CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COMP 303: THEORY OF COMPUTATION

STREAM: COMP. SC Y3S1 **TIME: 2 HOURS**

DAY/DATE: MONDAY15/12/2014 **2.30P.M – 4.30 P.M**

INSTRUCTIONS:

1. Answer question **ONE** and any other **TWO** questions
2. Marks are awarded for clear and concise answers

SECTION A

ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION 1 [30 Marks]

a) A Context Free Grammar G1 is given in the following format

$A \rightarrow 0A1$

$A \rightarrow B$

$B \rightarrow \#$

Formally define the Context Free Grammar G1 [4 Marks]

b) Differentiate between Turing acceptable and Turing decidable languages. [4 Marks]

c) Discuss the Church – Turing Thesis highlighting its contributions to the field of computing. [3 Marks]

d) Define the classes P and NP [4 Marks]

e) You have been given the following definition of a finite state machine / finite automaton M1.

M1= $(Q, \sum, \partial, q_o, F)$, where

i. Q={s1,s2,s3}
ii. $\sum$={x,y}
iii. ∂ is described as

	x	y
s1	s1	s2
s2	s3	s2
s3	s2	s2

iv. q_o is the start state
v. F={s2}

Give the state diagram for this machine [5 Marks]

f) Discuss the effect of the Cook-Levin theorem to the field of Computer Science [5 marks]

g) You are given the running time of a certain Algorithm to be as follows:
$f(n)=6n^3+2n^2+20^n+40$

i. Present the big-O notation of the function [2 Marks]

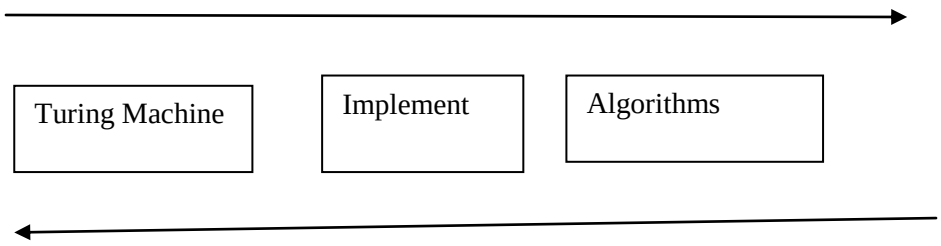
ii. Show step by step how you arrived at your answer in i above [3 Marks]

SECTION B

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

Question 2 [20 Marks]

a) You are given the following diagram



Discuss the diagram using your knowledge of Theory of Computation [4 Marks]

b) Let L be the language $\{0^n1^n|n>=0\}$. Use the pumping lemma to prove that language L is not regular [6 Marks]

c) You are given the Context Free Grammar defined by the following substitution rules

S->AB
S->ASB
A->a
B->b

Rewrite the above Grammar to aabb [6 Marks]

d) A Turing Machine M is needed to decide a certain the acceptance problem of a Deterministic Finite Automaton A_{DFA} where B is a DFA and w is a string of a language. Present an algorithm used by Turing Machine M to decide ADFA [4 Marks]

QUESTION 3 [20 MARKS]

a) With the help of a diagram, show how Non Deterministic Finite Automaton differs from Push Down Automaton [6 Marks]

b) Let the Alphabet $\sum$ be the standard 26 letters {a, b… z}. If A={good, bad} and B={boy, girl) then find:

i. AUB [2 Marks]

ii. AoB [2 Marks]

iii. A* [2 Marks]

c) Differentiate between regular and non-regular languages [2 Marks]

d) You are given the following language L= $\{0^n1^n|n>=0\}$. Discuss how a DFA D determines whether this language is regular or not regular [6 Marks]

Question 4 [20 Marks]

a) A DFA M is a five tuple machine where M = (Q, Σ, δ, s, F). Define each component of machine M [5 Marks]

b) Differentiate between enumerators and deciders [3 Marks]

c) You are given the language $L=\{a^m b^n | m>=n\}$

i. Describe this language [5 Marks]

ii. Give TWO examples of strings found in this language [2 Marks]

d) Discuss how to design a finite automaton that recognizes languages having a substring 001 in an input string [5 Marks]

QUESTION 5 [20 MARKS]

a) Giving examples from searching algorithm problem, discuss the following terms used in the Theory of Complexity

i. Worst Case

ii. Best Case

iii. Average Case [6 Marks]

b) You are given the following algorithm for a simple sort problem

```
for (int x=0; x<n; x++)
        {
         int min = x;
         for (int y=x; y<n; y++)
         {
                  if (array[y]<array[min])
                    min=y;
         }
         int temp = array[x];
         array[x] = array[min];
         array[min] = temp;
        }
```

Determine the running time of the algorithm explaining how you arrived at your solution [10 Marks]

c) Given the following function, discuss the divide and conquer aspects of Algorithms
$T(n) = aT(n/b) + f(n)$ [4 Marks]
