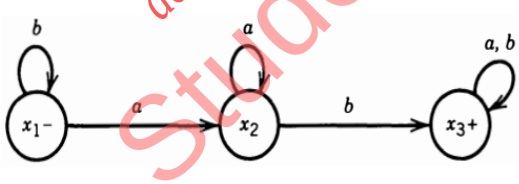
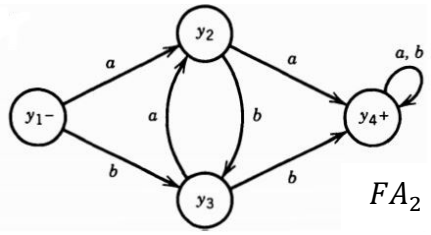
Unique Paper Code	: 32341502
Name of Course	: B.Sc. Hons. Computer Science
Name of the Paper	: Theory of Computation
Semester	: V
Duration of Examination	: 3 Hours
Maximum Marks	: 75 Marks
Students admitted in the year	: 2015, 2016, 2017, 2018

Instructions for Candidates:

1. Answer any **FOUR** questions.
2. All questions carry equal marks.
3. Assume $\sum = \{a, b\}$ for all the questions unless specified otherwise.

1.	Construct a regular expression and corresponding deterministic finite automaton (DFA) defining a language comprising all strings of length 5 or more such that the letter appearing just before the last is same as the second letter of the string.
2.	Construct a finite automaton (FA) for $FA_1 + FA_2$, $FA_1.FA_2$, and ${FA_1}^*$.  FA_1  FA_2
3.	For languages, $L_1: (aa + ab + ba + bb)^*$ and $L_2: (a + b)^* aa(a + b)^*$, construct respective DFA's and derive a finite automaton that defines $L_1 \cap L_2$. Also, construct a regular expression for the resultant DFA.
4.	Prove that the language $L = \{a^n b^{2m} a^{2m} b^n : n \geq 1\}$ is non-regular and construct a Pushdown Automaton (PDA) that accepts L. Trace the working of PDA on the string **aabbbbaaaabb**.

5.	Consider the following context free grammar (CFG): $S \rightarrow 0\ A\ 0 \mid 1\ B\ 1 \mid B\ B$ $A \rightarrow C$ $B \rightarrow S \mid A$ $C \rightarrow S \mid \in$ Eliminate $\in$ – productions, followed by the elimination of unit productions, and then remove all the useless symbols. Also, put the resultant grammar into Chomsky Normal Form (CNF). Here, $\in$ represents the null string.
6.	Considering $\sum = \{a, b, \triangleright, \sqcup\}$, design a Turing Machine (TM) (single tape or multi-tape as you prefer) that transforms $\sqcup$ w $\sqcup$ **to** $\sqcup$ w w $\sqcup$. Show the trace of TM on the string $\sqcup$ abb $\sqcup$.