

(2 ½ Hours)

[Total Marks: 75]

**N.B. 1) All questions are compulsory.**

2) Figures to the right indicate marks.

3) Draw suitable diagrams and illustrations wherever necessary.

4) Mixing of sub-questions is not allowed.

## **Q. 1    Attempt All the Questions**

**A. Choose the correct alternative**

- i. The next state of an automaton at any instant of time is determined by the present state and the present input.

- a) state, output
  - b) input, output
  - c) state, input
  - d) output, start state

- ii. A type 1 grammar is also called

- a) context dependent
  - b) natural grammar
  - c) context free
  - d) regular grammar

- iii. Turing machines can accept \_\_\_\_\_ languages.

- a) type-0
  - b) type-1
  - c) type-2
  - d) type-3

- iv. If  $L$  is context-sensitive language, then  $L$  is \_\_\_\_\_ by linear bound automata.  
The converse is \_\_\_\_\_.

- a) rejected true

- a) rejected, true      b) accepted, true  
c) rejected, false      d) accepted, false

- a) set of all strings of 0's and 1's ending in 00 can be described by the regular expression  $(0+1)^*00$

- v. The set of all strings of 0's and 1's ending in 00 can be described by the regular expression

- a)  $(01)^*00$       b)  $01^*00$   
c)  $(0+1)^*00$       d)  $(0+1)^*(00)^*$

**B. Fill in the blanks (Choose correct one from the pool)**

(5M)

{moore, tree, terminal, accepting, non-regular, regular, mealy, pumping lemma}

- i. Final state is also called \_\_\_\_\_ state.

- ii. The set  $L = \{0^i 1^i \mid i \geq 1\}$  is \_\_\_\_\_.

- iii. An automaton in which the output will depend on both the present input and the present state is called \_\_\_\_\_ machine.

- iv. Context free grammar can be represented using \_\_\_\_\_.

- v. A \_\_\_\_\_ gives a necessary condition that can be used to show that certain sets are regular.

(5M)

**C. Explain the following terms in one or two lines**

- What does the language  $L$  represented by  $(11)^*$  describe?
- What are equivalent states?
- Find if the following statement is true or false.  
"The language  $L = \{a^n b^n \mid n \geq 1\}$  is context free language but not regular"
- If  $G$  is  $S \rightarrow aS \mid a$ , then what is  $L(G)$ ?
- Prove that  $A + (AB^*)B = AB^*$ .

(15M)

**Q.2 Attempt the following: (Any THREE)**

- Define Grammar. Obtain the grammar generating  $\{a^i b^j c^k \mid i, j, k \geq 1, i \neq j\}$ ?
- Find the deterministic acceptor equivalent to  $M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, \{q_2\})$  where  $\delta$  is given in the table below.

states/ $\Sigma$	a	b
$\rightarrow q_0$	$q_0, q_1$	$q_2$
$q_1$	$q_0$	$q_1$
$q_2$	$q_1$	$q_0, q_1$

- Briefly explain the steps of construction of minimum automaton.
- If  $G = (\{S\}, \{0,1\}, \{S \rightarrow 0S1, S \rightarrow \lambda\}, S)$ , find  $L(G)$ .
- Write a note on Chomsky Classification of Grammar
- Write a note on operations on languages.

(15M)

**Attempt the following: (Any THREE)****Q.3**

- What is derivation tree? Give example.
- Prove  $(a+b)^* = a^*(ba^*)^*$ . Also draw the transition system for  $a^*(ba^*)^*$ .
- Write a note on Normal forms for context free grammar.
- Define Regular Expression. Also prove that  
 $(1+00^*1)^* + (1+00^*1)(0+10^*1)^*(0+10^*1) = 0^*1(0+10^*1)^*$
- State and prove Arden's theorem.
- Explain the pumping lemma for CFG.

(15M)

**Q.4 Attempt the following: (Any THREE)**

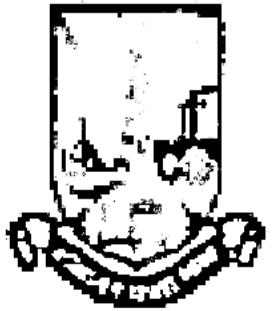
- Write a note on the model of a linear bound automata.
- What is the halting problem of a Turing machine? Explain.
- Write a note on unsolvable problems.
- Write a note on Variants of Turing Machine.
- Design a Turing machine that accepts  $\{0^n 1^n \mid n \geq 1\}$
- Write a note on halting problem of Turing Machines.

**Pushdown Automaton**

**Q.5 Attempt the following: (Any THREE) (15M)**

- A. Construct a DFA with reduced states equivalent to the regular expression:  
 $10 + (0+11)0^*1$
- B. a. Null productions: Production of the form  $A \rightarrow \lambda$   
b. Unit productions: Production of the form  $A \rightarrow B$   
c. Empty string: String of length zero  
d. Terminal symbols: cannot appear on left side of production, cannot be further derived....  
e. Natural language: language generated by type 0 grammar.
- C. What are ambiguous grammar? Give example.
- D. Construct a PDA A accepting  $L = \{wcw^T \mid w \in \{a,b\}^*\}$  by final state.
- E. Define NFA. Give an example.

Topic



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Correction in Program No:- S0133 - S.Y.B.Sc. In Computer Science (SEMESTER - III)/ S2002 - Theory of Computation. QP\_Code:- 22217

Q 4 F) Please read as " Pushdown automaton (PDA) instead of " halting problem of Turing Machines ".

Q 5 B) State if the following are True Or False. (Add this instructions)

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