Paper id: 252286

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

MCA
(SEM II) THEORY EXAMINATION 2024-25
THEORY OF AUTOMATA & FORMAL LANGUAGES

TIME: 3 HRS **M.MARKS: 100**

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

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

a. Design a NFA for the language L ={ All strings over {0,1} that have at least two consecutive 0's or 1's.}

b. What is ε-closure of finite automata?

c. Differentiate between Mealy and Moore machine.

d. Let G be the given grammar :
$S \rightarrow 0B \mid 1A \quad A \rightarrow 0 \mid 0S \mid 1AA \quad B \rightarrow 1 \mid 1S \mid 0BB$
Produce left most derivation for string 00110101

e. Explain Halting problem of Turing Machine.

f. What areType-0 and Type-1 languages according to Chomsky Hierarchy.

g. Explain UniversalTM.

h. Design a FA to accept the string that always ends with110.

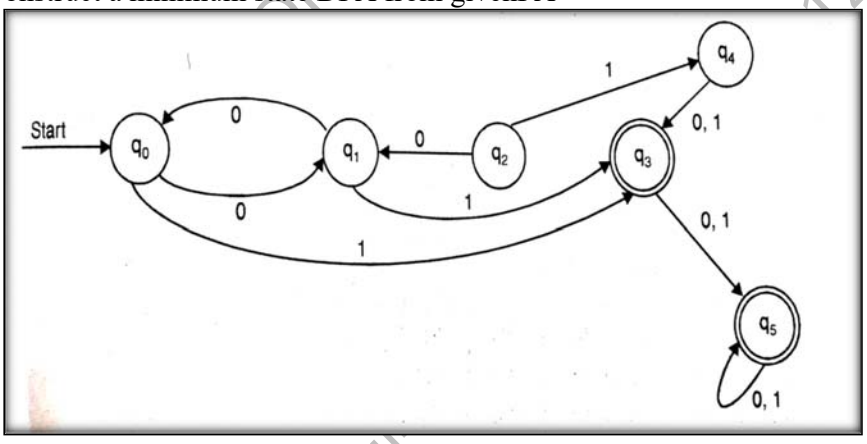
i. What is pumping lemma for regular languages?

j. What are the differences between DFA and NDFA?

SECTION B

2. Attempt any *three parts* ofthefollowing: **10 x 3 = 30**

a. Construct a minimum state DFA from givenFA



b. (i) Design a DFA which accepts the strings over { 0 , 1}*in which every 00 is followed immediately by a 1.
(ii) Consider the below given transition table for **NFA**:

Q / ∑	a	b	c	ε
Q_0	$\{Q_0\}$	ϕ	ϕ	$\{Q_1\}$
Q_1	ϕ	$\{Q_2\}$	ϕ	$\{Q_2\}$
Q_2	ϕ	ϕ	$\{Q_2\}$	ϕ

Draw the transition diagram of NFA with null transition from above table.
Convert this NFA to DFA.

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c. Give the formal definition of Push Down Automata. Design a PDA for the following language: **L = { wcw^R : w is set of all strings over a and b }**

d. **(i)**Eliminate useless grammar symbols from the below given grammar :
S → aC| SB A → bSCa B→ aSB | bBC C→ aBC | ad

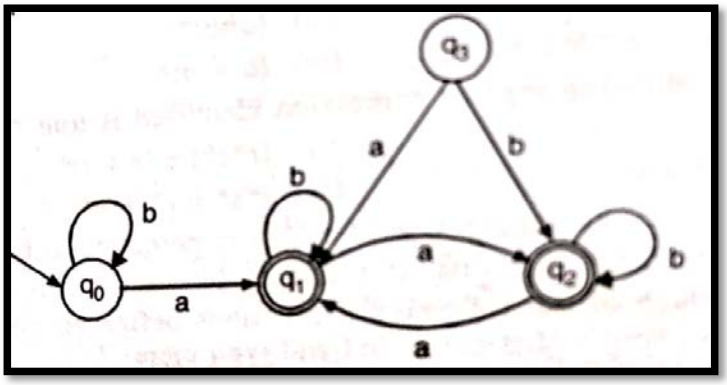
(ii) Reduce the below given grammar production rules into Chomsky Normal Form :
S → bA | aB A → bAA | aS | a B→ aBB | bS| b

e. Define Turing machine mathematically. Illustrate variants of Turing Machines.

SECTION C

3. Attempt any *one* part ofthefollowing: 10x 1 = 10

a. Apply Arden's theorem to find the regular expression corresponding to the finite automata givenbellow:



(b). (i) Construct a Moore machine that take set of all strings over Alphabet {0, 1} as input and produce **'A'** as output if input end with (10) or produce **'B'** as output if input end with (11) otherwise produce **'C'.**

(ii) Write the regular expression for **L={ a^{n}b^m:(n + m) iseven }**

4. Attempt any *one* part ofthefollowing: 10 x 1 = 10

(a) Using Pumping Lemma theorem , prove that the following language **L = {a^{n}ba^n}** is notregular

(b) Explain the Closure properties of regularlanguages.

5. Attempt any *one* part ofthefollowing: 10 x 1 = 10

(a) **(i)** Design the CFG for the following languages
L = { a^{n}b^{2n} c^m :n , m >=0 }

(ii) What are ambiguous grammars? Identify whether the following grammar rules are ambiguous or not :
S → a | abSb | aAb
A → bS | aAAb

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(b) Using Pumping Lemma theorem for context free languages , prove that the following language **L = {$a^n b^n c^n$}** is not ContextFree.

6. Attempt any *one* part ofthefollowing: 10x 1 = 10

(a) Design a two stack PDA for following language **L =**{$a^n b^n c^n d^n$ **: n >=1**}

(b) For the given CFG create equivalent PDA that accepts same language they generate.

S → XY
X → aX | bX | a
Y→ Ya | Yb | a

Give the steps of instantaneous description to show acceptance of string **w = baaab** Using obtained PDA**.**

7. Attempt any *one* part ofthefollowing: 10 x 1 = 10

(a) Design a TM for the following language L = { $a^n b^n$| n≥1}

(OR)

Design a Turing machine which accepts the language L ={ w∈(a ,b)* : w has equal number of a's and b's }

(b) (i) Let for ∑ ={0 ,1 } , X and Y are lists of three strings each given as below :

X ={ 1 , 10111 , 10} Y ={111 ,10 , 0}

Show that **101111110** is a solution for Post Correspondence Problem.

(ii) Write short noteson the following:

I. Recursive Language and Recursively EnumerableLanguage.
II. Linear Bounded Automata