Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA SEMESTER II –EXAMINATION – SUMMER 2015

Subject code: 620007 **Date:04-06-2015**

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)** 1. Define Compositions and inverse of functions using example. **04**

2. In each case, a relation on the aet {1,2,3} is given. Of the three properties reflexivity, symmetry and transitivity, Determine which ones the relation has. **03**

i) R = {(1,3),(3,1), (2,2)}

ii) R = {(1,1),(2,2),(3,3),(1,2)}

iii) R = Ø

(b) Prove that for every $n \geq 0$, $f(n) \leq (5/3)^n$ **07**

Q.2 **(a)** Answer the following,

(1) Find a regular expression corresponding to each of the following subsets of $\{0,1\}^*$ **04**

a. The language of all strings containing at least two 0's.

b. The language of all strings not containing the substring 00.

c. The language of all strings in which the number of 0's is even.

d. The language of all strings containing exactly two 0's.

(2) Prove that $\sqrt{2}$ is irrational. **03**

(b) Draw FA to recognize the following languages defined over $\{0,1\}^*$ **07**

(i) $(111 + 100)^*0$

(ii) $\{00\}^*\{11\}^*$

OR

(b) Consider languages L1 and L2 as under: **07**

L1 = {x | x ends with 01}

L2= {x| x ends with 11}

Draw FA for

i) L1

ii) L2

iii) L1- L2

Q.3 **(a)** An NFA with 1-5 states and input alphabet {a,b} has the following transition table. **07**

q	δ(q,a)	δ(q,b)
1	{1,2}	{1}
2	{3}	{3}
3	{4}	{4}
4	{5}	Ø
5	Ø	{5}

i) Draw a transition diagram.

ii) Calculate $\delta^*(1,ab)$.

iii) Calculate $\delta^*(1,abaab)$

(b) Define Λ closure. Give recursive definition of δ^* for NFA- Λ. Draw NFA - Λ recognizing $(0+1)^*(011+01010)(0+1)^*$ **07**

OR

Q.3 **(a)** Draw NFA- Λ accepting $\{0\}^*\{0,1\}^*\{0\}^*$. And Convert it to NFA and FA. **07**

(b) Define NFA. Give non recursive definition of δ^* for an NFA-Λ. Convert regular expression $(0+1)^*(10) + (00)^*(11)^*$ to an NFA-Λ. **07**

Q.4 **(a)** State the pumping lemma for regular languages. Prove using pumping lemma that pal, the language of palindromes is not regular. **07**

(b) Convert following grammar into CNF(Chomsky Normal Form). **07**

$S \rightarrow AACD$
$A \rightarrow aAb / \Lambda$
$C \rightarrow aC / a$
$D \rightarrow aDa/bDb/\Lambda$

OR

Q.4 **(a)** Define CFG. Find language corresponding to following CFG production. **07**

i) $S \rightarrow aSa \mid bSb \mid \Lambda$
ii) $S \rightarrow aS \mid bS \mid a$
iii) $S \rightarrow SaS \mid b$
iv) $S \rightarrow aT \mid bT \mid \Lambda$
$T \rightarrow aS \mid bS$

(b) Define DPDA. Give transition table for deterministic PDA recognizing following language. **07**

$L = \{ x \in \{0.1\}^* \mid n_0(x) \neq n_1(x) \}$

Q.5 **(a)** State pumping lemma for context free language(CFL). Prove that the language $L = \{a^i b^j c^k \mid i < j < k\}$ is not a context free language. **07**

(b) Define Turing Machine. Draw transition diagram for Turing machine accepting the following language. **07**

$L = \{a^i b^j \mid i < j \}$

OR

Q.5 **(a)** (1) Write a short note on recursive enumerable and recursive language. **04**
(2) Write a short note on derivation tree with reference to CFG. **03**

(b) Construct a Turing machine that accepts the language of palindromes over {a,b}. Also specify the moves to trace the strings abaa. **07**

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