This question paper contains 4 printed pages.]

1803 *Your Roll No. .....*

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

Paper 601 : Theory of Computation

(For 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.)

*Attempt **all** questions.*

Parts of a question must be answered together.

1. (a) Assume Alphabet $\Sigma=\{a, b\}$ unless stated. Consider the language S^*, where $S=\{ab, ba\}$

   (i) Write out all the words in S^* that have seven or fewer letters.

   (ii) Can any word in this language contain the substring aaa or bbb ?

   (iii) What is the smallest word not in S^* ?

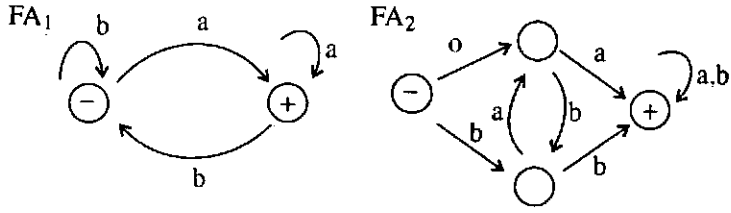
   4+1+1

   (b) Write a regular expression for the set of all words with no two consecutive a's. 2

[P.T.O.

2. (a) Build a DFA that accepts only those words that have even numbered occurrences of substring ab. 5

(b) Construct FA for the language ($FA_1 + FA_2$) where FA_1 and FA_2 are given below. 5



(c) Design a DFA that starts with a and has odd number of a's or starts with b and has even number of b's. 3

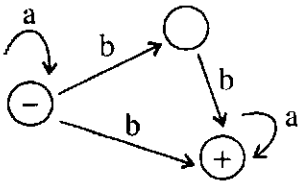
3. (a) Prove that the set of regular language is closed under interaction. 3

(b) For the pair of regular language Find systematically a regular expression and a FA that define $L_1 \cap L_2$

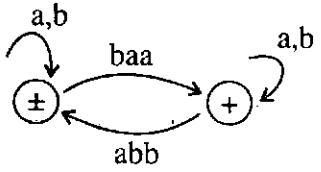
$L_1 = (a + b)\, b\, (a + b)^*$

$L_2 = b\, (a + b)^*$ 6

4. Convert NFA into DFA. 5



5. (a) Convert TG into Regular expression



7

(b) Use pumping lemma to show that the following language is non-regular

$\{a^n b^{2n}$ for $n > 1\}$. 5

6. (a) Consider CFG

$S \rightarrow XYX$

$X \rightarrow aX|bX|\wedge$

$Y \rightarrow bbb$ 3

(b) Obtain a CFG to generate a language of all non-palindromes over $\Sigma=\{a, b\}$. 4

7. Design a PDA to accept the following language over $\Sigma=\{0, 1\}$

$\{a^n b^n \mid n = 0\ 1\ 2 \ldots\}$ 6

8. (a) Design a Turing Machine which accepts the language

$L(\mu) = \{ a^n b^n c^n \mid n \geq 1 \}$ 5

(b) Prove that the recursive languages are closed under complementation. 3

(c) Consider $\Sigma = \{0\ 1\}$, design a Turing Machine that multiplies the value of the input string over Σ by 2. 4

(d) Describe Universal Turing Machine. 3