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10CS56

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Define Alphabet, String and Language. Give an example for each. **(04 Marks)**

b. Construct DFA for the following languages defines on $\Sigma = \{a, b\}$

(i) Set of all strings ending with 'bba'

(ii) Set of all strings beginning with 'ba'

(iii) $L = \{w | w \in \{a, b\}^* \text{ and } |w| \bmod 3 \neq 2\}$ **(10 Marks)**

c. Convert the following NFA to DFA.

δNFA	0	1
→p	{p, q}	{p}
q	{r, s}	{t}
r	{p, r}	{t}
*s	ϕ	ϕ
*t	ϕ	ϕ

(06 Marks)

2 a. Define Regular expression. Write regular expression to accept the following languages $L = \{a^n b^m : n \geq 1, m \geq 1, nm \geq 3\}$ **(08 Marks)**

b. Show that every language defined by a regular expression is also defined by a finite automata. **(06 Marks)**

c. Discuss any three applications for Regular expressions. **(06 Marks)**

3 a. State pumping lemma for regular language. Prove that $L = \{a^{n!} | n >= 0\}$ is not regular language. **(07 Marks)**

b. If h is homomorphism from alphabet Σ to alphabet T and L is regular language over T, then $h^{-1}(L)$ is also regular language. **(05 Marks)**

c.

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

i) Draw table of distinguish abilities for this automata.

ii) Construct minimum state equivalent DFA. **(08 Marks)**

4 a. Define context-free grammar and using the grammar given below, show the derivation tree for (i) (a101 + b1) * (a1 + b) (ii) (a1 + b1) * aa

G : E → I | E + E | E * E | (E)

I → a | b | Ia | Ib | I0 | I1 **(08 Marks)**

b. Define leftmost and rightmost derivations. Draw rightmost derivation for (a + b) * (b + c).
$G : E \rightarrow E + T \mid T$
$T \rightarrow T * F \mid F$
$F \rightarrow (E) \mid a \mid b \mid c$ **(06 Marks)**

c. Define ambiguous grammar. Show that the following grammars are ambiguous:
(i) $G : S \rightarrow aSbS \mid bSaS \mid \in$
(ii) $G : S \rightarrow SS$
$S \rightarrow aSb \mid bSa \mid \in$ **(06 Marks)**

PART – B

5 a. Define push Down Automata. Construct NPDA for accepting the following language.
$L = \{\omega\omega^R : \omega \in \{a, b\}^*\}$
Show all ID's to process the string 'baab' **(14 Marks)**

b. Convert the grammar to equivalent PDA.
$S \rightarrow 0AA$
$A \rightarrow 0S \mid 1S \mid 0$ **(06 Marks)**

6 a. Define GNF and CNF grammar. Reduce grammar into CNF
$S \rightarrow AaB/aaB$
$A \rightarrow \in$
$B \rightarrow bbA/\in.$ **(07 Marks)**

b. Define nullable, useless variable. Consider the grammar.
$S \rightarrow AC / aB / AD$
$A \rightarrow \in / ab / s$
$B \rightarrow Aa / AB$
$C \rightarrow AAa / \in$
$D \rightarrow EbD$
$E \rightarrow bb$
i) Eliminate $\in$ production.
ii) Eliminate any unit production in resulting grammar.
iii) Eliminate any useless production in resulting grammar. **(08 Marks)**

c. If L is context free language, then so is L^R. Prove. **(05 Marks)**

7 a. Define Turing Machine and Turing Machine to accept $L = \{a^n b^n c^n \mid n \geq 1\}$. Show that string 'abc' is accepted. **(12 Marks)**

b. Define Posts Correspondence Problem (PCP) and solve the PCP for the following lists, given below:

i	w_i	X_i
1	1	111
2	10111	10
3	10	0

(08 Marks)

8 a. Define Recursively Enumerable language. Prove that Diagonalization in not recursively enumerable. **(08 Marks)**

b. Write a note on :
i) Recursive language
ii) Post's correspondence problem. **(12 Marks)**

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