[This question paper contains 7 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7407** **J**

Unique Paper Code : 32341502

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

Name of the Paper : Theory of Computation

Semester : V

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

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

(b) **All** questions in **Section-A** are compulsory.

(c) Attempt any **four** questions from **Section-B**.

(d) Parts of a question must be answered together.

(e) Assume alphabet $\Sigma = \{a,b\}$ unless stated otherwise.

P.T.O.

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Section - A

1. (a) Do the following regular expressio represent the same language (give reason

$R_1 = ((a + b)(a + b))^* a$

$R_2 = (a + b)((a + b)(a + b))^* a$

(b) Write a regular expression and build deterministic finite automata for t language containing all strings having **a** every odd position. 2

(c) Describe in English the languag represented by the following regul expressions : 2

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

(ii) $(a + b)^*aa(a + b)^*$

(d) Describe pumping lemma for regul languages.

(e) Based on the language S = {aa, ba, ab, b describe the language S*.

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(f) What are the languages generated by the following grammars : 3+3

(i) $S \rightarrow XA$

$X \rightarrow aXb \mid \Lambda$

$A \rightarrow aA \mid \Lambda$

(ii) $S \rightarrow AB$

$A \rightarrow aA \mid \Lambda$

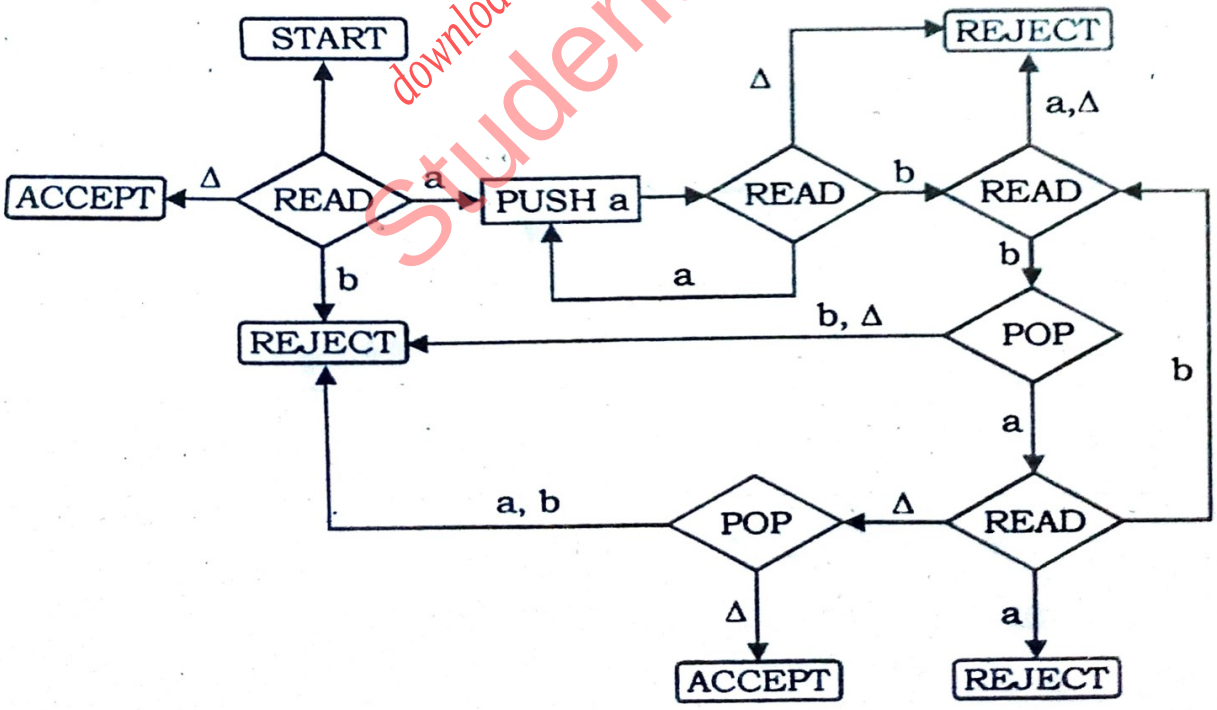
$B \rightarrow bB \mid \Lambda$

(g) Show that the following CFG is ambiguous : 3

$S \rightarrow X\,a\,X$

$X \rightarrow a\,X \mid b\,X \mid \Lambda$

(h) Describe the language (in English) accepted by the following PDA : 3



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(i) Describe the halting problem.

(j) Let $M=(K, \Sigma, \delta, s, \{h\})$, where

$K = \{q_0, q_1, h\}$

$\Sigma = \{a, b, \sqcup, \triangleright\}$

$S = q_0$

and δ is given by the following table :

q	σ	$\delta(q, \sigma)$
q_0	a	(q_1, b)
q_0	b	(q_1, a)
q_0	$\sqcup$	$(h, \sqcup)$
q_0	$\triangleright$	$(q_0, \rightarrow)$
q_1	a	$(q_0, \rightarrow)$
q_1	b	$(q_0, \rightarrow)$
q_1	$\sqcup$	$(q_0, \rightarrow)$
q_1	$\triangleright$	$(q_1, \rightarrow)$

Trace the computation of M starting from th configuration $(q_0, \triangleright \underline{a}abbba)$.

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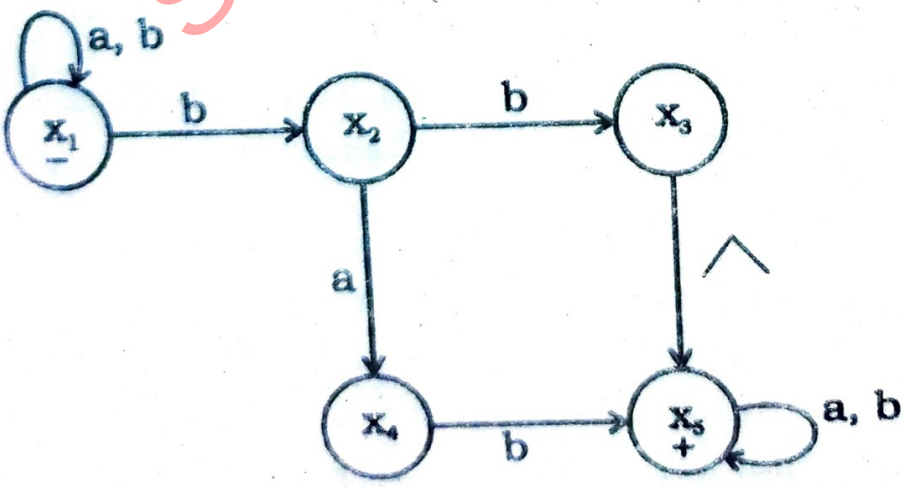
Section -B

2. (i) Let L=All strings that end with aa or bb. Construct DFAs for L and L' (i.e., Complement of L). 6

(ii) Is the language $\{a^m b^m ; m \geq 0\}$ regular? Justify using Pumping Theorem. 4

3. (i) Build an FA accepting the language comprising of all strings having first two characters same as the last two. 6

(ii) Convert the following Transition Graph (TG) into regular expression using Bypass algorithm. 4



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4. (i) Give Context Free Grammar (CFG) for the following language : 5

$\{a^i b^j c^k \mid i + j = k; i, j, k \geq 0\}$ and $\Sigma = \{a,b,c\}$

(ii) Build pushdown automation (PDA) to accept the following language : 5

$\{ Sb^{n+1}$; S is a string of only a's, n=length(S), $n \geq 1 \}$

5. (i) Convert the following CFG to CNF : 5

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow (E)$

$E \rightarrow 6 \mid 7$

The terminals here are + * ( ) 6 7.

(ii) Prove that the recursive languages are closed under complementation. 5

6. (i) Design a Turing Machine that scans to the right until it finds two consecutive a's and then halts. The alphabet of the Turing machine should be $\{a, b, \sqcup, \Delta\}$. 5

(ii) Prove that context-free languages closed under Union and concatenation. 5

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7. (i) Build FA for each of the following regular languages L_1 and L_2. 4

$L_1 = b(a+b)^*$ $L_2 = a(a+b)^*b + b(a+b)^*a$

(ii) Build FA for $L_1 \cap L_2$. 4

(iii) Describe in English the language represented by $L_1 \cap L_2$. 2

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