

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3160704

Date:02-12-2023

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.
4. Simple and non-programmable scientific calculators are allowed.

MARKS

- Q.1**
- (a) Say whether the statement $(p \wedge (p \rightarrow q)) \rightarrow q$ is tautology or contradiction. **03**
- (b) The given relation R on set $A = \{1,2,3\}$ determine whether the Relation is reflexive, symmetric or transitive, give reason. **04**
 $R = \{(1,1), (1,2), (2,1), (2, 2), (3,2),(3,3)\}$

- (c) Write Principle of Mathematical Induction. And prove for every $n \geq 1$, **07**

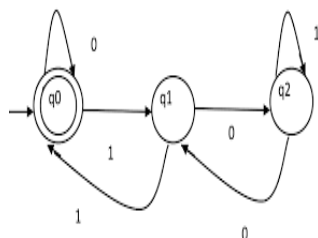
$$\sum_{i=1}^n \frac{1}{i(i+1)} = n/(n+1)$$

- Q.2**
- (a) Define FA and Write recursive definition of NFA **03**
- (b) Find a regular expression of following subsets of $\{0, 1\}^*$ **04**
1. The language of all strings that begin or end with 00 or 11.
 2. The language of all strings ending with 1 and not containing 00.
- (c) Draw Finite Automata to accept following over input alphabets $\Sigma = \{0, 1\}$ **07**
- (i) The language accepting strings not ending with '01' .
 - (ii) The language accepting strings not containing substring '00'

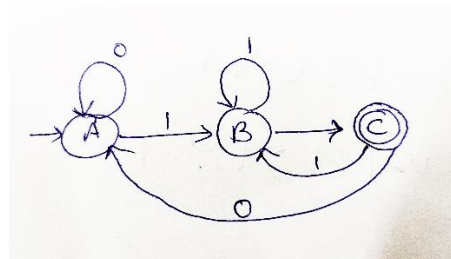
OR

- (c) Let M1 and M2 be the FAs pictured in Figure, recognizing languages L1 and L2 respectively. **07**

M1--



M2--



Draw FAs recognizing the following languages.

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

- Q.3**
- (a) Find context-free grammar for the language: $L = \{a^i b^j c^k \mid i=j+k\}$ **03**
- (b) Define mealy machine. Design and mealy machine that gives output 'x' if input of sequence is abb, otherwise z. **04**
- (c) Convert NFA- Λ to FA for following figure. **07**

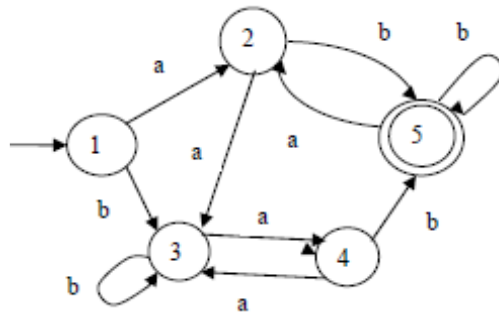
Q	$\delta(q, \wedge)$	$\delta(q, 0)$	$\delta(q, 1)$
-A	{B}	{A}	\emptyset
B	{D}	{C}	\emptyset
C	\emptyset	\emptyset	{B}
+D	\emptyset	{D}	\emptyset

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) Convert the given Moore machine into Mealy machine. Draw state transition diagram of Mealy machine. **04**

Present State	Next State		Output
	0	1	
$\rightarrow p0$	r	q0	ϵ
p1	r	q0	1
q0	p1	s0	0
q1	p1	s0	1
r	q1	p1	0
s0	s1	r	0
s1	s1	r	1

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



- Q.4** (a) State pumping lemma for context free language. **03**
- (b) Construct PDA for **04**
 $S \rightarrow 0AB$
 $A \rightarrow 1A \mid 1$
 $B \rightarrow 0B \mid 1A \mid 0$
Trace the string 01011 using PDA.
- (c) Write Kleen's Theorem part -1. **07**

OR

- Q.4** (a) Define Push Down Automata **03**
- (b) Using kleene's Theorem Draw NFA- Λ for a given RE $aa(ba)^*+b^*aba^*$ **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) Explain Universal Turing Machine **03**
- (b) Design a PDA to accept $L = \{xcy \mid x, y \in (a,b)^* \text{ and } |x| = |y|\}$. **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 $L = \{a^i b^j C^k \mid j = i+k\}$. **04**
- (c) Develop a Turing Machine to accept the language $L = \{X \mid N_a(X) = N_b(X), X \in \{a,b\}^*\}$. **07**