The Open University of Sri Lanka
B.Sc. Degree Programme – Level 05
Department of Computer Science
CSU 5305 – Theory of Computing
Final Examination (2nd semester) 2023/24
Duration: Two Hours Only

Date: 20.04.2024 Time: 9.30 a.m. – 11.30 a.m.

Answer Four Questions Only.

(01) (i) Write the names of the four grammar types in Chomsky Hierarchy of Grammars, in ascending order.

(ii) Give a pictorial representation of Chomsky Hierarchy of Grammars.

(iii) What are the types of Automata that recognize the grammar at each level of Chomsky Hierarchy?

(iv) Give the names of the most restricted and most flexible grammars in Chomsky Hierarchy of Grammars.

(v) Give an example for the most flexible grammar.

(25 marks)

(02) (i) What are the three main streams covered by CSU5305- Theory of Computing?

(ii) Define the following terms with regard to Theory of Computing

(a) Alphabet
(b) String
(c) Language
(d) Palindrome

(iii) If S and T are two sets of strings, write the definition of string concatenation in set notation.

(iv) Using your answer to question (02) part (iii), write the concatenation of the strings 100 and 001.

(v) What is meant by the reverse of a string? Provide an example to justify your answer.

(25 marks)

(03) (i) What is a derivation in Theory of Computing?

(ii) How many types of derivations are there in Theory of Computing? Give the names of the derivations.

(iii) Suppose the grammar G is given by $G < \{S\}, \{a, b\}, P, S >$,where P is

$S \rightarrow aSb$

$S \rightarrow \in$

Derive the string ***aaabbb***.

(iv) What is the connection between derivation and a derivation tree?

(v) Draw a derivation tree for the string that you derived in question (03) part (iii).

(25 marks)

(04) (i) What is the main difference between Deterministic Finite Automation (DFA) and Nondeterministic Finite Automation (NFA)?

(ii) Consider the Deterministic Finite Automation given below.

$M = (\{q_0, q_1, q_2\}, \{0,1\}, \delta, q_0, \{q_2\}$,where δ is given by

$\delta(q_0, 0) = q_0$ $\quad\quad$ $\delta(q_0, 1) = q_1$

$\delta(q_1, 0) = q_0$ $\quad\quad$ $\delta(q_1, 1) = q_2$

$\delta(q_2, 0) = q_2$ $\quad\quad$ $\delta(q_2, 1) = q_1$

Represent the above information in a transition graph.

(iii) If δ^* is the extended transition function, write the three conditions that should be satisfied by δ^*.

(iv) Use the three conditions that you gave as answer to question (04) part (iii) , and check whether the string 101 is accepted or rejected by the machine M.

(25 marks)

(05) (i) When you define a string with regard to Theory of Computing what is the important condition that should be stated?

(ii) What is meant by the length of a **string**?

(iii) Write regular expressions over $\sum = \{1\}$ to represent the following.

(a) The set of all strings with even length.

(b) The set of all strings with odd length.

(iv) (a) If A and B are two languages over an alphabet, write an **expression** for the intersection of A and B in set notation.

(b) Given that $A = \{001, 10, 1111,\}$ and $B = \{\in, 001\}$ over $< 0,1 >$, what is the intersection of A *and* B ?

(25 marks)

(06) (i) What are the conditions needed for a language to be a formal language?

(ii) Give the definition of a **Regular Language** with respect to Theory of Computing.

(iii) Write the corresponding regular languages of the regular expressions given below.

(a) $(a + b)^*$

(b) $(((a + b)(b^*))a)$

(c) $(a^*)(b^*)$

(iv) If L is a language over an alphabet. Write the names of L^* and L^+.

(25 marks)