CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE AWARD OF BACHELOR OF SCIENCE COMPUTER SCIENCE / BACHELOR OF SCIENCE APPLIED COMPUTER SCIENCE

COSC 340: THEORY OF COMPUTATION

STREAMS: BSc. COMP. SCI / BSc. APPLIED COMP. SCI **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 31/03/2021 **8.30 A.M. – 10. 30 A.M.**

INSTRUCTIONS:

- Answer Question **ONE** and any other **TWO** questions.
- Diagrams should be used whenever they are relevant to support an answer.
- Sketch maps and diagrams may be used whenever they help to illustrate your answer
- Do not write anything on the question paper
- This is a **closed book exam**, No reference materials are allowed in the examination room
- There will be **No** use of mobile phones or any other unauthorized materials
- Write your answers legibly and use your time wisely

SECTION A

ANSWER ALL THE QUESTIONS IN THIS SECTION

QUESTION ONE [30 MARKS]

a) Differentiate between regular and non-regular languages. [4 Marks]

b) Explain three differences between deterministic and non-deterministic finite automaton. [6 Marks]

c) Highlight any four types of Turing Machines. [4 Marks]

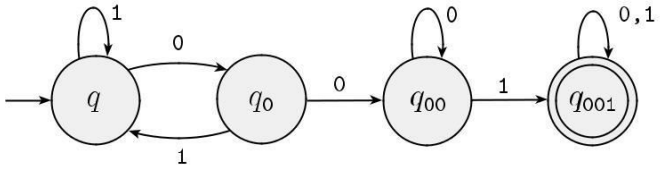
d) Given two strings such that string A is “Chuka” and string B is “University”, show the:

i. Union of string A and string B. [2 Marks]

ii. The star of string A. [1 Mark]

iii. The concatenation of string B and string A. [2 Marks]

e) Given the following machine:



i. Formally define the machine. [5 Marks]

ii. Explain what type of machine it is. [2 Marks]

iii. Identify any two strings accepted by the machine. [2 Marks]

f) Describe the central question in the Theory of Complexity. [2 Marks]

SECTION B

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO [20 MARKS]

a) A Turing machine can define either Turing acceptable or Turing recognizable languages. Demonstrating using a Turing Machine, differentiate between Turing Recognizable and Turing Decidable Languages. [8 Marks]

b) The following is a description of a given Context Free Grammar:

S→aSb→SS→ ε

i. Give a formal definition of this grammar. [4 Marks]

ii. Show how to generate the following languages from the grammar

abab [2 Marks]

aaabbb [2 Marks]

aababb [2 Marks]

c) Describe any two areas where Context Free Grammars are used in computer science. [2 Marks]

QUESTION THREE [20 MARKS]

a) The halting problem is a problem of interest in computer science.

i. Describe the halting problem. [2 Marks]

ii. Explain how a Turing Machine identifies the halting problem. [4 Marks]

iii. Discuss three ways in which the halting problem benefits the field of computer science. [6 Marks]

b) The following definition of a language is given $L=\{a^m b^n | m>=n\}$

i. Describe this language. [4 Marks]

ii. Give examples of two strings which are members of this language. [2 Marks]

iii. Explain whether this language is regular or non-regular. [2 Marks]

QUESTION FOUR [20 MARKS]

a) Giving a real example for each, describe the following class of problems found in computer science

i. NP-Complete problems. [3 Marks]

ii. NP problems. [3 Marks]

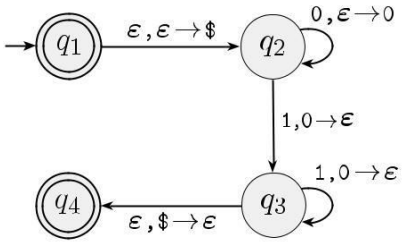
iii. P problems. [3 Marks]

b) Differentiate between the Finite automaton and Turing Machines in regards to space complexity [6 Marks]

c) Aided by a diagram, explain how a Deterministic Finite Automaton can be used in a toll gate. [5 Marks]

QUESTION FIVE [20 MARKS]

a) Given the following computation machine



i. Explain what type of a machine this is. [3 Marks]

ii. Give a formal definition of the machine. [3 Marks]

iii. Explain what type of languages are recognized by this machine and justify why this is so. [2 Marks]

iv. Identify any two strings accepted by this machine [2 Marks]

b) Define the pumping lemma as used in Theory of Computation. [2 Marks]

c) Giving an example, discuss how the pumping is used in a language defined as $L= (0^n 1^n | n>=0\}$. [8 Marks]
