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

Theoretical Foundation of Computer Science

Paper - IV

P. Pages : 4 **KNT/KW/16/7296**

Time : Three Hours * 0 1 5 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. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.

1. a) Which type of grammar is more powerful and why? **5**

b) Describe the concept of pigeon-hole principal with example? **5**

c) Explain following terms: **3**
1) Star closure of language 2) Positive closure of language 3) String & length of string.

OR

2. a) Explain following terms: **7**
1) Context sensitive grammar
2) Context free grammar
and also justify why context free grammar is context sensitive but vice versa is not possible?

b) With the help of mathematical induction prove that - **6**

1) $1^2 + 2^2 + 3^2 + \ldots\ldots + n^2 = \frac{n \times (n+1)(2n+1)}{6}$

2) $1 \cdot 2 \cdot 3 + 2 \cdot 3 \cdot 4 + \ldots\ldots + n(n+1)(n+2) = \frac{n(n+1)(n+2)(n+3)}{4}$

3. a) Design a DFA for following

1) For a string over $\langle 0,1 \rangle$ divisible by 3 binary **3**

2) $L = \left\{ W \;\middle|\; \begin{array}{l} W = \{a,b\}^* \\ n(a) \text{ of } W \pmod 4 = \\ \quad n(b) \text{ of } W \pmod 4 \end{array} \right\}$ **5**

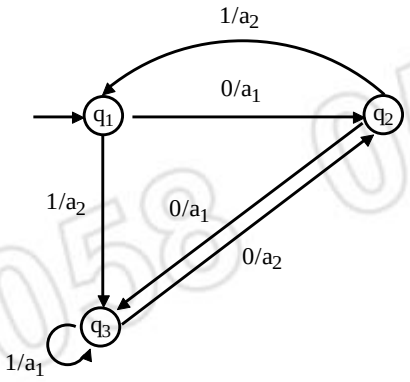
Where n(a) = no. of a's
n(b) = no. of b's

3) For a string which should contain 'ab' as substring $\sum = \{a,b\}^*$ **2**

4) For a string which should start with 1 and end with 01. Assume $\sum = \{0,1\}$ **4**

OR

4. a) Convert the following mealy machine into equivalent Moore machine? **7**



b) Minimize the following DFA. **7**

	State	a	b
→	q_0	q_1	q_0
	q_1	q_6	q_2
	q_2	q_3	q_1
*	q_3	q_3	q_0
	q_4	q_3	q_5
	q_5	q_6	q_4
	q_6	q_5	q_6
	q_7	q_6	q_3

5. a) Obtain the regular expression from following grammar. **3**

$S \rightarrow 1A \mid oC \mid o$

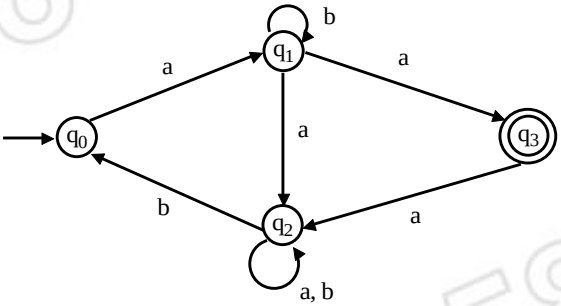
$A \rightarrow 1B$

$B \rightarrow 1B \mid 1D$

$C \rightarrow O$

$D \rightarrow oD \mid 01$

b) Find the regular expression for the given transition diagram using Arden's Theorem? **7**



c) Match the following pairs **3**

Group A	Group B
Left linear Grammar	$S \rightarrow aSSb \mid bSSa \mid \in$
Right linear Grammar	$S \rightarrow Ba \mid aa \mid Saa$
Ambiguous Grammar	$S \rightarrow abA \mid aA \mid b$

6. a) Find the minimum state DFA for following Regular Expression **8**

ab* (ab)* (a + b) b* + b

b) Convert the grammar into Chomsky Normal Form. **5**

$S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow Ab$

7. a) Differentiate between NPDA & DPDA. **5**

b) Construct CFG from following PDA. **8**

$\delta(q_0, 1, z_0) = (q_0, x\, z_0)$

$\delta(q_0, 1, x) = (q_0, xx)$

$\delta(q_0, 0, x) = (q_1, x)$

$\delta(q_0, \in, z_0) = (q_0, \in)$

$\delta(q_1, 1, x) = (q_1, \in)$

$\delta(q_1, 0, z_0) = (q_0, z_0)$

OR

8. a) Explain the model of PDA. **2**

b) Construct PDA from the given grammar. **5**

$E \rightarrow + EE \mid *EE \mid \$TF$

$T \rightarrow + T \mid +$

$F \rightarrow *F \mid +$

c) Construct PDA for following . **6**

$L = \{a^n b^m c^m d^n \mid n, m \geq 1\}$

9. a) Define the model of Turing machine and explain it's tuples? **5**

b) Construct Turing Machine for **9**
Input = W
output = $ W $ W
Where $W=\{a,b\}^+$

OR

10. a) Explain the types of Turing Machine? **6**

b) Design Turing Machine to convert 111 into 101. **8**

11. a) Explain the following terms.

1) Decidability and solvability. **3**

2) Recursive function. **2**

3) Post correspondence problem. **4**

4) Halting problem. **4**

OR

12. a) Explain the properties of Recursively Enumerable language. **7**

b) Define Ackermann's Function & compute A(1,1) , A(2,1) and A(2,2) **6**

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