Branch : CSE & IT Batch : Hinglish

WEEKLY TEST – 01
Subject : Theory of Computation

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. How many states are required in minimal DFA for regular expression $(a^*b^* + b^*(a^*b^*)^* + ab)$ on alphabet $\Sigma = \{a, b\}$?

(a) 3 (b) 4
(c) 5 (d) 1

[MCQ]

2. Let, $L_1 = a^*b^*$
$L_2 = b^*a^*$
$L_1 - L_2$

(a) ϕ (b) $\in$
(c) a^+b^+ (d) $a^* + b^*$

[NAT]

3. For regular expression $(ab^*b + a)(bba)(a^*b^*)(a + b)$, the length of the shortest string will be_____.

[MSQ]

4. Consider a regular expression:
Regular expression: $(10^* + 1)^* \cup (11 + 0)^*$
Which of the following string is/are generated by above regular expression?

(a) 1011011 (b) 0110110
(c) 0001110 (d) 1111111

[MCQ]

5. For language $L = \{w_1aaw_2 | w_1, w_2 \in \{a + b\}^* \ |w_1| < 3 \ \{|w_2| \le 1\}$
Which of the following will be correct regular expression?

(a) $(\in + a + b)^3$ aa $(a + b)$
(b) $(a + b)^3$ aa $(a + b)$
(c) $(\in + a + b)^2$ aa $(\in + a + b)$
(d) $(a + b)^2$ aa$(a + b)$

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider the following statements:
S_1: Complement of finite language always infinite.
S_2: Complement of infinite language can be finite.
S_3: Complement of infinite language can be infinite.
S_4: Complement of infinite language always finite.
Which of the following is correct?

(a) S_1 and S_2 are correct.
(b) S_1, S_2 and S_4 are correct.
(c) S_1, S_2 and S_3 are correct.
(d) S_1 and S_4 are correct.

[MCQ]

7. Let a language (L) = {ab, ba, aa, b}. Then what is the highest power of language to generate the string aaabbabb?

(a) L^5 (b) L^4
(c) L^6 (d) None of these

[MCQ]

8. For language $L = \{a^n | n \ge 0\}$on alphabet $\Sigma = \{a\}$. What will be the correct regular expression for L^3?

(a) $L^3 = \{a^{3n} | n \ge 0\}$
(b) $L^3 = \{a^n | n \ge 0\}$
(c) $L^3 = \{a^{3^n} | n \ge 0\}$
(d) None of these

[NAT]

9. How many states are required for language $L= \{a^m b^n c^q | m, n, q \geq 0\}$ on alphabet $\Sigma = \{a, b, c\}$?_____

[NAT]

10. Consider a language L on $\Sigma = \{a, b\}$, L = {w ; number of a's = 2 and number of b's = even} how many states are required in DFA to accept $\bar{L}$? _____.

Answer Key

1. **(d)**
2. **(c)**
3. **(5)**
4. **(a, b, d)**
5. **(c)**
6. **(c)**
7. **(a)**
8. **(b)**
9. **(4)**
10. **(7)**

Hints and solutions

1. (d)

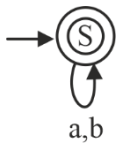
Regular expression = $a^*b^* + b^*(a^*b^*)^* + ab$

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

$= (a + b)^*$

$(a + b)^*$ will cover each and every string.

Minimal DFA:



Number of states = 1

2. (c)

$L_1 - L_2 = a^+ b^+$

3. (5)

$\underset{a}{(ab^*b + a)}$ $\underset{bba}{(bba)}$ $\underset{\in}{(a^*b^*)}$ $\underset{a\,/\,b}{(a + b)}$

Shortest string = abba ∈ a

= abbaa

= 5

4. (a, b, d)

Regular expression = $(10^* + 1)^* + (11 + 0)^*$

(a) 10 11 00 11 Possible

(b) 0 11 0 11 0 Possible

(c) 0 0 0 11 1 0 Not Possible

(d) 1 1 1 1 1 1 1 Possible

Note: Take either first regular expression or second regular expression but don't take both.

5. (c)

- $|w_1| < 3$: length of the string can be 0 length or 1 length or 2 length

  $|w_1| < 3$: $(\in + a + b)^2$
- $|w_2| \le 1$: length of the string can be either 0 length or 1 length

  $|w_2| \le$: $(\in + a + b)^1$

Regular expression = $(\in + a + b)^2$ aa $(\in + a + b)$

Hence, option (c) is correct.

6. (c)

S_1 True: $\overline{a.b} = (ab)^+$

S_2 True: $\overline{(a.b)^*} = \phi$

S_3 True: $\overline{a(a + b)^*} = b(a + b)^* + \in$

S_4 True: $\overline{(a + b)^*} = \phi$

$\overline{a(a + b)^*} = b(a + b)^* + \in$

- Complement of finite language always infinite.
- Complement of infinite language can be finite or infinite.

Hence, option (c) is correct.

7. (a)

String = aabbabb

L = {ab, ba, aa, b}

$\Rightarrow \underset{L}{\underline{a\ a}}\ \underset{L}{\underline{b}}\ \underset{L}{\underline{b}}\ \underset{L}{\underline{a\ b}}\ \underset{L}{\underline{b}}$

$\Rightarrow L^5$

Hence, option (a) is correct.

8. (b)

$L = \{an \mid n \ge 0\}$

$= \{\in, a, aa, aaa, \ldots\}$

$= a^*$

$L^2 = L * L$

$= a^* \times a^*$

$= a^*$

$L^3 = L^2 * L$

$= a^* \times a^*$

$= a^*$

$L = \{a^n \mid n \ge 0\}$

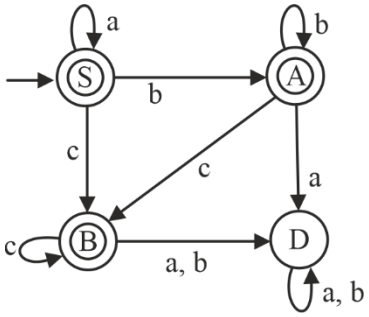
Hence, option (b) is correct.

9. (4)

$L = \{a^m b^n c^q \mid m, n, q \geq 0\}$

$L = \{a^*, b^*, c^*, aa \ldots bb \ldots cc \ldots\}$

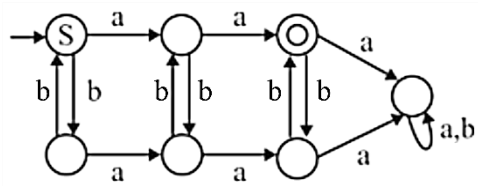
MDFA:



10. (7)

Range 7 to 7

- This type of language can be design by grid(mod) machine.



- Number of states in DFA is same as number of states in complement of DFA.
- So, number of states in $\bar{L}$ = 7.