III Semester M.C.A. Examination, January 2019  
(CBCS Scheme)  
MCA 303 : THEORY OF COMPUTATION  

Instructions:  
1) Part – A: Answer any 5 questions (5x6=30).  
2) Part – B: Answer any 4 questions (4x10=40).  

PART – A  

Answer any five full questions.  
(5x6=30)  

1. What is finite automata? What are its applications?  

2. Define NFA and E-NFA. Explain with suitable example.  

3. Explain Chomsky’s Hierarchy of grammar.  

4. Construct a DFA  
   a) String starts with ab or ba.  
   b) To accept even number of 0’s and even number of 1’s.  
   (3+3)  

5. Design a DFA to accept decimal strings divisible by 5.  

6. Eliminate unit productions from the grammar:  
   S → Aa|B|Ca  
   B → aB|b  
   C → Db|D  
   D → E|d  
   E → ab  

7. Write a note on pumping lemma for regular languages.  

8. Explain primitive recursive functions and μ-recursive functions.
PART - B

Answer any four full questions. (4x10=40)

9. Find DFA equivalent to the following:
   \[ N = \{(q_0, q_1, q_2), \{a, b\}, \delta, q_0, \{q_2\}\} \]
   where \( \delta \) is defined as follows:
   \[
   \begin{array}{c|cc}
   & a & b \\
   \hline
   q_0 & (q_0, q_1) & q_2 \\
   q_1 & q_0 & q_1 \\
   q_2 & \_ & (q_0, q_1) \\
   \end{array}
   \]

10. a) Obtain an NFA for the regular expression \( ab(a + b)^*a \). (5+5)
    b) Show that \( L = \{0^n 1^n \mid n \geq 1\} \) is not regular.

11. a) Explain Instantaneous description of PDA. (4+6)
    b) Obtain a Turing machine to accept the language \( L = \{0^n 1^n 2^n \mid n \geq 1\} \).

12. Find a CFG without E - productions, unit productions and useless productions equivalent to the grammar defined by
    \[ S \rightarrow aA|aB|C \\
    A \rightarrow aB|E \\
    B \rightarrow aA \\
    C \rightarrow cCD \\
    D \rightarrow abd \\
    \]
    Also express the simplified grammar in CNF.

13. Find the minimized DFA from the given transition table.
   \[
   \begin{array}{c|cc}
   & 0 & 1 \\
   \hline
   q_0 & q_1 & q_2 \\
   q_1 & q_0 & q_2 \\
   q_2 & q_3 & q_2 \\
   q_3 & q_3 & q_3 \\
   \end{array}
   \]

14. Write short notes on the following:
    a) Cook's Theorem
    b) NP - Completeness.
III Semester M.C.A. Examination, January 2016
(CBCS)
COMPUTER SCIENCE
MCA 303 : Theory of Computation

Time : 3 Hours
Max. Marks : 70

Instructions: 1) Answer any five questions from Section – A, each carries
six marks.

2) Any four questions from Section – B, each carries 10 marks.

SECTION – A

Answer any 5 questions. Each question carries 6 marks. (5x 6 = 30)

1. What is finite automata? What are the applications of finite Automata? 6

2. Define NFA and ε-NFA. Explain with suitable example. 6

3. Define Regular Expression. Explain the meaning of the regular expression
(a+b)*. 6

4. Define context free grammar. Show that if L1 and L2 are context free languages
then L1 U L2 is also context free. 6

5. Construct a pushdown automata that accepts the following language.

\[ L_{01} = \{ 0^n 1^n | n \geq 1 \} \] and illustrate its working. 6

6. Define Turing Machine. Explain Turing Machine model with its components. 6

7. Write a note on pumping lemma for regular languages. 6

P.T.O.
8. a) Define \( \mu \)-Recursive function. 

b) Convert the following CFG to CNF

\[
S \rightarrow 0A|1B \\
A \rightarrow 0AA|1S|1 \\
B \rightarrow 1BB|0S|0
\]

SECTION - B

Answer any 4 questions. Each question carries 10 marks. \( (4 \times 10 = 40) \)

9. Construct a Deterministic finite Automation (DFA) for the following:
   a) The String Ends with 10.
   b) Even number of 0's and odd number of 1's.
   c) To accept the language
      \[
      L = \{W : |W| \text{ mod } 4 = 0 \} \text{ on } \Sigma = \{0, 1\}
      \]

10. a) Explain parse tree and its properties. 
    b) Convert the following NFA into an equivalent DFA:

11. a) Define PDA and Instantaneous description of PDA.
    b) Obtain a PDA to accept the language \( L(M) = \{W_{CR}/W_{R}(a+b)^* \} \) where \( W_{CR} \) is the reverse of \( W \) and hence say whether its is a Deterministic PDA or not.