ROLL NO. ___________________

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

AMIETE – CS (Current & New Scheme)

Time: 3 Hours **June 2019** **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. Which is true for δ (q,ab):
(A) δ(q,a)∪ δ(q,b) **(B)** δ(δ(q,a),b)
(C) δ((q,a),b) **(D)** δ(q,a)∩ δ(q,b)

b. The minimal form of (R*)* is =
(A) R* **(B)** R* + R*
(C) R^+ + null **(D)** All of these

c. The regular expression for set of all strings of {a, b} that contain string ending is b and does not contain substring aa is given by
(A) (ba + ab)*b **(B)** (ab + bb)*b
(C) $(b + ab)^+$ b **(D)** None of these

d. When we convert a Finite Automata to CFG we get
(A) CFG **(B)** CSG
(C) Regular Grammar **(D)** Unrestricted Grammar

e. The intersection of a context free-language and a regular language is
(A) Context free **(B)** Regular but not context free
(C) Neither context free nor regular **(D)** Both regular and context free

f. Which of the following is not possible algorithmically?
(A) RE to CFG **(B)** NFA to DFA
(C) CFG to PDA **(D)** NPDA to DPDA

g. Complement of a recursive language is
(A) Recursive **(B)** Context Sensitive
(C) Recursive enumerable **(D)** Regular

h. A regular grammar is
(A) CFG **(B)** CSG
(C) Unrestricted **(D)** All of these

i. In a standard TM, δ (q ,a), q € Q, a € Ґ is
(A) defined for all (q,a) € Q × Ґ
(B) defined for some, not necessarily for all (q ,a) € Q × Ґ
(C) defined for no element (q , a) of Q × Ґ
(D) a set of triples with more than one element

j. (a + a*)* is equivalent to
(A) a(a*)* **(B)** a*
(C) aa* **(D)** None of these

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

Q.2 a. Explain principle of strong mathematical induction and use it to prove for every $n \geq 2$, number n is either a prime or a product of two or primes. **(3+5)**

b. Define automaton, give its model and explain characteristics of automaton. **(8)**

Q.3 a. State and formally, prove equivalence of NDFA and DFA by defining all five tuples and using mathematical induction. **(8)**

b. Design Deterministic finite automata for the following over subsets of {0,1}*:
(i) The string containing even number of zeros and odd number of ones.
(ii) The string ending in 1 and does not contain the substring 00.
(iii) The language of all strings containing exactly two zeros.
(iv) The language of all strings does not end with 01. **(2×4)**

Q.4 a. Give regular expression for each of the following over {0,1}: **(2×3)**
(i) The language of all strings in which number of 0's are even.
(ii) The language of all strings in which every zero is immediately followed by 11.
(iii) The set of all strings which has at most two zeros.

b. Construct the finite automaton equivalent to the regular expression (0+1)*(00+11)(0+1)* using following steps.
(i) Convert the given regular expression to NFA
(ii) Convert the NFA obtained from step (i) to DFA.
(iii) Minimize the DFA obtained from step (ii). **(3+4+3)**

Q.5 a. State and prove Pumping Lemma for regular languages. Check whether the language L = {xx | x €{a,b}* }is regular or not? **(4+4)**

b. Prove any regular language can be accepted by a finite automaton. **(8)**

Q.6 a. Give CFG for L ={x € {0,1}* | $n_0(x) \neq n_1(x)$} and check for the ambiguity for the Grammar S→SS|a|b **(4+4)**

b. Define DPDA & give DPDA without null for the L = {w € (0,1)*| $n_0(w) > n_1(w)$}. **(3+5)**

Q.7 a. Convert the following grammar to CNF:
S→AACD A → aAb|Λ C→aC|a D→aDa|bDb|Λ **(8)**

b. State & prove pumping lemma for CFG and check whether L = {$a^i b^i c^i$ | $i \geq 1$} is context free or not. **(8)**

Q.8 a. Design a Turing Machine accepting language L = {xx | x €{0,1}* }. **(8)**

b. Design a Turing Machine that creates a copy of input string to the right of the input over input alphabet [a,b]*. **(8)**

Q.9 a. Prove if L_1 and L_2 are recursive enumerable languages over ∑ then $L_1 \cup L_2$ and $L_1 \cap L_2$ are also recursively enumerable. **(8)**

b. Explain PCP and MPCP problems and prove that PCP is unsolvable. **(8)**