ROLL NO. _____

Code: AC68 Subject: FINITE AUTOMATA & FORMULA LANGUAGES

AMIETE – CS

Time: 3 Hours **DECEMBER 2013** **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 Choose the correct or the best alternative in the following: (2×10)

a. If S = {11}, then S^+ is:

(A) S = {11, 1111, 111111, ….. } **(B)** S = {^, 11, 1111, ...}
(C) S = {1, 111, 1111, ….. } **(D)** S = {11, 111, 1111, ...}

b. Which of the following productions are regular:

(A) S → Aa | Sab **(B)** S → aS | b
(C) S → bAa | Sa **(D)** S → bAa | bS

c. The language generated by the production set P = { S → aSb | ab} is:

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

d. According to Arden's theorem if P, Q and R are regular expressions then the solution of the equation R = Q + R.P is given by:

(A) $R = PQ^*$ **(B)** $R = PQ^+$
(C) $R = P^*Q^*$ **(D)** $R = QP^*$

e. Which one of the following is *not* a regular expression:

(A) $[(0 + 1)^* + (0a + 1b)^*]$ **(B)** $[(0 + 1)^* + (0a^* + b)]$
(C) $[(0 + 1)^* - (0a + 1b)^*]$ **(D)** $[(01)^* + (0a^* + 1b)^*]$

f. The complement of a regular set is :

(A) Not regular **(B)** Regular
(C) Context free **(D)** Context sensitive

g. If a non-deterministic automata has 3 states, then it's equivalent DFA will have states:

(A) 3 **(B)** 6
(C) 9 **(D)** 8

h. Which of the following is *true* for recursively enumerable (RE) and recursive language (RL)

(A) RE $\subseteq$ RL **(B)** RL $\subseteq$ RE
(C) RL $\not\subset$ RE **(D)** RL = RE

i. The halting problem of a Turing machine is:

(A) Decidable **(B)** Semi-decidable
(C) Undecidable **(D)** None of these

j. Which of the following grammar is said to be ambiguous?

(A) Type - 2 **(B)** Type - 3
(C) Type - 0 **(D)** Type - 1

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

Q.2 a. Prove by mathematical induction $n^4 - 4n^2$ is divisible by 3 for $n \geq 0$. **(8)**

b. What is the need to study Automata Theory in computer science? **(8)**

Q.3 a. Minimize the following DFA having state q_5 as final state: **(10)**

Present State	Next State	
	Input 0	Input 1
q_0	q_1	q_2
q_1	q_3	q_4
q_2	q_5	q_6
q_3	q_3	q_4
q_4	q_5	q_6
q_5	q_3	q_4
q_6	q_5	q_6

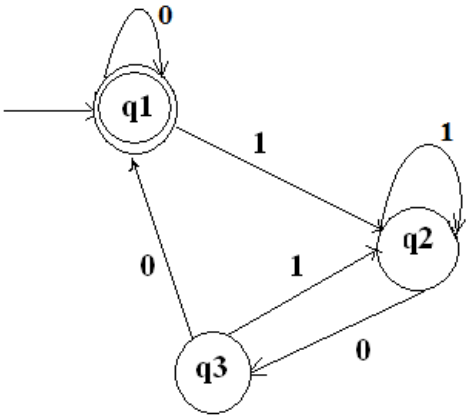
b. Design a finite automata for the language L = {w| w is of even length and w $\in$ (a, b)*}. **(6)**

Q.4 a. Let $V_N = \{S, B\}$, $V_T = \{a, b\}$, $P = \{S \rightarrow aBa, B \rightarrow aBa, B \rightarrow b\}$.
Find the language L(G) generated by the given grammar. **(8)**

b. Obtain the NFA without epsilon transition corresponding to the following regular expression:

$$0^*1(0 + 10^*1)^*$$ **(8)**

Q.5 a. Construct a regular expression corresponding to the state diagram given below **(8)**



b. Consider the following productions representing regular grammar G,

$S \rightarrow aA \mid a$

$A \rightarrow aA \mid aB \mid a$

$B \rightarrow bB \mid c$

Find the regular expression corresponding to regular grammar G. **(8)**

Q.6 a. Construct a PDA to accept strings containing equal number of 0's and 1's by null store. Show the moves of the PDA for the input string '011001'. **(10)**

b. What is ambiguity? Show that $S \rightarrow aS \mid Sa \mid a$ is an ambiguous grammar. **(6)**

Q.7 a. What are applications of pumping lemma in Chomsky's normal form? Convert the given grammar into Chomsky's Nf.

$S \rightarrow ASB$, $A \rightarrow aAS \mid a$, $B \rightarrow SbS \mid bB$ **(8)**

b. Find a reduced grammar equivalent to $G = (V_N, \Sigma, P, S)$ where set P is given as follows:

$S \rightarrow AB$, $A \rightarrow a$, $B \rightarrow b \mid C$, $D \rightarrow c$ **(8)**

Q.8 a. Design a Turing machine that recognizes all strings of even length over $\Sigma = (a, b)^*$ **(8)**

b. Write short note on universal Turing machine. **(8)**

Q.9 a. Prove that if a language L and it's complement L' are both recursively enumerable, then L is recursive. **(8)**

b. Define Post corresponding Problem (PCP). Check whether the following instance has no solution over $\Sigma = \{0, 1\}$. X and Y be the lists of the three strings as follows: **(8)**

	List A	List B
i	w_i	x_i
1	1	111
2	10111	10
3	10	0