ROLL NO. _____

Code: AC68 Subject: FINITE AUTOMATA & FORMAL LANGUAGES

AMIETE – CS

Time: 3 Hours **DECEMBER 2014** **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. In Context free Grammar, Left hand side of a production consists of

(A) One non-terminal
(B) More than one non- terminal
(C) One terminal
(D) Terminals and non-terminals

b. For the set P(P(ø)), the number of elements are:

(A) 16 **(B)** 2
(C) 4 **(D)** 1

c. The language defined by the regular expression $r_1\ r_2$ is

(A) $L(r_1)L(r_2)$
(B) $L(r_1) \cup L(r_2)$
(C) $L(r_1)$ - $L(r_2)$
(D) None of these

d. The language of all words (made up of 0's and 1's) with at least two 0's can be described by the regular expression.

(A) 0(0+1)0(0+1)(0+1)01
(B) (0+1)010(0+1)
(C) 1010(0+1)
(D) All of these

e. Which of the following grammars are not ambiguous?

(i) $S \rightarrow S \mid S, S \rightarrow a$

(ii) $S \rightarrow a\ aAb\ abSb$
$A \rightarrow aAAb\ bS$

(iii) $S \rightarrow aB \mid ab$
$A \rightarrow aAB \mid a$
$B \rightarrow ABb \mid b$

(A) (i) only
(B) (i) and (iii)
(C) (i) and (ii)
(D) All of these

f. Data structure used in a Push down Automation (PDA) is

(A) Linked List
(B) Queue
(C) Stack
(D) Array

g. Which of the following Statements are true?
(i) Every context-free language is context-sensitive.
(ii) There exists a context-sensitive language that is not context-free.
(iii) Every context-sensitive language need not be recursive.

(A) (i) and (ii)
(B) (ii) and (iii)
(C) All statements are true
(D) None of these

h. A parse tree for a string in L(G) is a tree where

(A) The root is the start symbol for G
(B) The leaf nodes are the terminal symbols of G
(C) The children of a node T (from left to right) correspond to the symbols on the right hand side of some production for T in G.
(D) All of these

i. There are _____ tuples in Turing machine.

(A) 4
(B) 5
(C) 6
(D) 7

j. The following problem(s) are called decidable problem(s).

(A) The two Finite Automata's are equivalent
(B) The two regular expressions define the same language
(C) Both **(A)** and **(B)**
(D) None of these

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

Q.2 a. Given A= {1, 3, 5, 6} Determine P (A) (Power set of A). **(2)**

b. Illustrate the terms- Language, Concatenation of Language, String and Concatenation of String. Explain each term with suitable example. **(6)**

c. Use mathematical induction to show that $\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}$ **(8)**

Q.3 a. What are the Applications of Finite Automata? Also Define DFA and NFA. **(4)**

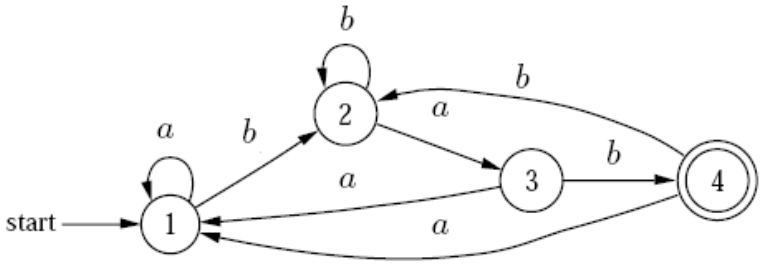
b. Construct a DFA to accept strings of 0's and 1's having a sub string 00. **(4)**

c. Obtain the equivalent DFA for the given NFA, M= ($\{q_0, q_1, q_2\}$, {a, b}, δ, q_0, $\{q_1\}$) with transition table as given below. **(8)**

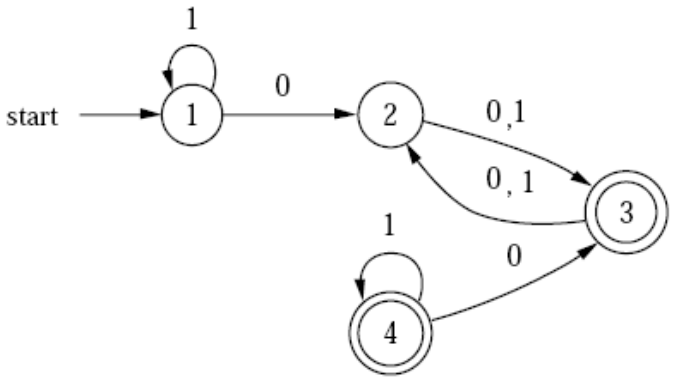
	a	b
q_o	$\{q_1, q_2\}$	$\varnothing$
q_1	$\varnothing$	$\{q_2\}$
q_2	$\varnothing$	$\{q_2\}$

Q.4 a. Define ambiguous grammar. Show that which of the following regular expressions are ambiguous or not? **(8)**
(i) 1101***** $\cup$ 11101 $\cup$ 11001***** $\cup$ 1
(ii) a((ab)*****cd) ***** $\cup$ a(ababcb***)***a*****

b. Find the languages accepted by the following automata: **(8)**
(i)



(ii)



Q.5 a. Define Context free grammar (CFG).Explain the language (in English) generated by the following Context free grammar: **(3+4)**

$S \rightarrow XY$

$X \rightarrow 0X \mid 1X \mid \Lambda$

$Y \rightarrow 100 \mid 101 \mid 110 \mid 111$

b. Write Short Notes on the following with suitable example: **(3×3)**
(i) Right Linear Grammar
(ii) Left Linear Grammar
(iii) Parse Trees

Q.6 a. Given $L = \{0^m 1^n \mid m < n\}$. Construct **(4×3)**
(i) a context-free grammar that accepts L
(ii) a Pushdown automata(PDA) accepting L by empty store
(iii) a Pushdown automata(PDA) accepting L by final state

b. What are the differences between the Non- Deterministic Pushdown automata (NPDA) and Deterministic Pushdown automata (DPDA)? **(4)**

Q.7 a. State the Pumping Lemma theorem. Prove that the language $L = \{a^n b^n\}$, $n \in N$ is non-regular using the pumping lemma. **(8)**

b. Explain the following: **(4+4)**
(i) Normal forms for Context free Grammars
(ii) Conversion from PDA to CFG

Q.8 a. Explain problems that Computers cannot solve. Use an example to illustrate. **(6)**

b. Define Turing machine. Construct a Turing machine to accept the language that adds two given integers. **(10)**

Q.9 a. Show that the Post Correspondence Problem (PCP) is decidable if the alphabet is unary, i.e., $\Sigma = \{1\}$. **(8)**

b. Prove that if a Language L_1 is recursive and L_2 is recursively enumerable, then $L_2 - L_1$ is necessarily recursively enumerable. **(8)**