

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-VI • EXAMINATION – WINTER • 2014**

**Subject Code: 160704**

**Date: 05-12-2014**

**Subject Name: Theory of Computation**

**Time: 02:30 pm - 05:00 pm**

**Total Marks: 70**

**Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

**Q.1 (a)** Answer the following: **07**

- (i) Given the relation R in A as  $R = \{(1,1), (2,2), (2,3), (3,2), (4,2), (4,4)\}$  is R (a) reflexive (b) symmetric (c) transitive? (d) antisymmetric?  
 (ii) Show that  $2^n > n^3$  for  $n > 10$  by Mathematical Induction.

**(b)** Answer the following: **07**

- (i) Give recursive definition of each of the following sets.  
 a. The set T of positive integer divisible by 2 or 7.  
 b. The set U of all string in  $\{0,1\}^*$  containing the substring 00.  
 (ii) Prove that for any every  $n \geq 0, n(n^2+5)$  is divisible by 6.

**Q.2 (a)** Find a regular expression corresponding to each of the following subsets of  $\{0, 1\}^*$ . **07**

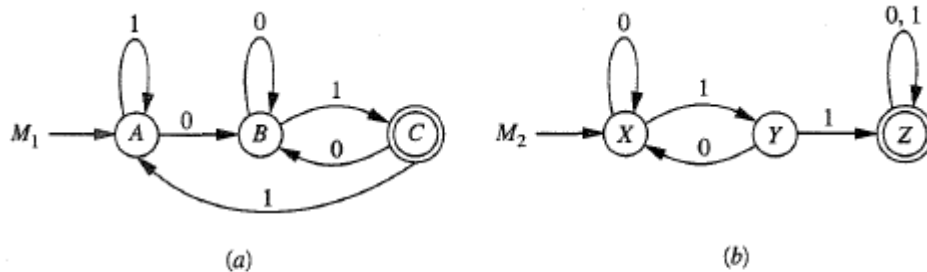
- i. The language of all strings that do not contain the substring 110.
- ii. The language of all strings containing both 101 and 010 as substrings.
- iii. The language of all strings in which both the number of 0's and the number of 1's are odd.

**(b)** For each of the following regular expressions, draw an FA recognizing the corresponding language. **07**

- i.  $1(01 + 10)^* + 0(11 + 10)^*$
- ii.  $(010 + 00)^*(10)^*$

**OR**

**(b)** Let  $M_1, M_2$  and  $M_3$  be the FAs pictured in Figure below, recognizing languages  $L_1, L_2,$  and  $L_3$  respectively. **07**



Draw FAs recognizing the following languages.

- i.  $L_1 \cup L_2$
- ii.  $L_1 \cap L_2$
- iii.  $L_1 - L_2$
- iv.  $L_1 \cap L_3$
- v.  $L_3 - L_2$

- Q.3** (a) Explain Pumping Lemma and its applications. **07**  
 (b) Generate the Context-Free Grammars that give the following languages. **07**  
 (i)  $\{w \mid w \text{ contains at least three 1s}\}$   
 (ii)  $\{w \mid w \text{ starts and ends with the same symbol}\}$   
**OR**
- Q.3** (a) Write Kleene's theorem part -1. **07**  
 (b) For given CFG G, find Chomsky normal form: **07**  
 G has productions:  $S \rightarrow AaA \mid CA \mid BaB$   $A \rightarrow aaBa \mid CDA \mid aa \mid DC$   
 $B \rightarrow bB \mid bAB \mid bb \mid aS$   $C \rightarrow Ca \mid bC \mid D$   $D \rightarrow bD \mid \Lambda$
- Q.4** (a) Write a Turing Machine to copy strings. **07**  
 (b) Write PDA for following languages: **07**  
 $\{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } j = i \text{ or } j = k\}$ .  
**OR**
- Q.4** (a) Write a Turing Machine to delete a symbol. **07**  
 (b) Write PDA for following languages: **07**  
 $\{x \in \{a, b, c\}^* \mid n_a(x) < n_b(x) \text{ or } n_a(x) < n_c(x)\}$ .
- Q.5** (a) Explain Universal Turing Machine and Halting Problem. **07**  
 (b) Answer the following **07**  
 (i) Explain time and space complexity  
 (ii) Explain P and NP completeness  
**OR**
- Q.5** (a) Explain unbounded minimization and  $\mu$  recursive functions. **07**  
 (b) Top down and bottom up parsing. **07**

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