This question paper contains 7 printed pages]

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B.Sc. (H) Computer Science/VI Sem.   C

Paper 601 : THEORY OF COMPUTATION

(Admissions of 2001 and onwards)

Time : 3 Hours   *Maximum Marks* : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 (Section A) is compulsory.

Attempt any *four* questions from Section B.

Parts of a question should be attempted together.

Assume $\Sigma = \{a, b\}$ for all the questions unless

specified otherwise.

Section A

1.   (*a*)   Let $S = \{ab, bb\}$ and $T = \{ab, bb, bbbb\}$.   2

Show that :

$$S^* = T^*.$$

(*b*)   Define deterministic finite automata.   2

(c)   Consider the CFG :   2

       $S \rightarrow XaXaX$

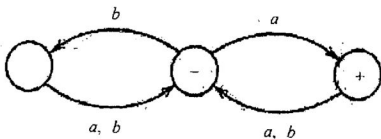 $X \rightarrow bX|aX| \wedge$

Describe the language this CFG generates.

(d)   What is a "dead-end state" in a finite automata ? Explain with an example.   2

(e)   Write the regular expression for the language having words in which a appears tripled (in clumps of 3), if at all.   2

(f)   Describe the language for the given finite automata :   3

(g)   Build a finite automata that have only those words that have length fewer than four letters.   3

(*h*) Design a turing machine that erases all characters in its tape.   3

(*i*) Describe the language for the following regular expression :   4

  (*i*) bba*(a + b)

  (*ii*) ((a + b)a)*.

(*j*) Using bypass algorithm, convert the following transition graph into a regular expression :   4
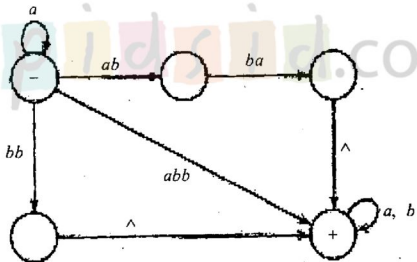
(*k*) Construct a PDA for a language   4

  L = {a^{n}S, where S starts with b and

  Length (S) = n}.

(*l*) Using pumping lemma, show that language 4

$$\{a^n \ b^n \text{ where n is square of 1, 2. 3,...........}\}$$

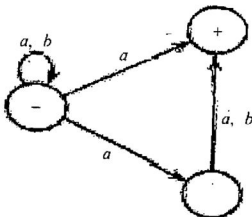$$= \{ab. \ aaaabbbb. \ aaaaaaaaabbbbbbbbb,.........\}$$

is non-regular.

Section B

2. (*a*) Given finite automata machine FA_1. Using Kleene's theorem algorithm, find $(FA_1)^*$: 5

FA_1
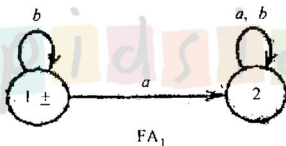
(*b*) Convert the following non-deterministic finite automata to deterministic finite automata : 5

3. (a) For the following pairs of regular language, build a finite automata and regular expression that define $L_1 \cap L_2$: 4+2=6

L_1 : $(ab^*)^*$

L_2 : $a(a + b)^*$.

(b) Prove that the language 4

$\{a^n b^n c^n$ where n = 1, 2, 3, 4.........$\}$

is non-context free.

4. (a) Find the CFG for the language containing all words that have different first and last letters. 5
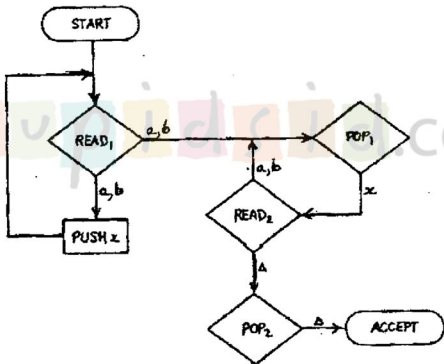
(b) Show that the following CFG is ambiguous : 5

$S \rightarrow XaX$

$X \rightarrow aX|bX| \wedge$.

P.T.O.

5. (a) Describe universal Turing Machine. 4

(b) Prove that a language is recursive language then its complement L˙ is also recursive. 6

6. (a) Given a PDA :

(i) Write the language represented by this PDA. 2

(ii) Trace the PDA for the string *bbba*. 4

(b) Describe the function of the following Turing Machine using the string $U w \underline{U}$ where a is any letter from alphabet set :   4

$$>L_U \longrightarrow R \xrightarrow{\;a \neq U\;} \cdot U R_U^2 a L_U^2 a$$

$$\downarrow U$$

$$\cdot R_U$$
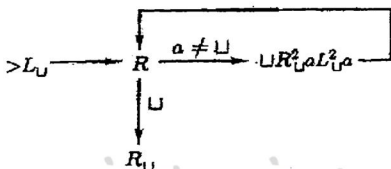
7. (a) If $\Sigma = \{x\}$, then what is Σ^+ ? Is $\Sigma^+ = \Sigma^*$?   2

(b) Build a finite automata that accepts only those words that do not end with ba.   4

(c) Prove that if L_1 and L_2 are Regular Languages, then $L_1 + L_2$, $L_1 \, L_2$ are also Regular Languages.   4