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10CS56

Fifth Semester B.E. Degree Examination, June/July 2023
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Find a deterministic finite automata that recognizes each of the following sets ($\Sigma=\{0, 1\}^*$)
i) { 0 } ii) {1, 00}, iii) $\{1^n \mid n = 2, 3, 4 \ldots\}$. **(10 Marks)**

b. State the alphabets Σ for the following languages :
i) $L = \Sigma^* = \{\in, 0, 1, 00, 01, 11, 000, 001, 010, \ldots\ldots\}$
ii) $L = \Sigma^+ = \{a, aa, aaa \ldots\ldots\}$
iii) $L = \Sigma^+ = \{\in\}$. **(05 Marks)**

c. Design a DFA that recognizes the following language :
L = { W/W is non-empty & has 1 on every odd position }. **(05 Marks)**

2 a. Consider the following ∈- NFA :

	∈	a	b	c
→ p	ϕ	{ p }	{ q }	{ r }
q	{ p }	{ q }	{ r }	ϕ
* r	{ q }	{ r }	ϕ	{ p }

i) Compute the ∈-closure of each state ii) Convert the ∈- NFA to DFA. **(08 Marks)**

b. Define Regular expression. Convert the following automation to a regular expression using state elimination technique. [Refer Fig.Q2(b)]. **(08 Marks)**

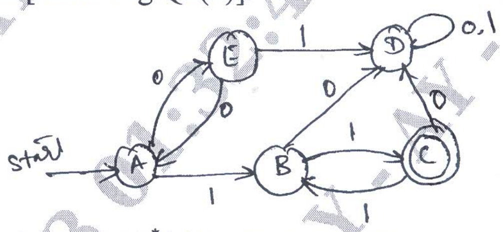

Fig. Q2(b)

c. Convert the regular expression $(0 + 1)^* \mid (0 + 1)$ to an NFA. **(04 Marks)**

3 a. State and prove pumping lemma for regular languages. **(05 Marks)**

b. Obtain the regular expression from the following finite automation using state elimination method.

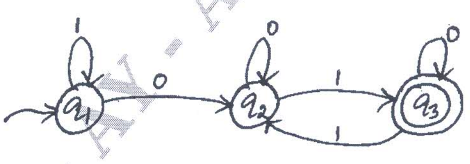

Fig. Q3(b)

(10 Marks)

c. When two states are equivalent or distinguishable? Minimize the following DFA using table filling algorithm. **(05 Marks)**

δ	0	1
→ q_1	q_2	q_3
q_2	q_3	q_5
* q_3	q_4	q_3
q_4	q_3	q_5
* q_5	q_2	q_5

4 a. Give a Context Free Grammar (CFC) for each of the following language over the alphabet $\Sigma = \{a, b\}$.
i) All strings in the language $L = \{ a^n b^m a^{2n} / n, m \geq 0 \}$.
ii) All non empty strings that start and end with the same symbol.
iii) All strings with more a's than b's. **(07 Marks)**

b. Is the following language L is regular? Justify your answer.
$L = \{ a^n / n \text{ is prime} \}$ **(07 Marks)**

c. State and prove the pumping Lemma for Regular language. **(06 Marks)**

PART – B

5 a. Define PDA. Construct PDA that accepts the language $L = \{ww^R \mid w \in (a+b)^*$ and w^R is the reversal of w }. Write IDs for the string aabbaa. **(10 Marks)**

b. Convert the following CFG to PDA and give the procedure for the same.
$S \rightarrow aABB \mid aAA$
$A \rightarrow aBB \mid a$
$B \rightarrow bBB \mid A$
$C \rightarrow a$ **(10 Marks)**

6 a. What are useless productions? Eliminate $\in$, unit and useless productions from the following grammar :
$A \rightarrow bA/Bba/aa$
$B \rightarrow aBa/b/D$
$C \rightarrow CA/AC/B$
$D \rightarrow a/\in$. **(10 Marks)**

b. Define Chomskey normal form. Convert the following CFG to CNF :
$S \rightarrow aSb/ab/Aa$
$A \rightarrow aab$. **(06 Marks)**

c. Prove that the context free languages are closed under union. **(04 Marks)**

7 a. For the CFG with productions :
$S \rightarrow a/aAB \mid aCb$, $A \rightarrow aB \mid \in$, $B \rightarrow Ba/A \mid \in$,
$C \rightarrow B \mid bCb \mid S$, $D \rightarrow dd \mid cC$
i) Eliminate $\in$ productions ii) Eliminate the unit productions
iii) Eliminate the useless symbols. **(10 Marks)**

b. Prove that the context free Languages are closed under Union concatenation and Kleen closure. **(10 Marks)**

8 Write short notes on :
a. Multitape turing machine
b. Post's correspondence problem.
c. Pumping Lemma for CFL.
d. Recursive languages. **(20 Marks)**

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