Branch : CSE & IT **Batch : Hinglish**

Theory of Computation

Turing Machine Recursively Enumerable

Turing Machine -1

DPP 01

[MCQ]

1. Let M be a turing machine having Q = {q_0, q_1, q_2, q_3, q_4} a set of states, input alphabet {0, 1}. The tape alphabets {0, 1, B, x, y}. The symbol B is used to represent the end input string. The initial and final states are q_0 and q_4 respectively. The transitions are as follows:

1. $(q_0, 0) = (q_1, x, R)$ **2.** $(q_0, y) = (q_3, y, R)$
3. $(q_1, 0) = (q_1, 0, R)$ **4.** $(q, 1) = (q_2, y, L)$
5. $(q_1, y) = (q_1, y, R)$ **6.** $(q_2, 0) = (q_2, 0, L)$
7. $(q_2, x) = (q_0, x, R)$ **8.** $(q_2, y) = (q_2, y, L)$
9. $(q_3, y) = (q_3, y, R)$ **10.** $(q_3, B) = (q_4, B, R)$

Which of the following statement is true about M?

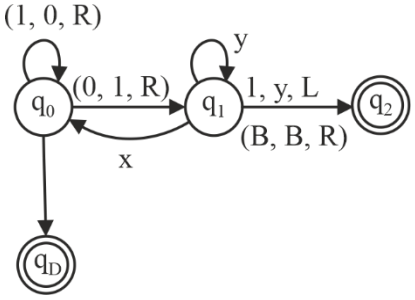
(a) M accepts on L = $\{0^n 1^m \mid n, m \geq 0\}$.
(b) M accepts 010 as a substring.
(c) M accepts on L = $\{0^n 1^n \mid n \geq 0\}$.
(d) M accepts on 011 as a substring.

[MCQ]

2. Consider the following turing machines:
(i) Single-tape TM
(ii) Multi-tape TM
(iii) Universal TM
Which of the above TM's are equivalent?
(a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iii) (d) (i), (ii), and (iii)

[MSQ]

3. If the following turing machine accepts L = $\{(0 + 1)^*\}$, then what will the value of x and y?



(a) x = (1, 1, R); y = (0, 0, R)
(b) x = (1, 0, R); y = (0, 1, R)
(c) x = (1, 1, R); y = (1, 1, R)
(d) x = (0, 1, R); y = (1, 0, R)

[MCQ]

4. Which of the following statement is/are correct regarding tuples of turing machine
(a) TM has six tuples which are {Q, T, Σ, δ, q_0, F}.
(b) Σ is the input alphabet.
(c) T is the tape alphabet.
(d) Q is finite set of states.

[MCQ]

5. Consider a Turing machine with following restrictions
(i) Head can only read and cannot write.
(ii) Head can move only in one direction.
The Turing machine with above restrictions is known as _____.
(a) Turing machine
(b) Linear bounded automata
(c) Push down automata
(d) Finite Automata

[MCQ]

6. Consider the given grammar:
$S \rightarrow aAScccc \mid \in$
$Aa \rightarrow aA$
$Ac \rightarrow bbc$
$Ab \rightarrow bbb$
Which of the following language is derived by the above grammar?
(a) L = $\{a^n b^n c^n \mid n \geq 0\}$
(b) L = $\{a^n b^{2n} c^n \mid n \geq 0\}$
(c) L = $\{a^n b^{2n} c^{3n} \mid n \geq 0\}$
(d) L = $\{a^{4n} b^{3n} c^{2n} \mid n \geq 0\}$

[MCQ]

7. Consider the following transitions of a turing machine M:

$\delta(q_0, a) = (q_1, B, R)$

$\delta(q_0, b) = (q_1, B, R)$

$\delta(q_0, B) = (q_3, B, R)$

$\delta(q_1, b) = (q_2, B, R)$

$\delta(q_1, a) = (q_2, B, R)$

$\delta(q_2, a) = (q_0, B, R)$

$\delta(q_2, b) = (q_0, B, R)$

The language derived by the equivalent turing machine defined as?

(a) L = {w: |w| is even}

(b) L = {w: |w| is odd}

(c) L = {w: |w| is multiple of 3}

(d) None of these

[MCQ]

8. Minimum number of stacks required by push down automata to behave like a turing machine.

(a) 1 (b) 2

(c) 3 (d) None of these

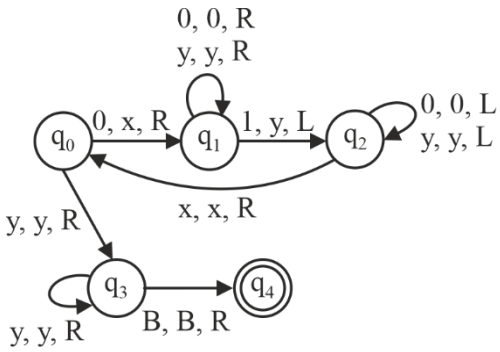
Answer Key

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

Hints & Solutions

1. (c)

Turing machine for the given transitions



The above turing machine M accepts on L = $\{0^n 1^n \mid n \geq 0\}$

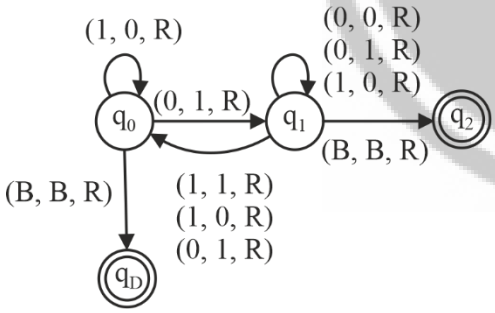
$\therefore$ option (c) is correct.

2. (d)

All turing machine can solve same set of problem. However, complexity of solving a problem may differ.

3. (a, b, d)

Turing machine for accepting $(0 + 1)^*$ is as follows:



So, clearly option (a), (b) and (d) are correct.

4. (b, c, d)

TM has seven tuples which are (Q, T, B, Σ, δ, q_0, F).

Σ is the input alphabet. Correct.

T is the tape alphabet. Correct.

Q is the finite set of states. Correct.

$\therefore$ (b), (c), (d) are correct.

5. (d)

If a turing machine has unidirectional and read only head so it can only accept regular languages and acts like a finite automata.

6. (c)

String derived by given grammar are:

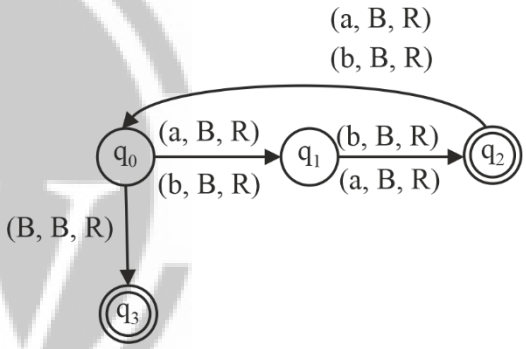
{∈, abbccc, aabbbbcccccc, ……}

So, the L = $\{a^n b^{2n} c^{3n} \mid n \geq 0\}$

$\therefore$ Option (c) is correct.

7. (c)

The equivalent turing machine for given transitions is:



It can be seen the language contain strings whose length is multiple of 3.

8. (b)

Push down automata with 2 or more stacks is equivalent to turing machine.