



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 214221

Roll No.

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**MCA**

**(SEM. II) THEORY EXAM. 2014-15  
INTRODUCTION TO AUTOMATA  
THEORY AND LANGUAGES**

Time : 3 Hours]

[Total Marks : 100

**Note :** Attempt the questions as indicated.

**Q1.** Attempt any *four* questions from the following :  $5 \times 4 = 20$

- a) Let  $L_1$  and  $L_2$  be two language sets then compute  $L_1 + L_2$ , if  $L_2 = \epsilon$  (null string).
- b) Construct a NFA that accepts the set of all strings containing at least two 0's where  $\Sigma = \{0, 1\}$ .

- c) Define a NFA and compute its language.
- d) Prove that  $(111^*)^* = (11 + 111)^*$ .
- e) Construct a NFA with  $\epsilon$ -moves for the regular expression  $(01)^*(0+1)^*$ .
- f) Show that if  $L$  is a regular language, then  $L^n$  is regular for  $n \geq 0$ .

**Q2.** Attempt any *two* questions from the following : - 10x2=20

- a) Define regular expression. Describe the language denoted by the regular expression  $(0+1)^* 1^* (0+1)^*$ .
- b) Let  $\Sigma = \{0,1\}$ , then prove that  $L = \{0^i 1 1^j \mid j \text{ is a multiple of } i\}$  is not regular.
- c) Prove that complement of a regular language is closed.

**Q3.** Attempt any *two* questions from the following: 10x2=20

- a) Find the CFG for the language  $L = \{a^i b^j c^k \mid i=j \text{ or } i=k\}$ .
- b) Show that the language  $L = \{0^n 1^m \mid m = n^2\}$  is not a CFL.
- c) Show that the grammar is ambiguous and find an equivalent unambiguous grammar.

$$S \rightarrow SS \mid a \mid b$$

**Q4.** Attempt any *two* questions from the following: 10x2=20

- a) What is a push down automaton (PDA)? Describe the acceptance of a PDA.
- b) Construct the PDA for the language  $L = \{w w^R \mid w \text{ in } \{0, 1\}^*\}$ , where  $R$  stands for reverse string.
- c) Prove that  $L = \{a^n b^{2^n} a^n \mid n \geq 0\}$  is not a CFL.

Q5. Attempt any *two* questions from the following : 10x2=20

- a) Draw a transition diagram for a Turing machine accepting the language  $\{a^n b^n c^n \mid n \geq 0\}$ .
- b) Write a short note on any *one* of the following :
  - (i) Rice's Theorem
  - (ii) P and NP class of problems
- c) Define the recursive enumerable language. Disprove that the complement of a recursive enumerable language is closed.