

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

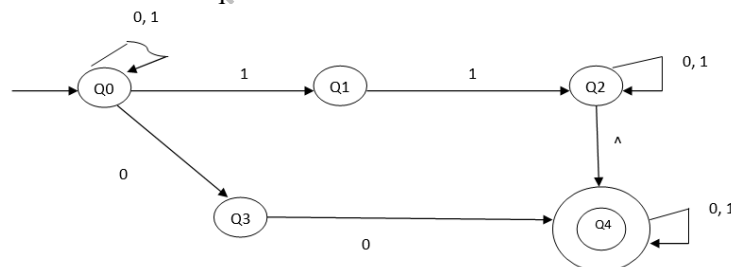
2. Attempt any three of the following: 10x3=30

- (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:
 $S \rightarrow ABD \mid AC$
 $A \rightarrow aA \mid bAa \mid a$
 $B \rightarrow bbA \mid aB \mid AB$
 $C \rightarrow aCa \mid aD$
 $D \rightarrow aD \mid bC$
 Convert the above grammar into Chomsky Normal Form.
- (d) Design a PDA for the language $L = \{WW^T \mid W = (a+b)^*\}$
- (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

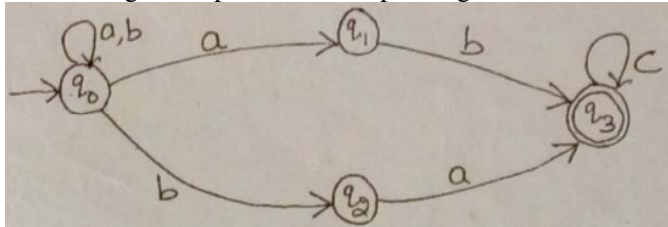


- (b) Construct a minimum state automata equivalent to a DFA whose transition table is as follows where q_3 and q_4 are final state.

State/ Σ	Input	
	A	b
\rightarrow 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 $L = \{a^p \mid p \text{ is prime}\}$ 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:

$$E \rightarrow E + E \mid E - E \mid E * E \mid E \wedge E \mid N$$

$$N \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$$

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 $L = \{a^n b^n c^n \mid n \geq 1\}$

- (b) Generate CFG for the given PDA M is defined as

$M = (\{q_0, q_1\}, \{0, 1\}, \{x, z_0\}, \delta, q_0, z_0, q_1)$ where δ is given as follows: $\delta(q_0, 1, z_0) = (q_0, xz_0)$

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

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

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

$$\delta(q_1, \epsilon, x) = (q_1, \epsilon)$$

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

$$\delta(q_1, 0, z_0) = (q_1, \epsilon)$$

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

- (a) Design a Turing Machine for the language:

$$L = \{a^n b^n c^n \mid n \geq 1\}$$

- (b) Write short notes on:

- (i) Variants of Turing Machine
- (ii) Post Correspondence problem
- (iii) Universal Turing Machine