ROLL NO. _____

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

AMIETE – CS (Current & New Scheme)

Time: 3 Hours **DECEMBER 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. Grammars that can be translated to DFAs:

(A) Left linear grammar **(B)** Right linear grammar
(C) Generic grammar **(D)** All of these

b. If language L={0,1}*, then the reversed language L^R =

(A) {0,1}* **(B)** {}*
(C) {1}* **(D)** {0}*

c. Let L be the language generated by regular expression 0*10* and accepted by the deterministic finite automata M. Consider the relation RM defined by M. As all states are reachable from the start state, RM has ..... equivalence classes.

(A) 2 **(B)** 4
(C) 5 **(D)** 6

d. Let L = {0^n1^n | n≥0} be a context free language. Which of the following is correct?

(A) L' is context free and L^k is not context free for any k≥1
(B) L' is not context free and L^k is context free for any k≥1
(C) Both L' and L^k are context free for any k≥1
(D) Both L' and L^k are not context free for any k≥1

e. Match the following :

List - I	**List - II**
(a) {a^nb^n|n> 0} is a deterministic context free language	**(i)** but not recursive language
(b) The complement of {a^nb^na^n|n> 0} is a context free language	**(ii)** but not context free language
(c) {a^nb^na^n} is context sensitive language Automation	**(iii)** but cannot be accepted
(d) L is a recursive language	**(iv)** but not regular

Codes: (a) (b) (c) (d)
(A) (i) (ii) (iii) (iv)
(B) (i) (ii) (iv) (iii)
(C) (iv) (iii) (ii) (i)
(D) None of the above is correct match

f. The language of all non-null strings of a's can be defined by a context free grammar as : S→a S|S a| a
The word a^3 can be generated by _____ different trees
(A) 2 **(B)** 3
(C) 4 **(D)** 5

g. There are exactly _____ different finite automata with three states x, y and z over the alphabet {a, b} where x is always the start state.
(A) 64 **(B)** 256
(C) 1024 **(D)** 5832

h. A grammar G is LL(1) if and only if the following conditions hold for two distinct productions $A \rightarrow \alpha \mid \beta$
a.I. First (α) ∩ First (β) ≠ {a} where a is some terminal symbol of the grammar.
b. II. First (α) ∩ First (β) ≠ λ
c. III. First (α) ∩ Follow(A) = φ if λ ϵ First (β)
(A) I and II **(B)** I and III
(C) II and III **(D)** I,II,III

i. A Given a Turing Machine
M = ({q0,q1,q2,q3}, {a,b}, {a,b,B}, δ, B, {q3})
Where δ is a transition function defined as
δ(q0,a) = (q1,a,R) , δ(q1,b) = (q2,b,R) ,δ(q2,a) = (q2,a,R) ,δ(q2,b) = (q3,b,R)
The language L(M) accepted by the Turing Machine is given as:
(A) aa*b **(B)** abab
(C) aba*b **(D)** aba*

j. Regular expression for the complement of language L = {a^nb^m I n ≥ 4, m ≤ 3} is
(A) (a + b)* ba(a + b)* **(B)** a* bbbbb*
(C) (λ + a + aa + aaa)b* + (a + b)* ba(a + b)* **(D)** None of the above

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

Q.2 a. Define the transition graph and transition table for a deterministic finite automaton (DFA). **(5)**

b. Deign a DFA to accept the language L={w|w is of even length and begin with 01}. **(5)**

c. Give nondeterministic finite automata to accept the following languages over {0,1}*
(i) The set of all strings containing exactly two occurrences of 01
(ii) The set of all strings such that everyone is followed immediately by 00. **(3+3)**

Q.3 a. Show that if L is regular, so is L^R. **(5)**

b. Find the regular expression for the following language:
(i) The complement of L={ a^nb^m; n< 4,m≤3}
(ii) L={w€{0,1}*} **(3+3)**

c. Show that 0+1+2+.....+n=n(n+1)/2 for every n≥0 . **(5)**

Q.4 a. How that any regular grammar G for which L (G)≠ Ø must have at least one production of the form A⟶ x, where A € V and x € T*. **(6)**

b. Construct the right and left linear grammar for the language L={a^nb^m; n ≥ 2,m ≥ 3} **(4)**

c. Show that the language L={$a^nb^kc^{n+k}$;n ≥ 0, k ≥ 0}is not regular. **(6)**

Q.5 a. Show that the following grammar is ambiguous and construct the unambiguous grammar equivalent grammar for the following: **(3+3)**

S ⟶ AB/aaB, A ⟶ a/Aa, B ⟶ b

b. Eliminate the useless production from the following: **(5)**

S ⟶ a/a A/B/C
A ⟶ aB/λ
B ⟶ Aa
C ⟶ cCD
D ⟶ ddd.

c . Convert the following grammar to Chomsky normal form **(5)**

S ⟶ ABa
A ⟶ aab
B ⟶ Ac

Q.6 a. Construct the puhdown automaton(PDA) which accepts the language L={wcw^T; w€{a,b}* } by final state. **(6)**

b. Explain Finite Automate in Detail. **(5)**

c. Show that any left linear grammar is unambiguous. **(5)**

Q.7 **a.** Sketch the construction of Turing machine that can perform addition and multiplication of a positive integer x and y given in the usual decimal notation. **(8)**

b. Construct a Turing machine to compute the function : **(8)**
$f(w)=w^R$, where $w \in \{0,1\}^+$

Q.8 **a.** Prove that $A_{\text{context sensitive grammer}}$ is decidable, where $A_{\text{context sensitive grammer}}$={(G,w)| the context sensitive grammar G accepts the input string w**}.(8)**

b. Show that there exists a language over Σ that is not recursively enumerable. **(8)**

Q.9 **a.** Prove that the following language is not context free language: **(6)**
$L=\{a^n b^n; n \geq 0, n \neq 0\}$

b. The family of linear languages is not closed under intersection. Justify with example **(5)**

c. Let L1 be a context free language and L2 be regular. Show that there exit an algorithm to determine whether or not L1 and L2 have common element. **(5)**

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