PAPER ID-411411

Subject Code: BCS402

Roll No: | | | | | | | | | | | | | |

BTECH

(SEM IV) THEORY EXAMINATION 2023-24

THEORY OF AUTOMATA AND FORMAL LANGUAGES

TIME: 3 HRS **M.MARKS: 70**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

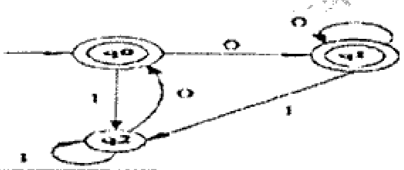
SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a.	Give the mathematical definition of DFA. Differentiate between NFA and DFA.
b.	Construct Deterministic Finite Automata (DFA) to accept string that always ends with 101 over alphabet $\Sigma = \{0,1\}$
c.	Give regular expressions that represent the language (L), which has all binary strings having two consecutive 0s and two consecutive 1s over the alphabet $\Sigma = \{0, 1\}$.
d.	Compute the Language generated by the given CFG $G = (\{S\}, \{a, b\}, P, S\}$ where P is defined by: $\{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \varepsilon\}$
e.	Let G be the grammar $S \rightarrow 0B \mid 1A$ $A \rightarrow 0 \mid 0S \mid 1AA$ $B \rightarrow 1 \mid 1S \mid 0BB$ Determine the leftmost derivation for the string 00110101
f.	Explain the concept of two stack PDA. Give an example of a language that is accepted by two stack PDA but not accepted by normal one stack PDA.
g.	Explain Multi Tape Turing Machine.

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 21**

a.	Construct a Finite automata (DFA) which accepts all binary numbers whose decimal equivalent is divisible by 4 over $\Sigma = \{0, 1\}$.
b.	Compute the regular expression using Arden's Theorem for the following DFA. 
c.	Write an equivalent left linear grammar from the given right linear grammar. $S \rightarrow 0A \mid 1B$ $A \rightarrow 0C \mid 1A \mid 0$ $B \rightarrow 1B \mid 1A \mid 1$ $C \rightarrow 0 \mid 0A$
d.	Differentiate between DPDA and NPDA. Construct a PDA that accepts language $L = \{a^n b^n \mid n \geq 1\}$.
e	Differentiate between Deterministic Turing machine and Non-Deterministic Turing machine. Design a Turing machine for the language $L=\{ww \mid w \in (a + b)^*\}$.

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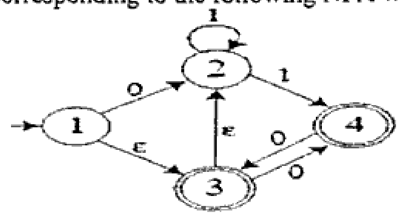
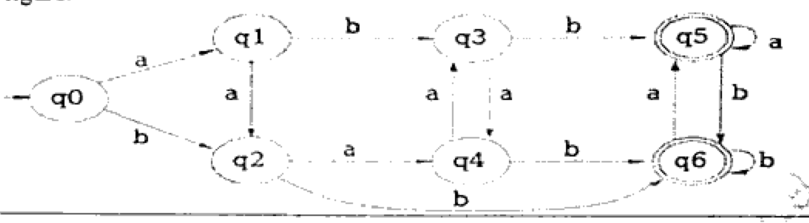
SECTION C

3. Attempt any *one* part of the following: **7 x 1 = 7**

a.	Construct a DFA corresponding to the following NFA with ϵ moves: 
b.	Express in the minimum state automata equivalent to DFA described in below figure: 

4. Attempt any *one* part of the following: **7 x 1 = 7**

a.	State Pumping Lemma for Regular Language. Show that the given language $L=\{a^p \mid \text{Where } p \text{ is a prime}\}$ is not regular.
b.	Discuss closure properties (i.e. union, concatenation, complement, intersection and difference) of regular language.

5. Attempt any *one* part of the following: **7 x 1 = 7**

a.	Reduce the given grammar G = ({S, A, B}, {a, b}, P, S) to Chomsky Normal form. Where P is defined by: $S \rightarrow bA \mid aB$ $A \rightarrow bAA \mid aS \mid a$ $B \rightarrow aBB \mid bS \mid b$
b.	Design a CFG for the following language: (i) $L=\{0^m 1^n \mid m \neq n \ \& \ m, n >= 1\}$ (ii) $L=\{a^p b^q c^r \mid p+q=r \ \& \ p, q >= 1\}$

6. Attempt any *one* part of the following: **7 x 1 = 7**

a.	Construct PDA equivalent to the following CFG G = ({S, A}, {0,1}, P, S} where P is defined by: $S \rightarrow 0S1 \mid A$ $A \rightarrow 1A0 \mid S \mid \varepsilon$

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b.	Find the equivalent CFG of the following PDA P = ({q0, q1,}, {a, b}, {a, z0}, δ, q0, z0) where δ is given by: δ (q0, a, z0) = (q0, az0) δ (q0, a, a) = (q1, aa) δ (q1, a, a) = (q1, ε) δ (q1, ε, z0) = (q1, ε)

7. **Attempt any *one* part of the following:** **7 x 1 = 7**

a.	Construct Turing Machine that accepts language L={$a^{2n}b^n$ | n>=1}. Also show the instantaneous description for the string w = aaaabb.
b.	Explain the any two of the following: i. Universal Turing Machine. ii. Post Correspondence Problem. iii. Recursive and recursively Enumerable Languages