ROLL NO. _____

Code: AC68/AC120
Subject: FINITE AUTOMATA & FORMAL LANGUAGES

AMIETE – CS (Current & New Scheme)

Time: 3 Hours **JUNE 2016** **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 x = 1010 and y = 0011 then the concatenation is given by

(A) 1101 **(B)** 10100011
(C) 00111011 **(D)** 1011

b. The highest type number which can be applied to the grammar S→aSb | ab | aA is

(A) 2 **(B)** 1
(C) 0 **(D)** 4

c. If L is recursive then $\overline{L}$ is:

(A) Recursively enumerable **(B)** Regular
(C) Recursive **(D)** CFG

d. A type 3 grammar is also known as:

(A) Context sensitive **(B)** Context free
(C) Recursive **(D)** Regular

e. The regular expression for L = {a, aa, aaa, ...} is given by

(A) a^* **(B)** a^+
(C) a + aa + aaa **(D)** None of these

f. The halting problem of Turing machine is:

(A) Decidable **(B)** Recursive
(C) Undecidable **(D)** None of these

g. A CFG is converted into CNF to

(A) Incorporate ambiguity **(B)** Reduce productions
(C) Remove ambiguity **(D)** None of these

h. If there are 4 states in an NDFA, the corresponding DFA will have at most or maximum

(A) 4 states **(B)** 8 states
(C) 16 states **(D)** 12 states

i. Which of the following is not a palindrome?

(A) xxyxx **(B)** xzyxyzx
(C) yzyxyzy **(D)** xyzyz

j. Consider the production rules S → 0S1 | 01. The language generated by these rules is

(A) L(G) = $\{0^n1^n \mid n \geq 0\}$ **(B)** L(G) = $\{0^n1^n \mid n \geq 1\}$
(C) L(G) = $\{(01)^n \mid n \geq 1\}$ **(D)** L(G) = $\{(01)^n \mid n \geq 0\}$

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

Q.2 a. Prove by mathematical induction $2^x \geq x^2$ for all $x \geq 4$. **(8)**

b. Define finite automata. Show that the string baababaab is accepted by the finite machine whose state transition table is given below: **(8)**

State	Input	
	a	b
Start State q_0	q_0	q_0, q_1
q_1	q_2	---
q_2	q_4	q_3
q_3	q_5	---
q_4	---	q_5
Final State q_5	q_5	q_5

Q.3 a. Find a DFA that accepts the language defined by the NFA, **(8)**
$M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$
where δ is given as follows:

State	Input	
	0	1
q_0	q_0, q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_3
q_3	----	q_2

b. Design DFA over $\sum = \{0, 1\}$ for the following: **(8)**
(i) $L = \{w \mid |w| \bmod 3 = 0\}$
(ii) $L = \{w \mid |w| \bmod 3 = 1\}$

Q.4 a. Give a grammar that specifies each of the following languages: **(8)**
(i) $L = \{aaaa, aabb, bbaa, bbbb\}$
(ii) $L = \{x \mid x \in (a, b)^*$, the number of a's in x is a multiple of 3$\}$

b. Enumerate different types of grammar under Chomsky Hierarchy with suitable examples. **(8)**

Q.5 a. Show that $L = \{a^n b^n \mid n > 0\}$ is not a regular set. **(8)**

b. Define regular expression. Let $\sum = \{a, b\}$. Write regular expressions for the following: **(4x2)**
(i) All strings in $\sum^*$ with ending at ab.
(ii) All strings in $\sum^*$ with no more than three a's.

Q.6 a. Construct a context free grammar generating the following language: **(8)**
$\{a^n b^n \mid n \geq 1\} \cup \{a^m b^{2m} \mid m \geq 1\}$

b. Construct a push down automata accepting $L = \{a^n c b^{2n} \mid n \geq 1\}$ by null store. **(8)**

Q.7 a. Define the two normal forms Chomsky and Greibach for context free grammar. **(8)**

b. Let G be $S \rightarrow AB$, $A \rightarrow a$, $B \rightarrow C|b$, $C \rightarrow D$, $D \rightarrow E$ and $E \rightarrow a$. Eliminate the unit productions and get an equivalent grammar. **(8)**

Q.8 a. Define Turing machine. Construct a Turing machine that replaces every a in the string of a's and b's with b and every b with a. **(8)**

b. Prove that a halting problem of Turing machine is undecidable. **(8)**

Q.9 a. Define the following languages. Also show the pictorial representation between them:
(i) Recursively enumerable
(ii) Recursive, and
(iii) Non-recursively enumerable **(10)**

b. Does the Post Correspondence Problem (PCP) with two lists $x = (b, bab^3, ba)$ and $y = (b^3, ba, a)$ have a solution? **(6)**