Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2018

Subject Code:2160704 Date:27/11/2018

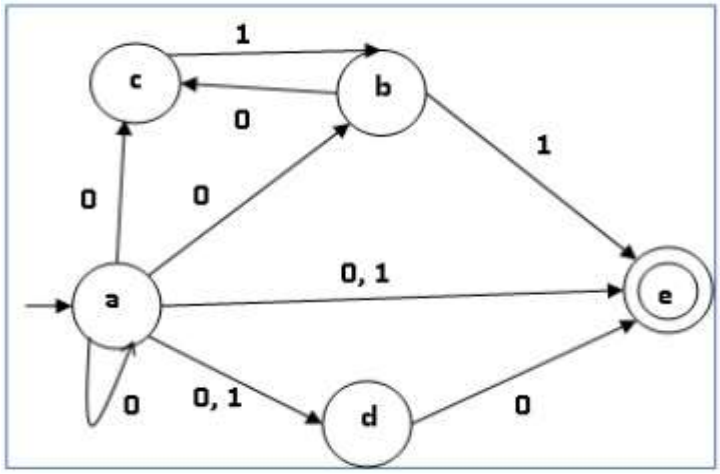
Subject Name:Theory of Computation

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.**

			MARKS
Q.1	**(a)**	Define one-to-one, onto and bijection function.	**03**
	(b)	Explain reflexivity, symmetry, and transitivity properties of relations.	**04**
	(c)	State the principle of mathematical induction and prove by mathematical induction that for all positive integers n 1+2+3+……..+n = n (n+1)/2.	**07**
Q.2	**(a)**	What are the closure properties of regular languages?	**03**
	(b)	Explain moore machine and mealy machine.	**04**
	(c)	What are the applications of finite automata? Draw Finite Automata to accept following. (i) the language accepting strings ending with ’01’ over input alphabets Σ = {0, 1} (ii) the language accepting strings ending with ‘abba’ over input alphabets Σ = {a, b}	**07**
		OR	
	(c)	Define NFA-Λ. Explain how to convert NFA-Λ into NFA and FA with suitable example.	**07**
Q.3	**(a)**	State pumping lemma for regular languages.	**03**
	(b)	Explain Union Rule and Concatenation Rule for Context Free Grammar.	**04**
	(c)	Write difference between DFA and NDFA. Convert the following NDFA to DFA.	**07**



OR

Q.3	**(a)**	Define Context-Sensitive Grammar. What is the language of following context-sensitive grammar? $S \rightarrow aTb \mid ab$ $aT \rightarrow aaTb \mid ac.$	**03**
	(b)	Find a regular expression corresponding to each of the following subsets of {0, 1}* (i) The language of all strings that begin or end with 00 or 11.	**04**

(ii) The language of all strings beginning with 1 and ending with 0.

(c) What is CNF? Convert the following CFG into CNF. **07**

$S \rightarrow ASA \mid aB,$

$A \rightarrow B \mid S,$

$B \rightarrow b \mid \varepsilon$

Q.4 **(a)** What is Turing Machine? Write advantages of TM over FSM. **03**

(b) Define CFG. When a CFG is called an 'ambiguous CFG'? **04**

(c) Define PDA. Describe the pushdown automata for language $\{0^n1^n \mid n \geq 0\}$. **07**

OR

Q.4 **(a)** Write a short note on Universal Turing Machine. **03**

(b) Describe recursive languages and recursively enumerable languages. **04**

(c) Explain push down automata with example and their application in detail. **07**

Q.5 **(a)** Define grammar and chomsky hierarchy. **03**

(b) What are the applications of regular expressions and finite automata? **04**

(c) Draw a transition diagram for a Turing machine for the language of all palindromes over {a, b}. **07**

OR

Q.5 **(a)** Compare FA, NFA and NFA-^. **03**

(b) Write a short note on church-turing thesis. **04**

(c) Explain primitive recursive function by suitable example. **07**

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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 $=>^*$. 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

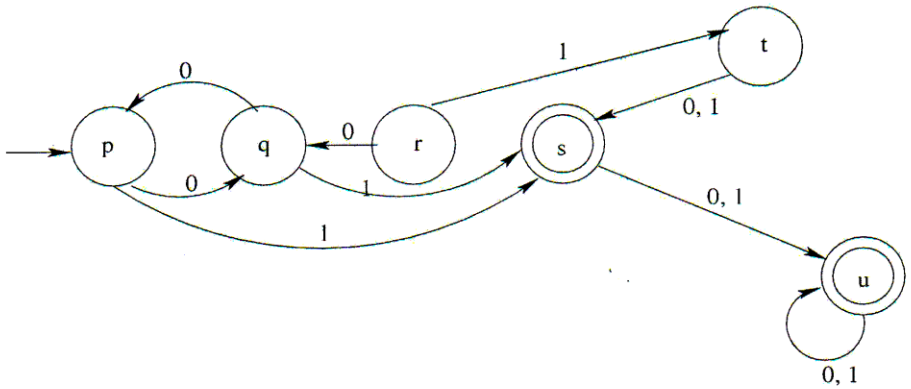

Fig. 1 for Q 2 (c)

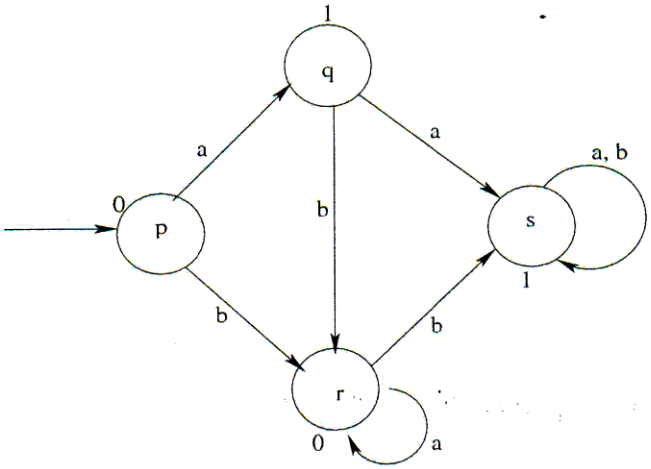

Fig. 2 for Q 3 (b)

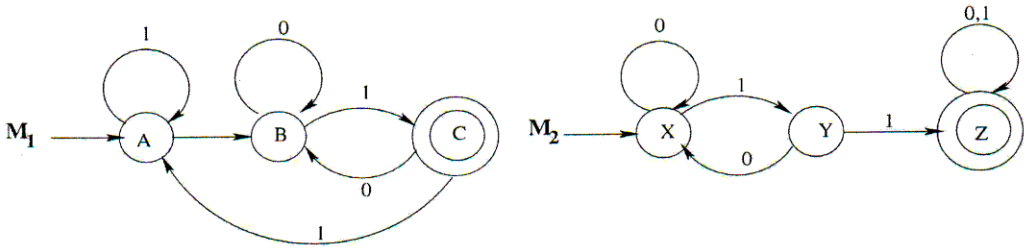

Fig. 3 for Q 3 (c) (OR)

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