



Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.  
Candidate are required to give their answers in their own words as far as practicable

**Group-A (Very Short Answer Type Question)**

1. Answer any ten of the following :

[ 1 x 10 = 10 ]

- (I) What type of grammar is Context-sensitive grammar ?
- (II) Give two applications of TM .
- (III) What is a universal Turing machine?
- (IV) Give two applications of Context free languages .✓
- (V) Give two examples/applications designed as finite state systems.
- (VI) What is context-free language?
- (VII) Define context sensitive grammar.
- (VIII) How can you proceed for Turing machine construction?
- (IX) What are the various representation of TM?
- (X) Define finite automaton.
- (XI) What do you mean by k-equivalent states ?
- (XII) When a grammar is said to be ambiguous ?

**Group-B (Short Answer Type Question)**

Answer any three of the following :

[ 5 x 3 = 15 ]

2. Find context-free grammars for the language (with  $n \geq 0, m \geq 0, k \geq 0$ ):  
 $L = \{a^n b^m c^k, k = n + 2m\}$ .

[5]

3. Discuss Universal Turing Machine (TM)

[5]

4. Show that the following grammar is ambiguous:  
 $S \rightarrow aSbS \mid bSaS \mid \lambda$ .

[5]

5. Consider the grammar  $G = (\{S\}, \{a, b\}, S, P)$   
with P given by

$S \rightarrow aSb$

$S \rightarrow \epsilon$

What will be the language of the grammar?

[5]

6. What is the Turing Machine Halting Problem?

[5]

**Group-C (Long Answer Type Question)**

Answer any three of the following :

[ 15 x 3 = 45 ]

7. Discuss with examples how to simplify context-free grammar:

[ 5+5+5 ]

- a) By removing the useless production
- b) By moving  $\lambda$ -production
- c) By removing unit production

8. (a) What is Turing Machine?

[ 5 ]

- (b) How can Turing Machines be used as language acceptors?

[ 3 ]

- (c) For  $\Sigma = \{0, 1\}$ , design a Turing machine that accepts the language denoted by the regular expression  $00^*$ .

[ 7 ]

9. (a) When a Problem is said to be Undecidable ?

[ 5 ]

- (b) Let  $\Sigma = \{a, b\}$ . Write down the grammar that generates the following language :

[ 5 ]

$L = \{a^n b^m : n \geq 0, m < n\}$ .

- (c) Show that the grammars

[ 5 ]

$S \rightarrow aSb \mid bSa \mid SS \mid a$

and

$S \rightarrow aSb \mid bSa \mid a$

are not equivalent.

[ 5 ]

10. (a) Consider the language  $L = \{a^n : n = 3 \text{ or } n \text{ is even}\}$ . Construct a DFA for this language.

[ 5 ]

(b) For  $\Sigma = \{a, b\}$ , construct a DFA that accepts all strings with an even number of a's.

[ 5 ]

(c) For  $\Sigma = \{a, b\}$ , construct DFA that accepts all strings with exactly one a.

[ 15 ]

11. Discuss Chomsky hierarchy of languages with examples.

\*\*\* END OF PAPER \*\*\*

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