(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE

IN

COMPUTER SCIENCE

COURSE CODE: BCS 315

COURSE TITLE: AUTOMATA THEORY

DATE: 11/04/2023   **TIME:** 8:00-10:00 am

INSTRUCTIONS TO CANDIDATES

Answer **Question ONE (1)** and any other **TWO**

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating
This Paper Consists of 2 Printed Pages. Please Turn Over.

QUESTION 1

a) Differentiate between the following with respect to finite automata.

    i.   Accepting a string and accepting a language.   **(4 Marks)**

    ii.   Differentiate between Mealy and Moore machines.   **(4 Marks)**

b) Explain the meaning of the *'weak form'* and the *'strong form'* of Turing Thesis.

     (4 Marks)

c) Study fig. x below to answer the questions that follow. *Show your working.*

    i.   Determine the language accepted by the NFA.   **(3 Marks)**

    ii.   Construct the state diagram for the equivalent DFA   **(10 Marks)**

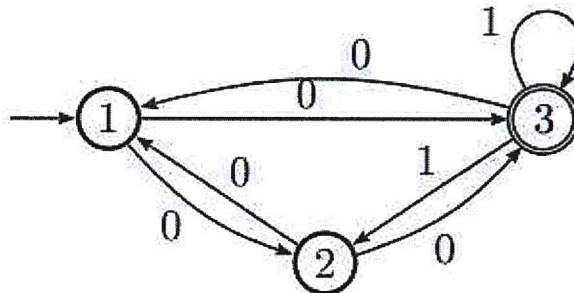fig. x.

d) Design a minimal NFA, given that;   **(5 Marks)**

$$L = \{abab^n : n \geq 0\} \cup \{aba^n : n \geq 0\}$$
$$M = (\{q_0, q_1, q_2, q_3, q_4\}, \{a, b\}, \delta, q_0, \{q_2, q_3, q_4\})$$

e) Explain the concept of polymorphism and hence outline any three advantages.

     (5 Marks)

SECTION B: ***ANSWER ANY TWO QUESTIONS***   *{20 MARKS EACH}.*

QUESTION 2

a) Explain the terms ***acceptor*** and ***transducer*** with respect to finite automata. **(3 Marks)**

b) Use three features to distinguish between a deterministic finite automata (DFA) and non-deterministic finite automata (NDFA). **(6 Marks)**

c) The Chomsky Hierarchy comprises four types of languages; describe the hierarchy highlighting the languages and their associated grammars and machines. **(6 Marks)**

d) State the Pumping Lemma for Regular Grammars and hence explain its application. **(5 Marks)**

QUESTION 3

a) Formally define a Deterministic Finite Automaton (DFA) **(5 Marks)**

b) Describe a Turing machine, and hence explain the meaning of a universal Turing machine. **(6 Marks)**

c) Design a DFA, which recognizes the language: **(9 Marks)**

$L(M) = \{w \in \{a, b, c\}^* \mid w$ starts and ends with the same symbol$\}$

QUESTION 4

a) Outline a methodological approach you would use to prove that a language L is not regular. **(6 Marks)**

b) Formally define context-free grammar. **(4 Marks)**

c) Describe Left and Right Recursive Grammars. **(4 Marks)**

d) When is a function **f** said to be ***"Turing computable"?*** **(4 Marks)**

e) The Obtain the regular expressions for the language given by **(2 Marks)**

$L1 = \{a^{2n} b^{2m+1} \mid n \geq 0, m \geq 0\}$

QUESTION 5

a) Determine whether the language given below is a context free language (CFL) or not. Show your working. **(5 Marks)**

$$L = \{a^m b^m c^n : m \geq n \geq 2m\}.$$

b) Prove that $L = \{a^m b^m : m \geq 0\}$ is not regular. **(8 Marks)**

c) Design a DFA, M which accepts the language; $L(M) = \{W \in (a, b)^* : w$ does not contain three consecutive b's). Clearly show your working. **(7 Marks)**

End of Exam