MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SMA 394: THEORY OF COMPUTATION

DATE: **TIME:**

INSTRUCTIONS: Answer Question ONE and Any Other TWO Questions.

QUESTION ONE (COMPULSORY) [30 MARKS]

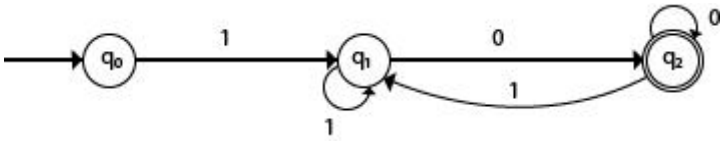
a) Define Theory of Computing (2 marks)

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

i. Deterministic finite automata
ii. Non-Deterministic finite automata

c) Discuss three Traditional areas of Theory of Computing (6 marks)

d) Describe the language denoted by following finite automaton over the alphabet {0, 1}. (4 marks)



Write the regular expression for the following language (6 marks)

i. The set of strings over {0,1} that end in 3 consecutive *1's*.
ii. The set of strings over {0,1} that have at least one *1*.
iii. The set of strings over {a,b} that start with *a* but not having consecutive *b's*.

e) Design a NFA for the transition table over $\sum = \{0,1\}$ as given below: (4 marks)

State	0	1
→q0	q0, q1	q0, q2
q1	q3	ε
q2	q2, q3	q3
→q3	q3	q3

f) Design Deterministic Finite Automata with $\sum = \{0, 1\}$ that accepts all string ending with 01. (4 marks)

QUESTION TWO [20 MARKS]

a) Describe the following terms as it applies to automata theory and languages 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. You can use table to show the results (6 marks)

c) Outline four relationships between Complexity and Computability as used in theory of computation (4 marks)

QUESTION THREE [20 MARKS]

a) Draw a DFA for the language accepting strings ending with 'abb' over input alphabets $\Sigma = \{a, b\}$. (6 marks)

b) Discuss three application areas of Context Free Grammars as it applies in automata theory and languages (6 marks)

c) Construct a turing machine which accepts the language of aba over $\sum = \{a, b\}$. (4 marks)

d) Outline four justifications for studying Theory of Computing (4 marks)

QUESTION FOUR [20 MARKS]

a) Design an NFA with $\sum = \{0, 1\}$ accepts all string ending with 10. (6 marks)

b) With help of examples, discuss the following operations on regular expression (6 marks)

i. Union
ii. Intersection

iii. Kleen closure

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

d) Explain the pumping Lemma (2 marks)

QUESTION FIVE [20 MARKS]

a) Describe the language denoted by following regular expression (4 marks)

i. r.e. = (b* (aaa)* b*)*
ii. r.e = 1 (0+1)* 0

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

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

d) List the four components used to form a context free grammar. (4 marks)