



- 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) Define and explain the following terms with suitable examples: 8
- i) Transitive closure
  - ii) Reflexive transitive closure
  - iii) Equivalence Relation
  - iv) Countability and diagonalization
- b) What is formal grammar? Explain different types of formal grammars by giving rules/format of production for each formal grammar. 5

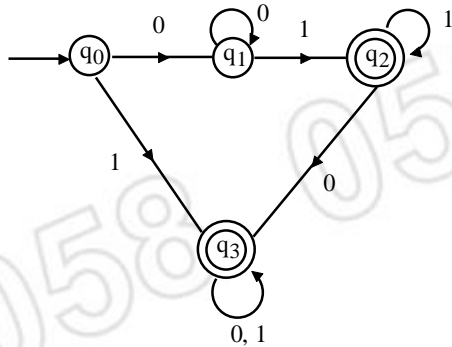
**OR**

2. a) Prove the following by using principle of mathematical induction- 6
- i)  $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$
  - ii)  $1 + 2 + \dots + n = \frac{n^2 + n}{2}$
- b) What is string, prefix, suffix, proper prefix & proper suffix with examples. 4
- c) Short Note on Pigeon hole principle. 3
3. a) Design DFA to check whether ternary number is divisible by three. 5
- b) What are the applications of finite Automata explain in detail. 5
- c) Differentiate NFA & DFA 3

**OR**

4. a) Design DFA which accepts the set of strings that either start with 01 or end with 01 over  $\Sigma\{0, 1\}$  5

- b) Design Moore M/C for a binary I/P sequence such that if it has a substring 101 the M/C output A, if it has a substring 110, the Machine O/P B, Otherwise it O/P C. **6**
- c) Give Analytical Definition of Moore & Melay Machine. **2**
5. a) Find regular expression for the following transition diagram – **8**



- b) Obtain an equivalent left linear grammar for the following right linear grammar – **6**
- $S \rightarrow bA$   
 $A \rightarrow aA \mid bB \mid b$   
 $B \rightarrow bA$   
 Also Mention the steps

**OR**

6. a) Find equivalent Greibach normal form representation for the following CFG. **8**
- $S \rightarrow AA \mid 0$   
 $A \rightarrow SS \mid 1$
- b) Construct NFA with and without E – transition equivalent to the following regular expression – **6**
- $R_1 = 10 + (0 + 11) 0^*1$

7. a) Construct PDA for the following language **7**
- $L = \{a^{2n} b^n \mid n > 0\}$
- b) Construct PDA equivalent to the following grammar: **7**
- $S \rightarrow aAA$   
 $A \rightarrow aS \mid bS \mid a$   
 and show acceptance rejection for the string 'aaabaaaa'

**OR**

8. a) Prove that  $L = \{a^j b^j c^j \mid j \geq 1\}$  is not a CFL. **8**
- b) Explain, with suitable example, closure and decision properties of CFL. **6**
9. a) Design a T. M. to find 2's complement of a given binary number. **7**

b) Explain briefly about universal turing machine.

6

**OR**

10. a) Design T.M. to recognize all palindrome strings over {a, b}

7

b) What are different types of Turing machine? Explain each type in brief.

6

11. a) Define Ackerman's function? What is the significance of it?  
Compute  $A(1,1)$ ,  $A(2,1)$ ,  $A(1,2)$  and  $A(2,2)$ .

7

b) Explain the properties of recursive enumerable language.

6

**OR**

12. a) Show that the function  $ABS(x,y) = |x-y|$  is primitive recursive.

7

b) What is PCP and modified PCP. Give one solution for the PCP for following sequences shown in table –

6

| i | A      | B   |
|---|--------|-----|
| 1 | 0      | 000 |
| 2 | 010001 | 01  |
| 3 | 01     | 1   |

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