

The Open University of Sri Lanka  
 B.Sc. Degree Programme –Level 05  
 Department of Mathematics and Computer Science  
 Final Examination -2013/2014  
**CPU3144: Theory of Computing**  
 Duration Two hours



Date: 28<sup>th</sup> November 2014

Time: 1.30pm-3.30pm

**Answer Four Questions only**

01. (i) Define Automation.  
 (ii) Give the formal definition of a Deterministic Finite Automation (DFA).  
 (iii) When does a DFA accept a string?  
 (iv) What are the differences between a Non-Deterministic Finite Automation (NFA) and a DFA?

02.(i) Write the definition of a substring, a prefix and a suffix of a string.

- (ii) Write down the set of substrings, set of prefixes and the set of suffixes of the string *aardvark* over the alphabet  $\{a, \dots, z\}$ .  
 (iii) What is the condition that a prefix is said to be a proper prefix and a suffix to be a proper suffix.  
 (iv) Write down three substrings that are not substrings of *aardvark*.

03 (i) What is meant by Chomsky hierarchy of grammars.

- (ii) Write the names of the Chomsky hierarchy of grammars.  
 (iii) Using your answer to part (ii) name the grammar type given below.

$$G = \langle N, \Sigma, P, S \rangle$$

$$N = \{S\}$$

$$\Sigma = \{a, b\}$$

$$P = \{S \rightarrow aSb, S \rightarrow \epsilon\}$$

(iv) Given a Grammar  $G = (\{s\}, \{a, b\}, S, P)$  with  $P$  defines  $S \rightarrow aSb$

$$S \rightarrow \epsilon$$

Obtain a sentence in the language generated by  $G$  and the sentential form.

04. (i) What is a Regular Expression and a Regular Language.
- (ii) A language is a set of strings over an alphabet. What are the conditions this set has to satisfy for the language to be regular.
- (iii) Write the corresponding regular languages for the Regular Expressions given below.
- $(a+bc)$
  - $a(b+c)$
  - $a^*b^*$
  - $a^*(b+cc)$
- (iv) Let  $\Sigma = \{a,b\}$ , write the regular expression for the following sets.
- All strings in  $\Sigma^*$  with number of a's divisible by three.
  - All strings in  $\Sigma^*$  with exactly one occurrence of the substring aaa.

05. State with justification, whether each of the following statements is true or false.

- $\{a^m b^{2n} \mid m \geq 0 \text{ and } n \geq 0\}$  is regular.
- Any finite subset of  $\{a,b\}^*$  is a regular language.
- If  $L_1 = \{\epsilon, 0, 1\}$  and  $L_2 = \{01, 11\}$ . Then their composition is :  
 $L_1 L_2 = \{01, 11, 001, 011, 101, 111\}$

06. The following defines an automation M with two input symbols and three states.

$A = \{a,b\}$ , input symbols

$S = \{s_0, s_1, s_2\}$ , internal states

$Y = \{s_0, s_1\}$ , final states

State transition function  $\delta : S \times A \rightarrow S$  defined by,

$\delta(s_0, a) = s_0$ ,  $\delta(s_1, a) = s_0$ ,  $\delta(s_2, a) = s_2$

$\delta(s_0, b) = s_1$ ,  $\delta(s_1, b) = s_2$ ,  $\delta(s_2, b) = s_2$

Draw the transition table and the transition graph.

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