Branch : CSE & IT Batch : Hinglish

WEEKLY TEST – 03

Subject : Theory of Computation

Topic : NFA and Regular Language

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Which of the following is a regular language?

(a) $L = \{a^{n^n} \mid n \geq 1\}$

(b) $L = \{a^{m^n} \mid n \geq 1, m = n^2\}$

(c) $L = \{a^{m^n} \mid n \geq 1, m > n\}$

(d) None of these

[MCQ]

2. Which of the following is a non-regular language?

(a) $L = \{wxwy \mid x,y,w \in (a + b)^+\}$.

(b) $L = \{xwyw \mid x,y,w \in (a + b)^+\}$.

(c) $L = \{wxyw \mid x,y,w \in (a + b)^+\}$.

(d) All of the above.

[MCQ]

3. Let L be any formal language. If L^* is regular language then what is L?

(a) L is regular.

(b) L is non-regular.

(c) L is CFL.

(d) None of these.

[MCQ]

4. Consider the following two statements:

[I]: There exist a regular language L_1, such that for all language L_2, $L_1 \cup L_2$ is always regular.

[II]: If all states of deterministic finite automata (DFA) except start state are final states then language accepted by DFA is Σ^+.

Which of the following is correct?

(a) S_1 only.

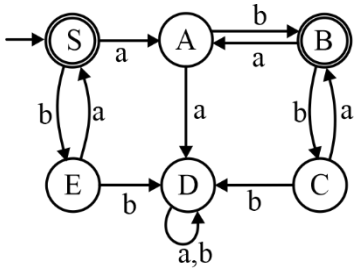
(b) S_2 only.

(c) Both S_1 and S_2 are true.

(d) None of these.

[MCQ]

5. Consider the following DFA:



The correct transition of δ*(S, abaab) is?

(a) {D}

(b) {S, A, B, D}

(c) {A, B, A, D, D}

(d) {B, D}

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Assume R_1, R_2 and R_3 are three regular expressions. Given, $R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$ for any R_2 and R_3. Which of the following could be correct condition which always satisfies the above equation?

(i) $R_1 = R_2$

(ii) $R_1 = R_3$

(iii) $R_1 = \phi$

(a) Only (i) and (ii) are correct.

(b) Only (i) and (iii) are correct.

(c) Only (ii) and (iii) are correct.

(d) (i), (ii) and (iii) are correct.

[MCQ]

7. Consider the following statements:

[I]: Concatenation of two finite language cannot be commutative until at least one of them is empty or null.

[II]: Let L be language, reversal of L does not contain any string present in language L except $\in$.

Which of the following is correct?

(a) (I) only.

(b) (II) only.

(c) Both (I) and (II) are correct.

(d) None of these.

[NAT]

8. Let us consider the following regular expression $R = a^*b^* + b^*a^*$.

How many equivalence classes of expression that represent language are equivalent to regular expression R?

[MSQ]

9. Consider the following languages:

$L_1 = \{a^m b^n c^p \mid m, n, p \geq 0\}$.

$L_2 = \{a^m b^m c^p \mid m, p \geq 0\}$.

$L_3 = \{a^{2m} b^{2m} c^p \mid m, p \geq 0\}$.

Which of the following is/are correct?

(a) $L_1 \subseteq L_2$ and $L_2 \subseteq L_1$.

(b) $L_2 \subseteq L_1$ and $L_3 \subseteq L_1$.

(c) $L_3 \subseteq L_2$ and $L_2 \subseteq L_1$.

(d) $L_2 \subseteq L_3$ and $L_3 \subseteq L_1$.

[MCQ]

10. Consider the following languages L_1 and L_2:

$L_1 = \{0^m 1^n \mid m = n, m, n \geq 0\}$

$L_2 = \{0^m 1^n \mid m, n \geq 0\}$

Let, $L = L_2 - L_1$, then what is the language L?

(a) $L = \{0^m 1^n \mid m, n \geq 0\}$.

(b) L is regular.

(c) $L = \{0^m 1^n \mid m \neq n\}$, non-regular.

(d) $L = \{0^m 1^n \mid m \neq n\}$, regular.

Answer Key

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

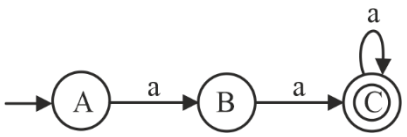
Hints and Solutions

1. (c)

$L = \left\{a^{m^n} \mid n \geq 1, m > n\right\}$

$\Rightarrow L = \left\{a^{m^1} \mid m \geq 2\right\} \cup \left\{a^{m^2} \mid m \geq 3\right\} \cup ...$

$\Rightarrow L = \left\{a^i \mid i \geq 2\right\}$ is a regular language.



This accepts L.

2. (c)

(a) $L = \{wxwy \mid x,y,w \in (a+b)^+\}$

$L = [a(a + b)^+ a(a + b)^+] + [b(a + b)^+ b(a + b)^+]$

$\Rightarrow$ L is regular language.

(b) $L = \{xwyw \mid x,y,w \in (a + b)^+\}$

$L = [(a + b)^+ a(a + b)^+a] + [(a + b)^+ b(a + b)^+b]$

$\Rightarrow$ L is regular language.

(c) $L = \{wxyw \mid x,y,w \in (a + b)^+\}$

$\Rightarrow$ L is non-regular language.

3. (d)

If L^* is regular, L may or may not be a regular.

Example 1: $L^* = (a + b)^*$ is regular, L = (a + b) is regular.

Example 2: $L^* = \{(a^P)^* \mid P \text{ is prime}\}$ is regular but $L = \{a^P \mid P \text{ is prime}\}$ is non-regular.

$\therefore$ Option (d) is correct.

4. (a)

S_1 True:

$L_1 = \sum^*$

$L_1 \cup L_2 = \sum^* \cup L_2 = \sum^*$ (Regular)

S_2 False:

May or may not be $\sum^+$

For example: DFA for language ending with "a" on alphabet {a, b}.

5. (c)

$\delta^*(S, abaab) = a\ b\ a\ a\ b$

$A\ B\ A\ D\ D$

So, answer will be (c)

6. (d)

$R_1 + R_2R_3 = (R_1 + R_2)\ (R_1 + R_3)$

(i) If $R_1 = R_2$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$R_2 + R_2R_3 = (R_2 + R_2)(R_2 + R_3)$

$R_2 + R_2R_3 = R_2(R_2 + R_3)$

$= R_2 + R_2R_3$ is correct.

(ii) If $R_1 = R_3$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$R_3 + R_2R_3 = (R_3 + R_2)(R_3 + R_3)$

$= (R_2 + R_3)R_3$

$= R_3 + R_2R_3$ is correct.

(iii) If $R_1 = \phi$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$\phi + R_2R_3 = (\phi + R_2)(\phi + R_3)$

$R_2R_3 = R_2\ R_3$ is correct.

$\therefore$ (i), (ii) and (iii) conditions are correct.

7. (d)

[I]: $L_1 = \{a\}$

$L_2 = \{a\}$

$L_1 \cdot L_2 = a \cdot a$

$L_2 \cdot L_1 = a \cdot a$

Commutative

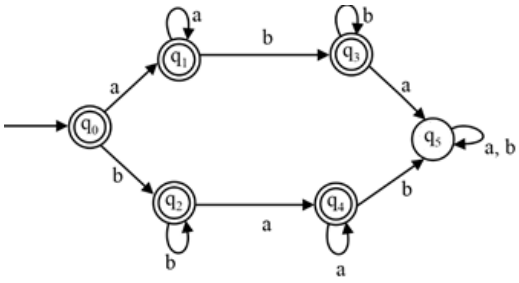
[II]: $L = (a + b)^*$

$L^R = (a + b)^*$

Hence, option (d) is correct.

8. (6)

$R = a^*b^* + b^*a^*$



$R = a^*b^* + b^*a^*$

$= (\in + aa^*) = (\in + bb^*) + (\in + bb^*)(\in + aa^*)$

$= \in + aa^* + bb^* + aa^* bb^* + bb^* aa^*$

$[\because a^* = (\in + aa^*)]$

Number of equivalence classes are equivalent to minimum number of states in DFA.

Regular expression for each state represents each equivalence class.

So,

$[q_0] = \in$

$[q_1] = aa^*$

$[q_2] = bb^*$

$[q_3] = aa^* + bb^*$

$[q_4] = bb^* aa^*$

$[q_5] = (aa^*bb^*a + bb^*aa^*b)(a + b)^*$

9. (b, c)

- $L_3 \subseteq L_1$ True
- $L_2 \subseteq L_1$ True
- $L_3 \subseteq L_2$ True

(a) False (b) True

(c) True (d) False

10. (c)

$L_1 = \{0^m1^n \mid m = n, m, n \geq 0\}$

$L_2 = \{0^m1^n \mid m, n \geq 0\}$

$L = L_2 - L_1$

$= L_2 \cap \overline{L_1}$

$= (0^*1^*) \cap \{0^m1^n \mid m \neq n\}$

$= \{0^m1^n \mid m \neq n\}$ non-regular (CFL)