

MCA
(SEM II) THEORY EXAMINATION 2022-23
THEORY OF AUTOMATA & 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

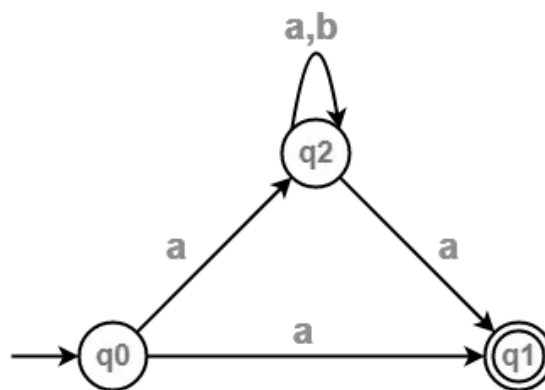
- (a) Differentiate between alphabets and strings.
- (b) What do you understand by dead state in transition diagram.
- (c) Design a regular expression that accepts all strings containing at exactly two a's over the input $(a + b)^*$.
- (d) Elaborate the principal used in pumping lemma.
- (e) What is unit production?
- (f) What do you mean by ambiguous grammar?
- (g) Define "Instantaneous Description (ID)" of PDA.
- (h) What is need of special initial stack symbol in PDA?
- (i) Differentiate between Recursive and Recursively Enumerable Languages.
- (j) What do you mean by Halting Problem of Turing Machine?

SECTION B

2. Attempt any three of the following:

10x3=30

- (a) Discuss transition function of NFA. Convert the given NFA into DFA. Also write tuples of corresponding DFA.



- (b) What do you mean by derivation of grammar. Productions of a grammar 'G' are defined as:

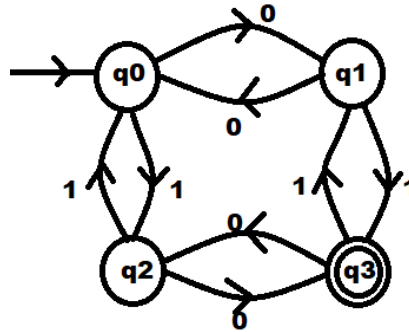
$$S \rightarrow 0B \mid 1A$$

$$A \rightarrow 0 \mid 0S \mid 1AA$$

$$B \rightarrow 1 \mid 1S \mid 0BB.$$

For the string 00110101, explore (a) the leftmost derivation, (b) the rightmost derivation. (c) the leftmost derivation tree, (d) the rightmost derivation tree.

- (c) What do you mean by left linear and right linear grammar? Write down the grammar for given DFA.



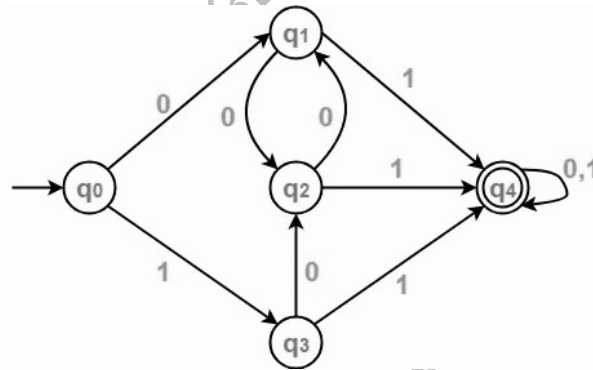
- (d) Design a PDA that will accepts all even length palindromes over the input symbols $\{a,b\}^*$. Also justify your transition diagram for the string $w = \text{"abbbaaabbba"}$.
- (e) Define Post's Correspondence Problem (PCP) and Modified PCP with its applications. Find a PCP solutions of the lists $x = (b, bab^3, ba)$ and $y = (b^3, ba, a)$.

SECTION C

3. Attempt any *one* part of the following:

10x1=10

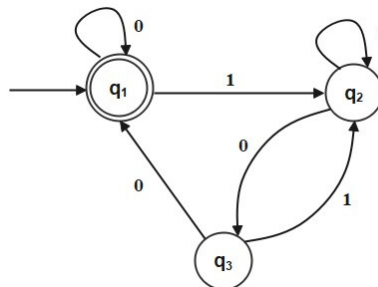
- (a) Define Deterministic Finite Automata (DFA). Mathematically represent a DFA that will accept all strings of 0's and 1's except '101' as a substring.
- (b) What do you understand by minimum state automation? Construct a minimum state automation for the given transition diagram.



4. Attempt any *one* part of the following:

10x1=10

- (a) What do you mean by Regular Languages? Discuss the closure properties of Regular Languages.
- (b) State Arden Theorem. Find out the regular expression for the given transition diagram.



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

- (a) Discuss Chomsky Hierarchy in detail.
- (b) What do you mean by Chomsky Normal form (CNF)? After simplification convert the given productions of CFG into CNF.
 $S \rightarrow ABA$
 $A \rightarrow aA \mid \epsilon$
 $B \rightarrow aB \mid \epsilon$

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

- (a) What do you mean by Push Down Automata (PDA)? Discuss deterministic PDA with suitable example.
- (b) Using two stacks construct a PDA that will accept the Languages $L = \{a^n b^n c^n; n \geq 1\}$.

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

- (a) Define Turing Machine. Design a Turing Machine that will convert lower case characters to upper case characters for the inputs $\{a, b\}^*$.
- (b) Write short note on following:
 - (i) Variants of Turing Machines
 - (ii) Church's Thesis