ROLL NO. ___________________

Code: AC68 Subject: FINITE AUTOMATA & FORMULA LANGUAGES

AMIETE – CS (Current Scheme)

Time: 3 Hours **JUNE 2015** **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. If two finite state machines are equivalent they should have the same number of

(A) States **(B)** Edges
(C) State and Edges **(D)** None of these

b. For which of the following application regular expression cannot be used?

(A) Designing compiler **(B)** Developing text editors
(C) Simulating sequential circuits **(D)** All of these

c. The basic limitation of a FSM is that

(A) It cannot remember arbitrary large amount of information
(B) It sometimes recognizes grammars that are not regular
(C) It sometimes fails to recognize grammars that are regular
(D) All of the these

d. Which of the following is the most general phase structured grammar?

(A) Regular **(B)** Context- sensitive
(C) Context free **(D)** None of these

e. For input null, output produced by a mealy machine is

(A) Null **(B)** Dependent on present state
(C) Depends on given machine **(D)** Cannot decide

f. Given the language L = {ab, aa, baa}, which of the following strings are in L*?
(i) abaabaaabaa (ii) aaaabaaaa (iii) baaaaabaaaab (iv) baaaaabaa

(A) (i), (ii) and (iii) **(B)** (ii), (iii) and (iv)
(C) (i), (ii) and (iv) **(D)** (i), (iii) and (iv)

g. The following grammar
$G = (N, T, P, S)$
$N = \{S, A, B, C, D, E\}$
$T = \{a, b, c\}$
$P : S \rightarrow aAB$

$AB \rightarrow CD$
$CD \rightarrow CE$
$C \rightarrow aC$
$C \rightarrow b$
$bE \rightarrow bc$ is

(A) type 3 **(B)** type 2 but not type 3
(C) type 1 but not type 2 **(D)** type 0 but not type 1

h. Consider the following language
$$L = \{a^n b^n c^n d^n \mid n \geq 1\}$$
L is

(A) CFL but not regular **(B)** CSL but not CFL
(C) Regular **(D)** Type 0 language but not type 1

i. The regular expression for the following DFA is :-

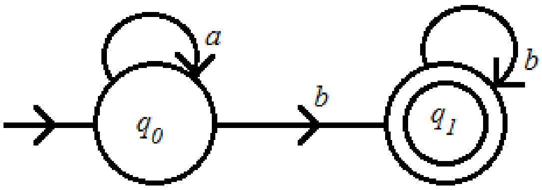

Fig. 1

(A) a + bb* **(B)** (a + b)*
(C) bb*a **(D)** a*bb*

j. Which string is not accepted by the following FSA?

(A) 00111 **(B)** 01010
(C) 00110 **(D)** 11010

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

Q.2 a. Prove that for every positive integer n; the number of subsets of an n-element set is 2^n (using mathematical induction). **(8)**

b. Define Chomsky hierarchy with its automation and production rules. **(8)**

Q.3 a. Find a deterministic finite accepter that recognizes the set of all strings on X:{a, b} starting with the prefix ab. **(8)**

b. Define a non-deterministic automata. Convert the NFA M = ({q_0, q_1, q_2}, {0, 1}, δ, q_0, {q_2}) into a DFA. The transition function δ is given as:- **(8)**

δ	0	1
→ q_0	q_0	q_0, q_1
q_1	q_2	q_2
q_2	ϕ	ϕ

Q.4 a. Find a regular expression for the language,
L = {W €{0,1}*: W has no pair of consecutive zeros}. **(8)**

b. Convert the regular expression to NFA with $\in$-transition.
r.e. $\Rightarrow (0+1)^* \mid (0+1)$ **(8)**

Q.5 a. Prove that if L and M are regular languages, then $L \cap M$ is also regular. **(8)**

b. Using the pumping lemma to show that L:{$a^n b^n$: $n \geq 0$} is not regular. **(8)**

Q.6 a. Prove that language L = {$a^n b^m$: $n \neq m$} is context free language. **(8)**

b. Construct an npda for the language **(8)**
L = { w €{a,b}* : $n_a(w) = n_b(w)$}.

Q.7 a. Convert the grammar with start symbol S, to Chomsky normal form. Show all the relevant steps briefly. **(8)**
S→ε | c ST | TSc | SS,
T→ a | b

b. Show that language L = {$a^n b^n$: $n \geq 0$, $n \neq 100$} is context free. **(8)**

Q.8 a. Proceed with the following tasks: **(8)**
(i). Draw a state diagram of a Turing Machine M recognizing the language L = { $a^n b^n a^n$ $n \geq 0$} over the alphabet ∑ = {a, b}.

(ii). Consider the input string w = aabbaa. Write the whole sequence of configurations that M will enter when run on w.

(iii). Does M accept w?

b. Define Turing Machine and explain it's working. Also define the language accepted by a TM. **(8)**

Q.9 a. Define the Turing Machine Halting Problem. **(8)**

b. Define the Post Correspondence Problem. **(8)**
Let $\sum = \{0, 1\}$ and take A and B as
$w_1 = 11$, $w_2 = 100$, $w_3 = 111$
$v_1 = 111$, $v_2 = 001$, $v_3 = 11$. Give a PC solution for this problem.
If we take
$w_1 = 00$, $w_2 = 001$, $w_3 = 1000$
$v_1 = 0$, $v_2 = 11$, $v_3 = 011$
Then, is there PC solution exist? Justify your answer.