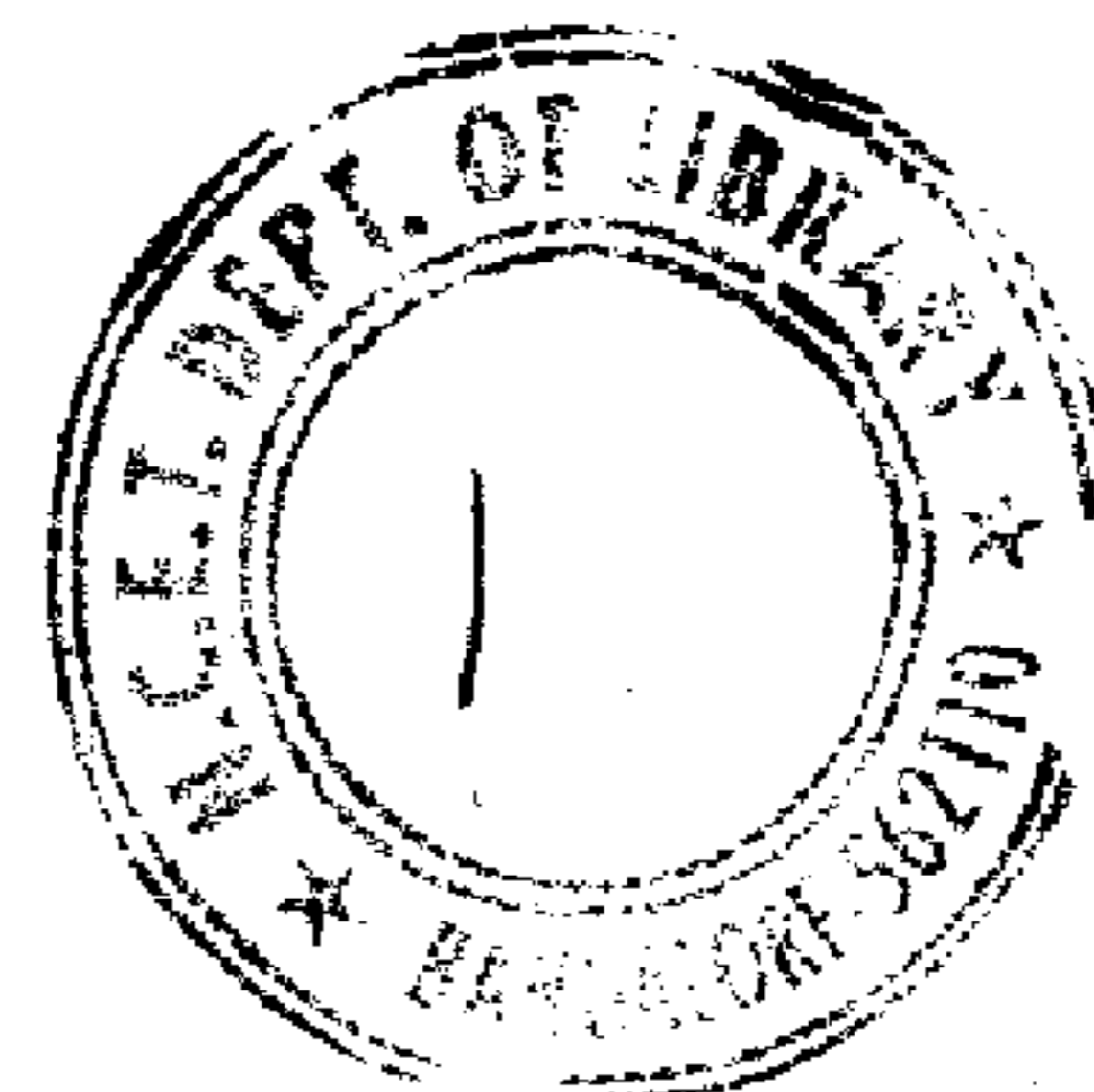


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**Fifth Semester B.E. Degree Examination, Dec.08/Jan.09**  
**Formal Languages and Automata Theory**

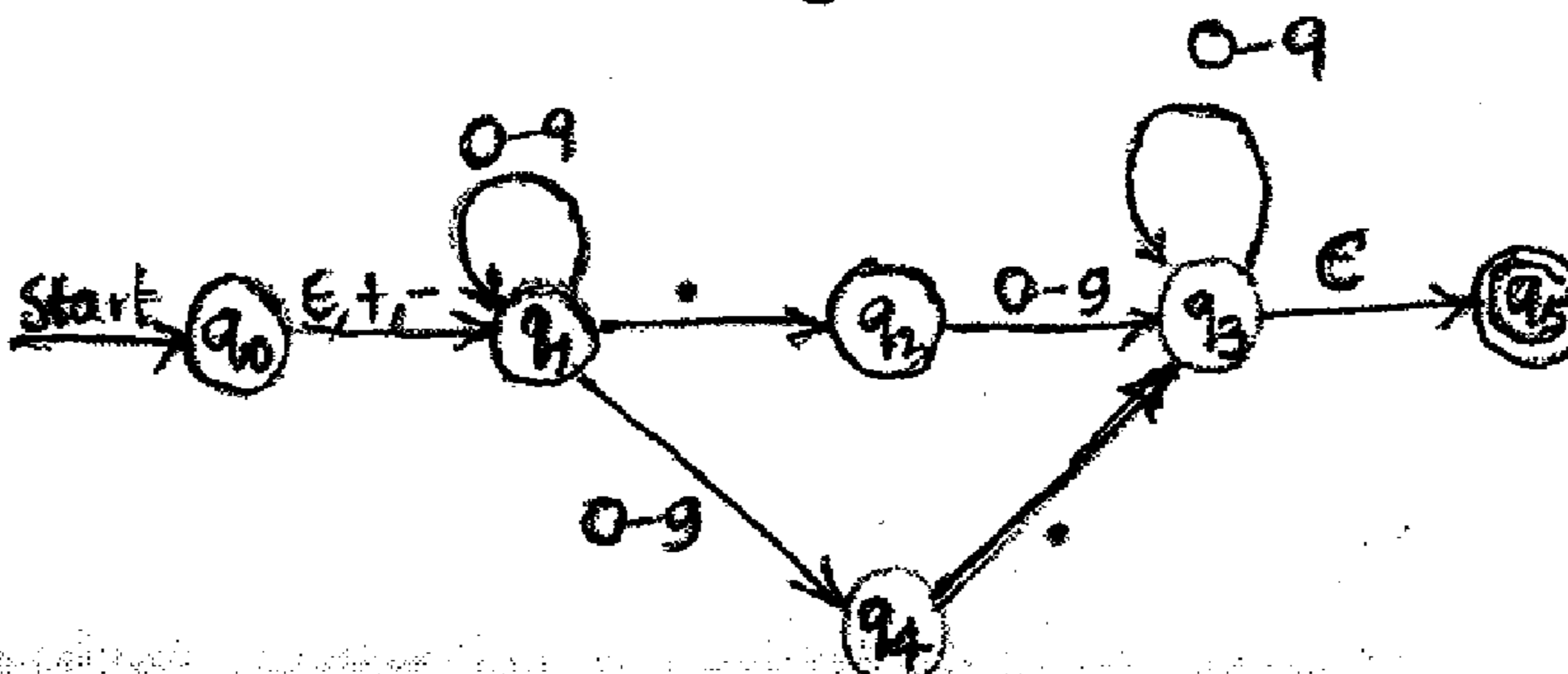
Time: 3 hrs.

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 begins 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  $\epsilon$ -NFA and design the  $\epsilon$ -NFA or NFA for the following languages.
    - i) abc, abd, and aacd {Assume  $\Sigma = a, b, c, d$ }
    - ii)  $\{ab, abc\}^*$  {Assume  $\Sigma = \{a, b, c\}$ .} (06 Marks)
- 2 a. Convert the following  $\epsilon$ -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)  $L = \{a^n b^m : n \geq 4, m \leq 3\}$ . (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

$\delta$	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 grammar and write context free grammar for the following languages.  
 i)  $L = \{a^i b^j c^k : i + j = k, i \geq 0, j \geq 0\}$ .  
 ii)  $L = \{a^n b^m c^k : n + 2m = k\}$ . (07 Marks)
- b. Consider the grammar.  
 $E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$   
 Find leftmost and rightmost derivation for the string  $+* - xyxy$  and write parse tree. (08 Marks)
- c. What is ambiguous grammar? Prove that the following grammar is ambiguous on the string "aab"  $S \rightarrow a \mid as \mid abs \mid \epsilon$ . (05 Marks)

## PART - B

- 5 a. Define PDA and construct a PDA that accepts the following languages.  
 $L = \{w : w \in (a + b)^* \text{ and } n_a(w) = n_b(w)\}$ . Write the instantaneous description for the string "aababb". (12 Marks)
- b. For the following grammar 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 grammar.  
 $S \rightarrow ABC \mid BaB$   
 $A \rightarrow aA \mid BaC \mid aaa$   
 $B \rightarrow bBb \mid a \mid D$   
 $C \rightarrow CA \mid AC$   
 $D \rightarrow \epsilon$   
 i) Eliminate  $\epsilon$ -productions.  
 ii) Eliminate Unit productions in the resulting grammar.  
 iii) Eliminate Useless production in the resulting grammar. (09 Marks)
- b. What is Chomsky normal form? Convert the following grammar to 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 Turing 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". (14 Marks)
- 8 Write short notes on following:  
 i) Post's correspondence problem.  
 ii) Recursive languages.  
 iii) Universal Turing Machine.  
 iv) Pumping lemma for CFL. (20 Marks)

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