ROLL NO. _____

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

AMIETE – CS (Current & New Scheme)

Time: 3 Hours **December 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. Which of the following statements is correct?

(A) A = { If $a^n b^n$ | n = 0,1, 2, 3 ..} is regular language
(B) Set B of all strings of equal number of a's and b's defines a regular language
(C) L (A* B*)∩ B gives the set A
(D) None of these

b. Which of the following CFG's can't be simulated by an FSM?

(A) S --> Sa | b
(B) S --> aSb | ab
(C) S --> abX, X --> cY, Y --> d | aX
(D) None of these

c. A class of language that is closed under

(A) union and complementation has to be closed under intersection
(B) intersection and complement has to be closed under union
(C) union and intersection has to be closed under complementation
(D) both **(A)** and **(B)**

d. Following context free grammar

S —> aB | bA
A —>b | aS | bAA
B —> b | bS | aBB

Generates strings of terminals that have

(A) equal number of a's and b's
(B) odd number of a's and odd number b's
(C) even number of a's and even number of b's
(D) odd number of a's and even number of a's

e. Pumping lemma is generally used for proving that

(A) given grammar is regular
(B) given grammar is not regular
(C) whether two given regular expressions are equivalent or not
(D) None of these

f. The language of all words with at least 2 a's can be described by the regular expression

(A) (ab)*a and a (ba)* **(B)** (a + b)* ab* a (a + b)*
(C) b* ab* a (a + b)* **(D)** all of these

g. Which of the following statement is wrong?

(A) Any regular language has an equivalent context-free grammar.
(B) Some non-regular languages can't be generated by any context-free grammar
(C) Intersection of context free language and a regular language is always context-free
(D) All languages can be generated by context- free grammar

h. CFG can be recognized by a

(A) push-down automata **(B)** 2-way linear bounded automata
(C) both **(A)** and **(B)** **(D)** none of these

i. A given grammar is called ambiguous if

(A) two or more productions have the same non-terminal on the left hand side
(B) a derivation tree has more than one associated sentence
(C) there is a sentence with more than one derivation tree corresponding to it
(D) brackets are not present in the grammar

j. What is the highest type number which can be applied to the following grammar?
S —> Aa, A —> Ba, B —> abc
(A) Type 0 **(B)** Type 1
(C) Type 2 **(D)** Type 3

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

Q.2 a. Prove that; Every Expression has equal left and right parenthesis. **(5)**

b. Given the NDFA as shown in Fig.1. Determine the equivalent DFA for the above given NDFA. **(5)**

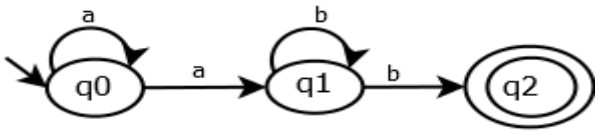

Fig. 1

c. Design an **ε-**NFA that accepts decimal numbers consisting of :
(1) An optional + or – sign (2) a string of digits (3) a decimal point (4) Another string of digits. Either this string of digits (2) be empty, but at least one of the two strings of digits must be non empty. **(6)**

Q.3 a. Use induction on to show that | un | = n| u| for all strings u and all n. **(6)**

b. Given L is the language that is accepted by NFA in Fig. 2. Determine an NFA that accepts L U $\{a^5\}$. **(10)**

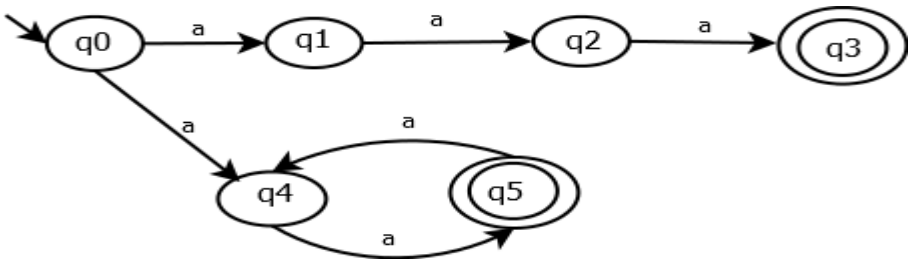

Fig. 2

Q.4 a. Find the regular expressions for the language defined by.

(i) L1= { $a^n b^m$: n≥ 1, m≥ 1, nm≥ 3}

(ii) L2= { ab^n w : n≥ 3, w € $\{a, b\}^+$}

(iii) L3= { vwv: v, w € $\{a, b\}^*$,|v|=2 }

(iv) L4= { w: |w| mod 3=0} **(2x4 = 8)**

b. Prove that L= { $a^n b^k$: n ≥ k and n ≥ 0} is not regular. **(4)**

c. Find the right linear grammar for the language L ((aab*ab)*) **(4)**

Q.5 a. Prove that the language L is given by L={$a^n b^n$| n≥, n ≠1000} is context free. **(6)**

b. What is derivation tree? Explain with example. **(5)**

c. Prove that the class of regular set is closed under complementation. **(5)**

Q.6 a. Given a CFG as G=(){S,A,B,C,E},{ a, b, c } ,P,S) with production given by

S -> AB
A -> a
B ->b
B ->C
E -> c/ λ

Obtain L (G) and obtain an equivalent grammar L (G_1) by eliminating useless terminals and productions. **(8)**

b. Obtain a grammar in Chomsky Normal Form (CNF) equivalent to the grammar G with productions P given by: **(8)**

S -> ABa
A -> aab
B -> AC

Q.7 a. Construct PDA accepting { $a^n b^m a^n$ | m, n ≥ 1} by final state. **(10)**

b. Prove that the class of CFLs is not closed under the intersection operation. **(6)**

Q.8 a. Define the Linear bounded automata. **(6)**

b. Design a turing Machine to add two given integers. **(10)**

Q.9 a. Prove that " P is a property of languages that is satisfied by some but not all recursively enumerable languages, then decision problem:

D: Given a TM, does not L(TM) have property P is unsolvable **(10)**

b. Define Post coresspondance problem. **(6)**