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06CS56

Fifth Semester B.E. Degree Examination, Dec. 2013/Jan. 2014
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define DFA. Mention the difference between DFA and NFA. **(04 Marks)**

b. Design DFA for the following language over $\Sigma = \{a, b\}$
i) The set of strings containing substring abb
ii) The set of strings with exactly three a's
iii) $L = \{awa \mid w \in (a + b)^*\}$. **(10 Marks)**

c. Design NFA or ϵ - NFA for the following languages
i) abc, abd, aacd $\{\Sigma = \{a, b, c, d\}\}$
ii) $\{ab, abc\}^*$ $\{\Sigma = \{a, b, c\}\}$. **(06 Marks)**

2 a. Consider the following ϵ - NFA.

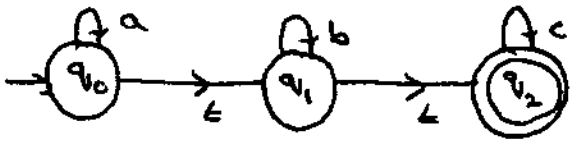

Fig. Q2(a)

i) Compute ECLOSURE of each state
ii) Convert above ϵ - NFA to DFA. **(08 Marks)**

b. Obtain regular expression for the following DFA by state elimination methods. **(07 Marks)**

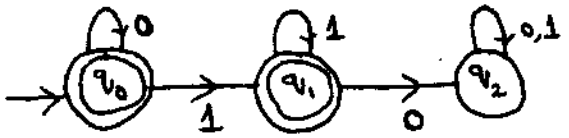

Fig. Q2(b)

c. Write regular expression for the following languages over $\Sigma = \{a, b\}$
$L = \{w \mid \mid w \mid \bmod 3 = 0\}$
$L = \{a^n b^m \mid n \geq 0, m \geq 0, (m + n) \text{ is even}\}$
$L = \{a^n b^{2n} \mid n \geq 0\}$. **(05 Marks)**

3 a. State and prove pumping lemma theorem for regular languages. **(08 Marks)**

b. Show that the following language is not regular $L = \{a^n b^n \mid n \geq 0\}$. **(07 Marks)**

c. Using table filling algorithm show that the language accepted by the following two DFAs are same. **(05 Marks)**

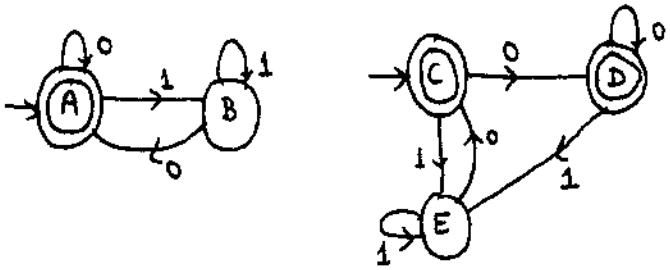

Fig. Q3(c)

4 a. Define CFG. Obtain CFG for the following :
i) $L = \{a^n b^{2n} \mid n \geq 0\}$
ii) $L = \{a^n b^{n-3} \mid n \geq 3\}$
iii) For regular expression $(a + b)^*$. **(07 Marks)**

b. Consider the grammar G with following productions E → +EE | * EE | - EE | x | y
Find LMD, RMD and write parse tree for the string + * – xyxy. **(06 Marks)**

c. What is ambiguous grammar? Show that the following grammar is ambiguous on the string ibtibtaea.
S → iCtS | iCtSeS | a
C → b. **(07 Marks)**

PART – B

5 a. Describe the languages accepted by PDA. **(04 Marks)**

b. Construct a PDA that accepts the following : $L = \{w \mid w \in (a+ b)^*$ and $N_a(w) = N_b(w)\}$, write the instantaneous description for the string abba. **(10 Marks)**

c. Convert the following CFG to PDA that accept the same language by empty stack.
S → aABC, A → aB|a, B → bA|b, C → a. **(06 Marks)**

6 a. What are useless symbols? Eliminate useless symbols from the following grammar :
S → AB | CA, A → a, B → BC | AB, C → aB|b. **(07 Marks)**

b. What are unit production? Eliminate unit productions from the following grammar :
S → Aa|B, B → A|bb, A → a| bc|B. **(05 Marks)**

c. What is CNF? Convert the following grammar into CNF
S → aAD, A → aB|bAB, B → b, D → d. **(08 Marks)**

7 a. Explain with diagram, the working of a Turing machine and multitape Turing machine. **(08 Marks)**

b. Design a Turing machine that accepts the language. $L = \{a^n b^n \mid n \geq 1\}$. Also write the transition diagram and instantaneous description for the string aabb. **(12 Marks)**

8 Write short notes on the following :
a. Multi tape Turing M/C
b. Halting problem of TM
c. Recursive language
d. Post's correspondence problem. **(20 Marks)**

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