This question paper contains 7 printed pages]

Your Roll No.....

1955

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

P.T.O.

(c) Consider the CFG : 2

$S \rightarrow XaXaX$

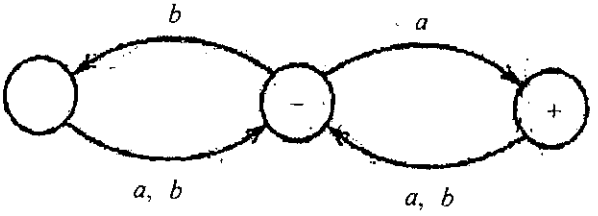
$X \rightarrow bX|aX|\wedge$

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

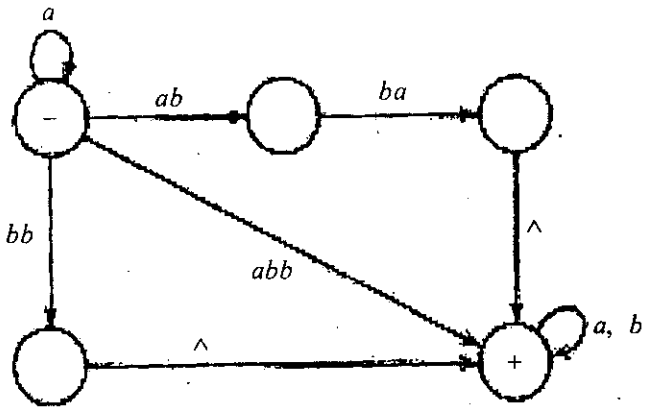
(*h*) Design a turing machine that erases all characters in its tape. 3

(*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$\}$.

P.T.O.

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

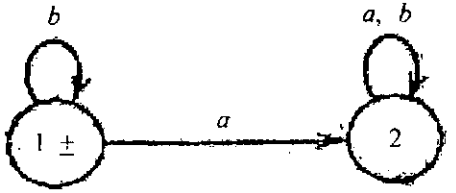
$\{a^n b^n$ where n is square of 1, 2, 3,.....$\}$

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

is non-regular.

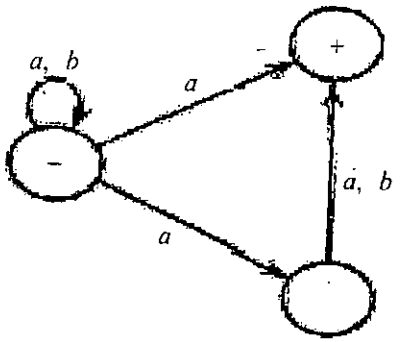
Section B

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

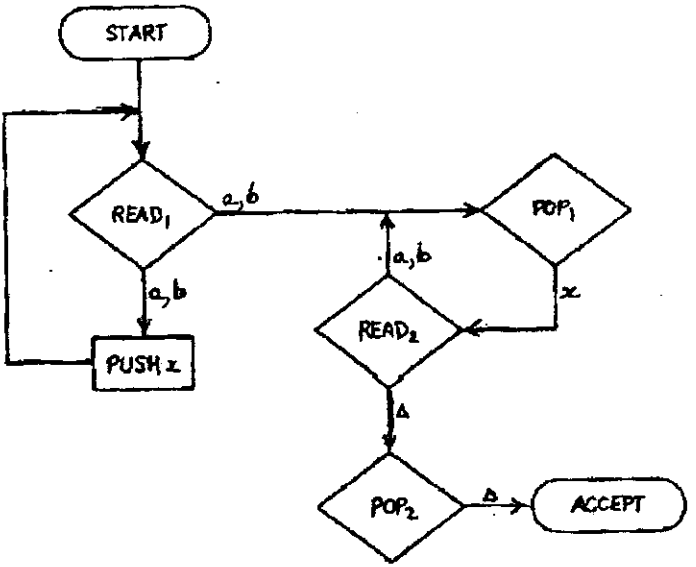
$S \rightarrow XaX$

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

5. (*a*) Describe universal Turing Machine. 4

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

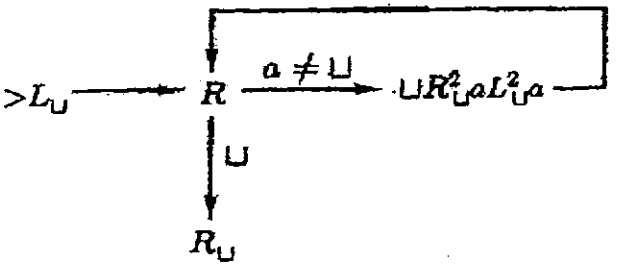
6. (*a*) Given a PDA :



(*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 UwU where *a* is any letter from alphabet set : 4



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