

**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.

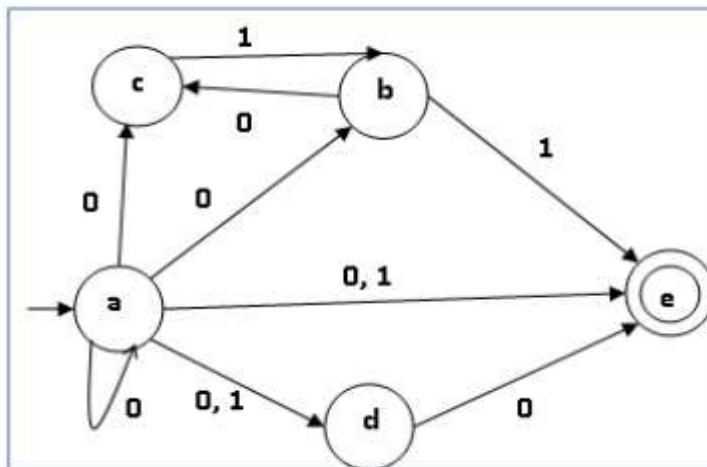
**MARKS**

- Q.1**
- |     |   |           |
|-----|---|-----------|
| (a) | Define one-to-one, onto and bijection function.   | <b>03</b> |
| (b) | Explain reflexivity, symmetry, and transitivity properties of relations.  | <b>04</b> |
| (c) | State the principle of mathematical induction and prove by mathematical induction that for all positive integers $n$ $1+2+3+\dots+n = n(n+1)/2$ . | <b>07</b> |

- Q.2**
- |     |   |           |
|-----|---|-----------|
| (a) | What are the closure properties of regular languages?   | <b>03</b> |
| (b) | Explain moore machine and mealy machine.  | <b>04</b> |
| (c) | What are the applications of finite automata? Draw Finite Automata to accept following.         | <b>07</b> |
|     | (i) the language accepting strings ending with '01' over input alphabets $\Sigma = \{0, 1\}$    |           |
|     | (ii) the language accepting strings ending with 'abba' over input alphabets $\Sigma = \{a, b\}$ |           |

**OR**

- |     |  |           |
|-----|--|-----------|
| (c) | Define NFA- $\Lambda$ . Explain how to convert NFA- $\Lambda$ into NFA and FA with suitable example. | <b>07</b> |
|-----|--|-----------|
- Q.3**
- |     |   |           |
|-----|---|-----------|
| (a) | State pumping lemma for regular languages.                                | <b>03</b> |
| (b) | Explain Union Rule and Concatenation Rule for Context Free Grammar.       | <b>04</b> |
| (c) | Write difference between DFA and NDFA. Convert the following NDFA to DFA. | <b>07</b> |

**OR**

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

- (ii) The language of all strings beginning with 1 and ending with 0. **07**
- (c) What is CNF? Convert the following CFG into CNF. **07**  
 $S \rightarrow ASA \mid aB,$   
 $A \rightarrow B \mid S,$   
 $B \rightarrow b \mid \epsilon$
- 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  $\{0^n 1^n \mid n \geq 0\}$ . **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- $\Lambda$ . **03**  
 (b) Write a short note on church-turing thesis. **04**  
 (c) Explain primitive recursive function by suitable example. **07**

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**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  $\Lambda$  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:  $P \rightarrow (\neg P \vee \neg Q)$ . Is it a tautology? A contradiction? Or neither? Justify your answer. **03**

- Q.2** (a) Define DFA and NFA and NFA-  $\Lambda$  **03**
- (b) Give recursive definitions of the extended transition functions,  $\delta^*$  (i.e., for strings) for DFA and NFA. **04**
- (c) Minimize the DFA shown in Fig. 1. **07**

**OR**

- (c) Consider the NFA- $\Lambda$  depicted in following table: **07**

	$\Lambda$	a	b	c
$\rightarrow p$	$\Phi$	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	$\Phi$
* r	$\{q\}$	$\{r\}$	$\Phi$	$\{p\}$

(i) Compute the  $\Lambda$ -closure of each state.(ii) Convert the NFA- $\Lambda$  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  $L = \{x \in \{0,1\}^* \mid x \text{ is a palindrome}\}$  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-  $\Lambda$  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  $L_1 \cup L_2$ . **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: **07**  
 $S \rightarrow A1B$   
 $A \rightarrow 0A \mid \Lambda$   
 $B \rightarrow 0B \mid 1B \mid \Lambda$   
 Give leftmost and rightmost derivations of the string 00101. Also draw the parse tree corresponding to this string.
- OR**
- Q.4** (a) Define CFG. When is a CFG called an 'ambiguous CFG'? **03**
- (b) Consider following grammar: **04**  
 $S \rightarrow ASB \mid \Lambda$   
 $A \rightarrow aAS \mid a$   
 $B \rightarrow SbS \mid A \mid bb$   
 i. Eliminate useless symbols, if any.  
 ii. Eliminate  $\Lambda$  productions.
- (c) Convert the following grammar to a PDA: **07**  
 $I \rightarrow a \mid b \mid Ia \mid Ib \mid IO \mid II$   
 $E \rightarrow I \mid E * E \mid E + E \mid (E)$
- 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  $\{0^n 1^n \mid n \geq 1\}$ . **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**

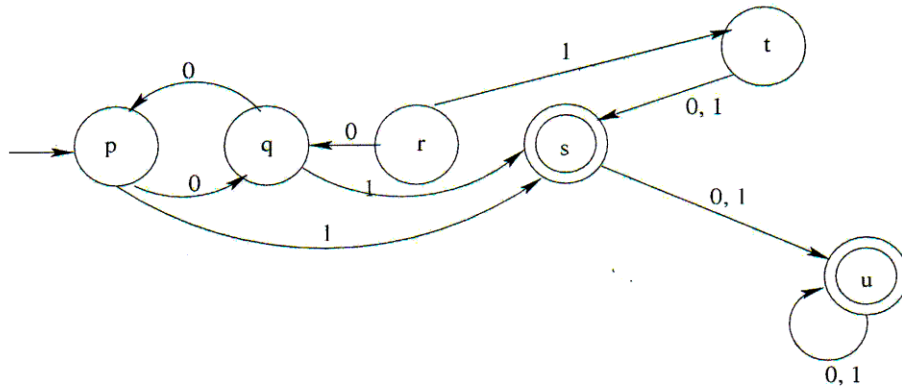


Fig. 1 for Q 2 (c)

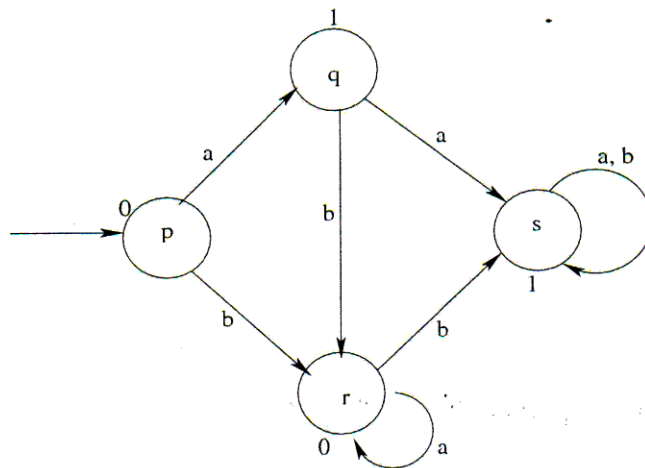


Fig. 2 for Q 3 (b)

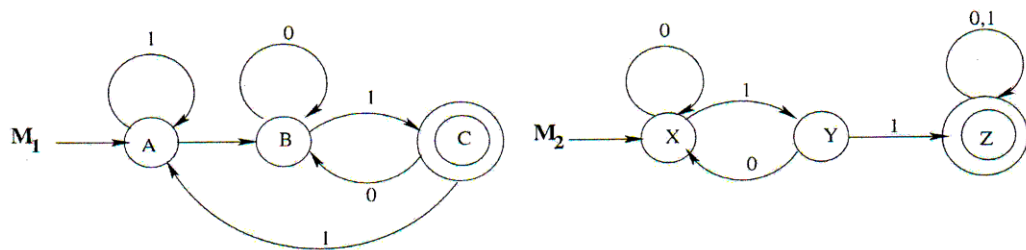


Fig. 3 for Q 3 (c) (OR)

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