Printed Pages: 02 **Sub Code: ECS403**
Paper Id: 110218 **Roll No.**

B. TECH.
(SEM IV) THEORY EXAMINATION 2018-19
THEORY OF AUTOMATA & FORMAL LANGUAGES

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. Write a regular expression to denote a language L which accepts all the strings that begin or end with either 00 or 11.
b. Differentiate between FA and PDA.
c. Write the applications of finite automata.
d. How do we determine equivalence of two DFA? Explain with an example.
e. Remove the Unit productions from the following grammar:
$S \rightarrow aSb|A$, $A \rightarrow cAd|cd$
f. Identify the language generated by context free grammar $S \rightarrow (S)|SS|(\ )$
g. Explain briefly about two stack PDA.
h. Distinguish between DPDA & NPDA.
i. Differentiate between Recursive & Recursive enumerable languages.
j. Define halting problem of Turing machine.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Design FA for the following languages containing binary strings:
(i) Having both 00 and 11 as substring.
(ii) Number of 0's is odd and number of 1's is multiple of 3.
b. State closure properties of regular languages. Also Prove that regular languages are closed under intersection and difference.
c. Convert the following PDA into its equivalent CFG.
Transition function is defined as:
$\delta(q_0, 0, Z_0) = \{(q_0, 0Z_0)\}$
$\delta(q_0, 0, 0) = \{(q_0, 00)\}$
$\delta(q_0, 1, 0) = \{(q_1, \in)\}$
$\delta(q_1, 1, 0) = \{(q_1, \in)\}$
$\delta(q_1, \in, Z_0) = \{(q_2, \in\ )\}$

d. Write the procedure to convert a given CFG into equivalent grammar in CNF. Apply the procedure and convert the grammar with following production into CNF: $S \rightarrow bA|aB$, $A \rightarrow bAA|aS|a$, $B \rightarrow aBB|bS|b$
e. Design a Turing machine that accepts Palindromes of binary numbers.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) Describe Chomsky hierarchy of languages with proper example.

(b) Design an NFA for the language containing strings ending with ab or ba. Also convert the obtained NFA into equivalent DFA.

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) State Arden's theorem and construct regular expression for the following FA using Arden's theorem:

State	Input	
	0	1
A	{A, B}	ϕ
B	C	{A, B}
C	B	ϕ
A is the initial state and C is Final State		

(b) Using pumping lemma, prove that the language $L = \left\{a^{i^2} \mid i \geq 1\right\}$ is not regular.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Define Greibach normal form for a CFG. Reduce the following CFG into GNF: $S \rightarrow AB, A \rightarrow BS \mid a, B \rightarrow SA \mid b$

(b) Let G be the grammar S $\rightarrow$0B|1A, A $\rightarrow$0|0S|1AA, B $\rightarrow$1|1S|0BB
For the string 00110101, find:
(i) The leftmost derivation. (ii) The rightmost derivation. (iii) The derivation tree.

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) Construct a PDA to accept the language L = $\left\{WcW^R \mid W \in (a,b)^+\right\}$ by empty stack.

(b) Prove that "L is accepted by a PDA M_1 by empty store if and only if L is accepted by a PDA M_2 by final state.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Find a PCP solution for the following sets A = {ab, ba, b, abb, a}, B= {aba, abb, ab, b, bab}

(b) Explain various types of Turing Machines with example.