Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – WINTER 2013

Subject Code: 160704 Date: 06-12-2013

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.**

Q.1 Answer the following. **14**

(a) Write Regular Expressions for the following languages of all strings in {0,1}*

(i) Strings that start with 1 and do not end with 10.

(ii) Strings with length 6 or less.

(b) Prove that $\sqrt{2}$ (square root of 2) is Irrational by method of Contradiction.

(c) Design a CFG(Context Free Grammar) for the following language.
L = { $0^i 1^j 0^k$ / j > i+k }

(d) Explain one-to-one, onto and bijection function with suitable example.

Q.2 **(a)** Using Principle of Mathematical Induction, Prove that for every n >= 1, **07**

$7 + 13 + 19 + \ldots + (6n + 1) = n(3n + 4)$

(b) Compare FA , NFA and NFA- Λ. **07**

For the following Regular Expression draw an NFA-Λ recognizing the corresponding language.

$(0 + 1)^* (10+110)^* 1$

OR

(b) Prove Kleene's Theorem (Part I): Any Regular Language can be accepted by a Finite Automaton(FA) . **07**

Q.3 **(a)** Convert following NFA- Λ to NFA and FA. **08**

Q	δ(q, Λ)	δ(q, 0)	δ(q, 1)
A	{B,D}	{A}	Ø
B	Ø	{C}	{E}
C	Ø	Ø	{B}
D	Ø	{E}	{D}
E	Ø	Ø	Ø

(b) Draw FA for accepting: **06**

(i)The string in {0,1}* ending in 1 and not containing substring 00.

(ii)The strings with odd no. of 1's and odd no. of 0's

OR

Q.3 **(a)** Draw Finite Automata (FA) for following languages: **08**

L_1 = {x / 11 is not a substring of x, x Є {0,1}*}

L_2 = {x / x ends with 10, x Є {0,1}* }

Find FA accepting languages (i) $L_2 – L_1$ and (ii) $L_1 \cap L_2$

(b) Prove that the following CFG is Ambiguous. **06**
S → S + S | S * S | (S) | a
Write the unambiguous CFG for the above grammar. Draw Parse tree for the string a + a * a.

Q.4 **(a)** For the language L = { xcx^r / x Є {a,b}* } (Palindrome with middle character=c), Design a PDA(Push Down Automata) and trace it for string "abacaba". **07**

(b) Convert following CFG to equivalent Chomsky Normal Form(CNF). **07**
S → AACD | ACD | AAC | CD | AC | C
A → aAb | ab
C → aC | a
D → aDa | bDb | aa | bb

OR

Q.4 **(a)** Design and draw a deterministic PDA accepting strings of the language L = { x ∈{ a, b}* | $n_a(x) > n_b(x)$ }. Trace it for the string "aababaab". **07**

(b) Define Turing Machine. Draw a Turing Machine(TM) to accept Palindromes over {a,b}. (Even as well as Odd Palindromes) **07**

Q.5 Write short notes on the following (Any FOUR) **14**
(i) Equivalence Relation.
(ii) Universal Turing Machine.
(iii) The Sets P, NP, PSpace and NPSpace.
(iv) The Primitive Recursive Functions.
(v) Application of Pumping Lemma.
(vi) Basic Complexity Classes.

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