Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 160704 Date: 05/01/2013

Subject Name: Theory Of Computation

Time: 02.30 pm - 05.00 pm Total Marks: 70

Instructions:

1. **Attempt any five 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 contains odd number of 0's (zeroes).

(ii) Strings that begin or end with 00 or 11.

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

(c) Define Context Free Grammar (CFG). Describe the language accepted by following CFG:

S → aSa | bSb | a | b | Λ

(d) Define one-to-one, onto and bijection function.

Check whether the function **f: R → R+**, $\mathbf{f(x) = x^2}$ is "one to one" or "onto".

Q.2 **(a)** Write definition of finite automata and draw FA for the strings: **07**

(i)The string in {0,1}* ending in 10 or 11.

(ii)The string corresponding to Regular expression $\{11\}^*\{00\}^*$

(b) Using Principle of Mathematical Induction, Prove that **07**

For every n >= 1,

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

OR

(b) Prove that the following CFG is Ambiguous. **07**

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.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) Compare FA , NFA and NFA- Λ. For the following Regular **06**

Expression draw an NFA-Λ recognizing the corresponding language.

$(0 + 1)^* (10+01)^* 11$

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) $L_1 \cap L_2$ and (ii) $L_1 - L_2$

(b) Prove Kleene's Theorem: Any Regular Language can be accepted by a Finite Automaton(FA) . **06**

Q.4 **(a)** For the language $L = \{ xcx^r / x Є \{a,b\}^* \}$ design a PDA(Push Down Automata) and trace it for string "bacab". **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 with more a's than b's. Trace it for the string "abbabaa". **06**

(b) Answer the following. **08**

(i) Design a CFG for the following language.

$L = \{ 0^i 1^j 0^k \ / j > i + k \ \}$

(ii) What do you mean by Regular Language? Explain the application of the Pumping Lemma to show a Language is Regular or Not.

Q.5 **(a)** Draw a Turing Machine(TM) to accept Palindromes over {a,b}. (Even as well as Odd Palindromes) **08**

(b) Explain in Brief: **06**

(i) Halting Problem.

(ii) Basic Complexity Classes.

OR

Q.5 Write short notes on the following: **14**

(i) The Primitive Recursive Functions..

(ii) The Sets P, NP, PSpace and NPSpace.

(iii) Top Down Parsing And Bottom Up Parsing.

(iv) Universal Turing Machine.

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