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

Theoretical Foundations of Computer Science

P. Pages : 3 **NRT/KS/19/3381**

Time : Three Hours * 0 6 4 2 * 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.

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

b) Prove the following using method of induction. **7**

$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}.$$

OR

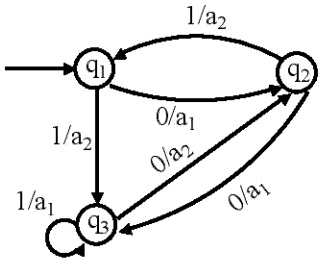
2. a) Let R = {(1,2), (2,3), (3,1)} & A = {1,2,3}. Find Reflexive, symmetric & transitive closure of R. **4**

b) Define : **3**
i) Kleene closure ii) Positive closure
with an example.

c) Explain pigeon-hole principle in detail. **6**

3. a) Construct a DFA over $\sum = \{0,1\}$ for the "Language accepting 1100 or 1010 as a substring". **7**

b) Convert following mealy machine into equivalent Moore machine. **6**

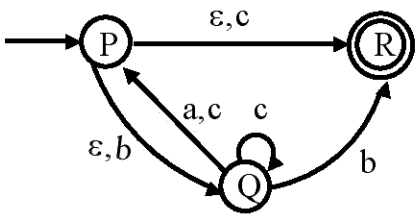


OR

4. a) Construct DFA equivalent to : **6**
$M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0 \{q_2\})$
Where δ is defined by its state table.

State	Input	
	a	b
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_2\}$
q_1	$\{q_0\}$	$\{q_1\}$
q_2	--	$\{q_0, q_1\}$

b) Convert the NFA with ε -transition to NFA without ε -transition. **7**



5. a) What is Regular Grammar? Find left linear and right linear grammar for the following regular expression. **8**

i) (0+1)* 00 (0+1)* ii) 0* (1(0+1))*

b) Convert the following grammar into CNF **6**

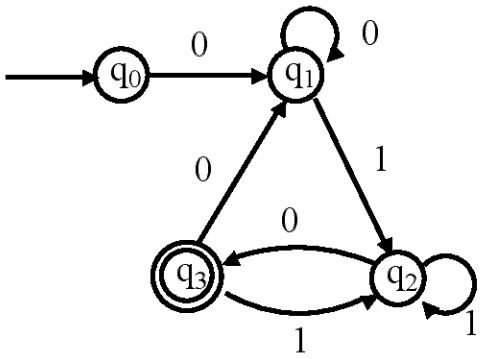
$S \rightarrow ABa$

$A \rightarrow aab$

$B \rightarrow Ab$

OR

6. a) Find Regular expression for following transition diagram. **7**



b) Explain closures properties of Regular set. **7**

7. a) Design PDA for the language **7**

$L = \{\omega \subset \omega^R \mid \omega \in (0+1)^*\}$.

R : Reverse string.

b) Explain the modal of PDA and its acceptance by stack and acceptance by final state. **6**

OR

8. a) Explain pumping lemma theorem for context free language. **6**

b) Convert following CFG into PDA. **7**

$E \rightarrow aAB \mid d$

$A \rightarrow BA \mid a$

$B \rightarrow Ead \mid c$

9. a) Design a Turing machine for the language **8**

$$L = \{WW^R \mid W \in (0+1)^*\}$$

R : Reverse string.

b) Explain the modal of linear bounded automata. **6**

OR

10. a) Explain : Turing machine as transducers with example. **7**

b) Design a Turing machine that computes the function f (m,n) = m +n. **7**

11. a) What is Ackermann's function, calculate A (1, 1) A (1, 2) A (2, 1). **6**

b) Explain the properties of Recursively enumerable language. Give relation between recursive & recursive enumerable language. **7**

OR

12. a) What is significance of PCP, solve the following using PCP. **7**

$A = \{b, bab^3, ba\}$ $B = \{b^3, ba, a\}$.

b) Write a short note on LBA. **6**

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