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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **CO301 - Theory of Computer Science**

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Maximum Marks : **60**

Duration : **3 Hrs**

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**Answer Key Submission Type:** No marking scheme and solution

Instructions:

1. All questions are compulsory.
2. Illustrate your answer with suitable figures/sketches wherever necessary.
3. Assume suitable additional data; if required.
4. Use of drawing instruments and non programmable calculators is allowed.
5. Figures to the right indicate full marks.

1) Solve any two sub-questions.

a) Define and differentiate DFA and NFA. [6]

b) Construct a deterministic finite automaton equivalent to  $M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$  where  $\delta$  is given by following transition table: [6]

| State \ $\Sigma$  | 0          | 1     |
|-------------------|------------|-------|
| $\rightarrow q_0$ | $q_0, q_1$ | $q_0$ |
| $q_1$             | $q_2$      | $q_1$ |
| $q_2$             | $q_3$      | $q_3$ |
| $q_3$             | ----       | $q_2$ |

c) Construct a Mealy Machine which is equivalent to the Moore Machine given by following table: [6]

| Present State     | Next State |       | Output |
|-------------------|------------|-------|--------|
|                   | a=0        | a=1   |        |
| $\rightarrow q_0$ | $q_3$      | $q_1$ | 0      |
| $q_1$             | $q_1$      | $q_2$ | 1      |
| $q_2$             | $q_2$      | $q_3$ | 0      |
| $q_3$             | $q_3$      | $q_0$ | 0      |

2) Solve any two sub-questions.

a) Prove  $(a+b)^* = a^*(ba^*)^*$ . [6]

b) Prove  $(1+00^*1) + (1+00^*1)(0+10^*1)^*(0+10^*1) = 0^*1(0+10^*1)^*$ . [6]

c) Show that  $L = \{0^i 1^i \mid i \geq 1\}$  is not regular. [6]

3) Solve any two sub-questions.

a) Let G be the grammar  $S \rightarrow 0B \mid 1A, A \rightarrow 0 \mid 0S \mid 1AA, B \rightarrow 1 \mid 1S \mid 0BB$ . For the string 00110101, find (i) The leftmost derivation, (ii) The rightmost derivation, and (iii) The derivation tree. [6]

b) Construct a reduced grammar equivalent to the grammar: [6]

$S \rightarrow aAa$

$A \rightarrow Sb \mid bCC \mid DaA$

$C \rightarrow abb \mid DD$

$E \rightarrow aC$

$D \rightarrow aDA$

c) Construct a grammar in greibach normal form equivalent to the grammar  $S \rightarrow AA \mid a, A \rightarrow SS \mid b$ . [6]

4) a) Construct a PDA equivalent to the following context free grammar:  $S \rightarrow 0BB, B \rightarrow 0S \mid 1S \mid 0$ . Test whether string  $010^4$  is acceptable. [6]

b) Explain the model of linear bounded automaton. [6]

5) a) Design a Turing Machine M to recognize the language  $\{1^n 2^n 3^n \mid n \geq 1\}$ . [6]

b) Explain Chomsky hierarchy of languages. [6]

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