

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-VI (OLD) - EXAMINATION – WINTER 2017**

**Subject Code: 160704**

**Date: 16-11-2017**

**Subject Name: Theory Of Computation**

**Time: 02:30 pm to 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)** Define relation. Define reflexive and transitive relation. A relation R is given as  $R = \{(0,0), (1,1), (2,2), (3,3), (3,1), (1,0), (0,1), (1,3)\}$ . Prove that R is reflexive, symmetric but Not transitive. **07**

**(b)** Define language. **07**

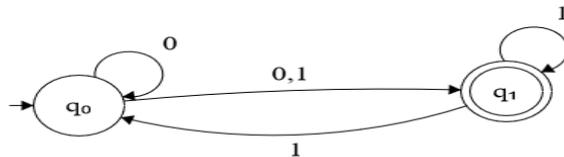
Draw Deterministic Finite Automata for the following languages

- i)  $L_1 = \{x \in (0,1)^* \mid x \text{ contains } 101\}$
- ii)  $L_2 = \{x \in (0,1)^* \mid x \text{ contains odd number of zero and ends with } 00\}$
- iii)  $L_3 = \{x \in (0,1)^* \mid x \text{ ends with } 11\}$

**Q.2 (a)** State proof by contradiction. **02**

Prove that  $\sqrt{2}$  is an irrational number. **05**

**(b)** Define NFA and NFA- $\Lambda$ . Convert the following NFA to DFA **07**



**OR**

**(b)** Define weak principle of mathematical induction. Using Mathematical induction prove that  $1+2+3+\dots+n = n*(n+1)/2$  **07**

**Q.3 (a)** Define Context Free Grammar. Design a CFG for the following language **07**

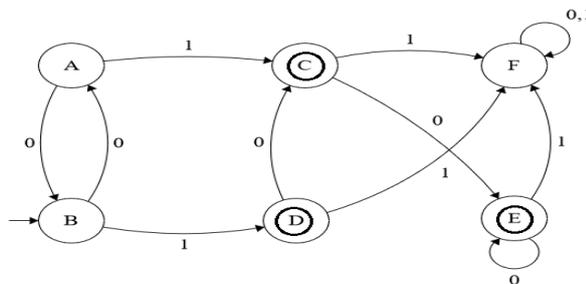
$L = \{a^n b^n \mid n > 0\}$ .

**(b)** Prove that the following language is ambiguous and convert into unambiguous **07**

$E \rightarrow E + E \mid E * E \mid id$

**OR**

**Q.3 (a)** Minimize the following FA. **07**



**(b)** State pumping lemma for FA. Prove that **07**

$L = \{ 0^n 1^n \}$  is not regular

- Q.4 (a)** Define PDA. Draw a PDA for the following language **07**  
 $L = \{ 0^n 1^n \mid w \in (0,1)^* \text{ and } n \geq 0 \}$
- (b)** Write regular expression for the following languages **07**  
i)  $L_1 = \{ x \in (0,1)^* \mid x \text{ ends with } 11 \}$   
ii)  $L_2 = \{ x \in (0,1)^* \mid x \text{ contains both } 101 \text{ and } 110 \}$
- OR**
- Q.4 (a)** Prove that any Regular Language can be accepted by FA. **07**
- (b)** Draw the PDA for the following language **07**  
 $L = \{ a^i b^j c^k \mid i = j+k \}$
- Q.5 (a)** Convert the following language in Chomsky normal form. **07**  
 $S \rightarrow ASB \mid SAB \quad A \rightarrow BC \quad B \rightarrow bB \mid c \quad C \rightarrow e$
- (b)** Write Short note on Universal Turing Machine. **07**
- OR**
- Q.5 (a)** Define a Turing Machine. Design a Turing machine for deleting  $n$ th symbol from a string  $w$  from the alphabet  $\Sigma = \{0,1\}$ . **07**
- (b)** Prove that following  $\text{add}(x,y) = x+y$  is primitive recursive function. **07**

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