UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION

COURSE	:	**DATA STRUCTURES AND ALGORITHMS**
COURSE CODE	:	**ECE532**
EXAMINATION	:	**JANUARY 2018**
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

This examination paper consists of 9 printed pages

QUESTION 1

a) Find the syntax errors in the following code shown in **Figure Q1a**, and rewrite the correct code accordingly.

```
1.    int *zPtr;
2.    int number;
3.    int z[5] = { 1, 2, 3, 4, 5 };
4.    *zPtr = z; // zPtr will point to array z
5.    number = zPtr;
6.    number = *zPtr[2]; /* assign array element 2 (the
                            value 3) to variable number */
7.    for (int i = 0; i < 5; i++)
8.          cout << *zPtr[i] << endl; /* print entire
                                         array z */
9.    delete *zPtr; // clear the zPtr memory location
```

Figure Q1a

(5 marks)

b) **Figure Q1b(i)** shows five nodes connected in a linked list.

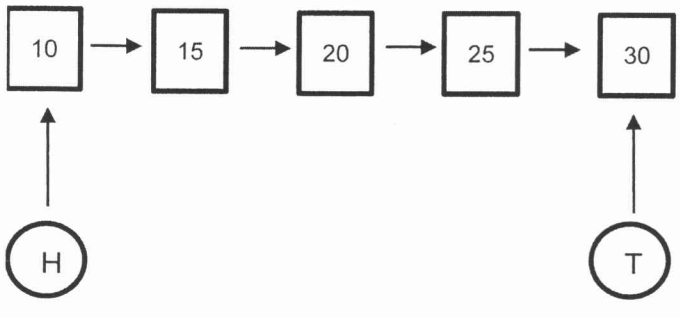

Figure Q1b(i)

i) Determine the content of each node shown in **Figure Q1b(i)** when the following programming codes executed:

```
int main()
{
      int value = 100;
      struct node* temp = H;
      while(temp)
      {
            if(temp->info%2==0)
                  temp->info=value+1;
            else
                  temp->info=value-1;
            temp = temp->link;
      }
      return 0;
}
```

Figure Q1b(ii)

(5 marks)

ii) Based on the following function prototype

```
void calculate (node*);
```

write the function definition that will calculate the number of nodes in the linked-list.

(5 marks)

c) Illustrate the following mathematical equation in the form of binary expression tree.

$$Z - (A + B) * C\hat{}(\frac{D}{E})$$

(5 marks)

QUESTION 2

a) Based on the given structure shown in **Figure Q2a**, indicate the appropriate C++ statement for the following criteria using the `deg_student` structure variable.

```
struct student {
      int ID;
      string name;
      int semester;
      char faculty[100];
      float gpa;
      float cgpa;
      char program[20];
} deg_student = {123,"Ahmad",4,"FKE",3.3,3.5,"EE241"};
```

Figure Q2a

i) Set ID to 101.
ii) Set name to your own name.
iii) Set semester to 5.
iv) Set gpa to 3.66.
v) Set cgpa to 3.75.

(5 marks)

b) Analyze the following expressions, and determine its **INFIX** equivalent.

i) + – * A B ^ C D / E G
ii) M N – P R S – / W * +

(10 marks)

c) Based on the function prototype below

```
int binSearch (node*tree,int key);
```

write the function definition that will search through a binary tree to find element stored in variable `key`. This function should use recursive function concept and will return value **1** if the searched value found.

(5 marks)

QUESTION 3

a) Based on the programming codes shown in **Figure Q3a**, state the complete function definition for `int max(int[],int)` that will determine the maximum value from an array, and return the value back to the `main()` program.

```
#include <iostream>

int max(int[],int);

int main()
{
      int n=4;
     int num[4] = {2,4,6,8};
      cout<<"The maximum number is "<<max(num,n);
      return 0;
}
```

Figure Q3a

(5 marks)

b) The Greatest Common Divisor (GCD) of two numbers is the largest positive number that divides each of the integers. This can be explained in the following function :

$$GCD\ (x,y) = \begin{cases} x, & y = 0 \\ GCD\left(y, remainder\ of \frac{x}{y}\right), & y > 0 \end{cases}$$

Represent the above function in C++ programming by using recursive function concept. The function prototype is given as `int GCD (int x, int y).`

(5 marks)

c) Given the following array of data:

15	29	11	36	47	48	7	4	39	12	5	**29**

By using **QUICKSORT** sorting concept, determine the content of the array for each iteration. Use the last element of the array as the starting pivot value each time the partitioning is done (29 for the first iteration). You must show the content of the array clearly in each iteration.

(10 marks)

QUESTION 4

a) i) In data structure, there are two types of queue which are static and dynamic queues. Static and dynamic queues can be implemented using array and linked list respectively. Identify the two advantages and two disadvantages for static queue.

(4 marks)

ii) The disadvantages of using static queue can be solved by using dynamic queue. **Figure Q4a** shows the C++ programming codes for dynamic queue using linked list. Based on the program, illustrate the process and variables involved after each bolded statement have been executed. Support your answer by using linked list diagrams for queue implementation.

```
#include<iostream>
using namespace std;

struct Node{
    int Data;
    Node *next;
}*front,*rear;

void Enqueue(int value);
void Dequeue();
bool isEmpty();

int main(){
    front=rear=NULL;

    Enqueue(100);
    Enqueue(200);
    Dequeue();
    Enqueue(300);
    Dequeue();
    Dequeue();

    return 0;
}
```

Figure Q4a

(6 marks)

b) **Figure Q4b** represents a combination of directed and undirected graph, which illustrates the distances between ten checkpoints in a treasure hunt competition. Each participant must complete a given task in every checkpoint. Starting from checkpoint A, find the shortest path to all other checkpoints by using Dijkstra's Algorithm.

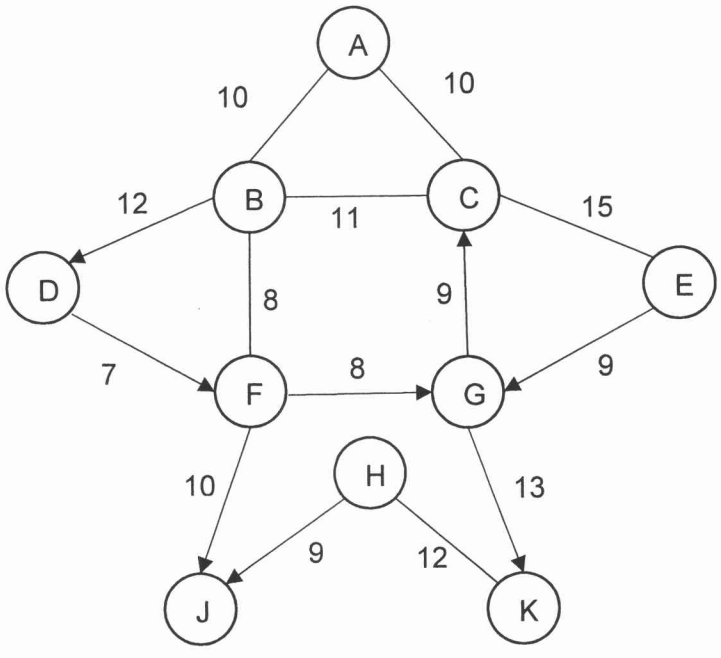

Figure Q4b

(10 marks)

QUESTION 5

a) Determine the function definition for merge sorting algorithm using C++ programming codes based on the following function prototype:

```
void merge_sort(int Array[], int startIndex, int endIndex);
```

(5 marks)

b) Ali will travel to a number of places to collect the data for research purpose. Due to the budget constraint, he must minimize the travelling costs. These places are denoted as vertices as shown in **Figure Q5b(i)**. The costs for travelling from one place to another are represented in the adjacency matrix as depicted in **Figure Q5b(ii)**.

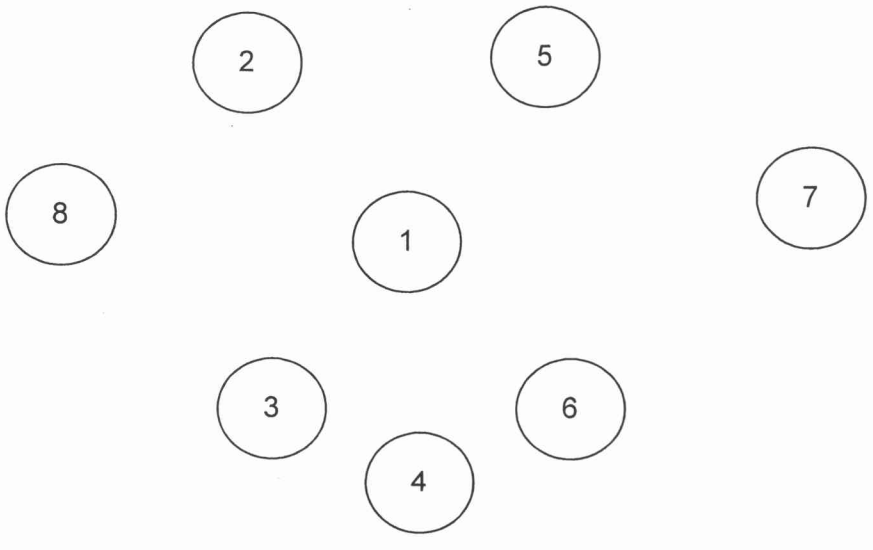

Figure Q5b(i)

∞	30	20	∞	30	25	∞	∞
30	∞	40	∞	40	∞	∞	30
20	40	∞	10	∞	30	∞	40
∞	∞	10	∞	∞	15	∞	∞
30	40	∞	∞	∞	40	50	∞
25	∞	30	15	40	∞	40	∞
∞	∞	∞	∞	50	40	∞	∞
∞	30	40	∞	∞	∞	∞	∞

Figure Q5b(ii)

i) Draw and label the graph in **Figure Q5b(i)** by inserting the edges based on the information in **Figure Q5b(ii)**.

(3 marks)

ii) By using Prim's Algorithm, design the minimum spanning tree and calculate the total minimum cost for the student to travel.

(7 marks)

c) Bubble sort is a simple and well-known sorting algorithm. It is used in practice as an introduction to the sorting algorithms because the method is stable and adaptive.

Based on the function prototype

```
void bubbleSort(int arr[], int n);
```

write the function definition for bubble sort, where `arr[]` is the set of numbers and `n` is the array size.

(5 marks)

END OF QUESTION PAPER