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10CS56

Fifth Semester B.E. Degree Examination, July/August 2022
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

1 a. What is Automata? Discuss why to Study Automata. **(06 Marks)**

b. Define DFA and design DFA for the following languages:
(i) Decimal integers divisible by 3.
(ii) String of a's and b's, such that every block of five consecutive symbols have atleast two b's. **(10 Marks)**

c. Define NFA and design an NFA for the language L^2, where $L = \{awa \mid w \in \{a,b\}^n, n \geq 0\}$. **(04 Marks)**

2 a. Define ε-NFA and design an ε-NFA to accept decimal numbers and convert the constructed ε-NFA to its equivalent DFA. **(10 Marks)**

b. Define a Regular Expression and give the Regular Expression for the following languages:
(i) $L_1 = \{a^n b^m \mid m+n \text{ is even}\}$ (ii) $L_2 = \{a^n b^m \mid m \geq 1, n \geq 1, n*m \geq 3\}$ **(06 Marks)**

c. Convert the following Finite Automata to a Regular Expression [Refer Fig.Q2(c)].

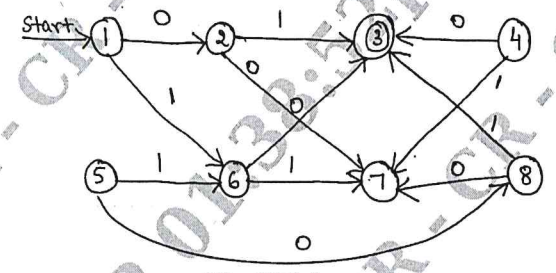

Fig.Q2(c) **(04 Marks)**

3 a. State and prove pumping Lemma for regular languages. **(06 Marks)**

b. Show that $L = \{ww \mid w \in \{a,b\}^*\}$ is not regular. **(06 Marks)**

c. Minimize the following DFA using Table.Q3(c) filling algorithm. **(08 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

Table.Q3(c)

4 a. Define the following terms with an example:
(i) Left Most Derivation (LMD)
(ii) Right Most Derivation (RMD)
(iii) Sentential form
(iv) Yield of a tree
(v) Parse tree **(05 Marks)**

b. Define Context Free Grammar and generate CFG for the language:
(i) $L_1 = \{w = w^R \mid w \text{ is in } \{a, b\}^*\}$ (ii) $L_2 = \{a^n b^m c^k \mid k = m + n, \ m, n, k \geq 0\}$ **(05 Marks)**

c. What is an ambiguous grammar? Show that the following grammar is ambiguous:
$S \rightarrow SbS \mid a$ **(05 Marks)**

d. Write the LMD, RMD and Parse Tree for the string "+ * – xyxy" using the grammar:
$E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$ **(05 Marks)**

PART – B

5 a. Define Push Down Automata and also discuss the languages accepted by a PDA. **(06 Marks)**

b. Design a PDA to accept the language $L = \{0^{2n} 1^n \mid n \geq 1\}$ and also show the moves made by PDA for the string "000011". **(10 Marks)**

c. Convert the following CFG to PDA:
$S \rightarrow a\ A\ BB \mid a\ AA$
$A \rightarrow a\ BB \mid a$
$B \rightarrow b\ BB \mid A$
$C \rightarrow a$ **(04 Marks)**

6 a. Eliminate the useless symbols and productions from the following grammar.
$S \rightarrow AB \mid AC$
$A \rightarrow aA \mid bAa \mid a$
$B \rightarrow bbA \mid aB \mid AB$
$C \rightarrow aCa \mid aD$
$D \rightarrow aD \mid bC$ **(07 Marks)**

b. Define CNF and convert the following grammar into CNF:
$S \rightarrow ABa$
$A \rightarrow aab$
$B \rightarrow Ac$ **(06 Marks)**

c. Prove that the family of context free languages is closed under union, concatenation and star closure. **(07 Marks)**

7 a. Design a Turing Machine for the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$. Write the Transition diagram and also indicate the moves made by the Turing machine for the input "001122". **(14 Marks)**

b. Define Turing Machine and Explain the working of a basic Turing Machine with a neat diagram. **(06 Marks)**

8 Write short notes on:
a. Multi Tape Turing Machine **(05 Marks)**
b. Non-Deterministic Turing Machine **(05 Marks)**
c. Post's Correspondence Problem **(05 Marks)**
d. Universal Turing Machine. **(05 Marks)**

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