Printed Pages: 02 **Sub Code: RCS403**
Paper Id: 110257 **Roll No.**

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

Time: 3 Hours ***Total Marks: 70***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. For the given language $L_1 = \varepsilon$, $L_2 = \{a\}$, $L_3 = \emptyset$. Compute $L_1 L_2^* \cup L_3^*$.
b. Design a FA to accept the string that always ends with 101.
c. Write regular expression for set of all strings such that number of a's divisible by 3 over $\Sigma = \{a,b\}$
d. Construct the CFG for the Language $L = \{a^{2n}b^n \mid n>=3\}$.
e. What do you mean by ε-Closure in FA?
f. Explain Universal TM.
g. Explain Two Stack PDA.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Construct a minimum state DFA from given FA

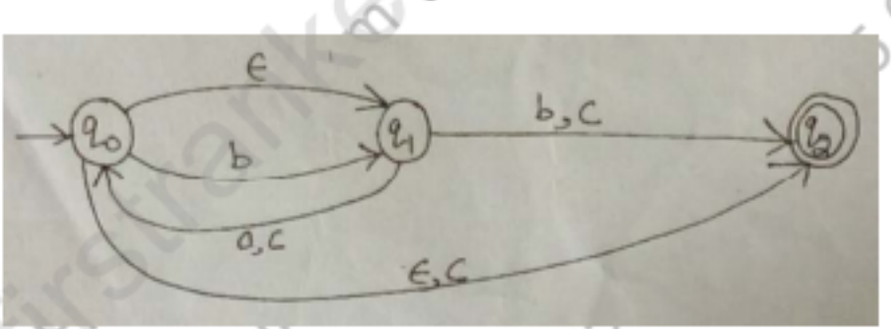

Fig. 1

b. Find the regular expression corresponding to the finite automata given bellow:

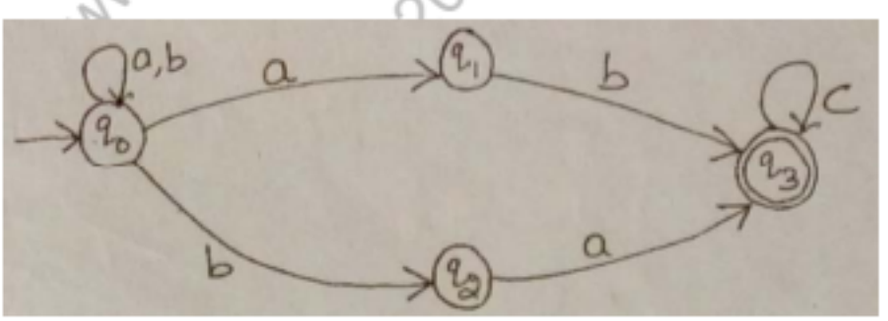

Fig. 2

P.T.O

c. Convert the following CFG to its equivalent GNF:
$S \rightarrow AA \mid a$, $A \rightarrow SS \mid b$.

d. Design a PDA for the following language:
$L = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$

e. Design a TM for the following language:
$L = \{ a^{n+2} b^n \mid n > 0 \}$

SECTION C

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

(a) Design FA for ternary number divisible by 5.

(b) Explain Myhill-Nerode Theorem using suitable example.

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

(a) Prove that the following Language $L = \{a^n b^n\}$ is not regular

(b) Explain the Closure properties of regular expression.

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

(a) Design the CFG for the following language:
i) $L = \{0^m 1^n \mid m \neq n \ \& \ m,n \geq 1\}$
ii) $L = \{a^l b^m c^n \mid l + m = n \ \& \ l,m \geq 1\}$

(b) Prove that the following Language $L = \{a^n b^n c^n\}$ is not Context Free.

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

(a) Design a PDA for the Language $L = \{WW^R \mid W = \{a,b\}^*\}$

(b) Generate CFG for the given PDA M is defined as
$M = (\{q_0, q_1\}, \{0,1\}, \{X, Z_0\}, \delta, q_0, Z_0, q_1)$ where δ is given as follows:
$\delta(q_0,1, Z_0) = (q_0, XZ_0)$
$\delta(q_0,1, X) = (q_0, XX)$
$\delta(q_0,0, X) = (q_0, X)$
$\delta(q_0, \varepsilon, X) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, X) = (q_1, \varepsilon)$
$\delta(q_1,0, X) = (q_1, XX)$
$\delta(q_1,0, Z_0) = (q_1, \varepsilon)$

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

(a) Design a TM for the following language:
$L = \{ a^n b^n c^n \mid n \geq 1\}$

(b) Write short note on:
i) Recursive Language and Recursively Enumerable Language.
ii) PCP problem and Modified PCP Problem