Test

Theory of Computation

Time: 60 min.

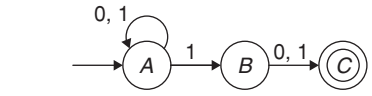
Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. Phrase structure languages, context-sensitive languages, context-free languages and regular languages are commonly referred to as languages of type-0, 1, 2, and 3 respectively. Then, Chomsky's Hierarchy states that
(A) type-0 ⊇ type-1 ⊇ type-2 ⊇ type-3
(B) type-0 ⊃ type-1 ⊃ type-2 ⊃ type-3
(C) type-0 ⊂ type-1 ⊂ type-2 ⊂ type-3
(D) type-0 ⊆ type-1 ⊆ type-2 ⊆ type-3

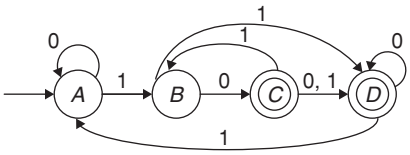
2. Let L be a language recognizable by a finite automaton. The language Reverse $(L) = \{x$ such that x is the reverse of y where $y \in L\}$ is a
(A) Regular language
(B) Context-sensitive language
(C) Context-free language
(D) Phrase-structure language

3. Which of the following statement is true?
(A) It is possible to construct an NFA with more number of states than its equivalent minimum DFA.
(B) There can be a DFA with more than one start state.
(C) Both (A) and (B)
(D) None of these

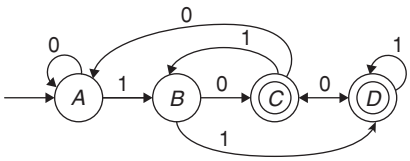
4. Which of the following is an equivalent DFA for the NFA shown below:



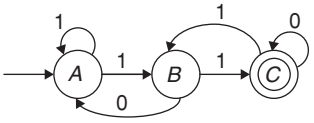
(A)



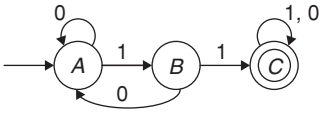
(B)



(C)

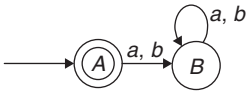


(D)



5. Which one of the following regular expressions over {0, 1} denotes the set of strings not containing 100 as a substring?
(A) 0*(1*0)*
(B) 0*1*01*
(C) (0*(10 + 1)*)*
(D) 0*1010*

6. The following transition diagram of a finite automaton accepts



(A) All word over sigma (a, b) such that symbol a and b alternate.
(B) Only empty string.
(C) Only the λ_1 meaning this automaton accepts no string of length greater than zero.
(D) All words over sigma (a, b) except λ.

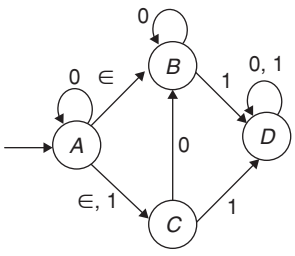
7. Sentence that can be generated from the following production grammar is
$S \rightarrow aS/bA$
$A \rightarrow d/ccA$
(A) *aabccccd*
(B) *ababccccd*
(C) *bccddd*
(D) *aaccdb*

8. Pumping lemma is generally used for proving
(A) A given grammar is regular
(B) A given grammar is non-regular
(C) Whether two given regular expression are equivalent or not
(D) Both (A) and (C)

9. Finite state machine can recognize
(A) Only context-free grammar
(B) Only regular grammar
(C) Any unambiguous grammar
(D) Any grammar

10. Which of the following is false?
(A) Regular sets are closed under reversal.
(B) Regular sets are closed under substitution.
(C) Regular sets are closed under intersection.
(D) None of these

11. For the DFA shown below $\hat{\delta}(A, 01)$ will be



(A) $\{B, D\}$ (B) $\{C, D\}$
(C) $\{A, B, C\}$ (D) $\{A, B, C, D\}$

12. 'NFA can be simulated by a DFA'. The statement is
(A) True (B) False
(C) Depends on NFA (D) Depends on DFA

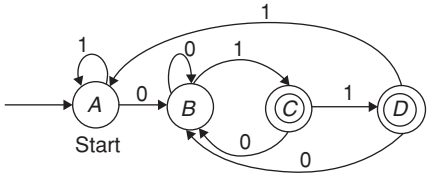
13. Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least
(A) N^2 (B) 2^N
(C) $2N$ (D) $N!$

14. Let $M = (K, \Sigma, \delta, S, F)$ be a finite state automaton, Where
$K = \{A, B\}$
$\Sigma = \{a, b\}$
$S = A$
$F = \{B\}$,
$\delta(A, a) = A$
$\delta(A, b) = B$
$\delta(B, a) = B$ and
$\delta(B, b) = A$.

A grammar to generate the language accepted by M can be specified as G = (V, Σ, R, S), where

$V = K \cup \Sigma$, and $S = A$. Which one of the following set of rules will make $L(G) = L(M)$?
(A) $\{A \to aB, A \to bA, B \to bA, B \to aA, B \to \in\}$
(B) $\{A \to aA, A \to bB, B \to aB, B \to bA, B \to \in\}$
(C) $\{A \to bB, A \to aB, B \to aA, B \to bA, B \to \in\}$
(D) $\{A \to aA, A \to bA, B \to aB, B \to bA, A \to \in\}$

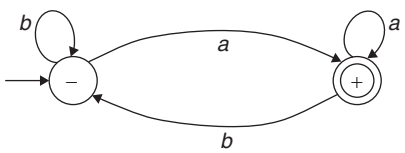
15 A deterministic finite automaton M shown below has a start state A and accepting state D. Which of the following regular expression denotes the set of all words accepted by M?



(A) 0 0 1 (B) 1 0* 1* 10
(C) 1* 0* 0 0 1 (D) (0/1)* 0 1 1

16. Which of the following regular expression is/are true?
(A) $(x^*)^* = x^*$ (B) $(x + y)^* = x^* + y^*$
(C) $x^*y^* = x^* + y^*$ (D) All of these

17. Consider the FA shown in the figure given below, where '–' is the start sate and '+' is the ending state. The language accepted by the FA is



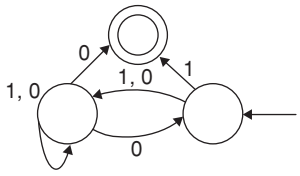
(A) $(a + b)^*b$ (B) $(a + b)^*a$
(C) a^*b (D) a^*b^*

18. Which of the following statement is false?
(A) The family of regular language is closed under the complementary operation.
(B) If L is a regular language, $L_1 = \{UV: U \in L, |V| = 2\}$ is also regular.
(C) If L is a regular language, $L_1 = \{UV: U \in L, V \in L^R\}$ is also regular.
(D) None of these

19. Which of the following is false?
(A) $L = \{0^i 1^m 2^m: i \geq 1, m \geq 1\}$ over $\Sigma = \{0, 1, 2\}$ is regular.
(B) $L = \{a^n b^l a^k, k \geq n + I\}$ is not regular.
(C) $L = \{UWW^2V: U, V, W \in \{a, b\}^+\}$ is regular.
(D) $L = \{a_n b_k : n > k\} \cup \{a_n b_k : n \neq k - 1\}$ is not regular.

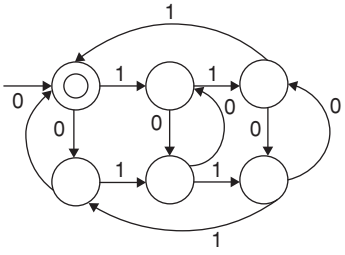
20. Consider a DFA over $\Sigma = \{a, b\}$ accepting all strings which have number of a's divisible by 6 and number of b's divisible by 8. What is the minimum number of states that the DFA will have?
(A) 16 (B) 15
(C) 48 (D) 8

21. For the NFA M given below. Let the language, accepted by M be L. Let L_1 be the language accepted by the NFA M_1, obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting states of M to accepting states. Which of the following statement is true?



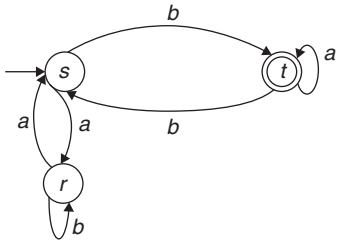
(A) $L_1 = A$ (B) $L_1 \subseteq L$
(C) $L_1 = \{0, 1\}^*$ (D) $L_1 = (0, 1)^* - L$

22. The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively.



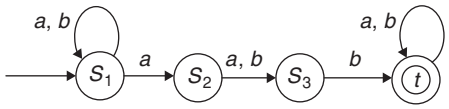
(A) Divisible by 3 and 2
(B) Odd and even
(C) Even and odd
(D) Divisible by 2 and 5

23. In the automaton below, s is the start state and t is only final state.



Consider the strings
$U = a\ b\ b\ a\ b\ a$
$V = b\ a\ b$ and
$W = a\ a\ b\ b$
Which of the following statement is true?
(A) The automaton accepts U and V but not W.
(B) The automaton accepts each of U, V and W.
(C) The automaton rejects U, V and W.
(D) The automaton accepts U but rejects V and W.

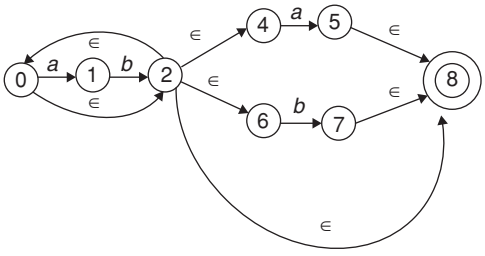
24. Which regular expression best describe the language accepted by the non-deterministic automaton below?



(A) $(a + b)^*a(a + b)b$
(B) $(a + b)^*a(a + b)b(a + b)^*$
(C) $(abb)^*$
(D) $(a + b)^*$

25. Which of the following strings are accepted by the regular expression:(0/1)* 0(0/1) (0/1)
(A) 000 or 001 (B) 001 or 010
(C) 010 or 011 (D) All the above

26.

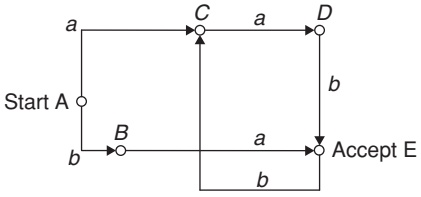


The above diagram represents NFA of regular expression.
(A) $(ab)^*\ (a/b/\in)$. (B) $(ab)^*\ (a/b)$.
(C) $(ab)^*\ (a/\in)$. (D) $(ab)^*\ (b/\in)$.

27. If 'a' is a terminal and S, A, B are three (3) non-terminals, then which of the following is regular grammar.
(A) $A \rightarrow a\ B/a\ A$ (B) $A \rightarrow B\ a/B\ a\ a$
(C) $A \rightarrow a\ B$, $B \rightarrow bA$ (D) $S \rightarrow \in$, $A \rightarrow a\ S/b$

28. Consider the grammar
$S \rightarrow ABc/Abc$
$BA \rightarrow AB$
$Ab \rightarrow ab$
$Aa \rightarrow aa$
Which of he following sentences can be derived by this grammar?
(A) aab (B) $abcc$
(C) $abab$ (D) abc

29.



The language recognized by the following finite automation is
(A) $aabb^* + bab^*$
(B) $(aab\ (bab^*))^*$
(C) $(aab + ba)\ (bab)^*$
(D) $(aab^* + bab^*)^*$.

30. From the following regular expressions over an alphabet $\{a, b\}$ given below, which can yield all the possible strings over $\sum (a, b)$?
(i) (a^*b^*)
(ii) $(a + b)^*$
(A) Only (i) (B) Only (ii)
(C) Both (A) and (B) (D) None of these

Answers Keys

1. B	**2.** A	**3.** A	**4.** B	**5.** B	**6.** B	**7.** A	**8.** B	**9.** B	**10.** D
11. B	**12.** A	**13.** B	**14.** B	**15.** D	**16.** A	**17.** B	**18.** D	**19.** A	**20.** B
21. C	**22.** A	**23.** D	**24.** B	**25.** D	**26.** A	**27.** D	**28.** D	**29.** C	**30.** B