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10CS56

Fifth Semester B.E. Degree Examination, July/August 2021

Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions.

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) $L = \{w | w \in \{a, b\}^*$ 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. Convert the following ∈-NFA to DFA [Refer Fig.Q2(a)]

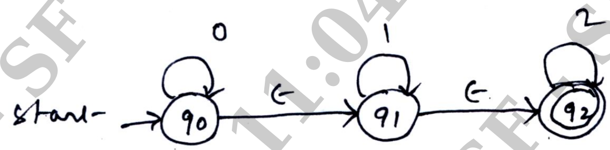

Fig.Q2(a) **(08 Marks)**

b. Define regular expression and give two examples of regular expressions, explaining the meaning of each. **(06 Marks)**

c. Convert the following regular expressions to ∈-NFA.

(i) $a(b + c)^*b$ (ii) $a(ab + ba)^*$. **(06 Marks)**

3 a. State and prove pumping lemma for regular languages and prove that $L = \{0^n 1 0^n \mid n \geq 1\}$ is not regular. **(10 Marks)**

b. Consider the following DFA:

(i) Draw the table of distinguishable states

(ii) Construct the minimum state equivalent DFA.

State	Input	
	0	1
∈A	B	C
B	D	E
C	F	G
*D	D	E
E	F	G
*F	D	E
*G	F	G

(10 Marks)

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

$G: E \to I \mid E + E \mid E * E \mid (E)$
$I \to a \mid b \mid Ia \mid Ib \mid I0 \mid I1$ **(08 Marks)**

b. Define leftmost and rightmost derivations. Draw rightmost derivation for $(a + b) * (b + c)$.

$G: E \to E + T \mid T$
$T \to T * F \mid F$
$F \to (E) \mid a \mid b \mid c$ **(06 Marks)**

c. Define ambiguous grammar. Show that the following grammars are ambiguous:

(i) $G: S \to aSbS \mid bSaS \mid \in$
(ii) $G: S \to SS$
$S \to aSb \mid bSa \mid \in$ **(06 Marks)**

5 a. Define PDA and construct a PDA to recognize $L = \{a^n b^n \mid n \geq 1\}$

(i) Construct transition diagram
(ii) Define all parameters of the constructed PDA
(iii) Show using instantaneous description that 'aabb' is accepted. **(12 Marks)**

b. Convert the following grammar to PDA.

$G: E \to E + T \mid T$
$T \to T * F \mid F$
$F \to (E) \mid a \mid b \mid c$

Show that '$a + b * c$' is accepted by the PDA. **(08 Marks)**

6 a. State and prove pumping lemma for context-free languages. Show that $L = \{a^n b^n c^n \mid n \geq 1\}$ is not a context-free language. **(10 Marks)**

b. Eliminate useless symbols in the grammar given below by

(i) Eliminating $\in$ productions.
(ii) Eliminating unit productions
(iii) Eliminate useless symbols.

$G: S \to ABC \mid BaB$
$A \to aA \mid BaC \mid aaa$
$B \to bBb \mid a \mid D$
$C \to CA \mid AC$
$D \to \in$ **(10 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 Write short notes on:

a. Recursive languages
b. Non-deterministic Turing Machine
c. Mutli-tape Turing Machines
d. Undecidability **(20 Marks)**

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