CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

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

RESIT / SPECIAL EXAMINATION

COSC 340: THEORY OF COMPUTATION

STREAMS: BSC COMP.SCI/ BSC APPLIED COMP. SCI TIME: 2 HOURS

DAY/DATE: MONDAY 16/11/2020 11.30 A.M. – 1.30 P.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 QUESTIONS IN THIS SECTION

QUESTION ONE [30 MARKS]

a) Identify and explain any three areas in Computer Science that benefit from Context Free Grammars [6 Marks]

b) Using appropriate diagrams, differentiate between Deterministic Finite Automaton and Non Deterministic Finite Automaton [6 Marks]

c) Describe the seven components that are used to formally describe a Turing Machine [3 marks]

d) Giving an example for each differentiate between a set and a tuple [4 Marks]

e) Present the symbol of Start and Final States of DFAs. Explain the role of the start and final states of a DFA [6 Marks]

f) Discuss the Church-Turing thesis [5 Marks]

SECTION B

ANSWER <u>ANY TWO</u> QUESTIONS FROM THIS SECTION

QUESTION TWO [20 MARKS]

a) Assume we have two regular languages L (A) = {boy, girl} and L (B) = {good, bad}. Show the results of the regular operations below on the two languages:

   i. Conjunction of Language L(A) and Language L(B) [2 Marks]

   ii. Star of Language L(B) [2 Marks]

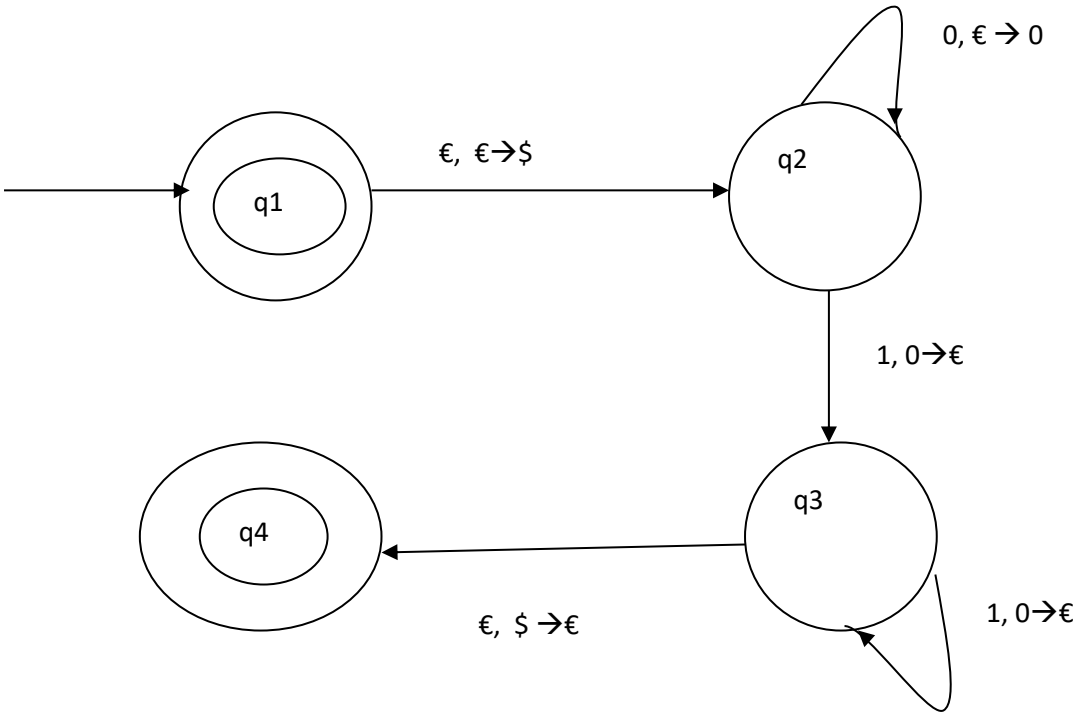
b) Describe the relationship between a computer virus and the theory of computability [7 Marks]

c) For each of the following languages, construct a DFA that accepts the language. In all cases, the alphabet is {0, 1}.

   i. { w | the length of w is divisible by three} [3 Marks]
   ii. { w | 110 is not a substring of w} [3 Marks]
   iii. { w | w contains at least five 1s} [3 Marks]

QUESTION THREE [20 MARKS]

a) A pushdown Automata PDA P is presented as follows:



Making reference to the Push Down Automaton above:

a) Define the language accepted by PDA P [4 Marks]

b) Discuss the computation of PDA P [10 Marks]

c) Let B be the set of all infinite sequences over {0, 1}. Show that B is uncountable, using a proof by diagonalization. [6 Marks]

QUESTION FOUR [20 MARKS]

a) Explain the relationship between cryptography and the theory of complexity [4 Marks]

b) Compare and contrast Push Down Automata to the following computation models:

i. DFA [2 Marks]
ii. NFA [2 Marks]
iii. Turing Machines [2 Marks]

c) Consider the context-free grammar G = (V,Σ,R,A), where V = {A, B}, Σ = {0, 1}, A is the start variable, and R consists of the rules

$A \rightarrow BAB|B|\in$

$B \rightarrow 00|\in$

Convert this grammar to a Context-Free Grammar in Chomsky Normal Form whose language is the same as that of G. [10 Marks]

QUESTION FIVE [20 MARKS]

a) An Automatic door is one real life implementation of Finite Automaton computational model.

i. Explain the workings of an Automatic door [2 Marks]

ii. Present the State diagram of such an Automatic door [3 Marks]

iii. Formally define the State diagram of the Automatic door [5 Marks]

b) Explain how you would apply knowledge in the following to your computing profession:

i. Regular Expressions [3 Marks]

ii. Finite Automaton [2 Marks]

iii. Pumping Lemma [2 Marks]

iv. Kleene's theorem [3 Marks]
