Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 160704 **Date: 17/05/2012**

Subject Name: Theory of Computation

Time: 10:30 am – 01:00 pm **Total Marks: 70**

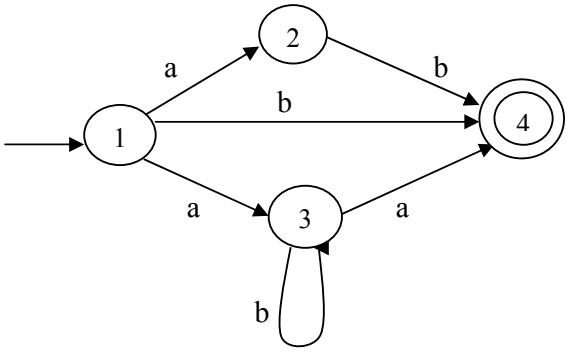
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define Mathematical Induction and prove the following: **07**
For every $n \geq 0$,

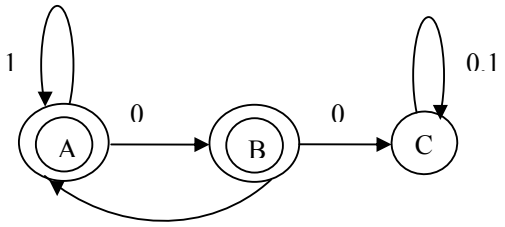
$$\sum_{i=0}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$$

(b) Convert the following NFA into FA. **07**

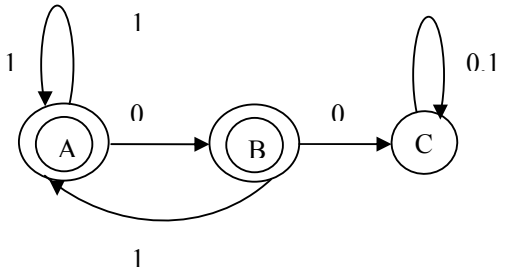


Q.2 **(a)** Suppose that L_1 and L_2 are the subsets **07**

L_1 =



L_2 =



Draw the FAs recognizing the following languages.

- $L_1 \cap L_2$
- $L_1 - L_2$

(b) Define Pumping Lemma. Use the Pumping Lemma to show that the following languages are not regular. **07**

- $L = \{ 0^n 1 0^{2n} \ / \ n \geq 0 \}$
- $L = \{ 0^i 1^j 0^k \ / \ k > i+j \}$

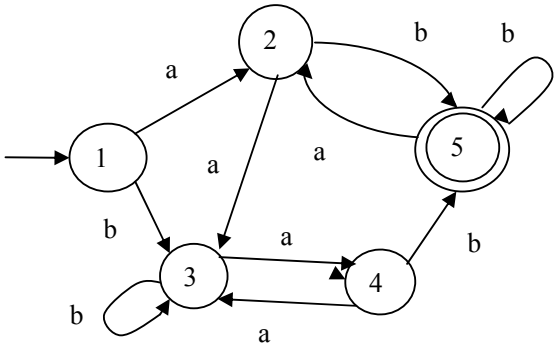
OR

(b) Define δ* for! FA− NFA and NFA-Λ. Also Calculate δ* (1, ab) and **07**

δ* (1, abaab) from the following transition table.

q	$\delta(q, a)$	$\delta(q, b)$
1	{ 1 , 2}	{1}
2	{ 3}	{3}
3	{4}	{4}
4	{5}	Ø
5	Ø	{5}

Q.3 **(a)** Minimize the following DFA (If Possible). **07**



(b) Prove: There are context-free languages L_1 and L_2 so that $L_1 \cap L_2$ is not a CFL and there is a CFL L so that L' is not a CFL **07**

OR

Q.3 **(a)** Given the CFG G, find a CFG G' in Chomsky Normal form generating L(G) – { Λ} **07**

$S \longrightarrow AaA \mid CA \mid BaB$

$A \longrightarrow aaBa \mid CDA \mid aa \mid DC$

$B \longrightarrow bB \mid bAB \mid bb \mid aS$

$C \longrightarrow Ca \mid bC \mid D$

$D \longrightarrow bD \mid \Lambda$

(b) Define PDA and design PDA for $L = \{ x \in \{ a, b\}^* \mid n_a(x) > n_b(x) \}$ **07**

Q.4 **(a)** Prove: Any Regular Language can be accepted by a finite automaton (Kleene's Theorem, Part - I) **07**

(b) Explain Derivation Tree, Expression Tree and Ambiguity with Example. **07**

OR

Q.4 **(a)** Define CFG and Design a CFG for the following language. **07**
$L = \{ 0^i 1^j 0^k \ / j > i + k \}$

(b) Attempt the following : **07**

- Draw FA for (11+110)* 0
- Write a Regular Expression for the String of 0's and 1's in which string ends with 1 and does not contain substring 00.

Q.5 **(a)** Draw the TM for $L = \{ss \mid s \in (a, b)^* \}$ **07**

(b) Explain Universal TM and Church Turing Thesis **07**

OR

Q.5 **(a)** Differentiate the NP Hard and NP Complete Problems. **07**

(b) Explain Cook's Theorem. **07**

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