ROLL NO. _____

Code: AC68 Subject: FINITE AUTOMATA & FORMULA LANGUAGES

AMIETE – CS (NEW SCHEME)

Time: 3 Hours **JUNE 2012** **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 is <u>not</u> a regular language?

(A) $L_1 = \{a^n b^n c^n \mid n \geq 0\}$ **(B)** $L_2 = \{a^5 b^{10} c^{100}\}$
(C) $L_3 = \{a^m b^n \mid 1 \leq m \leq 5, n \geq 5\}$ **(D)** $L_4 = \{a^n \mid n \neq 3\}$

b. For which type of the grammar a derivation tree can not be drawn?

(A) Regular Grammar **(B)** Context Sensitive
(C) Context Free **(D)** Left Regular Grammar

c. In a DFA defined over $\Sigma = \{a, b\}$ and with number of states equal to FOUR, how many entries are there in its transition table?

(A) 16 **(B)** 4
(C) 2 **(D)** 8

d. Language produced by the grammar with productions: $S \rightarrow aS$, $S \rightarrow aA$ and $A \rightarrow b$ is

(A) a*ab **(B)** $(a \vee b)^*b$
(C) $(a \vee b)^*a$ **(D)** $(ab)^*b$

e. Concatenation of two regular languages yields

(A) Context free language **(B)** Context Sensitive Language
(C) A palindrome **(D)** Regular language

f. A problem is said to un-decidable if there exists

(A) No Turing Machine that always terminates.
(B) No push down automata
(C) Turing Machine that terminates when solution exists but may loop when there is no solution.
(D) No Finite Automata

g. A grammar is converted into CNF to

(A) Remove ambiguity, if any
(B) Incorporate ambiguity, if any
(C) CNF has nothing to do with ambiguity of a grammar
(D) None of the above.

h. A language is said to be ambiguous if

(A) There exists an ambiguous grammar for the language
(B) All grammar generating the language must be ambiguous
(C) There exists no terminating Turing machine for language
(D) There exists non deterministic push down automata

i. For a given Finite Automata, an equivalent ……. language can be determined.

(A) Regular **(B)** context-free
(C) Free language **(D)** Context sensitive

j. Which of the following does not characterize a FA as NFA

(A) ε - Move **(B)** Multiple moves on same symbol
(C) One move on multiple symbols **(D)** No move from a state

---

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

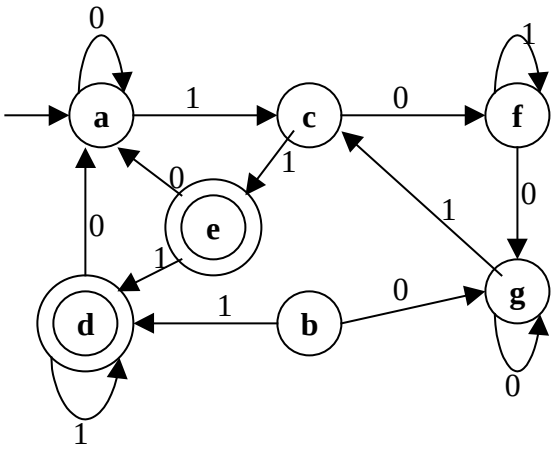
Q.2 a. Write in brief the application of Finite Automata in Computer Science. **(4)**

b. A palindrome is defined as a string that reads the same forward and backward. Give the alternative (formal language theory) definition of a palindrome. **(4)**

c. For the language L = {w = 10^{*} b (010) a}, write its set of alphabets, represent L in set theoretic notation and show that L contains infinite number of strings.**(8)**

Q.3 a. Give regular expression for
(i) all strings of 0's and 1's with atleast two consecutive 0's.
(ii) all strings of 0's and 1's beginning with 1 and not having two consecutive 0's.
(iii) all strings of 0's and 1's ending in 011. **(6)**

b. Simplify the following FSM showing each step involved in minimization. **(10)**



Q.4 a. Draw a DFA for the language $L = \{b^k a^m \mid k, m \geq 0, k \neq 2, m \neq 3\}$ **(6)**

b. Prove that languages generated by the following two grammars are same
$G_1 : S \rightarrow aS, S \rightarrow bA, A \rightarrow b$
$G_2 : S \rightarrow aS, S \rightarrow Ab, A \rightarrow b$
What happens when first production in G_2 i.e. $S \rightarrow aS$ is changed to $S \rightarrow Sa$?
(10)

Q.5 a. Prove that regular expressions $(a + b + aa)^*$ and $(a + b)^*$ over $\Sigma = \{a, b\}$ are equivalent. **(8)**

b. Show that $L = \{a^m b^n \mid m, n \geq 0\}$ is a regular language whereas $L = \{a^n b^n \mid n \geq 0\}$ is not a regular language. **(8)**

Q.6 a. Show that the language $L = \{a^n \mid n$ is an integral power of $2\}$ is generated by the following grammar **(10)**

(i) $S \rightarrow ACaB$, (ii) $Ca \rightarrow aaC$,
(iii) $CB \rightarrow DB$, (iv) $CB \rightarrow E$,
(v) $aD \rightarrow Da$, (vi) $AD \rightarrow AC$
(vii) $aE \rightarrow Ea$ (viii) $AE \rightarrow \varepsilon$

b. Draw a PDA that accepts a palindrome. **(6)**

Q.7 a. When a Context Free Grammar is said to be in CNF and GNF? How it helps in removing ambiguity in a Type III grammar? **(8)**

b. Prove that $L = \left\{ a^i b^j c^k \middle| i < j < k \right\}$ is not a context-free language. **(8)**

Q.8 a. Prove that halting problem of Turing machine is not decidable. **(8)**

b. Design a Turing machine to accept the language $\left\{ a^n b^n \middle| n \geq 1 \right\}$. **(8)**

Q.9 Write short notes on any **TWO** of the following:

(i) Post Correspondence Problem
(ii) Recursively enumerable language
(iii) Computational Complexity **(8+8)**