This question paper contains **4+2** printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **6075**

Unique Paper Code : **234501** **D**

Name of the Paper : **Theory of Computation (CSHT-511)**

Name of the Course : **B.Sc. (Hons.) Computer Science**

Semester : **V**

Duration : **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*) Is for all sets $(S^+)^* = (S^*)^+$? 2

(*b*) Generate a CFG for a^*b^*. 2

(*c*) Give Regular expression for all words that do not end in a double letter. 2

P.T.O.

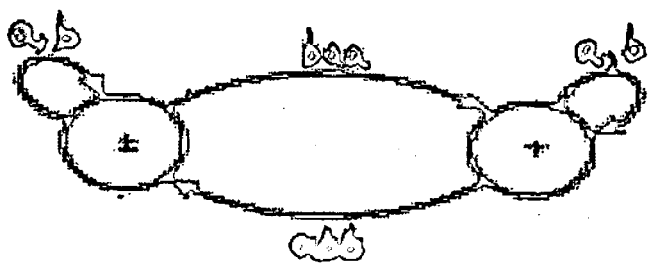
(*d*) Define Deterministic Finite Automata. 2

(*e*) Design a Deterministic Finite Automata for all strings that either starts with ab or ends with ba. 3

(*f*) Give the full details of the following Turing Machines : 3

$$>\mathrm{L}\ \mathrm{L} \text{ and } >\mathrm{L} \xrightarrow{\mathrm{U}} \mathrm{R}$$

(*g*) Convert the following Transition graph into Regular Expression. 4



(*h*) Convert the following CFG into CNF : 4

$$\mathrm{S} \rightarrow b\mathrm{A} \mid a\mathrm{B}$$

$$\mathrm{A} \rightarrow b\mathrm{AA} \mid a\mathrm{S} \mid a$$

$$\mathrm{B} \rightarrow a\mathrm{BB} \mid b\mathrm{S} \mid b$$

(*i*) Show that the language $L = \{a^n b\, a^{n+1}$ where $n = 1\ 2\ 3....\}$ is non-regular. 4

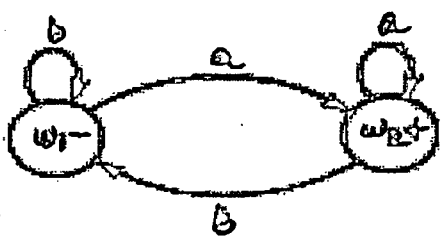
(*j*) Construct a DFA for the language where every 00 is followed by 1 over alphabet set {0, 1}. 4

(*k*) Construct PDA :

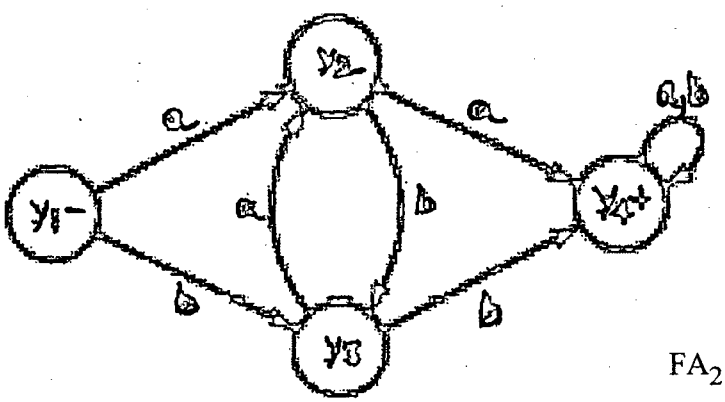
$$L = \{a^n\ b^n\ c^{n+m} : n >= 0, m >= 0\}.$$ 5

Section B

2. (*a*) Find the Union Machine for the given FA_1 and FA_2. 5

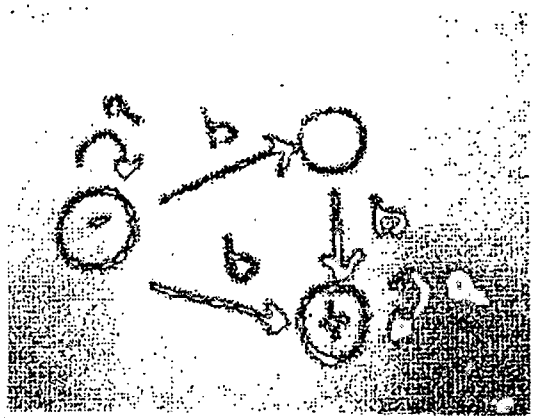


FA_1



FA_2

(*b*) Convert the given NFA into DFA. 5



3. (*a*) Build a DFA and give Regular Expression that define $L_1 \cap L_2$ where :

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

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

(*b*) Show that the language :

$$L = \{a^n\, b^n\, a^n\, b^n\, a^n \quad \text{where } n = 1\ 2\ 3...\}$$

is non Context Free. 4

4. (*a*) Show the Complement of the Context Free Language may or may not be Context Free. 5

(*b*) Show that the CFG is ambiguous :

$$S \rightarrow XaX$$

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

5

5. (*a*) Explain the Concept of Random Access Turing Machine. 2

(*b*) Explain Halting Problem. 2

(*c*) Give PDA for the language :

$$L = \{a^n\ b^{2n} \quad \text{where } n = 1\ 2\ 3....\}.$$ 6

6. (*a*) Show that if L is recursive, then L is also recursively enumerable. 4

(*b*) Design a Turing Machine which gives two's complement of a given input in binary form on the input tape. 6

7. (*a*) Describe the Language for the following Regular Expressions : 3

(*i*) $(a+b)^* ab(a+b)^*$

(*ii*) $(a(a+bb)^*)^*$

(*b*) Build a DFA that accepts all words with exactly four letters. 3

(*c*) Trace the following PDA for the given string sequence *aaaabb*. 4