MACHAKOS UNIVERSITY

University Examinations for 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MATHEMATICS)

SMA 394: THEORY OF COMPUTATION

DATE: 18/4/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS

Answer **question ONE and any other TWO questions.**

QUESTION ONE (30 MARKS)

a) Design a context-free grammar (CFG) for the language $\{a^n b^n : n \geq O\}$. (6 marks)

b) Discuss the Application areas of Context Free Grammars as it applies in computing (6 marks)

c) Explain the following terms as used in automata theory (4 marks)

i. Deterministic

ii. Non-Deterministic

d) Describe Time and Space Complexity as it applies to complexity theory (4 marks)

e) Let A = {1, 2, 3, 4}. Which ordered pairs are in the relation $R = \{(a, b) \mid a < b\}$? (4 marks)

f) List and explain THREE variants of Turing Machine (6 marks)

QUESTION TWO (20 MARKS)

a) Based on the top-down parsing, list and explain the FOUR types of transitions as it applies to Push Down Automaton (8 marks)

b) Explain three traditional areas of theory of computation (6 marks)

c) Construct a Push Down Automaton that accepts $L= \{ ww^R \mid w = (a+b)^* \}$ (6 marks)

QUESTION THREE (20 MARKS)

a) With help of examples, discuss the following set operations (8 marks)

i. Union

ii. Intersection

iii. Set difference

iv. Complement

b) Describe THREE different cases of complexities as it applies to complexity theory (6 marks)

c) Construct finite state automata that recognizes all possible strings over the alphabet {0,1} ending with two consecutive zeros. (6 marks)

QUESTION FOUR (20 MARKS)

a) Automata Theory deals with definitions and properties of different types of "computation models". List and explain some examples of such models (6 marks)

b) Let a non-deterministic finite automaton be as shown below with the 5-tuples. Draw a finite state diagram showing the next possible states after an input 0 and 1 is applied to the present state; then generate a table showing the next possible states (10 marks)

- ✓ $Q = \{a, b, c\}$
- ✓ $\sum = \{0, 1\}$
- ✓ $q_0 = \{a\}$
- ✓ $F=\{c\}$
- ✓ The transition function δ as

c) Describe the following sets by regular expression (4 marks)

i. {01,10}

ii. {101}

iii. { λ,1,11,111,...}

iv. {1,11,1111,....}

QUESTION FIVE (20 MARKS)

a) Describe the following terms as it applies to theory of computation giving examples in each case (10 marks)

i. Alphabet

ii. String

iii. Kleene star

iv. Kleene closure / plus

v. Length of a string

b) Design a Turing Machine that reads a string representing a binary number and erases all leading 0's in the string. However, if the string comprises of only 0's, it keeps one 0. (6 marks)

c) State four important components in a grammatical description of a language in context free grammar (4 marks)