Branch : CS   Batch : Hinglish

Theory of Computation
Turing Machine

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]

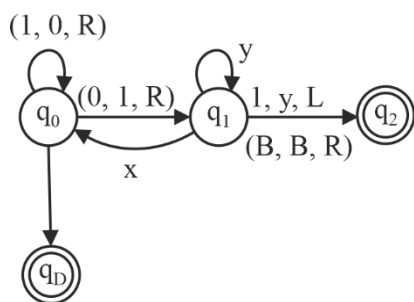2. Consider the following turing machines:
   (i) Single-tape TM
   (ii) Multi-tape TM
   (iii) Universal TM

   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 $\{Q, T, \Sigma, \delta, q_0, F\}$.
   (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:
   $S \rightarrow aASccc \mid \in$
   $Aa \rightarrow aA$
   $Ac \rightarrow bbc$
   $Ab \rightarrow bbb$

   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) $L = \{w: |w| \text{ is even}\}$

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

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

(d) None of these

[MCQ]

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

(a) 1
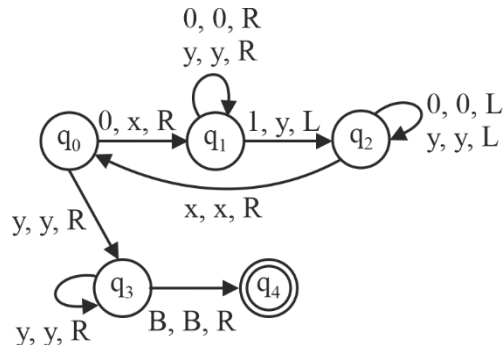
(b) 2

(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

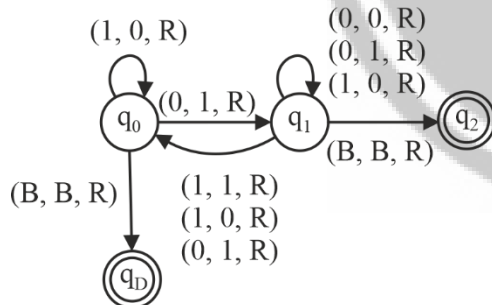The above turing machine M accepts on $L = \{0^n 1^n \mid n \geq 0\}$

∴ 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 $(Q, T, B, \Sigma, \delta, q_0, F)$.

Σ is the input alphabet. Correct.

T is the tape alphabet. Correct.

Q is the finite set of states. Correct.

∴ (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)
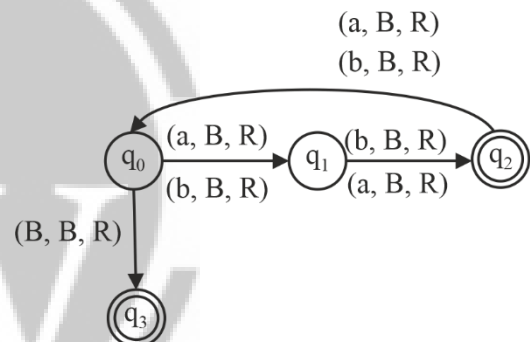
String derived by given grammar are:

$\{\in, abbccc, aabbbbcccccc, \ldots\ldots\}$

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

∴ 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.