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B.Tech DEGREE EXAMINATION, MAY 2024

Fifth Semester

18AIC303T - FORMAL LANGUAGES AND AUTOMATA THEORY

(For the candidates admitted during the academic year 2018-2019 to 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.

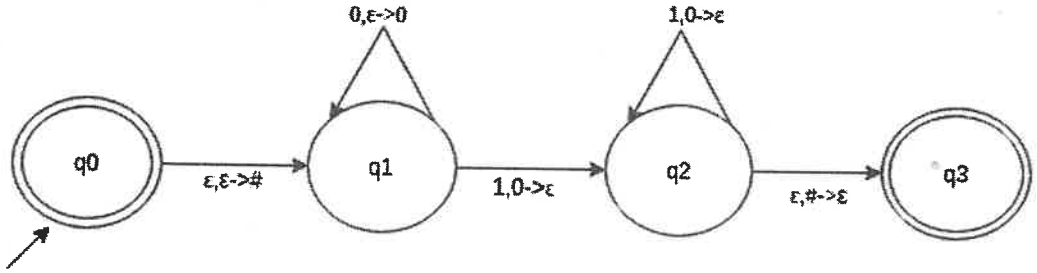
Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	Given Language: L= {ab U aba}* If X is the minimum number of states for a DFA and Y is the number of states to construct the NFA, |X-Y|=? (A) 2 (B) 3 (C) 4 (D) 1	1	3	1
2.	Which of the following x is accepted by the given DFA (x is a binary string ∑= {0,1})? (A) divisible by 3 (B) divisible by 2 (C) divisible by 2 and 4 (D) divisible by 3 and 2	1	3	1
3.	According to the given transitions, which among the following are the epsilon closures of q1 for the given NFA? Δ (q1, ε) = {q2, q3, q4} Δ (q4, 1) = q1 Δ (q1, ε) = q1 (A) q4 (B) q2,q3,q4 (C) q1 (D) q1,q2,q3,q4	1	2	1
4.	For NFA with ε-moves, which among the following is correct? (A) Δ: Q X (∑ U {ε}) -> P(Q) (B) Δ: Q X (∑) -> P(Q) (C) Δ: Q X (∑*) -> P(Q) (D) All of the mentioned	1	2	1
5.	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	1	3	2
6.	Generate a regular expression for the given language: L(x): {x | {0,1}*| x 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	1	3	2
7.	The minimum number of transitions to pass to reach the final state as per the following regular expression is:{a,b}*{baaa} (A) 4 (B) 5 (C) 6 (D) 3	1	1	2
8.	With reference to the process of conversion of a context free grammar to Chomsky Normal Form, the number of variables to be introduced for the terminals are: S->ABa A->aab B->Ac (A) 4 (B) 3 (C) 2 (D) 5	1	3	2

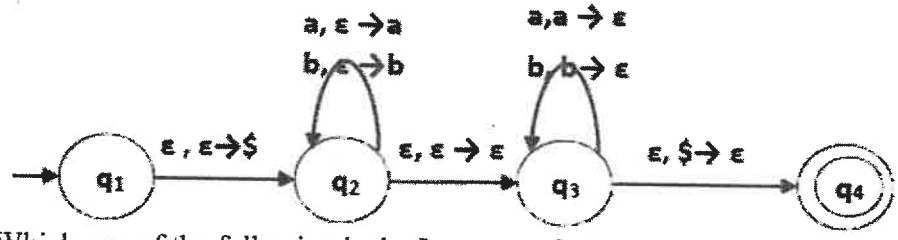
9. Which of the following option resembles the given PDA? 1 3 3



(A) $\{0^n1^n|n>=0\}$
(B) $\{0^n1^{2n}|n>=0\}$
(C) $\{0^{2n}1^n|n>=0\}$
(D) None of the mentioned

10. A PDA machine configuration (p, w, y) can be correctly represented as: 1 1 3
(A) (current state, unprocessed input, stack content)
(B) (unprocessed input, stack content, current state)
(C) (current state, stack content, unprocessed input)
(D) none of the mentioned

11. 1 3 3



Which one of the following is the Language for the given diagram
(A) $L = \{ ww^R \mid w = (a+b)^* \}$
(B) $L = \{ wcw^R \mid w = (a+b)^* \}$
(C) $L = \{ ww \mid w = (a+b)^* \}$
(D) None

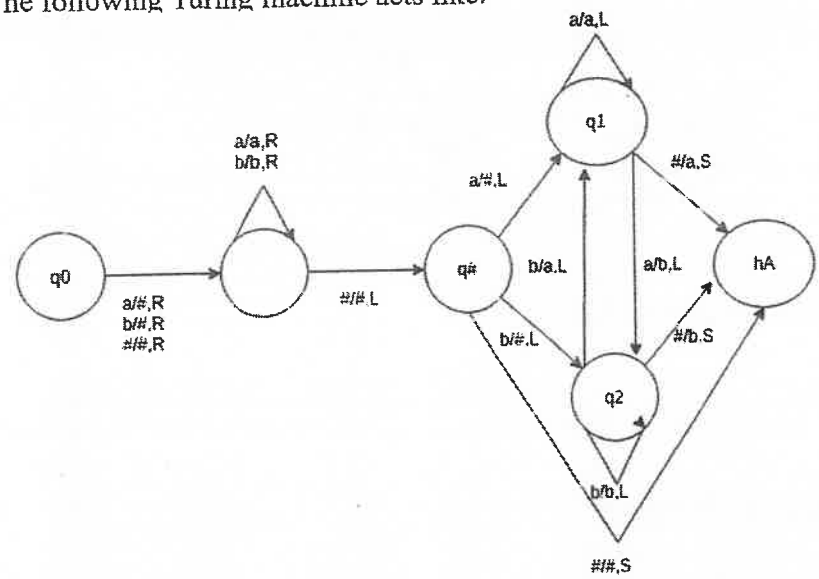
12. Which of the following grammars are ambiguous? 1 4 4

(A) S→SS|aSb|bSa|ε
(B) S→aSbS|bSaS | ε
(C) S→aAB
(D) B→A| ε

Choose the correct answer from the options given below:
(A) (A) and (C) only
(B) (B) only
(C) (B) and (C) only
(D) (A)(B) and (C)

13. If T1 and T2 are two Turing machines. The composite can be represented using the expression: 1 2 4
(A) T1 U T2
(B) T1 X T2
(C) T1T2
(D) None of the mentioned

14. The following Turing machine acts like:



(A) Copies a string
(B) Delete a symbol
(C) Insert a symbol
(D) None of the mentioned

1 2 4

15. Which among the following options are correct?
Statement 1: TMs can accept languages that are not accepted by any PDA with one stack.
Statement 2: But PDA with two stacks can accept any language that a TM can accept.
(A) Statement 1 is correct but Statement 2 is false
(B) Statement 2 is correct while Statement 1 is false
(C) Statement 1 and 2, both are correct
(D) Statement 1 and 2, both are false

1 1 4

16. Which of the following are the models equivalent to Turing machine?
(A) Multi tape Turing machine
(B) Multi track Turing machine
(C) Register machine
(D) All of the mentioned

1 2 5

17. Problems that cannot be solved by any algorithm are called?
(A) Tractable problems
(B) Intractable problems
(C) Undecidable problems
(D) Decidable problems

1 2 5

18. _____ is the class of decision problems that can be solved by non-deterministic polynomial algorithms.
(A) NP
(B) P
(C) Hard
(D) Complete

1 2 5

19. Rec-DFA = { | M is a DFA and M recognizes input w}.
Fill in the blank:
Rec-DFA is _____
(A) Undecidable
(B) Decidable
(C) Non finite
(D) None of the mentioned

1 2 5

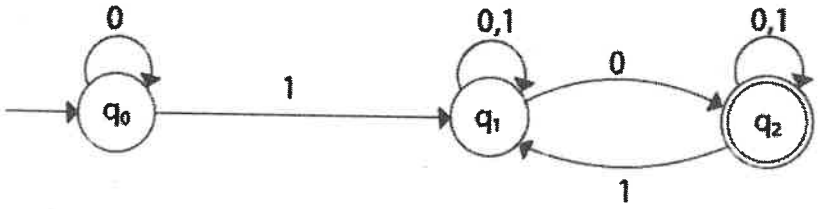
20. According to the rice's theorem, If P is a non trivial property, Lp is :
(A) Infinite
(B) Decidable
(C) Undecidable
(D) None of the mentioned

1 2 5

PART - B (5 × 4 = 20 Marks) **Marks BL CO**

Answer **any 5** Questions

21. Construct the DFA equivalent to the NFA N=({q0,q1,q2},{0,1},δ,q0,{q1}) and the diagram is given by — 4 | 3 | 1



22. Construct Regular Expression for the given DFA. — 4 | 3 | 2

States/Input	0	1
->q1	q2	q1
q 2	q3	q1
*q 3	q3	q2

23. Show that the following language is not regular — 4 | 3 | 2
    a. L={ww | w {a,b}*}
    b. L= {$a^i b^j c^k$ |k>=i+j, i, j>=1}

24. Construct PDA for the language L={$a^m b^m c^n$ | m ,n >=1} — 4 | 3 | 3

25. 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. — 4 | 2 | 4

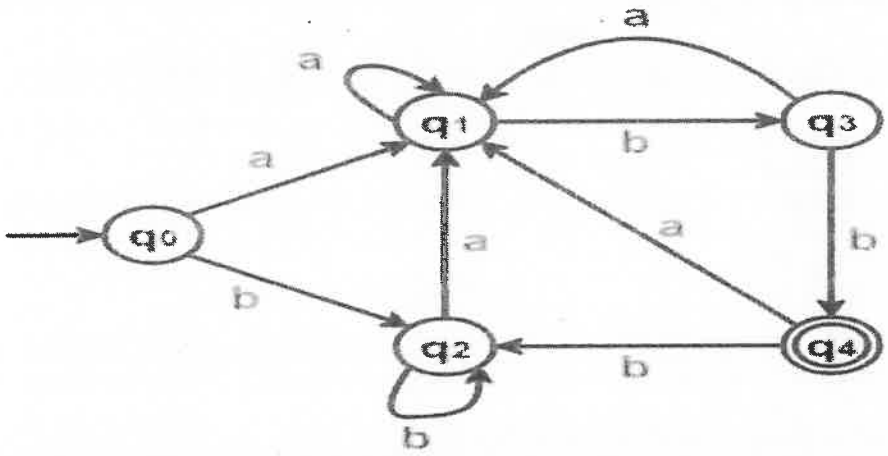
26. Show that the following grammar is ambiguous by showing (a) two parse trees (b) two leftmost derivations (c) rightmost derivations — 4 | 2 | 2
    S -> a | abSb | aAb
    A -> bS | aAAb

27. Convert the grammar to a PDA that accepts the same language by empty stack and trace for the string 01. — 4 | 3 | 4
    S-> 0S1 | A
    A-> 1A0 | S | ε

PART - C (5 × 12 = 60 Marks) — **Marks** | **BL** | **CO**

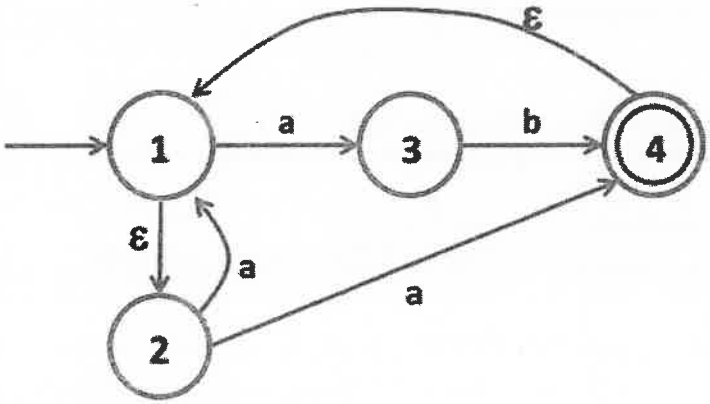
Answer **all** Questions

28. (a) Minimize the following DFA and draw the resultant DFA 12 3 1



(OR)

(b) Convert the following ε-NFA into DFA.



29. (a) Consider the grammar 12 3 2

$S \rightarrow 0A0 \mid 1B1 \mid BB$

$A \rightarrow C$

$B \rightarrow S \mid A$

$C \rightarrow S \mid \varepsilon$

i. Are there any useless symbols? If any,eliminate them
ii. Eliminate Ɛ – Productions
iii. Eliminate Unit Productions

Convert the grammar to Chomsky Normal Form

(OR)

(b) Convert the following grammar into Greibach Normal Form

S-->AA
A-->BB |0
B-->SS |1

30. (a) Design a PDA for the language 12 3 3

i. $L = \{a^{2n} b^{n+1} \mid n>=1\}$

ii. $L = \{a^n b^m c^m d^n \mid n, m >=1\}$

(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

$\delta(q_0, 0, z_0) = (q_0, x z_0)$

$\delta(q_0, 0, x) = (q_0, xx)$

$\delta(q_0, 1, x) = (q_1, x)$

$\delta(q_1, 0, x) = (q_1, \varepsilon)$

$\delta(q_1, 1, z_0) = (q_0, z_0)$

$\delta(q_0, \varepsilon, z_0) = (q_0, \varepsilon)$

31. (a) Design a Turing machine 12 3 4

(i) $F(x, y) = x + y$ if $x >= y$

$y - x$ if $y > x$

simulate the working of machine for x=0,y=2

(ii) L= { Start with a and has odd number of a's and start with b and has even number of b's }

(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 post correspondence problem with an example. 12 2 5

ii) Prove that the halting problem of a Turing machine is unsolvable.

(OR)

(b) i) Explain Time and space complexity of Turing Machines

ii) Explain in detail the complexity Class P,NP,NP hard and NP Completeness.

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