

B.Tech DEGREE EXAMINATION, NOVEMBER 2023.

Fifth Semester

18AIC303T - FORMAL LANGUAGE AND AUTOMATA THEORY*(For the candidates admitted during the academic year 2020 - 2021 & 2021 - 2022)***Note:**

- i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours**Max. Marks: 100****PART - A (20 × 1 = 20 Marks)**

Marks BL CO

Answer all Questions

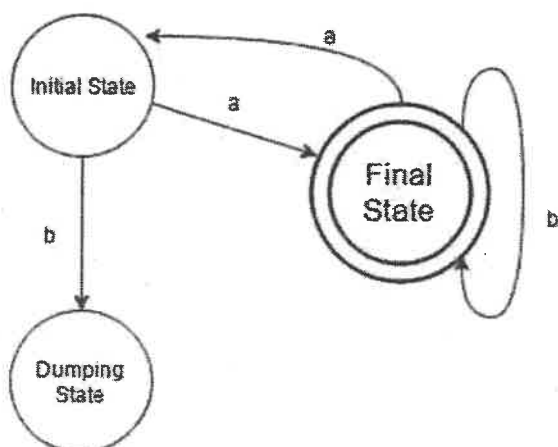
1. Transition function maps

(A) $\Sigma * Q \rightarrow \Sigma$ (B) $Q * \Sigma \rightarrow Q$ (C) $\Sigma * \Sigma \rightarrow Q$ (D) $Q * Q \rightarrow \Sigma$

1 1 1

2. Which of the following will not be accepted by the following DFA?

1 1 1



(A) ababaabaa

(B) abbbbaa

(C) abbbbaabb

(D) abbaabb

3. Write the set of strings accepted by the finite automata.

1 1 1

(A) 0^*1^* (B) 0^* (C) 1^* (D) $0^* + 1^*$

4. According to the given transitions, which among the following are the epsilon closures of q1 for the given NFA?

1 1 1

 $\delta(q1, \epsilon) = \{q2, q3, q4\}$ $\delta(q4, 1) = q1$ $\delta(q1, \epsilon) = q1$

(A) q4

(B) q2

(C) q1, q2, q3, q4

(D) q2, q3, q4

5. In pumping lemma, If we select a string w such that
- $w \in L$
- , and
- $w = xyz$
- , which of the following portions cannot be an empty string?

1 1 2

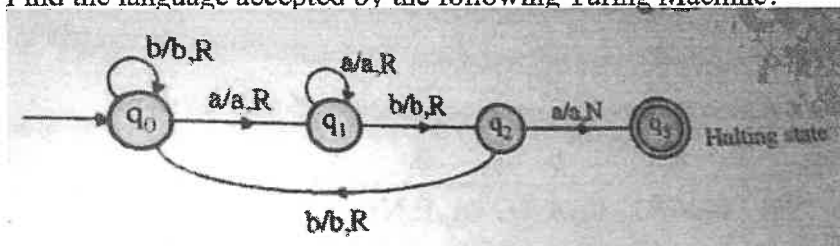
(A) y

(B) x

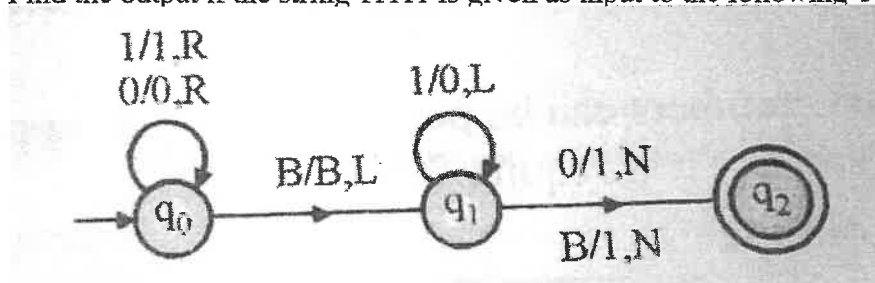
(C) z

(D) x, z

6. The Regular Expression in which any number of 0's is followed by any number of 1's followed by any number of 2's is _____ 1 1 2
 (A) $1^*0^*2^*$ (B) $0^*1^*2^*$
 (C) $0+1+2$ (D) $1+0+2$
7. The context free grammar $S \rightarrow SS|0S1|1S0$ generates _____ 1 1 2
 (A) Empty string (B) Unequal number of 0's and 1's
 (C) Any number of 0's followed by any number of 1's (D) An equal number of 0's and 1's
8. Which of the following grammars are in Chomsky Normal Form: 1 1 2
 (A) $S \rightarrow AB, S \rightarrow BCA|0|1|2|3$ (B) $S \rightarrow ABa, A \rightarrow aab, B \rightarrow Ac$
 (C) $S \rightarrow AB|BC|CD, A \rightarrow 0, B \rightarrow 1, C \rightarrow 2, D \rightarrow 3$ (D) $S \rightarrow aa | AB$
9. Which of the following correctly recognize the symbol '|-' in context to PDA? 1 1 3
 (A) Stack topmost symbol (B) or/not symbol
 (C) Transition function (D) Moves
10. A pushdown automata is different than finite automata by: 1 1 3
 (A) Its memory (B) Number of states
 (C) Difficulty in design (D) Epsilon moves
11. Push down machine represents 1 1 3
 (A) Type 1 grammar (B) Type 2 grammar
 (C) Type 0 grammar (D) Type 3 grammar
12. Equivalent CFG notation for the transition function $\delta(q_1, a, A) = (q_2, \epsilon)$ 1 1 3
 (A) $[q_1, A, q_2] \rightarrow a[q_1, A, q_2]$ (B) $[q_1, A, q_2] \rightarrow \epsilon$
 (C) $[q_1, A, q_2] \rightarrow a$ (D) $[q_2, A, q_1] \rightarrow a$
13. Find the language accepted by the following Turing Machine? 1 2 4



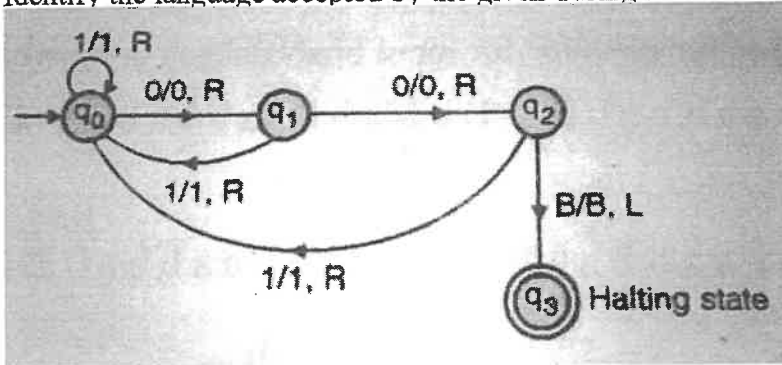
- (A) Any number of a's and b's (B) Strings starts with aba
 (C) Strings with abaa as substring (D) Strings ends with aba
14. Find the output if the string 11111 is given as input to the following Turing Machine? 1 1 4



- (A) 011111 (B) 111111
 (C) 100000 (D) 111110

15. Identify the language accepted by the given Turing Machine?

1 2 4



- (A) Strings of odd number of 0's
(B) Strings ending with 00
(C) Strings with 10001 as substring
(D) Strings starting with 00

16. A Turing machine operates over:

1 1 4

- (A) Infinite memory tape
(B) Finite memory tape
(C) Depends on the algorithm
(D) Stack

17. According to the rice's theorem, If P is a non trivial property, Lp is :

1 1 5

- (A) Decidable
(B) Infinite
(C) Undecidable
(D) Recursive

18. A problem is ----- if it is in NP and for which no polynomial time deterministic algorithm is not available so far.

1 1 5

- (A) NP-complete
(B) NP-hard
(C) NP
(D) P

19. If a language L and its complement L' are recursively enumerable then L is -----

1 1 5

- (A) Diagonal Language
(B) Universal language
(C) Recursively Enumerable language
(D) Recursive language

20. Post correspondence problem is

1 1 5

- (A) Decidable decision problem
(B) Undecidable decision problem
(C) Not a decision problem
(D) Recursively Enumerable

PART - B (5 × 4 = 20 Marks)

Marks BL CO

Answer any 5 Questions

21. Design a DFA for the language $L = \{ a^n \mid n \bmod 4 = 3, n \geq 0 \}$.

4 2 1

22. Find the nullable symbol from the following grammar and remove ϵ -production.

4 3 2

$S \rightarrow aAa \mid bBb \mid \epsilon$
 $A \rightarrow C \mid a$
 $B \rightarrow C \mid b$
 $C \rightarrow CDE \mid \epsilon$
 $D \rightarrow A \mid B \mid ab$

23. Show that the following grammar is ambiguous by showing (a) two parse trees (b) two leftmost derivations (c) rightmost derivations

4 2 2

$S \rightarrow a \mid abSb \mid aAb$
 $A \rightarrow bS \mid aAAb$

24. Design a PDA for the language $L = \{ wcw^r \mid w \in (0,1)^* \}$

4 2 3

25. Convert the grammar

4 2 3

$S \rightarrow 0S1 \mid A$
 $A \rightarrow 1A0 \mid S \mid \epsilon$

to a PDA that accepts the same language by empty stack and trace for the string 01.

26. Design a Turing machine to check whether a string over $\{a, b\}$ contains equal number of a's and b's. Also verify the string "w = baab" is accepted or not by the Turing machine.

4 3 4

27. Explain Properties of Recursive and Recursively enumerable languages.

4 2 5

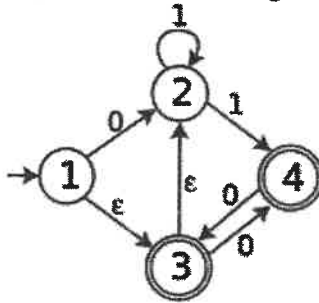
PART - C (5 × 12 = 60 Marks)

Answer all Questions

Marks BL CO

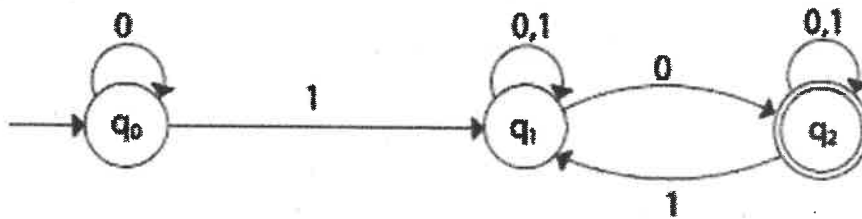
28. (a) Convert the following ϵ -NFA into DFA.

12 3 1



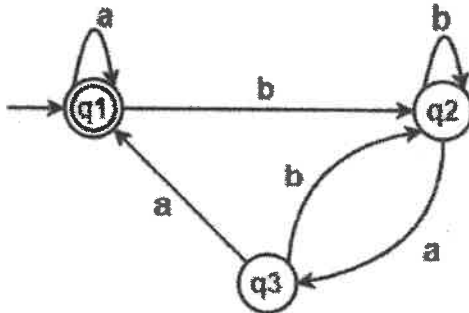
(OR)

- (b) Construct the DFA equivalent to the NFA $N = (\{q_0, q_1, q_2\}, \{0, 1\}, \delta, q_0, \{q_2\})$ and the diagram is given below



29. (a) Construct RE for the following DFA using Kleene's theorem.

12 3 2



(OR)

- (b) Convert the following grammar into Greibach Normal Form

$S \rightarrow AA$
 $A \rightarrow BB \mid 0$
 $B \rightarrow SS \mid 1$

30. (a) Design a PDA for the language $L = \{a^{3n}b^{n+1} \mid n \geq 0\}$ by using empty stack and final state method also solve

12 4 3

- I. Transition function
 II. PDA tuples
 III. Trace the string for $n=2$

(OR)

- (b) Convert the PDA $P = (\{q_0, q_1\}, \{0, 1\}, \{x, z_0\}, \delta, q_0, z_0, \phi)$ to a CFG if δ is given by

$\delta(q_0, 0, z_0) = (q_0, x z_0)$
 $\delta(q_0, 0, x) = (q_0, xx)$
 $\delta(q_0, 1, x) = (q_1, x)$
 $\delta(q_1, 0, x) = (q_1, \epsilon)$
 $\delta(q_1, 1, z_0) = (q_0, z_0)$
 $\delta(q_0, \epsilon, z_0) = (q_0, \epsilon)$

31. (a) Design a Turing machine to compute the multiplication of two unary numbers. Also, simulate the working of the machine for $3 * 2$. 12 4 4
 (OR)
 (b) Design a Turing machine that computes the function
 (i) $f(m,n) = m+n$
 (ii) $f(m,n) = m-n$
32. (a) (i) Explain Rice's theorem with an example. 12 2 5
 (ii) Prove the theorem "A language L is recursive if and only if L and its complement L' are recursively enumerable".
 (OR)
 (b) (i) Explain the post-correspondence problem with an example.
 (ii) Prove that the halting problem of a Turing machine is unsolvable.

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