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06CS56

Fifth Semester B.E. Degree Examination, May/June 2010
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. Define the following terms, with an example for each:
i) String ii) Alphabet iii) Powerset iv) Language. **(08 Marks)**

b. Mention the differences between DFA, NFA and ∈-NFA. **(04 Marks)**

c. Convert the following ∈-NFA to DFA. [Refer Fig.Q1(c)]. **(08 Marks)**

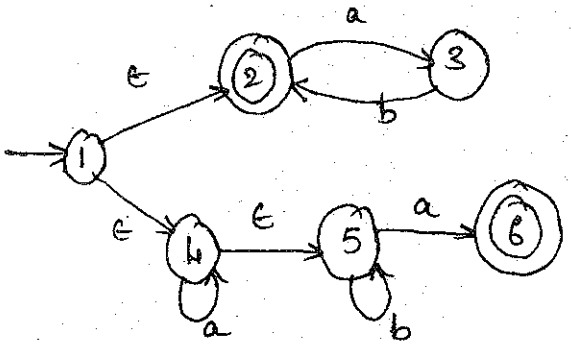

Fig.Q1(c)

2 a. Define a regular expression. Find regular expression for the following languages on {a, b}:
i) $L = \{ a^{2n} b^{2m} : n \geq 0 , m \geq 0 \}$ ii) $L = \{ w : |w| \bmod 3 = 0 \}, w \in \{a, b\}^*$ **(08 Marks)**

b. Prove that if L and M are regular languages, then so is $L \cap M$. **(06 Marks)**

c. Convert the regular expression $(01 + 1)^*$ to an ∈-NFA. **(06 Marks)**

3 a. State pumping lemma for regular languages. Prove that the language $\{a^n b^n \mid n \geq 1\}$ is non-regular. **(10 Marks)**

b. Define distinguishable and indistinguishable states. Minimize the following DFA using table filling algorithm.

	f	0	1
→	A	B	F
	B	G	C
*	C	A	C
	D	C	G
	E	H	F
	F	C	G
	G	G	E
	H	G	C

(10 Marks)

4 a. Define CFG. Obtain CFG for the following languages:
i) $L = \{ ww^R \mid w \in \{a, b\}^* \}$, w^R is the reversal of w } ii) L = { w : w has a substring ab} **(10 Marks)**

b. What is an ambiguous grammar? Show that the following grammar is ambiguous.
$E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid (E) \mid a$
where E is the start symbol. Find the unambiguous grammar. **(10 Marks)**

PART – B

5 a. Define PDA. Design PDA to accept the following language by final state.

$L = \{ w \mid w \in \{a, b\}^*, N_a(w) = N_b(w) \}$

Draw the graphical representation of PDA. Also, show the moves made by the PDA for the string abbaba. **(12 Marks)**

b. Convert the following CFG to PDA.

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid A$

$C \rightarrow a$ **(08 Marks)**

6 a. What are useless symbols? Eliminate $\in$, unit and useless productions from the following grammar:

$S \rightarrow Aa\ A \mid CA \mid BaB$

$A \rightarrow aaBa \mid CDA \mid aa \mid DC$

$B \rightarrow bB \mid bAB \mid bb \mid aS$

$C \rightarrow Ca \mid bC \mid D$

$D \rightarrow bD \mid \in$ **(10 Marks)**

b. What is CNF and GNF? Obtain the following grammar in CNF:

$S \rightarrow aBa \mid abba$

$A \rightarrow ab \mid AA$

$B \rightarrow aB \mid a$ **(10 Marks)**

7 a. Prove that the context free languages are closed under union, concatenation and reversal. **(10 Marks)**

b. Design a turning machine that performs the following function:

$q_0 w \vdash^* q_f ww$ for any $w \in \{1\}^*$ **(10 Marks)**

8 Write short notes on:

a. Multitape TM

b. Post correspondence problem

c. Chomsky hierarchy

d. Applications of regular expressions. **(20 Marks)**

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