UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION

COURSE	:	DATA STRUCTURES AND ALGORITHMS
COURSE CODE	:	ECE532
EXAMINATION	:	DECEMBER 2016
TIME	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of five (5) questions.

2. Answer ALL questions in the Answer Booklet. Start each answer on a new page.

3. Do not bring any material into the examination room unless permission is given by the invigilator.

4. Please check to make sure that this examination pack consists of :

    i)   the Question Paper
    ii) an Answer Booklet – provided by the Faculty

5. Answer ALL questions In English.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

QUESTION 1

a) The program in **Figure Q1a** demonstrates a pointer dereferencing.

```cpp
1 #include <iostream>
2 using namespace std;
3
4 int main()
5 {
6     int d = 7, r = 77, mk = 700;
7     int *ptr = NULL;
8
9     cout << "The value that Drmk need is d, r, and mk:\n";
10    cout << d << " " << r << " " << mk << endl;
11
12    ptr = &d;
13    *ptr += 700-77;
14
15    ptr = &r;
16    *ptr += 77*2;
17
18    ptr = &mk;
19    *ptr += 7+(7*3);
20
21    cout << "The values that Drmk received for d, r, and mk:\n";
22    cout << d << " " << r << " " << mk << endl;
23    return 0;
24}
```

Figure Q1a

i) Write output of the program.

(3 marks)

ii) What is the result or outcome of the statement in line 15 after it has been executed?

(1 mark)

iii) What is the result or outcome of the statement in line 19 after it has been executed?

(1 mark)

b) **Figure Q1b** is the struct definition of modified linux kernel from kernel version 2.4.12. It is a singular linked list that store hundreds of elements. One of the elements is **int lock_depth** that indicate how many times this process had acquired the control over linux kernel.

```
/* The Linux Process Control Block
 * From: /usr/src/linux/include/linux/sched.h
 * Kernel version 2.4.12
 */

struct task_struct {
        volatile long state;
        unsigned long flags;
        int sigpending;
        mm_segment_t addr_limit;
        struct exec_domain *exec_domain;
        volatile long need_resched;
        unsigned long ptrace;
        int lock_depth;
        struct task_struct *next_task ;
};
```

Figure Q1b

Apply and write a function that count the number of occurrence for **lock_depth** between 5 to 10. The function should walk through (traverse) each node in the linked list and count the number of nodes that have value **lock_depth** between 5 to 10. This function should return an integer value to the caller.

(10 marks)

c) Describe each of the following terms
   i)   Root Node
   ii)   Parent Node
   iii) Child Node
   iv)   Leaf Node
   v)   Height of tree

(5 marks)

QUESTION 2

a) i) Define an array A of 10 elements of type doubles.

(1 marks)

ii) Write a code segment that prints out an array of doubles of size N.

(2 marks)

iii) Write a code segment that finds the sum of two arrays.

(2 marks)

b)

```
int find_factorial(int n)
{
    if(n==0)
        return(1);

    return(n*find_factorial(n-1));
}
```

Figure Q2b

Figure Q2b is a function that calculates factorial of a number recursively. Analyzed the execution of this recursive function call and return one by one using box and arrow for initial n value equal to 11.

(10 marks)

c) The following set of strings has been entered by a user:

MAR, MAY, NOV, AUG, APR, JAN, DEC, JUL

i) Construct the Binary Search Tree

(2 marks)

ii) Differentiate the output Preorder and Inorder Traversal.

(3 marks)

QUESTION 3

a)   Write a program that calculate the sum and average of an array. The program then need to find the largest and lowest element in that array.

(5 marks)

b)   Convert the following infix expression into post fix. Show your steps clearly.

(A*B*C)+(D-F)/(J+I)*((L+O)-(V*H))

(5 marks)

c)   Analyzed sorting algorithm with the following:

     i)   Describe the difference between Quick and merge sort.

(2 marks)

     ii)   Describe two similarities between Quick and Merge sort.

(6 marks)

     iii)   Describe the difference between (bubble, selection and insertion) versus merge and quick sort.

(2 marks)

QUESTION 4

a) Write a complete queue implementation in C/C++ that use linked list by including the function enqueue(int), int dequeue(), ifEmpy().

(10 marks)

b) The Dijkstra's Algorithm is used to find the shortest path between two nodes. Apply this concept on graph illustrated in **Figure Q4b** with distance between each node in **Table Q4b** to solve the following:

i) Plan and find the shortest distance between A (starting node) and all other nodes.

ii) Determine the shortest path between node A and node G, and its minimum distance.
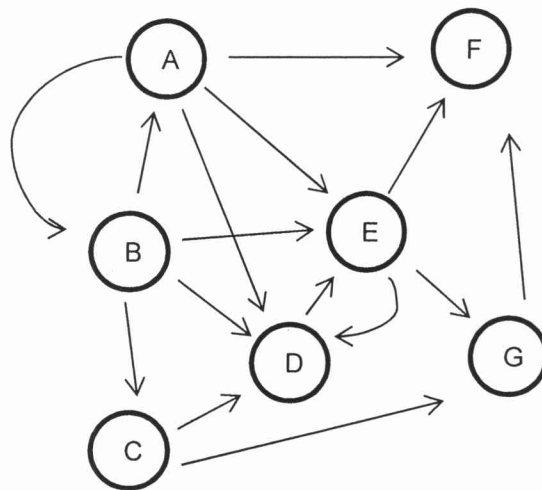
Figure Q4b

Table Q4b

From	To	Distance (km)
A	B	2.5
A	D	3
A	E	0.5
A	F	1
B	A	0.5
B	C	3
B	D	2
B	E	2.5
C	D	1
C	G	1.5
D	E	1
E	D	0.5
E	F	0.5
E	G	1.5
G	F	1

(10 marks)

QUESTION 5

a)   Formulate an analysis of performance comparison between searching method using linear and Binary search tree. Justify your answer using pseudocode or any assumptions.

(10 marks)

b)   A minimum spanning tree is a graph which consists of all the vertices, and it may not contain all the original edges. By using Kruskal's Algorithm, design the minimum spanning tree for the graph shown in **Figure Q5b**.

(10 marks)
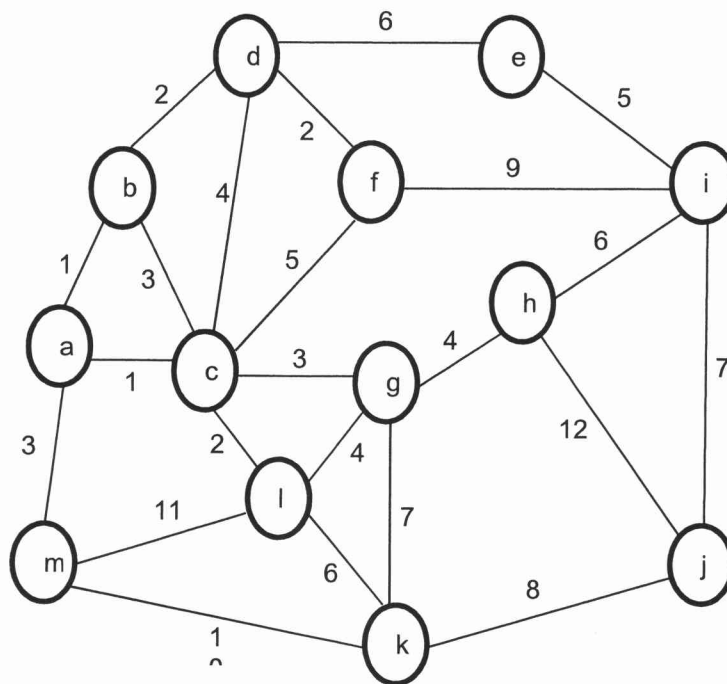
Figure Q5b

END OF QUESTION PAPER