B.E. (Computer Science Engineering) Fourth Semester (C.B.S.)

Theoretical Foundation of Computer Science

P. Pages : 3 **NRJ/KW/17/4436**

Time : Three Hours * 0 2 0 4 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.

1. a) Explain Pigeon hole principal. **3**

b) Define the following terms with suitable example. **8**
i) Prefix
ii) Suffix
iii) Substring
iv) Subsequences

c) Explain closure of a Relation, **2**

find R^* for

$R = \{(1,1),(1,2),(2,1),(2,3),(3,2)$

OR

2. a) Explain Chomsky Hierarchy in detail. **6**

b) Using Mathematical induction, prove that **7**

$P(n): 1.1! + 2.2! + 3.3! + ... + n.n!$

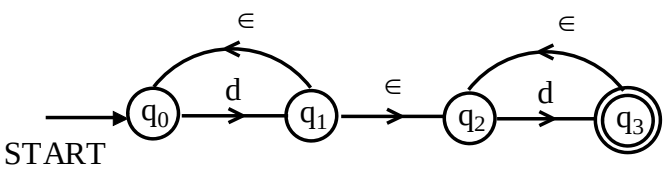
$= (n+1)! - 1, \quad n > 1$

3. a) Design a Finite Automata for accepting **7**

$$L = \left\{ w \;\middle|\; \begin{array}{l} w \in (a/b)^* \\ n(a) \text{ W M0D 3} > n(b) \text{ W M0D 3} \end{array} \right.$$

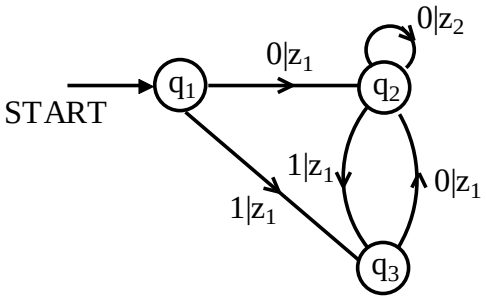
also write application of Finite Automata.

b) Obtain a Deterministic Finite Automata for **6**



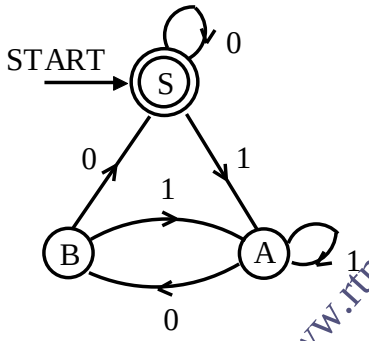
OR

4. a) Convert the given Mealy Machine into equivalent Moore Machine. **7**



b) Design a Moore and Mealy machine over $\Sigma = \{a, b\}$ such that it will generate output EVEN if the number of a's are Even & generate output ODD if number of a's are odd. **6**

5. a) Convert the given Finite Automata to equivalent Regular Expression. **8**



b) Construct NFA with $\in$ –transitions equivalent to the given Regular Expression. **6**

$$\boxed{R = 10 + (0+11)0^*1}$$

OR

6. a) Explain the procedure to convert Right linear grammar to equivalent left linear grammar, convert the given RLG into LLG. **8**

$S \rightarrow 01A \mid 10$

$A \rightarrow 10A \mid 10$

b) Convert the given grammar into GNF without renaming the grammar. **6**

$S \rightarrow AB$

$A \rightarrow BS \mid b$

$B \rightarrow SA \mid a$

7. a) Design a Non deterministic PDA for **7**

$$L = \left\{ WW^R \,\middle|\, \begin{array}{l} W \in (a/b)^* \\ W^R \text{ is Reverse of } W \end{array} \right.$$

Also explain STACK Execution with valid string.

b) Design a PDA for given CFG. **7**

$S \rightarrow XY$

$X \rightarrow AX \mid BX \mid a$

$Y \rightarrow YA \mid YB \mid a$

$A \rightarrow a$

$B \rightarrow b$

OR

8. a) Design a PDA for **7**

$$L = \left\{ W \,\middle|\, \begin{array}{l} W \in (a/b)^* \\ n_a(W) = n_b(W) \end{array} \right.$$

Where $n_a(W) \rightarrow$ Number of a's in W

& $n_b(W) \rightarrow$ Number of b's in W

b) Convert the given PDA to CFG. **7**

$\delta(q_0, a, z_0) \Rightarrow (q_0, xz_0)$

$\delta(q_0, a, x) \Rightarrow (q_0, xx)$

$\delta(q_0, b, x) \Rightarrow (q_1, \in)$

$\delta(q_1, b, x) \Rightarrow (q_1, \in)$

$\delta(q_1, \in, z_0) \Rightarrow (q_1, \in)$

9. a) Design a Turing Machine to perform $\frac{(n+1)}{2}$ where n is an uniary number. **7**

b) Explain different types of Turing Machine. **6**

OR

10 a) Design a Turing Machine that has **7**
INPUT : $\rightarrow$ #W# and generates
OUTPUT : $\rightarrow$ #W#W
where $W = \{ a, b \}^+$.

b) Explain various properties of Recursively Enumerable Language. **6**

11. a) What do you mean by Primitive Recursive Functions? Show that **7**
$A_{DD}(x, y)$ and SUB (x, y) are Primitive Recursive?

b) Write short notes on LBA. **6**

OR

12. a) What is Ackermann's Function, Calculate **7**
$A(1,1)$ $A(1,2)$ $A(2,1)$

b) What is the significance of PCP, Solve the following using PCP **6**

i	wi	xi
1	0	000
2	01000	01
3	01	1

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