Paper Code: NMCA-214 **Roll No.** | | | | | | | | | | |

MCA
(SEM II) EVEN SEMSTER EXAMINATION, 2015-2016
INTRODUCTION TO AUTOMATA THEORY & LANGUAGES

[Time: 3 Hours] **[MM: 100]**

Note: Attempt ALL questions.

Q1. Attempt any ***four*** parts of the following: - **[5x4 = 20]**

(a) Let $L_1 = (\mathbf{0} + \mathbf{1})^*$ and $L_2 = (\mathbf{\emptyset} + \boldsymbol{\varepsilon})$. Find $L_1.L_2$ and $L_1 + L_2$.
(b) Define a DFA and compute its language.
(c) Construct a NFA for the language $\boldsymbol{\varepsilon}^*$.
(d) Construct the DFA for the following languages:
  (i) The set of all strings that have three consecutive 0's followed by 1.
  (ii) The set of all strings that begin either 0 or 1 and ending with 1.
(e) Define **ε**-NFA. Construct the **ε**-NFA for the language accepting decimal numbers.
(f) Prove the equivalence between NFA and DFA.

Q2. Attempt any ***two*** parts of the following:- **[10x2 = 20]**

(a) Explain Kleen's theorem of finite automaton with example.
(b) Prove that following languages of $\Sigma = \{0, 1\}$ are not regular:
  (i) $L = \{1^n 0^{2n} \mid n \geq 1\}$
  (ii) $L = \{0^n \mid$ where n is a perfect square$\}$
(c) Describe the method to test that two descriptors for regular languages are equivalent.

Q3. Attempt any ***two*** parts of the following: - **[10x2 = 20]**

(a) Convert the following grammar G to a PDA that accepts the same language by empty stack.
  $G = (\{S, A\}, \{a, b\}, \{S \rightarrow aAA, A \rightarrow aS/bS/a\}, \{S\})$
(b) Convert the following CFG to GNF.
  $S \rightarrow AA/0$
  $A \rightarrow SS/1$
(c) Prove that following problems of CFL are undecidable.
  (i) Is the given CFG G is ambiguous?
  (ii) Are two CFL's the same?

Q4. Attempt any ***two*** parts of the following: - **[10x2 = 20]**

(a) Define a Turing machine and computes its language.
(b) Compute the natural function $f(x) = x * y$ using Turing machine model.
(c) Describe the halting problem of a Turing machine with example.

Q5. Attempt any ***two*** parts of the following: - **[10x2 = 20]**

(a) Prove that if a language L and its complement both are recursive innumerable, then L is recursive.
(b) Describe the Rice theorem with example.
(c) Define post's correspondence problem (PCP) with example.