Fifth Semester B.E. Degree Examination, Dec.08/Jan.09
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.***

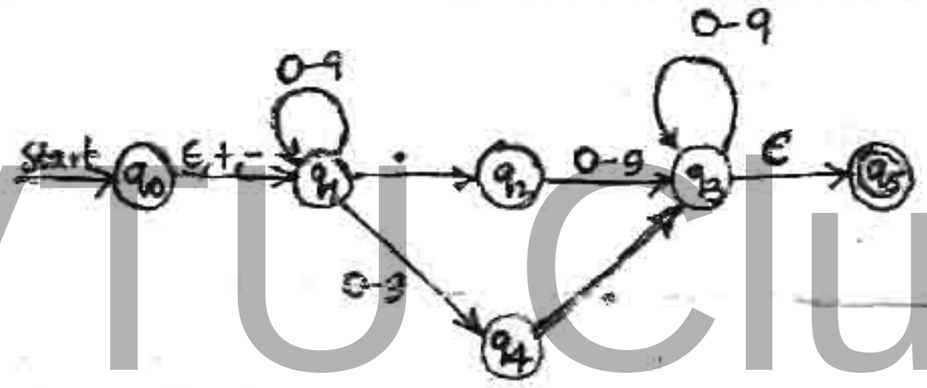
PART - A

1 a. What is Automata? Discuss why study automata. **(06 Marks)**

b. Define DFA and design the DFA for the following languages on $\Sigma = \{a, b\}$.
   i) The set of all strings that either begings or ends or both with substring 'ab'.
   ii) The set of all strings that ends with substring 'abb'.
   iii) $L = \{W : |W| \bmod 5 < > 0\}$ **(08 Marks)**

c Define $\in$ – NFA and design the E – NFA or NFA for the following languages.
   i) abc, abd, and aacd {Assume Σ = a, b, c, d}
   ii) {ab, abc}* {Assume $\Sigma = \{a, b, c\}$. **(06 Marks)**

2 a. Convert the following $\in$ I NFA to DFA using "Subset Construction scheme". **(08 Marks)**



b. Define Regular expression and write Regular expression for the following languages.
   i) $L = \{a^{2n} b^{2m+1} : m \geq 0, n \geq 0\}$.
   ii) $L = \{a^n b^m : (m + n) \text{ is even}\}$.
   iii) $L = \{a^n b^m : n >= 4, m <= 3\}$. **(06 Marks)**

c. Prove that every language defined by a Regular expression is also defined by Finite automata. **(06 Marks)**

3 a. If L_1 and L_2 are regular languages then prove that family of regular language are closed under $L_1 - L_2$. **(06 Marks)**

b. State and prove pumping lemma for regular languages. Apply pumping lemma for following languages and prove that it is not Regular $L = \{a^n : n \text{ is prime}\}$. **(08 Marks)**

c. Consider the DFA

δ	0	1
$\rightarrow q_1$	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 the table of distinguishable and Indistinguishable states for the automata.
ii) Construct minimum state equivalent of automata. **(06 Marks)**

4 a. Define context-free grammer and write context free grammer for the following languages.
i) $L = \{a^i b^j c^k : i + j = k, i >= 0, j >= 0\}$.
ii) $L = \{a^n b^m c^k : n + 2m = k\}$. **(07 Marks)**

b. Consider the grammer.
$E \rightarrow +EE \mid * EE \mid - EE \mid x \mid y$
Find leftmost and rightmost derivation for the string $+*-xyxy$ and write parse tree. **(08 Marks)**

c. What is ambigous grammer? Prove that the following grammer is ambigous on the string "aab" $S \rightarrow as \mid asbs \mid \in$. **(05 Marks)**

PART - B

5 a. Define PDA and construct a PDA that accepts the following languages.
$L = \{w : w \in (a + b)^*$ and $n_a(w) = n_b(w)\}$. Write the instantaneous description for the string "aababb". **(12 Marks)**

b. For the following grammer construct a PDA.
$S \rightarrow aABB \mid aAA$
$A \rightarrow aBB \mid a$
$B \rightarrow bBB \mid A$
$C \rightarrow a$. **(08 Marks)**

6 a. Consider the grammer.
$S \rightarrow ABC \mid BaB$
$A \rightarrow aA \mid BaC \mid aaa$
$B \rightarrow bBC \mid a \mid D$
$C \rightarrow CA \mid AC$
$D \rightarrow \in$
i) Eliminate t – productions.
ii) Eliminate Unit productions in the resulting grammer.
iii) Eliminate Useless production in the resulting grammer. **(09 Marks)**

b. What is Chomsky normal form? Convert the following grammer b Chomsky normal form.
$S \rightarrow ABa$
$A \rightarrow aab$
$B \rightarrow Ac$. **(05 Marks)**

c. If L_1 and L_2 are context free languages then prove that family of Context–free– languages are closed under Union and concatenation operations. **(06 Marks)**

7 a. Explain with neat diagram, the working of a Turning machine model. **(06 Marks)**

b. Design a Turing Machine to accept all set of palindromes over $\{0, 1\}^*$. Also write its transition diagram and Instantaneous description on the string "1 0 1 0 1". **(14Marks)**

8 Write short notes on following:
i) Post's correspondence problem.
ii) Recursive languages.
iii) Universal Turning Machine.
iv) Pumping lemma for CFL. **(20 Marks)**

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