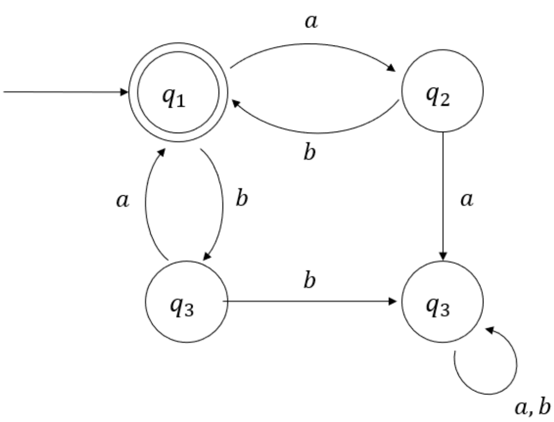
g.


0
1
0, 1
1
0
q_1
q_2
q_3

h.

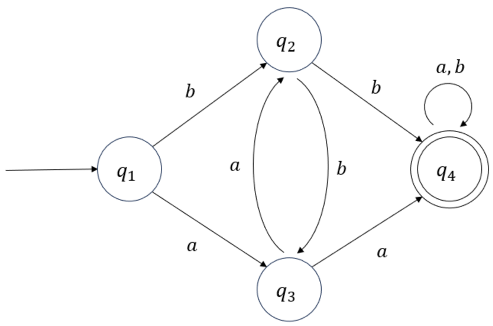

0
q_1
1
0
1
q_2
1
q_3
0

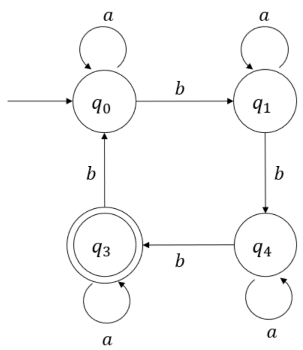
i.


a
q_1
q_2
b
a
b
a
b
q_3
q_3
a, b

j.

12. Construct a DFA with reduced states (minimized DFA) equivalent to the following regular expressions :
    a. $(0+1)^*(00+11)(0+1)^*$
    b. $10+(0+11)0*1$
13. Construct the transition systems equivalent to the following regular expressions :
    a. $(ab+a)^*(aa+b)$
    b. $(a^*b+b^*a)^*a$
    c. $a^*+(ab+a)^*$
    d. $a(a+b)*ab$
    e. a^*b+b*a
    f. $(aa+b)*(bb+a)*$
    g. $(ab+c^*)*b$
    h. $a+bb+bab*a$
14. Construct a deterministic finite automaton corresponding to the following regular expressions
    a. $(ab+a)^*(aa+b)$
    b. $(a^*b+b^*a)^*a$
    c. $a^*+(ab+a)^*$
    d. $(a+b)^*abb$
15. Construct a finite automaton accepting all strings over $\{0,1\}$ ending with 010 or 0010.
16. Construct a regular grammar G generating the regular set represented by $a^*b(a+b)^*$
17. If a regular grammar G is given by $S \to aS|a$, find M accepting L(G).
18. Let $G=(\{A_0,A_1,A_2,A_3\},\{a,b\},P,A_0)$, where P consists of
    $A_0 \to aA_0|bA_1,\ \ A_1 \to aA_2|aA_3,\ \ A_3 \to a|bA_1|bA_3,\ \ A_3 \to b|bA_0$.
    Construct an NDFA accepting $L(G)$.
19. Construct a finite automaton recognizing $L(G)$, where G is the grammar $S \to aS|bA|b$ and $A \to aA|bS|a$.
20. Find a regular grammar accepting the set recognized by the finite automaton given below :





21. Construct a deterministic finite automaton equivalent to the grammar

$$S \to aS|bS|aA, \qquad A \to bB, \qquad B \to aC, \qquad C \to \epsilon$$

22. Let $G = (\{A_0, A_1, A_2, A_3\}, \{a, b\}, P, A_0\}$ where P consists of

$$A_0 \to aA_0|bA_1$$

$$A_1 \to aA_2|aA_3$$

$$A_2 \to a|bA_1|bA_3$$

$$A_3 \to b|bA_0$$

Construct NFA accepting L(G).

23. Consider G whose productions are $S \to aAS|a, A \to SbA|SS|ba$. Show that $S \overset{*}{\Rightarrow} aabbaa$ and construct a derivation tree whose yield is $aabbaa$.
24. Let G be the grammar $S \to 0B|1A, A \to 0|0S|1AA, B \to 1|1S|0BB$. For the string 00110101, find (a) the leftmost derivation, (b) the rightmost derivation, and (c) the derivation tree.
25. If G is a grammar $S \to SbS|a$. Show that G is ambiguous.
26. Consider the grammar G which has the following productions and answer the questions :

$$A \to a|Aa|bAA|AAb|AbA$$

   a. What is the start symbol of G?
   b. Is $aaabb$ in $L(G)$?
   c. Is $aaaabb$ in $L(G)$?
   d. Is abb in $L(G)$?
27. Consider the grammar G which has the following productions and state whether the given statements are true or false :

$$S \to aB|bA, \qquad A \to aS|bAA|a, \qquad B \to bS|aBB|b$$

   a. $L(G)$ is finite.
   b. $abbbaa \in L(G)$
   c. $aab \notin L(G)$
   d. $L(G)$ has some strings of odd length.
   e. $L(G)$ has some strings of even length.
28. Consider the grammar G whose productions are $S \to aAS|a, A \to SbA|SS|ba$.
   Show that $S \Rightarrow aabbaa$. Also, construct a derivation tree.
29. $S \to aAS|aSS|\epsilon, \;\; A \to SbA|ba$. For the string $aabaa$, find
   a. the leftmost derivation

b. the rightmost derivation
c. the parse tree

30. Find a derivation tree of $a * b + a * b$ given that $a * b + a * b$ is in $L(G)$, where G is given by $S \rightarrow S + S \mid S * S, S \rightarrow a \mid b$.

31. A context free grammar G has the following productions :

$$S \rightarrow 0S0 \mid 1S1 \mid A, \qquad A \rightarrow 2B3, \qquad B \rightarrow 2B3 \mid 3$$

Describe the language generated by the parameters.

32. Consider the following productions :

$$S \rightarrow aB \mid bA$$

$$A \rightarrow aS \mid bAA \mid a$$

$$B \rightarrow bS \mid aBB \mid b$$

For the string $aaabbabbba$, find
a. the leftmost derivation
b. the rightmost derivation
c. the parse tree

33. Consider the grammar-

S → bB / aA

A → b / bS / aAA

B → a / aS / bBB

For the string w = bbaababa, find-
a. Leftmost derivation
b. Rightmost derivation
c. Parse Tree

34. Consider the grammar-

S → 0B / 1A

A → 0 / 0S / 1AA

B → 1 / 1S / 0BB

For the string w = 00110101, find-
a. Leftmost derivation
b. Rightmost derivation

c. Parse Tree

35. Show that the grammar $S \to a|abSb|aAb, A \to bS|aAAb$ is ambiguous.
36. Show that the grammar $S \to aB|Ab, A \to aAB|a, B \to ABb|b$ is ambiguous.
37. Show that the grammar $S \to aAS|aSS|\epsilon,\ \ A \to SbA|ba$ is ambiguous.
38. Find a reduced grammar equivalent to the grammar G whose productions are
$$S \to AB|CA, \qquad B \to BC|AB, \qquad A \to \alpha, \qquad C \to aB|b$$
39. Find a reduced grammar equivalent to the grammar G whose productions are
$$S \to aAa, \qquad A \to Sb|bCC|DaA, \qquad C \to abb|DD, \qquad E \to aC, \qquad D \to aDA$$
40. Find a reduced grammar equivalent to the grammar G whose productions are
$$S \to AC|B, \qquad A \to a, \qquad C \to c|Bc, \qquad E \to aA|\epsilon$$
41. Find a reduced grammar equivalent to the grammar G whose productions are
$$S \to AB, A \to a, B \to b, B \to C, E \to c$$
42. Find a reduced grammar equivalent to the grammar G whose productions are
$$S \to AB|CA, B \to BC|AB, A \to a, C \to aB|b$$
43. Find a reduced grammar equivalent to the grammar $S \to aAa, A \to bBB, B \to ab, C \to aB$.
44. Given a grammar $S \to AB, A \to a, B \to C|b, C \to D, D \to E, E \to a$, find an equivalent grammar which is reduced and has no unit productions.
45. Remove Unit Productions from the grammar whose productions are given below :
$$S \to XY, X \to a, Y \to Z|b, Z \to M, M \to N, N \to a$$
46. Remove Null Productions from the whose productions are given below :
$$S \to ABAC, A \to aA|\epsilon, B \to bB|\epsilon, C \to c$$
47. Remove Null Productions from the whose productions are given below :
$$S \to aS|AB, A \to \epsilon, B \to \epsilon, D \to b$$
48. Reduce the following grammar G to CNF. G is
    a. $S \to aAD, A \to aB|bAB, B \to b, D \to d.$
    b. $S \to aAbB, A \to aA|a, B \to bB|b.$
    c. $S \to 1A|0B, A \to 1AA|0S|0, B \to 0BB|1S|1$
    d. $S \to a|b|cSS$
    e. $S \to abSb|a|aAb,\ \ A \to bS\ |\ aAAb$
    f. $S \to ASA|bA, A \to B|S, B \to C$
49. Reduce the following grammar to GNF.
    a. $S \to SS, S \to 0S1|01$
    b. $S \to AB, A \to BSB, A \to BB, B \to aAb, B \to a, A \to b$

c. $S \to A0, A \to 0B, B \to A0, B \to 1$

50. Construct a PDA accepting all palindromes over $\{a, b\}$.

~~51. Construct a PDA accepting $L = \{a^i b^j c^k | i = j \text{ or } j = k\}$ by final state.~~

52. Construct a PDA accepting $L = \{a^n b^m a^n | m, n \geq 1\}$ by final state.

53. Construct a PDA accepting $L = \{a^n b^{2n} | n \geq 1\}$ by final state.

54. Construct a PDA accepting $L = \{a^n b^m c^n | m, n \geq 1\}$ by final state.

55. Construct a PDA accepting $L = \{a^m b^n | m > n, n \geq 1\}$ by final state.

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