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UG/5th Sem/Comp(H)/T/19

2019

B.Sc. (Honours)

5th Semester Examination  
**COMPUTER SCIENCE**

Paper - C12T

[Theory of Computation]

Full Marks : 60

Time : 3 Hours

*The figures in the margin indicate full marks.  
Candidates are required to give their answers  
in their own words as far as practicable.*

**Group - A**

Answer any *ten* questions from the following.

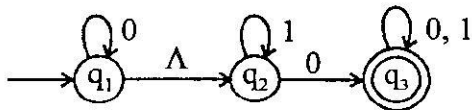
2×10=20

1. (a) Design a DFA that accepts odd no of 1's.
- (b) What is recursively enumerable language ?
- (c) What is meant by halting problem of a Turing machine ?

[ Turn Over ]

( 2 )

- (d) Distinguish between DPDA and NPDA.
- (e) Define context free grammar with a suitable example.
- (f) Construct a grammar that accepts any string over  $\{a, b\}$ .
- (g) Remove the null move and find an equivalent FA.



- (h) State the Arden's theorem related with regular expression.
- (i) What do you mean by Kleene star operation on language ?
- (j) State the Pumping lemma for regular language.
- (k) Suppose a language  $L_1\{10,0\}$  and another language  $L_2\{110,1\}$ . Then what is  $L_1 \cdot L_2$  ?

( 3 )

(l) Production rules of a CFG are as follows :

$$S \rightarrow AbS \mid aS \mid d$$

$$A \rightarrow aa \mid bd \mid \varepsilon$$

What is the set of terminals for this given grammar ?

(m) A production rule of a grammar G is

$$bA \rightarrow dBe$$

Is this grammar G a CFG ?

(n) An NFA is given with n-states. What will be the maximum number of states in a DFA which is equivalent to the given NFA ?

(o) Consider the problem S : "whether a given CFG is ambiguous". Is this problem a decidable problem ?

[ Turn Over ]

( 4 )

**Group - B**

Answer any *four* questions. 5×4=20

2. Construct the minimum state automaton equivalent to the finite automaton described by : 5

State	input = a	input = b
→ q <sub>0</sub>	q <sub>1</sub>	q <sub>0</sub>
q <sub>1</sub>	q <sub>0</sub>	q <sub>2</sub>
q <sub>2</sub>	q <sub>3</sub>	q <sub>1</sub>
⊙ q <sub>3</sub>	q <sub>3</sub>	q <sub>0</sub>
q <sub>4</sub>	q <sub>3</sub>	q <sub>5</sub>
q <sub>5</sub>	q <sub>6</sub>	q <sub>4</sub>
q <sub>6</sub>	q <sub>5</sub>	q <sub>6</sub>
q <sub>7</sub>	q <sub>6</sub>	q <sub>3</sub>

3. Construct a context free grammar which accepts

$$L = \{ a^n b c^n \mid n \geq 1 \} \quad 5$$

4. Convert the following grammar into GNF. 5

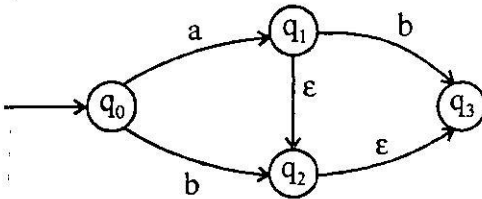
$$S \rightarrow AB$$

$$A \rightarrow BS / a$$

$$B \rightarrow SA / b$$

( 5 )

5. Define derivation tree. Describe left most and right most derivation with example. 1+4
6. Consider the following non-deterministic finite automata (NFA) : 5



Construct a DFA which is equivalent to this NFA.

7. Give a CFG that accepts the language

$$L = \{w c w^R \mid w \in \{a, b\}^* \text{ and } w^R \text{ is reverse of } w\} \quad 5$$

### Group - C

Answer *two* questions out of *four* questions.

10×2=20

8. (a) Design a Turing Machine that recognizes  $0!^*$ .
- (b) Write a short note on multitape turning machine. 7+3

[ Turn Over ]

9. Design PDA for the grammar

$G = (V_m, V_t, P, S)$  where  $V_m = \{S\}$   $V_t = \{a, b, c\}$  and  $P$  is defined as  $S \rightarrow aSa / bSb / c$ .

Change the following grammar into CNF

$S \rightarrow 0B / 1A$

$A \rightarrow 1AA / 0S / 0$

$B \rightarrow 0BB / 1$

6+4

10. (i) What is mealy machine ? Design a mealy machine that accepts any binary string as input and gives it's 1's complement as output.

(ii) Design a pda  $M$  that accepts the language

$$L = \{a^n cb^n \mid n \geq 1\} \quad (2+2)+6$$

11. (i) Consider a grammar  $E \rightarrow E + E \mid E * E \mid id$ .

Show that the string  $id+id*id$  has more than one leftmost derivations using parse tree.

(ii) Write a short note on Chomsky classification of languages.

(iii) What do you understand by recursive language ?

4+4+2

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