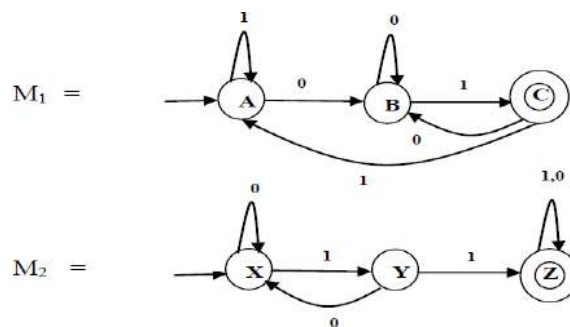


**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER– VI (NEW) EXAMINATION – WINTER 2021****Subject Code:3160704****Date:24/11/2021****Subject Name:Theory of Computation****Time:10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
<b>Q.1</b>	(a) Define one-to-one, onto and bijection function	<b>03</b>
	(b) The given relation R on set $A = \{1,2,3\}$ determine whether the Relation is reflexive, symmetric or transitive, give reason. $R = \{(1,1), (1,2), (1,3), (2,1), (2,2), (3,1), (3,3)\}$	<b>04</b>
	(c) Write Principle of Mathematical Induction. Prove that for every $n \geq 1$ , $1 + 3 + 5 + \dots + (2n - 1) = n^2$	<b>07</b>
<b>Q.2</b>	(a) Define FA and Write recursive definition of NFA	<b>03</b>
	(b) Find a regular expression of following subsets of $\{0, 1\}^*$ <ol style="list-style-type: none"> <li>1. The language of all strings that begin or end with 00 or 11.</li> <li>2. The language of all strings ending with 1 and not containing 00.</li> </ol>	<b>04</b>
	(c) Draw Finite Automata to accept following over input alphabets $\Sigma = \{0, 1\}$ <ol style="list-style-type: none"> <li>(i) The language accepting strings not ending with '01'.</li> <li>(ii) The language accepting strings next to last symbol '0'</li> </ol>	<b>07</b>
<b>OR</b>		
	(c) Let M1 and M2 be the FAs pictured in Figure, recognizing languages L1 and L2 respectively.	<b>07</b>



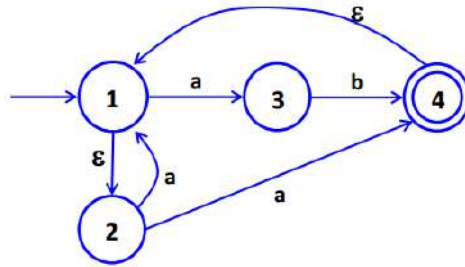
Draw FAs recognizing the following languages.

- a.  $L_1 \cup L_2$
- b.  $L_1 - L_2$

<b>Q.3</b>	(a) Give the difference between moore machine and mealy machine.	<b>03</b>
	(b) Define Context Free Grammar. Find context-free grammar for the language: $L = \{a^i b^j c^k \mid j = i + k\}$	<b>04</b>

- (c) Convert NFA-  $\Lambda$  to FA for following figure.

07



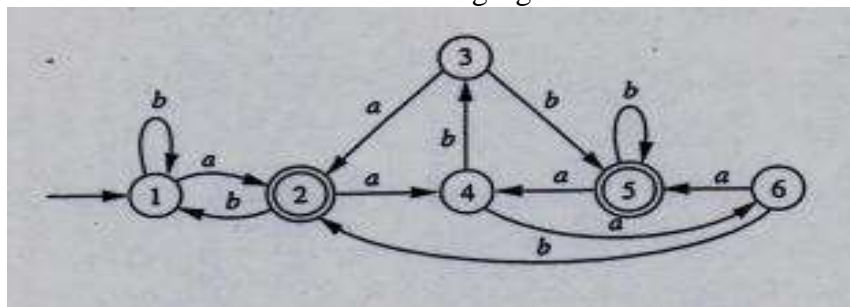
OR

- Q.3** (a) Define Ambiguous grammar. for following grammar say whether the grammar is ambiguous or not. give reason 03

$S \rightarrow ABA, A \rightarrow aA \mid \Lambda, B \rightarrow bB \mid \Lambda$

- (b) Design and mealy machine that gives output 1 if input of sequence abb comes, other wise 0. 04

- (c) Find minimum state FA for following figure. 07



- Q.4** (a) State pumping lemma for regular languages. 03

- (b) Give an unambiguous grammar for SIMPLE CALCULATOR contain +, -, \*, /,(,) operator for terminal 'id'. And draw a parse tree for (id+id)\*id-id 04

- (c) Write Kleen's Theorem part -1. 07

OR

- Q.4** (a) Find the CFG for the regular expression :  $(01^*1 + 1)^*(01)^*$  03

- (b) Using kleene's Theorem Draw NFA- $\Lambda$  for  $((0+1)^*10 + (00)^*)^*$  04

- (c) Given the context-free grammar G, find a CFG G' in Chomsky Normal Form. 07

$S \rightarrow AaA \mid CA \mid BaB$

$A \rightarrow aaBa \mid DC$

$B \rightarrow bb \mid aS$

$C \rightarrow Ca \mid bC \mid D$

$D \rightarrow bD \mid \Lambda$

- Q.5** (a) Define Pushdown Automata 03

- (b) Design a PDA to accept  $L = \{xycy \mid x, y \in (a,b)^* \text{ and } |x| = |y|\}$ . 04

- (c) Develop a Turing Machine to accept palindromes over  $\{a,b\}^*$  07

OR

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

- (b) Design a PDA to accept  $L = \{a^n b^n \mid n \geq 0\}$ . 04

- (c) Develop a Turing Machine to accept the language  $L = \{X \mid N_a(X) = N_b(X), X \in \{a,b\}^*\}$  07

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**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2022****Subject Code:3160704****Date:01/06/2022****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. Simple and non-programmable scientific calculators are allowed.

**MARKS**

- |            |   |           |
|------------|---|-----------|
| <b>Q.1</b> | (a) Define: Set, Subset, Complement   | <b>03</b> |
|            | (b) Write and explain the principle of mathematical induction using example.  | <b>04</b> |
|            | (c) Draw Finite automata for following regular expression:<br>(i). $(0 + 1)^*(1 + 00)(0 + 1)^*$<br>(ii). $(111 + 100)^*0$   | <b>07</b> |
|            |   |           |
| <b>Q.2</b> | (a) Explain Regular language & Regular expressions  | <b>03</b> |
|            | (b) Find a regular expression corresponding to each of the following subsets of $\{0,1\}^*$<br>(i). the language of all strings that do not end with 01<br>(ii). the language of all strings that begin with or end with 00 or 11 | <b>04</b> |
|            | (c) Prove Kleene's theorem part-1   | <b>07</b> |
|            | <b>OR</b>   |           |
|            | (c) Explain procedure to minimize finite automata   | <b>07</b> |
|            |   |           |
| <b>Q.3</b> | (a) Define Context free grammar & context free language   | <b>03</b> |
|            | (b) Write CFG for following<br>(i) $L = \{a^i b^j c^k \mid i=j \text{ or } j=k\}$<br>(ii) $L = \{a^i b^j c^k \mid j > i+k\}$  | <b>04</b> |
|            | (c) Convert following CFG to CNF :<br>$S \rightarrow S(S)^\wedge$   | <b>07</b> |
|            | <b>OR</b>   |           |
| <b>Q.3</b> | (a) Define Regular grammar and give example.  | <b>03</b> |
|            | (b) Explain types of derivation and ambiguity.  | <b>04</b> |
|            | (c) Convert following CFG to CNF :<br>$S \rightarrow aX/Yb \quad X \rightarrow S/^\wedge \quad Y \rightarrow bY/b$  | <b>07</b> |
|            |   |           |
| <b>Q.4</b> | (a) What is a pushdown automaton? Explain.  | <b>03</b> |
|            | (b) Give the difference between top down and bottom up parsing.   | <b>04</b> |
|            | (c) Design and draw deterministic PDA Accepting "Balance string of brackets"  | <b>07</b> |
|            | <b>OR</b>   |           |
| <b>Q.4</b> | (a) Explain deterministic pushdown automata.  | <b>03</b> |
|            | (b) Explain conversion from PDA to CFG.   | <b>04</b> |
|            | (c) Design and draw PDA to accept string with more a's than b's.  | <b>07</b> |

- |            |     |   |           |
|------------|-----|---|-----------|
| <b>Q.5</b> | (a) | What is Turing machine? Explain its capabilities. | <b>03</b> |
|            | (b) | Explain Church Turing thesis.                     | <b>04</b> |
|            | (c) | Design a Turing machine to copy a string.         | <b>07</b> |
|            |     | <b>OR</b>   |           |
| <b>Q.5</b> | (a) | Explain Primitive Recursive Functions.            | <b>03</b> |
|            | (b) | Explain Universal Turing machine                  | <b>04</b> |
|            | (c) | Design a Turing machine to delete a symbol.       | <b>07</b> |

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