Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160704 Date: 03/05/2017

Subject Name: Theory of Computation

Time: 10:30 AM to 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **In the questions the symbol Λ denotes the null string, i.e., the string of length zero.**

MARKS

Q.1 **Answer the following questions:**

1 Define onto and one-to-one functions. **02**

2 Give recursive definition of a tree. **03**

3 Define reflexivity, symmetry, and transitivity properties of relations. **03**

4 Consider the relation R = {(1,2), (1,1), (2,1), (2,2), (3,2), (3,3)} defined over {1, 2, 3}. Is it reflexive? Symmetric? Transitive? Justify each of your answers. **03**

5 Draw truth table for following logic formula: P → (¬P V ¬Q). Is it a tautology? A contradiction? Or neither? Justify your answer. **03**

Q.2 **(a)** Define DFA and NFA and NFA- Λ **03**

(b) Give recursive definitions of the extended transition functions, $\hat{\delta}$ (i.e., for strings) for DFA and NFA. **04**

(c) Minimize the DFA shown in Fig. 1. **07**

OR

(c) Consider the NFA-Λ depicted in following table: **07**

	Λ	a	b	c
→p	Φ	{p}	{q}	{r}
q	{p}	{q}	{r}	Φ
* r	{q}	{r}	Φ	{p}

(i) Compute the Λ-closure of each state.

(ii) Convert the NFA-Λ to a DFA.

Q.3 **(a)** Explain 'finite state machines with outputs'. Discriminate between Mealy and Moore machines. **03**

(b) Convert the Moore machine shown in Fig. 2 into an equivalent Mealy machine. **04**

(c) Use Pumping Lemma to show that L = {x Є $\{0,1\}^*$ | x is a palindrome} is not a regular language. **07**

OR

Q.3 **(a)** Give recursive definition of regular expressions. State the hierarchy of the operators used in regular expressions. **03**

(b) Using constructive approach determine NFA- Λ for the regular expression (0 + 1)*1(0 + 1). **04**

(c) Fig. 3 shows two DFAs M1 and M2, to accept languages L_1 and L_2, respectively. Determine DFAs to recognize L_1 U L_2. **07**

Q.4	**(a)**	Give formal definition of PDA. Give mathematical description of 'acceptance of a string by a PDA by empty stack'.	**03**
	(b)	Give the recursive definition of the iterated derivation (i.e., derivation in zero or more steps), denoted as $\Rightarrow^*$. Give mathematical description of the language of a CFG.	**04**
	(c)	Consider following grammar: S → A1B A → 0A | Λ B → 0B | 1B | Λ Give leftmost and rightmost derivations of the string 00101. Also draw the parse tree corresponding to this string.	**07**

OR

Q.4	**(a)**	Define CFG. When is a CFG called an 'ambiguous CFG'?	**03**
	(b)	Consider following grammar: S → ASB | Λ A → aAS | a B → SbS | A | bb i. Eliminate useless symbols, if any. ii. Eliminate Λ productions.	**04**
	(c)	Convert the following grammar to a PDA: I → a | b | Ia | Ib | I0 | I1 E → I | E * E | E + E | (E)	**07**
Q.5	**(a)**	Give definition of Turing Machine. What do you mean by an instantaneous description of a Turing Machine?	**03**
	(b)	Describe recursive languages and recursively enumerable languages.	**04**
	(c)	Design a Turing machine to accept the language $\{0^n1^n \mid n \geq 1\}$.	**07**

OR

Q.5	**(a)**	Briefly describe following terms: (1) halting problem (2) undecidable problem	**03**
	(b)	Using pumping lemma for CFL's, show that the language $L = \{a^m b^m c^n \mid m \leq n \leq 2m\}$ is not context free.	**04**
	(c)	Design a Turing machine for the language over {0,1} containing strings with equal number of 0's and 1's.	**07**

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Figures

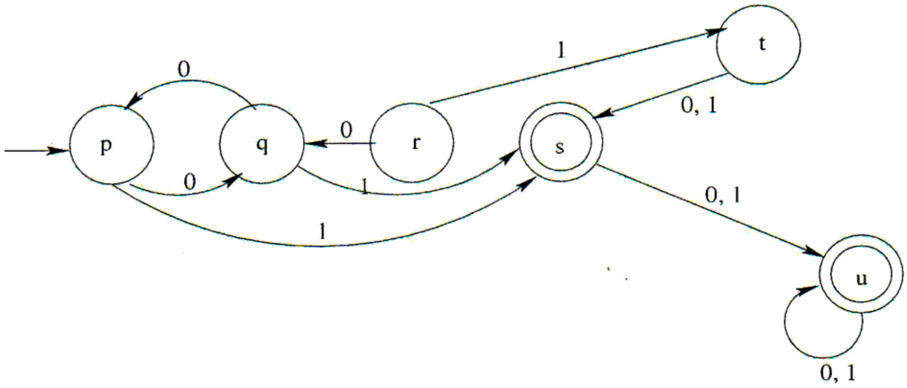

Fig. 1 for Q 2 (c)

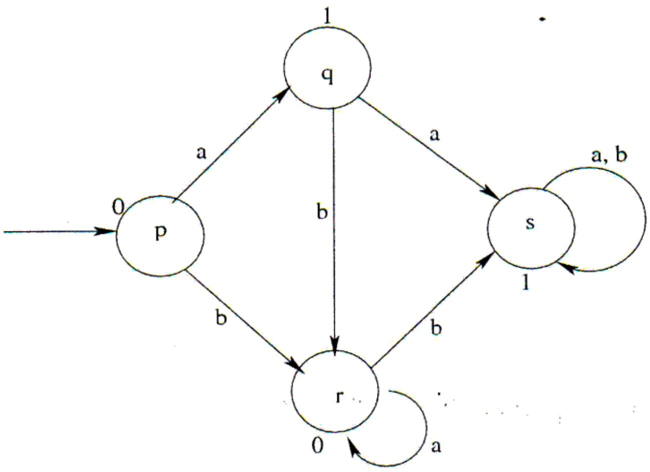

Fig. 2 for Q 3 (b)

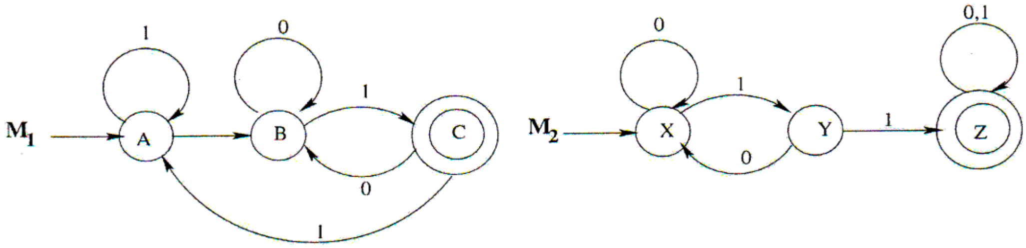

Fig. 3 for Q 3 (c) (OR)

Note: In Fig.3 for Q:3 (c) consider transition from A -> B having symbol 0.