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Roll No.

B.TECH
(SEM IV) THEORY EXAMINATION 2022-23
THEORY OF AUTOMATA AND FORMAL LANGUAGES

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

(a) What do you understand by grammar?
(b) What do you mean by ε-Closure in FA?
(c) State Arden's Theorem.
(d) State Kleen's Theorem.
(e) Derive the CFG for (a+b)*.
(f) Explain Chomsky Hierarchy.
(g) Explain pumping lemma for context free language.
(h) Draw the graphical representation for PDA.
(i) Explain Halting Problem of Turing Machine.
(j) Explain Linear bounded Automata.

SECTION B

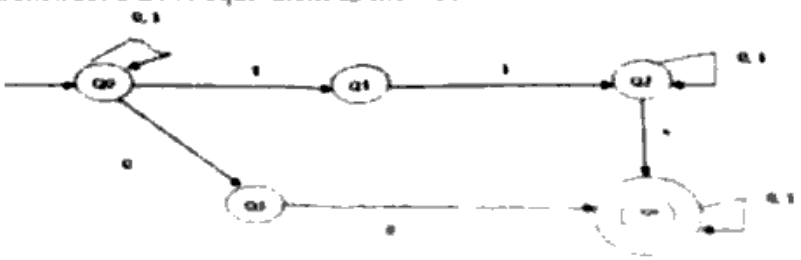
2. Attempt any *three* of the following: **10x3=30**

(a) Construct a DFA for ternary number divisible by 4.
(b) Determine the FA accepted by the language described by the regular expression: (0+1)*0(0+1)*0(0+1)* over the alphabet {0,1} and also mention the accepted language ?
(c) Consider the grammar with following production rules:
S→ABD | AC
A→aA | bAa |a
B→bbA | aB | AB
C→aCa |aD
D→aD | bC
Convert the above grammar into Chomsky Normal Form.
(d) Design a PDA for the language L= {WW^T | W= (a+b)* }
(e) Write short notes on:
i) Church's Thesis
ii) Recursive and Recursive Enumerable Language

SECTION C

3. Attempt any *one* part of the following: **10x1=10**

(a) Construct a DFA equivalent to the NFA

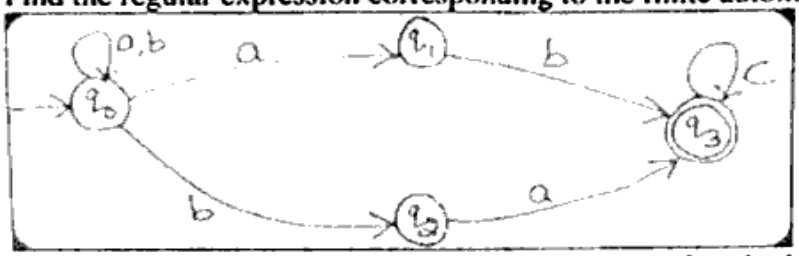


(b) Construct a minimum state automata equivalent to a DFA whose transition table is as follows where q3 and q4 are final state.

State/Σ	Input	
	A	b
→ Q0	Q1	Q2
Q1	Q4	Q3
Q2	Q4	Q3
Q3	Q5	Q6
Q4	Q7	Q6
Q5	Q3	Q6
Q6	Q6	Q6
Q7	Q4	Q6

4. Attempt any *one* part of the following: **10x1=10**

(a) Find the regular expression corresponding to the finite automata given below:



(b) State pumping lemma for regular language. Prove that the language L= {a^p | p is prime} is not regular.

5. Attempt any *one* part of the following: **10x1=10**

(a) A context free grammar G is given by the following productions:
E→E+E|E-E|E*E|E^E|N
N→0|1|2|3|4|5|6|7|8|9
Determine whether the grammar G is ambiguous or not.If ambiguous then construct an unambiguous grammar equivalent to G.

(b) Explain Closure properties of regular language.

6. Attempt any *one* part of the following: **10x1=10**

(a) Design a two stack PDA for the language L={$a^n b^n c^n$ | n>=1}.

(b) Generate CFG for the given PDA M is defined as
M = ({q0, q1}, {0,1} {x, z0}, δ, q0, z0, q1) where δ is given as follows: δ (q0,1, z0) = (q0, xz0)
δ (q0,1, x) = (q0, xx)
δ (q0,0, x) = (q0, x)
δ (q0, ε, x) = (q1, ε)
δ (q1, ε, x) = (q1, ε)
δ (q1,0, x) = (q1, xx)
δ (q1,0, z0) = (q1, ε)

7. Attempt any *one* part of the following: **10x1=10**

(a) Design a Turing Machine for the language:
L={$a^n b^n c^n$ | n>=1}

(b) Write short notes on:
(i) Variants of Turing Machine
(ii) Post Correspondence problem
(iii) Universal Turing Machine