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MCA
(SEM II) THEORY EXAMINATION 2023-24
THEORY OF AUTOMATA & FORMAL LANGUAGES

TIME: 3 HRS**M.MARKS: 100****Note: 1.** Attempt all Sections. If require any missing data; then choose suitably.**SECTION A****1. Attempt all questions in brief.**

Qno.	Question	Marks	CO
a.	What do you mean by Formal languages?	2	1
b.	What do mean by acceptability of string?	2	1
c.	State the Kleen's Theorem.	2	2
d.	Write down the Closure properties of Regular Languages.	2	2
e.	Differentiate Right Linear and Left Linear grammars.	2	3
f.	What do you mean by simplification of CFG?	2	3
g.	What do you mean by ambiguity in CFG?	2	4
h.	Define Nondeterministic Pushdown Automata.	2	4
i.	Define Linear Bounded automata.	2	5
j.	What do you mean by Halting Problem?	2	5

SECTION B**2. Attempt any three of the following:**

a.	Convert the following Mealy machine into an equivalent Moore machine: Mealy Machine Transition Table	10	1																																	
<table border="1"> <thead> <tr> <th rowspan="3">PresentState</th> <th colspan="4">NextState</th> </tr> <tr> <th colspan="2">a = 0</th> <th colspan="2">a = 1</th> </tr> <tr> <th>State</th> <th>Output</th> <th>State</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>$\rightarrow q_0$</td> <td>q_2</td> <td>0</td> <td>q_1</td> <td>0</td> </tr> <tr> <td>q_1</td> <td>q_0</td> <td>1</td> <td>q_3</td> <td>0</td> </tr> <tr> <td>q_2</td> <td>q_1</td> <td>1</td> <td>q_0</td> <td>1</td> </tr> <tr> <td>q_3</td> <td>q_3</td> <td>1</td> <td>q_2</td> <td>0</td> </tr> </tbody> </table>				PresentState	NextState				a = 0		a = 1		State	Output	State	Output	$\rightarrow q_0$	q_2	0	q_1	0	q_1	q_0	1	q_3	0	q_2	q_1	1	q_0	1	q_3	q_3	1	q_2	0
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q_3	q_3	1	q_2	0																																
b.	Explain the difference between Regular and Non-Regular Languages with suitable examples.	10	2																																	
c.	Find the derivation tree for the generating the string 11001010 from the following grammar: $S \rightarrow 1B 0A$, $A \rightarrow 1 1S 0AA$, $B \rightarrow 0 0S 1BB$.	10	3																																	
d.	Construct the PDA to accept the following language: $L = \{a^{2n}b^n \text{ where } n > 0\}$.	10	4																																	
e.	What do you mean by Non-deterministic Turing Machine. Also construct a TM over $\{a, b\}$ which contains a substring abb .	10	5																																	

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

a.	Check whether the strings 00101 and 110010 are accepted or not by the following FA:	10	1
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b.	<p>Convert the following ϵ - NFA to an equivalent DFA:</p>	10	1

4. Attempt any one part of the following:

a.	State and prove Arden's theorem.	10	2
b.	Construct an Finite Automata equivalent to the Regular expression given by: $R = (00 + 11)^*11(0 + 1)^*0$.	10	2

5. Attempt any one part of the following:

a.	Construct CFG for the regular expression: $R = (0 + 1)^*01^*$	10	3
b.	Give the following CFG having S as start symbol, find an equivalent CFG with no useless symbols. $S \rightarrow AB \mid CA, A \rightarrow a, B \rightarrow BC \mid AB, C \rightarrow aB \mid b$	10	3

6. Attempt any one part of the following:

a.	Prove that the language: $L = \{a^{i^2} : \text{where } i \geq 1\}$ is not context free.	10	4
b.	Construct a PDA that accepts the language generated by the following grammar: $S \rightarrow aB, B \rightarrow bA \mid bA \rightarrow aB$.	10	4

7. Attempt any one part of the following:

a.	Design a TM for a set of all strings with equal number of a and b .	10	5
b.	Define recursive function. Prove that the function: $f(x) = \begin{cases} \frac{x}{2} & \text{if } x \text{ is even} \\ \frac{x-2}{2} & \text{if } x \text{ is odd} \end{cases}$	10	5