

**Fourth Semester B. E. (CT) (C. B. S.)
Examination**

THEORY OF COMPUTATION

Paper-IV

Time : Three Hours]

[Max. Marks : 80

- N. B. : (1) Same answer book must be used for both section.
 (2) All questions carry marks as indicated.
 (3) Assume suitable data wherever necessary.
 (4) Illustrate your answers wherever necessary with the help of neat sketches.

1. (a) ✓ Explain Chomsky Hierarchy of language in detail ? 6

(b) Solve using Mathematical Induction.

$$\sum_{i=0}^n i^2 = \frac{n(n+1)(2n+1)}{6}$$

7

OR

2. (a) Explain in brief diagonalization principle. 5
- (b) Are the following sets are closed under the following operations, if not what are the respective closure ?
- (i) The odd integers under multiplication
 - (ii) The positive integers under division
 - (iii) The negative integers under subtraction
 - (iv) The negative integers under multiplication

(v) The ODD integers under division.

(vi) The odd integers under addition. 8

3. (a) Construct a Moore Machine whose output is 2's complement of binary number. Assume input to Moore machine is binary digit from MSB to LSB. 7

(b) Convert the given NFA to Equivalent DFA. Also describe the language accepted by it.

| Q ↓ \ E → | 0 | 1 |
|-----------|--------|--------|
| p | {p, q} | {p} |
| q | {r, s} | {t} |
| r | {p, r} | {t} |
| s | ϕ | ϕ |
| t | ϕ | ϕ |

.OR

4. (a) Construct a DFA accepting string over decimal digit that represents decimal number divisible by 6.

(Hint : Number Divisible by 2 and 3 are divisible by 6) 10

(b) Design a Moore Machine that generates the output EVEN if the numbers of a's are even and generates output ODD if the number of a's are odd over $\Sigma = \{a, b\}$. 4

5. (a) Give Regular Expression and transition diagram for finite automata for the following regular sets of

string over $\Sigma = \{a, b\}$

- (i) All string beginning with 'a' and ending with 'b'.
 - (ii) All string with atleast two consecutive 'a'.
 - (iii) All string containing the substring 'aba'. 7
- (b) Give the statement of Pumping Lemma and prove that $L = \{a^p \mid p \text{ is prime}\}$ is not regular. 6

OR

6. (a) Reduce the following grammar :—

$S \rightarrow ABC \mid BaB$

$A \rightarrow aA \mid BaC \mid aaa$

$B \rightarrow bBb \mid a$

$C \rightarrow CA \mid AC$ 5

- (b) Show that following grammar is ambiguous. 2

$S \rightarrow asbs \mid bsas \mid \epsilon$

- (c) Convert the given grammar in to GNF.

$S \rightarrow AA \mid 0$

$A \rightarrow SS \mid 1$ 6

7. (a) Design a PDA for accepting

$$L = \left\{ WCW^R \mid w \in (0/1)^* \text{ and } W^R \text{ is reverse of } W \right\}$$

8

- (b) Define a PDA and explain the difference between acceptance by final state and acceptance by empty stack. 6

OR

8. (a) Explain closure properties of CFL. 6

(b) Design a CFG for given PDA.

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

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

$$\delta(q_0, b, x) = (q_1, \epsilon)$$

$$\delta(q_1, b, x) = (q_1, \epsilon)$$

$$\delta(q_1, \epsilon, z_0) = (q_1, \epsilon)$$

8

9. (a) Design a Turing Machine of 2'S complement of binary number. 7

(b) Describe Linear Bounded Automata and the language accepted by LBA. 6

OR

10. (a) Construct a Turing Machine for performing multiplication of two numbers. 8

(b) Explain different types of Turing Machine. 5

11. (a) Define Ackermann's function. Compute for A(1,1), A(2,1) and A(2,2). 7

(b) What is the significance of PCP? Obtain the solution for

$$X = (01, 1, 1)$$

$$Y = (01^2, 10, 1^2)$$

6

OR

12. (a) What are Primitive Recursive functions? Show that SUM(x,y) and SUB(x,y) are PRF. 6

(b) What are the closure properties of Recursive and Recursively enumerable languages? 7