

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

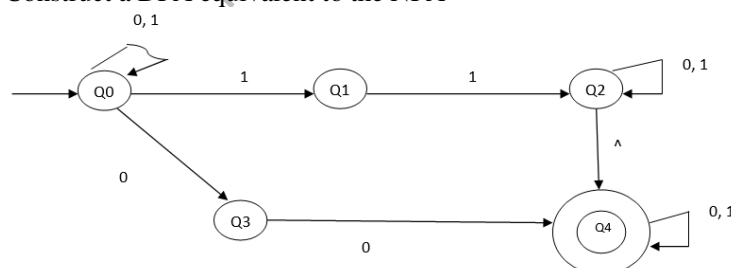
- (a) Construct a DFA for ternary number divisible by 4.
- (b) Determine the FA accepted by the language described by the regular expression: $(0+1)^*0(0+1)^*0(0+1)^*$ over the alphabet $\{0,1\}$ and also mention the accepted language?
- (c) Consider the grammar with following production rules:
 $S \rightarrow ABD \mid AC$
 $A \rightarrow aA \mid bAa \mid a$
 $B \rightarrow bbA \mid aB \mid AB$
 $C \rightarrow aCa \mid aD$
 $D \rightarrow aD \mid bC$
 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



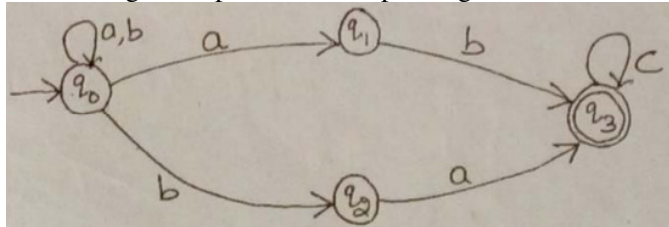
- (b) Construct a minimum state automata equivalent to a DFA whose transition table is as follows where q_3 and q_4 are final state.

State/ Σ	Input	
	A	b
$\rightarrow Q_0$	Q_1	Q_2
Q_1	Q_4	Q_3
Q_2	Q_4	Q_3
Q_3	Q_5	Q_6
Q_4	Q_7	Q_6
Q_5	Q_3	Q_6
Q_6	Q_6	Q_6
Q_7	Q_4	Q_6

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:

- Variants of Turing Machine
- Post Correspondence problem
- Universal Turing Machine