UNIVERSITY OF GHANA

B.SC INFORMATION TECHNOLOGY, FIRST SEMESTER EXAMINATIONS: 2017/ 2018

DEPARTMENT OF COMPUTER SCIENCE

CSIT 313: PROGRAM DESIGN AND DATA STRUCTURES (3 CREDITS)

INSTRUCTIONS:

ANSWER ALL QUESTIONS IN SECTION A AND ANY TWO (2) OTHER QUESTIONS FROM SECTION B (I.E. A TOTAL OF 3 QUESTIONS)

ANSWER ALL QUESTIONS IN ANSWER BOOKLETS PROVIDED

TIME ALLOWED: TWO AND A HALF (2½) HOURS

SECTION A:

(This Section carries 40 marks)

ANSWER ALL QUESTIONS IN THIS SECTION

1.

Briefly explain what Encapsulation is in Object Oriented programming.

[2 marks]

1.

State the processes involved in choosing a data structure.

[3 marks]

1.

Differentiate between a ***constructor*** and a ***destructor***.

[2 marks]

1.

What is the difference between a ***data structure*** and an ***abstract data*** type?

[2 marks]

1.

Briefly explain the process of Dynamic Memory Allocation in C++

[2 marks]

1.

List the data structures in this process above **(Question 5)**

[2 marks]

1.

What is a linked list?

[2 marks]

1.

Using a simple diagram, illustrate how a Binary Search on an array of numbers can be effected.

[3 marks]

1.

Give any 2 examples of using queues in computer systems.

[2 marks]

1.

Differentiate between ***struct*** and ***class*** in C++.

[2 marks]

1.

Use the table below to solve the following.

Name	**Value**
X	4
P	18
A	6

int *b = &a;

int k = *b

v = (x + p + k+ a) *2 + (k *4)*a

What is v?

[3 marks]

1.

Consider the following declaration of a **stack** class which keeps tracks of book numbers. Implement the member functions of the **stack** class below including the constructor and destructor.

[15 marks]

```
#ifndef_STACK_H_
#define _STACK_H_

class Stack
{
private :
    int booknumber;
    int top;
    int size;
    public :
        Stack();
        ~Stack();
void push (int num);
        int pop();
int peep();
        Bool isEmpty();
        Bool isFull();

}
```

```
#endif
```

SECTION B:

ANSWER ANY TWO (2) QUESTIONS FROM THIS SECTION

1.

a. Copy and complete the following table using big-O notation.

Sorting Algorithms	**Worst Case Scenario**	**Average Case Scenario**	**Best Case Scenario**
Selection Sort			
Insertion Sort			
Bubble Sort			
Merge Sort			
Quicksort			

[7 marks]

a. The code below is the content of a file "**queue.h**" that gives the declaration of the class **queue**. The class is meant to manage a static queue of 20 students

```
#ifndef_QUEUE_H_
#define _QUEUE_H_
#define MAX_SIZE 20
class Queue {
private:
String name[MAX_SIZE];
int front;
int rear;
public :
Queue();
~Queue();
```

```
void enqueue(String name)
String dequeue();
String front;
String rear;
bool isFull();
bool isEmpty();
};
#endif
```

[15 marks]

Define all the member functions of the class above including the constructor and destructor.

a. Write short notes on the following

I. Depth First Traversal

II. Breadth First Traversal

[8 marks]

1.

a. Below is a the declaration of a **B-Tree**. Implement the member functions in class BST i ncluding the constructor and destructor.

```
#ifndef_BST_H_
#define _BST_H_

struct node {
```

```
int data;
node *left;
node * right;
};

class BST
{
private :
Node * root;

public :
BST();
~BST();
bool find(int item, node * par, node *loc);
void inorderPrint(node *ptr);

};
#endif
```

[20 marks]

a. Complete the table below

Example of Algorithm	**Running Time in Big O Notation**
Linear Search	
Binary Search	
Insertion for unordered array	
Insertion for ordered array	
Deletion for unordered array	
Deletion for ordered array	

[5 marks]

a. What are the following terms under Graph Terminology

I. Weighted graph

II. Edge

III. Adjacency Matrix

IV. Incomplete graph

V. Undirected Graph

[5 marks]

1.

a. Below is a the declaration of a **Linked List**. Implement the member functions in class Linked List.

```
#ifndef_SLINK_H_
#define _SLINK_H_
struct node
```

```
 {
int data;
node *next;
};
class list
{

private:
node *head,
node *tail;
public:
list();
~list();
void add_start(int value)
void add_end(int value)
int first();
```

```
int removehead();
int removetail();
void displayAll();
void delete_first()
void delete_last();
bool isEmpty();
};
```

[15 marks]

a. Consider the graph below

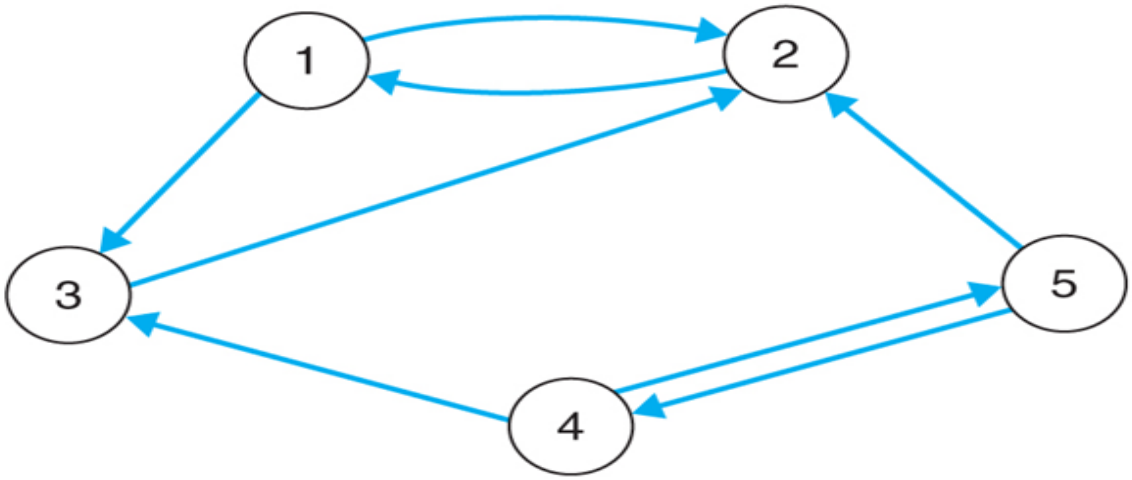


FIGURE 8.1B

The directed graph G = ({1, 2, 3, 4, 5}, {(1, 2), (1, 3), (2, 1), (3, 2), (4, 3), (4, 5), (5, 2), (5,4)})

Represent the graph using

I. Adjacency list representation

II. Adjacency matrix representation

[10 marks]

a. What are the following terms in tree terminology

I. N-ary tree

II. Degree or arity of a tree

III. Subtree

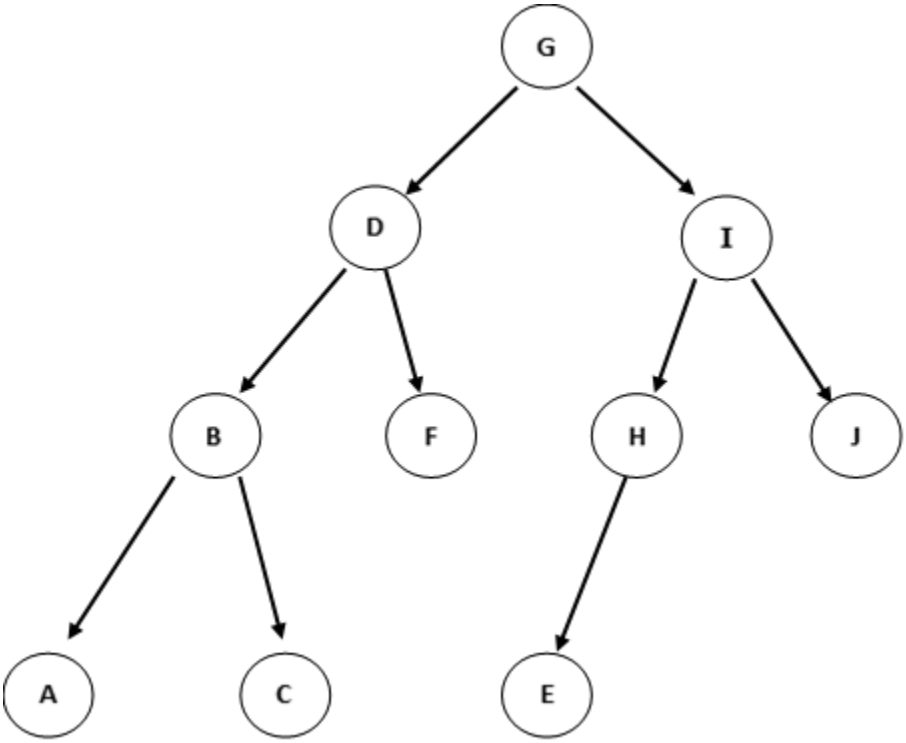
IV. Height of a(non-empty tree)

V. Leaf Node

[5 marks]

1.

a. Use the tree structure below to answer the following questions



I. What is the result of the “Preorder Transversal”

II. What is the result of the “Inorder Transversal”

III. What is the result of the “Postorder Transversal”

IV. Give two reasons why the tree above is a Binary Tree

[15 marks]

a. Write a function in C++ to perform Linear(Sequential)Search on an array

[9 marks]

a. What are the following terms in Linked List terminology

I. Node in a doubly linked list

II. Singly Linked List

III. Doubly Linked List

[6 marks]