

**Shivaji University , Kolhapur**  
**Question Bank For Mar 2022 ( Summer ) Examination**

Subject Code : 79139 Subject Name : Automata Theory

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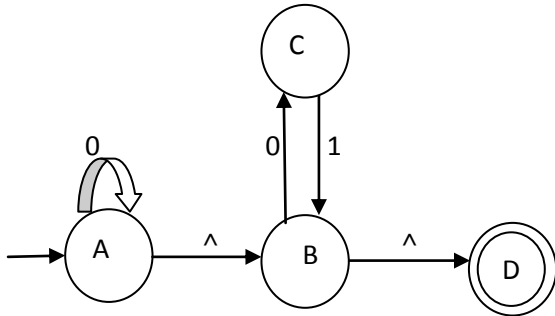
**Theory Questions**

1. Explain direct method of proof with the help of an example.
2. Prove that  $\sqrt{2}$  is irrational by using contradiction.
3. Explain about recursive definitions of sets.
4. Write the regular expressions for the following languages:
  - i) The set of strings of 0's and 1's with an odd number of 1's.
  - ii) The set of strings of 0's and 1's with exactly one pair of consecutive 0's.
5. What is regular expression and regular language? Write a regular expression for:
  - i) The string over {a,b} with an even number of a's?
  - ii) String over {a,b} in the infinite sequence:  
aba, a<sup>5</sup>, (aba)a<sup>6</sup>, a<sup>11</sup>, aba<sup>13</sup>, a<sup>17</sup>, ....?
  - iii) The language of C identifiers
6. What are regular languages? Explain with the help of examples.
7. Give an equivalent regular expression for each of the following.
  - i)  $1(0+1)^*(0+1)^*1$
  - ii)  $((0+1)(1+0))^*$
8. State and prove the theorem unions, intersection & complements of regular languages.
9. Explain DFA with extended transition function.
10. Define finite automata and design DFA for  $\Sigma=\{0,1\}$  for a language that ends with 11.
11. Design DFA corresponding to the regular expression  $(a+b)^*aba(a+b)^*$
12. What are the applications of finite automata? Explain in detail.
13. Explain NFA with extended transition function
14. Explain NFA  $\wedge$  with extended transition function
15. Explain minimization of FA with an example.
16. Design a DFA for following language.

$L = \{x \in (1, 0)^* / x \text{ starts with } 0\text{'s and ends with } 1\text{'s}\}$

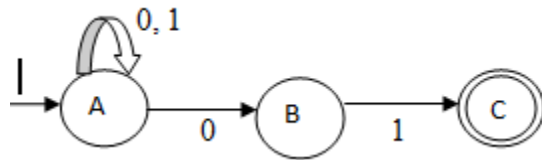
17. Differentiate between DFA and NFA. Write recursive definition of extended transition function  $\delta^*$  for NFA.

18. Convert the following NFA- $\Lambda$  to NFA.

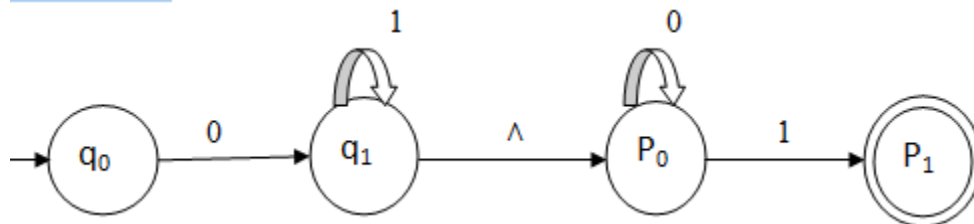


19. Define NFA. Write recursive definition of extended transition function  $\delta^*$  for NFA- $\Lambda$ .

20. Convert the following NFA to DFA



21. Given NFA



Find  $\delta^*(q_0, 101)$

22. State and prove Kleen's theorem Part-I.

23. State and prove Kleen's theorem Part-II.

24. Write a CFG for the language  $\{a^n b^n / n \geq 0\}$ .

25. Write a CFG for the syntax of programming languages.

26. Write a CFG for  $\{x / n_0(x) \neq n_1(x)\}$

27. Explain context free grammar and obtain grammar for language having equal number of 0's and 1's.

28. Prove that  $L_1$  and  $L_2$  are context-free languages, then the languages  $L_1 \cup L_2$ ,  $L_1 L_2$  and  $L_1^*$  are also CFLs

29. What is ambiguous grammar? Explain with the help of example.

30. Explain Chomsky Hierarchy.

31. Convert the following grammar to its Chomsky Normal Form

$S \rightarrow bA/aB$   
 $A \rightarrow bAA/aS/a$   
 $B \rightarrow aBB/bS/b$

32. Convert the following grammar to its Chomsky Normal Form.

$S \rightarrow AACD$   
 $A \rightarrow aAb / \wedge$   
 $C \rightarrow Ac / A$   
 $D \rightarrow aDa / bDb / \wedge$

33. What is left recursion? How to eliminate left recursion in a CFG.

34. Give the formal definition of PDA and draw the PDA for  $XCX^r$ , where  $X$  is string and  $\{a, b\}$  are the set of input alphabets.

35. Write note on PDA as a language acceptor.

36. Define the following terms:

- i) PDA
- ii) Acceptance of a string by a PDA

37. If  $G$  is a grammar  $S \rightarrow SbS$ ,  $S \rightarrow a$ . Show that  $G$  is ambiguous.

38. Explain deterministic PDA with example.

39. Construct DPDA to accept language of palindromes.

40. Construct DPDA to accepting balanced string of brackets.

41. Construct DPDA to accepting strings with more  $a$ 's than  $b$ 's.

42. Explain the concept of bottom up parsing with example.

43. Convert the following grammar to Top-down PDA:

$S \rightarrow aABB / Aaa$   
 $A \rightarrow aBB / a$   
 $B \rightarrow bBB / \wedge$

44. State and prove the pumping lemma for context free languages.

45. If  $L_1$  and  $L_2$  are context free languages, so that  $L_1 \cap L_2$  is not CFL then prove that  $L_1^c$  is not CFL.

46. Describe the proof of union and concatenation of CFLs is a CFL.

47. Apply pumping lemma to  $\{ss/s \in \{a,b\}^*\}$

48. Apply pumping lemma to  $\{a^i b^i c^i / i \geq 1\}$

49. Construct a string copy Turing machine.

50. Design a TM to delete a symbol.

51. Write notes on universal Turing Machine.

52. Explain about Turing machine as language acceptor.

53. Construct a TM for accepting reversing a string.

54. Construct a TM for accepting " $n \bmod 2$ ".

55. Construct a TM for computing function of  $L$  for the set of palindromes.

56. Construct a TM for copying a string.

57. Construct a TM for deleting a symbol.

58. Explain about combining Turing machines.

59. Explain the encoding function  $e$  in universal Turing machine.

60. Differentiate between Push Down Automata (PDA) and Turing machine (TM).

### MCQs

1. Which of the following is true?
  - a)  $(01)^*0 = 0(10)^*$
  - b)  $(0+1)^*0(0+1)^*1(0+1) = (0+1)^*01(0+1)^*$
  - c)  $(0+1)^*01(0+1)^*+1^*0^* = (0+1)^*$
  - d) All of the mentioned
2. A language is regular if and only if
  - a) accepted by DFA
  - b) accepted by PDA
  - c) accepted by LBA
  - d) accepted by Turing machine

3. Which of the following is not a regular expression?

- a)  $[(a+b)^*-(aa+bb)]^*$
- b)  $[(0+1)-(0b+a1)^*(a+b)]^*$
- c)  $(01+11+10)^*$
- d)  $(1+2+0)^*(1+2)$

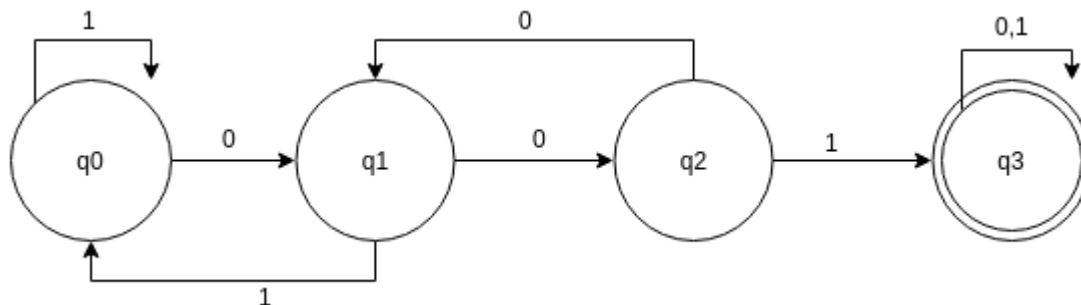
4. Regular expression are

- a) Type 0 language
- b) Type 1 language
- c) Type 2 language
- d) Type 3 language

5. Regular expressions are closed under

- a) Union
- b) Intersection
- c) Kleen star
- d) All of the mentioned

6. Which of the following is same as the given DFA?



- a)  $(0+1)^*001(0+1)^*$
- b)  $1^*001(0+1)^*$
- c)  $(01)^*(0+0+1)(01)^*$
- d) None of the mentioned

7. Which of the following statements is not true?

- a) Every language defined by any of the automata is also defined by a regular expression
- b) Every language defined by a regular expression can be represented using a DFA
- c) Every language defined by a regular expression can be represented using NFA with e moves
- d) Regular expression is just another representation for any automata definition

8. The total number of states required to automate the given regular expression  
 $(00)^*(11)^*$
- a) 3
  - b) 4
  - c) 5
  - d) 6
9. Which of the regular expressions corresponds to the given problem statement:  
P(x): Express the identifiers in C Programming language  
l=letters  
d=digits
- a)  $(l+)(d+)^*$
  - b)  $(l+d+)^*$
  - c)  $(l+)(l+d+)^*$
  - d)  $(+d)(l+d+)^*$
10. Generate a regular expression for the given language:  
 $L(x): \{x \in \{0,1\}^* \mid x \text{ ends with 1 and does not contain a substring 01}\}$
- a)  $(0+01)^*$
  - b)  $(0+01)^*1$
  - c)  $(0+01)^*(1+01)$
  - d) All of the mentioned
11. If  $L_1$  and  $L_2$  are regular languages, which among the following is an exception?
- a)  $L_1 \cup L_2$
  - b)  $L_1 - L_2$
  - c)  $L_1 \cap L_2$
  - d) All of the mentioned
12. DFA Transition function maps.
- a)  $\Sigma * Q \rightarrow \Sigma$
  - b)  $Q * Q \rightarrow \Sigma$
  - c)  $\Sigma * \Sigma \rightarrow Q$
  - d)  $Q * \Sigma \rightarrow Q$
13. Number of states require to accept string ends with 10.
- a) 3
  - b) 2

- c) 1  
d) can't be represented.
14.  $\delta^*(q, ya)$  is equivalent to .  
a)  $\delta((q, y), a)$   
**b)  $\delta(\delta^*(q, y), a)$**   
c)  $\delta(q, ya)$   
d) independent from  $\delta$  notation
15. Number of final state require to accept  $\Phi$  in minimal finite automata.  
a) 1  
**b) 2**  
c) 3  
d) None of the mentioned
16. Number of final state require to accept  $\Phi$  in minimal finite automata.  
a) 1  
**b) 2**  
c) 3  
d) None of the mentioned
17. For NFA with  $\epsilon$ -moves, which among the following is correct?  
**a)  $\delta: Q \times (\Sigma \cup \{\epsilon\}) \rightarrow 2^Q$**   
b)  $\delta: Q \times (\Sigma) \rightarrow 2^Q$   
c)  $\delta: Q \times (\Sigma^*) \rightarrow 2^Q$   
d) All of the mentioned
18. The automaton which allows transformation to a new state without consuming any input symbols:  
a) NFA  
b) DFA  
**c) NFA- $\epsilon$**   
d) All of the mentioned
19. Complement of a DFA can be obtained by  
a) making starting state as final state.  
b) no trivial method.  
**c) making final states non-final and non-final to final.**  
d) make final as a starting state.

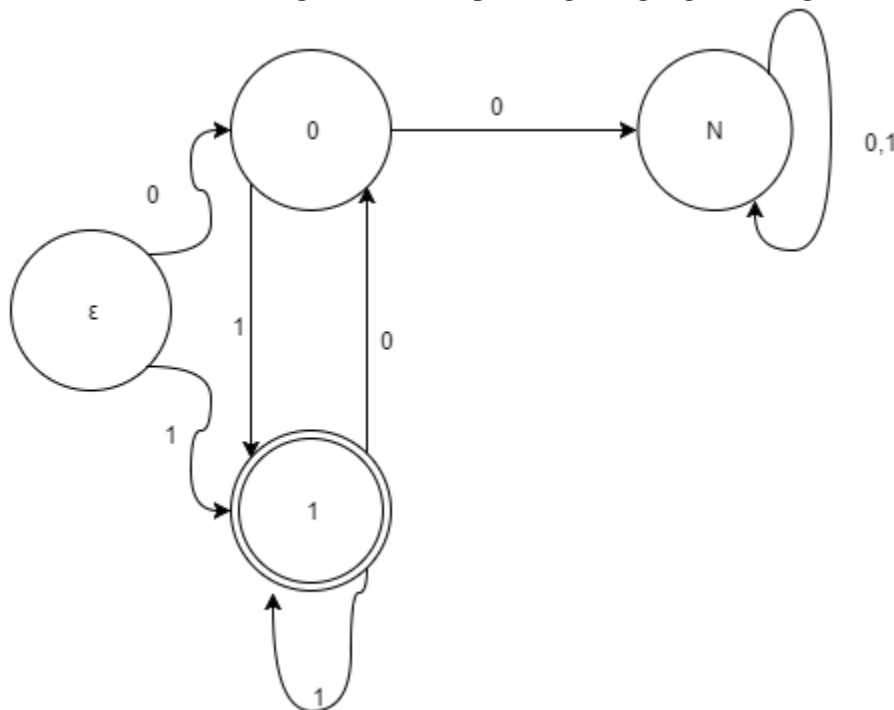
20. A regular language over an alphabet  $\Sigma$  is one that cannot be obtained from the basic languages using the operation

- a) Union
- b) Concatenation
- c) Kleene\*
- d) All of the mentioned

21. Which of the following is not a part of 5-tuple finite automata?

- a) Input alphabet
- b) Transition function
- c) Initial State
- d) Output Alphabet

22. Which of the following is the corresponding Language to the given DFA?



- a)  $L = \{x \in \{0, 1\}^* \mid x \text{ ends in } 1 \text{ and does not contain substring } 01\}$
- b)  $L = \{x \in \{0, 1\}^* \mid x \text{ ends in } 1 \text{ and does not contain substring } 00\}$
- c)  $L = \{x \in \{0, 1\}^* \mid x \text{ ends in } 1 \text{ and does not contain substring } 00\}$
- d)  $L = \{x \in \{0, 1\}^* \mid x \text{ ends in } 1 \text{ and does not contain substring } 11\}$

23. For a machine to surpass all the letters of alphabet excluding vowels, how many number of states in DFA would be required?

- a) 3
- b) 2



- c) 22
- d) 27

24. What is the Regular Expression Matching Zero or More Specific Characters

- a) x
- b) #
- c) \*
- d) &

25. Regular expression  $(x+y)(x+y)$  denotes the set

- a)  $\{xy, xy\}$
- b)  $\{xx, xy, yx, yy\}$
- c)  $\{x, y\}$
- d)  $\{x, y, xy\}$

26. The number of tuples in an extended Non Deterministic Finite Automaton:

- a) 5
- b) 6
- c) 7
- d) 4

27. What is wrong in the given definition?

Def:  $(\{q_0, q_1, q_2\}, \{0, 1\}, \delta, q_3, \{q_3\})$

- a) The definition does not satisfy 5 Tuple definition of NFA
- b) There are no transition definition
- c) Initial and Final states do not belong to the Graph
- d) Initial and final states can't be same

28. From the given table,  $\delta^*(q_0, 011) = ?$

| Q  | $\Delta(q, 0)$ | $\delta(q, 1)$ |
|----|----------------|----------------|
| q0 | $\{q_0\}$      | $\{q_0, q_1\}$ |
| q1 | $\{q_2\}$      | $\{q_2\}$      |
| q2 | $\{q_3\}$      | $\{q_3\}$      |
| q3 | $\Phi$         | $\Phi$         |

- a)  $\{q_0\}$
- b)  $\{q_1\} \cup \{q_0, q_1, q_2\}$
- c)  $\{q_2, q_1\}$
- d)  $\{q_3, q_1, q_2, q_0\}$

29.  $(0+^*)(1+^*)$  represents
- $\{0, 1, 01, \epsilon\}$
  - $\{0, 1, \epsilon\}$
  - $\{0, 1, 01, 11, 00, 10, \epsilon\}$
  - $\{0, 1\}$
30. A \_\_\_\_\_ is a sequence of statements which are either givens or deductions from previous statements, and whose last statement is the conclusion to be proved.
- Statement
  - Direct proof
  - Indirect proof
  - None of the above
31. There are \_\_\_\_\_ tuples in finite state machine.
- 4
  - 5
  - 6
  - unlimited
32. Minimum number of states of DFA requires to accept string ends with 10.
- 3
  - 2
  - 1
  - can't be represented.
33. Which of the following is correct RE of language having string start with 00
- $00(0+1)^*$
  - $(0+1)^*00$
  - $(0+1)^*00(0+1)^*$
  - None of the mentioned
34. Which of the following string does not belongs to the language having 0 immediately followed by 11.
- 01
  - 1011
  - 0011
  - 011011
35. DFA of which of the following language generates an Invalid or dead state.
- Starting with 00
  - Exactly two 0
  - Having length 4
  - All of these
36. How many states at minimum need to be formed to design DFA of language containing substring bb?

- a) 2
- b) 1
- c) 3
- d) 4

37. Which of the following is not accepting  $\wedge$  as input symbol?

- a) DFA
- b) NFA -  $\wedge$
- c) NPDA
- d) None of the mentioned

38. DFA of Which of the following language is having initial state as accepting state

- a) even number of 0
- b) not end with 10
- c) maximum length 6
- d) All of these

39. Which of the following statement is false?

- a) Union of two CFLs is also CFL
- b) Concatenation of two CFLs is also CFL
- c) Union of two Regular Languages is also Regular language
- d) Intersection of two CFLs is also CFL

40. Which of the following production type is in regular grammar?

- a)  $A \rightarrow aB$
- b)  $A \rightarrow a$
- c) Both a & b
- d) None of these

41. The minimum number of productions required to produce a language consisting of odd length palindrome strings over  $\Sigma = \{a, b\}$  is

- a) 3
- b) 4
- c) 5
- d) 6

42. Which of the following statement is correct?

- a) All Regular grammar are context free but not vice versa
- b) All context free grammar are regular grammar but not vice versa
- c) Regular grammar and context free grammar are the same entity
- d) None of the mentioned

43. Which of the following type of production must not be in CNF

- a) Unit Production
- b) Null Production
- c) Both a & b

d) none of the mentioned

44.  $\{a^n b^n | n \geq 0\}$  is a \_\_\_\_\_

- a) Regular language
- b) Context Free Language**
- c) Non Context Free Language
- d) Both a & b

45. If a grammar generates more than one derivation tree of at least one string then the grammar is called as \_\_\_\_\_

- a) Regular Grammar
- b) Context Free Grammar
- c) Ambiguous Grammar**
- d) None of these

46. Regular Expression for the language of words containing substring aa

- a)  $(a+b)^*aa$
- b)  $aa(a+b)^*$
- c)  $(a+b)^*aa(a+b)^*$**
- d)  $(a+b)^*a$

47. "CFG" stands for \_\_\_\_\_

- a) Context Free Graph
- b) Context Free Grammar**
- c) Context Finite Graph
- d) Context Finite Grammar

48. Transition move of PDA is decided by

- a) Current State
- b) Input Symbol
- c) Stack
- d) All of these**

49. PDA is of \_\_\_\_\_ tuple

- a) 3
- b) 4**
- c) 5
- d) 7

50. Which of the following PDA is nondeterministic

- a) Top Down PDA
- b) Bottom Up PDA
- c) Both A & B**
- d) None of these

51. Which of the following statement is not correct?

- a) Every Regular language is Context Free Language
- b) Union of two Regular languages is a Regular Language
- c) Odd Length palindrome is Context Free Language
- d) Intersection of Context Free language is Context Free Language

52. Which of the following is not a context free language?

- a)  $\{0^n 1^n | n \geq 0\}$
- b) Palindrome
- c) End with bb
- d) None of the mentioned

53. Which of the following task can Turing machine perform

- a) Language recognizing
- b) Compute Partial Function
- c) Both a & b
- d) None of these

54. Which of the following type of languages can Turing Machine recognize

- a) Regular
- b) Context Free
- c) Non Context Free
- d) All of these

55. Turing Machine is of \_\_\_\_\_ Tuple

- a) 4
- b) 5
- c) 6
- d) 7