ROLL NO. _____

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

AMIETE – CS (Current & New Scheme)

Time: 3 Hours **June 2018** **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 of the following statements is true?

(A) If a language is context free it can always be accepted by a deterministic push-down automaton

(B) The union of two context free languages is context free

(C) The intersection of two context free languages is context free

(D) The complement of a context free language is context free

b. Consider the grammar:

S→aSbS/ bSaS/ ε

The smallest string for which the grammar has two derivation trees:

(A) abab **(B)** aabb

(C) bbaa **(D)** aaabbb

c. A minimal DFA that is equivalent to an NDFA has:

(A) Always more states **(B)** Always less number of states

(C) Exactly 2^n states **(D)** Sometimes more states

d. Which of the following are not equivalent to expression (a + b + c)*?

(A) (a* + b* + c*)* **(B)** ((ab)* + c*)*

(C) (a* b* c*)* **(D)** (a* b* + c*)*

e. Which of the following is true for the following grammar?

E → E + E

E → E * E

E → id

(A) * has precedence over + **(B)** + has precedence over *

(C) Both are of same precedence **(D)** None of these

f. Consider three decision problems P1, P2 and P3. It is known that P1 is decidable and P2 is undecidable Which one of the following is true?
(A) P3 is decidable if P1 is reducible to P3
(B) P3 is undecidable if P3 is reducible to P2
(C) P3 is undecidable if P2 is reducible to P3
(D) P3 is decidable if P3 is reducible to P2's complement

g. Based on the accepting power, which of the following is true?
(A) Type 0 ⊂ Type 1 ⊂ Type 2 ⊂ Type 3
(B) Type 0 ⊂ Type 2 ⊂ Type 1 ⊂ Type 3
(C) Type 0 ⊃ Type 1 ⊃ Type 2 ⊃ Type 3
(D) Type 0 ⊃ Type 2 ⊃ Type 1 ⊃ Type 3

h. Finite automata can be used in
(A) Lexical Analysis **(B)** Syntax Analysis
(C) Semantic Analysis **(D)** None of these

i. The statement "A Turing machine can't solve halting problem" is
(A) True **(B)** False
(C) Still an open question **(D)** False when P!= NP

j. Let G and G1 be a CFG with productions
G : S → S + S | S*S | (S) | a
G1 : S → S + T | T
T → T*F | F
F → (S) | a
Then which of the following is true?
(A) L(G) ≠ L(G1) **(B)** L(G1) ⊆ L(G)
(C) L(G) ⊂ L(G1) **(D)** L(G) = L(G1)

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

Q.2 a. Explain the term finite Automata and formal languages. Why to study automata theory ? **(4)**

b. Explain the terms **(3+3+3+3)**
(i) DFA (ii) NFA (iii) NFA with epsilon moves (iv) 2-way finite automata

Q.3 a. Differentiate between Mealy and Moore machine. Construct a Moore machine to compute residue modulo for base 4(0,1,2,3) and convert it to Equivalent Mealay machine. **(8)**

b. Discuss various models of FA with output and Construct DFA for the following Languages:
(i) L1= {w: w ε (a + b)* w has "baab" as a substring.
(ii) L2= {w: w ε (a + b)* w has even number of a's and odd number of b's. **(4+4)**

Q.4 a. What is regular expression? Explain different properties of regular expressions and design regular expressions for following languages: **(4+2+2)**
(i) L= {w: w ε (a + b)* w has odd number of a's
(ii) L= {$a^n b^m$ | n≥ |3|, m ≤2}

b. Discuss Arden's Theorem and find out regular expression for given FA **(8)**

Q.5 a. Explain various closure properties of regular sets and with the help of Pumping lemma prove whether following language is regular or not: L1= {$a^n b^n$ | n>1}? **(8)**

b**.** What do you mean by derivation of tree? Explain left most and right most derivation tree and how these derivations are useful in deciding the ambiguity of any grammar. **(8)**

Q.6 a. Construct a DPDA which recognize the set of strings over {a,b}with equal number of a's and b's such that all a's and b's are consecutive & show that PDA having acceptance by final state and empty stack have equivalent language recognizing power**.** **(8)**

b. Let M= (q, {a, b,c}, {Z_0, A}, δ, q, Z_0, φ) be a PDA where transition function δ is given below: **(4+4)**
δ (q, a, Z_0)={(q, AZ_0)} δ (q , a, A)={(q_0,AA)} δ (q, c, A)={(q, A)} δ (q, b, A) ={(
q ,ε)} and
δ (q, ε,Z_0)={(q, ε)}
(i)What is the language accepted by this PDA.
(ii) Construct CFG equivalent to this PDA

Q.7 a. Using pumping lemma for CFL prove that below languages are not context free {p | p is a prime}. **(8)**

b. Why we use normal forms? Explain various normal forms and consider the grammar ({S, A, B},
{a,b}, P, S) with productions S→ bA|aB A→ bAA|aS|a B→ aBB|bS|b
and find an equivalent grammar in CNF. **(8)**

Q.8 a. Explain Turing Machine model and Design a Turing Machine for L= {$a^n b^n c^n$ | n≥1} **(8)**

b. Design a Turing machine to accept a Palindrome. **(8)**

Q.9 a. What do you think about P=NP? (i) Is it undecidable? (ii) Is it decidable? Explain your view. **(8)**

b. Write short note on the following: **(4+4)**
(i) Post's Correspondence Problem
(ii) Recursively enumerable languages