

NTK/KW/15-7448

**Fifth Semester B. E. (Computer Engg.)
Examination**

THEORY OF COMPUTATION

Time : Three Hours]

[Max. Marks : 80

- N. B. : (1) Due credit will be given to neatness.
(2) Assume suitable data wherever necessary.
(3) Illustrate your answers wherever necessary with the help of neat sketches.
(4) All questions carry marks mentioned against them.

1. (a) Give analytical definition of Non – deterministic and deterministic finite automata. Differentiate clearly between NFA and DFA. 6
(b) Consider the string $w = abbab$ write its prefix, suffix, proper prefix, proper suffix, substring and subsequence. If the length of a string is l then. Write the number possible for above mentioned strings. 7

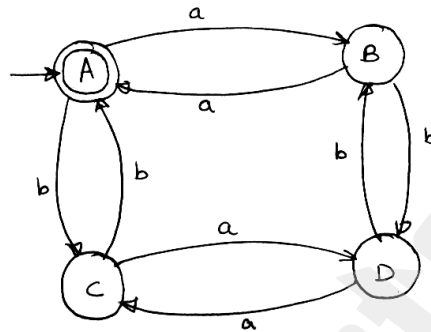
OR

2. (a) Check for the following automata the strings given are accepted or not.
(i) aabb
(ii) aababb
(iii) aabab

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Contd.

(iv) aabababb.



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(b) For $\Sigma = \{ 0, 1 \}$, design a DFA which accepts 1100 or 1010 only. And construct a minimum automata from the generated DFA. 6

(c) Differentiate between Mealy and Moore Machine. 3

3. (a) Prove the following identity using FA construction method :

(i) $(a^* ab + ba^*) a^* = (a + ab + ba)^*$

(ii) $(a + b)^* = a^* (ba^*)^*$. 6

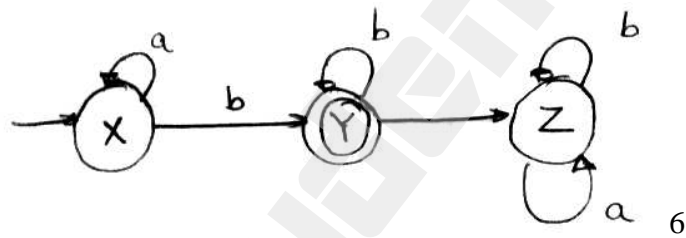
(b) Write the steps used for converting left linear Grammar to Right Linear grammar. And obtain the right linear grammar equivalent to the following given left linear grammar.

$$\begin{aligned}
 E &\rightarrow G1 \mid F0 \mid H0 \\
 F &\rightarrow H0 \mid F1 \mid G1 \mid 0 \\
 G &\rightarrow G1 \mid 1 \\
 H &\rightarrow F0
 \end{aligned}$$

8

OR

4. (a) Write any two reason, to explain how pumping lemma is useful for regular sets. And also state the pumping lemma. 4
- (b) Construct a regular grammar for the string $0^* 1(0+1)^*$ - 3
- (c) Write down the regular expression for language recognized by the finite state automata given below



5. (a) Convert the following CFG to GNF :—
 $A \rightarrow BB \mid +$
 $B \rightarrow AA \mid ,$ 5
- (b) Whether the grammar given below is ambiguous or not
 $E \rightarrow E - E \mid E * E \mid (E) \mid r$ 3
- (c) Reduce the following content free grammar.
 $S \rightarrow aBDh$
 $B \rightarrow Bbc \mid b$
 $D \rightarrow dD \mid \epsilon$ 5

OR

6. (a) Construct a PDA for the set of all palindromes over $\{a, b\}$, accepting the language

$$L = \{ ww^R / w \in (a + b)^* \} \cup \{ waw^R / w \in (a + b)^* \} \\ \cup \{ wbw^R / w \in (a + b)^* \}$$

7

- (b) Convert the following CFG to CNF :

$$\begin{aligned} S &\rightarrow oBE \\ B &\rightarrow oC \mid iBC \\ C &\rightarrow 1 \\ E &\rightarrow 1 \end{aligned}$$

6

7. (a) Explain the universal turing machine with neat sketch. 6

- (b) Design a turing machine M which performs the operation of subtraction. The subtraction is defined as $m - n$ for $m \geq n$ and zero for $m < n$.

7

OR

8. (a) Construct a context sensitive grammar for the languages

(i) $L_1 = \{ a^n b^n c^n : n \geq 1 \}$

(ii) $L_2 = \{ a^n b^m c^n d^m : n \geq 1, m \geq 1 \}$

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- (b) Explain with neat diagram, the model of Linear Bounded Automata (LBA). 5

9. (a) Explain all the properties of recursively enumerable language. 7

(b) Prove the following for the languages L_R and L_{NR}

$$L_R = \{ \langle M \rangle \mid L(M) \text{ is recursive} \} \text{ and}$$

$$L_{NR} = \{ \langle M \rangle \mid L(M) \text{ is not recursive} \}$$

"Neither L_R nor L_{NR} is recursively enumerable. 7

OR

10. (a) Does the following PCP's has the solution :—

(i) $\{ (ab, abb), (b, ba), (b, bbb) \}$

(ii) $\{ (x^3, yx^2), (x^3, xyx^3), (x, y) \}$

Justify your answer. 6

(b) Define the Ackermann's function and compute the value of following functions, if possible for them.

(i) $A(3, 3)$

(ii) $A(2, 1)$

(iii) $A(2, 2)$ 8

11. (a) What do you mean by primitive recursive function? Show that the function $f(a, b) = a + b$ is primitive recursive. 5

(b) Define μ – recursive. Write the definition of recursive function to find the factorial of n. 5

(c) Whether the mod function is primitive recursive or not, explain. 3

OR

12. (a) Explain with suitable example bounded and unbounded minimization. 8
- (b) Comment on the following statement :—
"A number – theoretic function f is effectively calculable if and if f is Turing computable". 5