ROLL NO. _____

Code: AC68 Subject: FINITE AUTOMATA & FORMULA LANGUAGES

AMIETE – CS

Time: 3 Hours **DECEMBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 **(2×10)**

a. A DFA defined over $\Sigma = \{a, b\}$ can recognize the following language.

(A) $L_1 = \{a^n b^n c^n \mid n \geq 0\}$ **(B)** $L_2 = \{a^5 b^{10} c^{100}\}$

(C) $L_3 = \{a^m b^n \mid 1 \leq m \leq 5, n \geq 5\}$ **(D)** $L_4 = \{a^{n^2} \mid n > 1\}$

b. The production rules $\{S \rightarrow aS, S \rightarrow aA$ and $A \rightarrow b\}$ belongs to which type of the grammar?

(A) Left Linear Grammar
(B) Right Linear Grammar
(C) Context Free
(D) Left Regular Grammar

c. Which of the following is not true?

(A) For every NFA there is a DFA
(B) We can draw a parsing tree for Type 0 Grammar
(C) Every Left Linear grammar has a corresponding Right Linear grammar
(D) Either **(A)** or **(C)**

d. A DFA may contain

(A) Multiple moves from one state to other states on the same alphabet symbol
(B) ε - move
(C) No move at all
(D) One move from one state to other state on the same alphabet symbol

e. The string of terminals produced by the grammar $\{S \rightarrow aSb, S \rightarrow aA$ and $A \rightarrow b\}$

(A) $L = \{a^m b^n \mid m, n \geq 0\}$ **(B)** $L = \{a^m b^n \mid m, n \geq 1\}$

(C) $L = \{a^n b^n \mid n \geq 0\}$ **(D)** $L = \{a^n b^n \mid n \geq 1\}$

f. A function is computable

(A) If there exists a Turing Machine to compute that function
(B) If the function is not recursively enumerable
(C) If the function is not partial recursively enumerable
(D) Only if a DFA can be drawn for that

g. Which of the following defines successor function S(x) of x?

(A) S(x+1) = S(x) + 1 **(B)** S(x) = S(x) + 1
(C) S(x) = x + 1 **(D)** S(x) = S(x–1) + 1

h. Which of following CFG can't be simulated by a FSM

(A) $S \rightarrow Sa \mid a$
(B) $S \rightarrow ab\ X,\ X \rightarrow CY,\ Y \rightarrow a \mid aX$
(C) $S \rightarrow aSb \mid ab$
(D) None of these

i. When a NFA with 4 states are converted into corresponding DFA, then that DFA will contain _____ state

(A) 4 **(B)** 8
(C) 16 **(D)** 32

j. A Turing machine can not be designed to recognize

(A) Regular language **(B)** Context sensitive language
(C) Context free language **(D)** Free language

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Define a palindrome. Give an example of palindrome. **(3)**

b. For all $n \geq 0$, prove $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$. **(8)**

c. Counter example cannot be used to prove a statement however it is very useful to disprove a statement. Justify. **(5)**

Q.3 a. Distinguish between DFA and NFA. Give a formal definition of finite automata. **(8)**

b. Design the deterministic finite automata for the language.
$L = \{w : n_a(w) = <3, w \in (a, b)^*\}$ **(8)**

Q.4 a. Explain any four algebraic laws for regular expressions. **(8)**

b. Write the basis and inductive steps of definition of Regular Expression. **(8)**

Q.5 a. Find the language generated by the following grammars
(i) G_1: $S \rightarrow aS$, $S \rightarrow bA$, $A \rightarrow cA|b$
(ii) G_2: $S \rightarrow Sb$, $S \rightarrow Ac$, $A \rightarrow bA|c$ **(8)**

b. Show that $L = \{a^n b^n | n \geq 0\}$ is not a regular language. **(8)**

Q.6 a. Design a CFG to accept palindrome strings over 0's and 1's **(6)**

b. Define Push Down Automata (PDA) and give moves of the PDA that accepts $\{wcw^R | w \text{ in } (0+1)^*\}$ by empty stack **(10)**

Q.7 a. Write the procedure to convert a CFG in GNF. How it helps in removing ambiguity in a Type II grammar? **(8)**

b. State the pumping lemma of CFG. **(4)**

c. Write a short note on Chomsky hierarchy of languages. **(4)**

Q.8 a. Give definition of Restricted Turing Machine with a suitable example. **(8)**

b. Define proper subtraction and draw a Turing machine to compute it. **(8)**

Q.9 a. Define a Post Correspondence Problem (PCP). Show that S = {(b, bbb), (babbb, ba), (ba, a)} has a solution over $\Sigma = \{a, b\}$. **(8)**

b. State and prove the halting problem of Turing machine. **(8)**