Time:3 hours **End Semester Exam: MTH409** **Full Marks 100**

1. a Rewrite the following code segment using a switch statement: [2]

```
char c;
int n, m;
if ( c == 't')
n++;
else
m += 2;
```

b What is wrong with the following statement? Rewrite it correctly. [4]

```
char x_string[8]="This is a string";
```

c You are naming a variable in your program. Which of the following are legal identifiers?

(i) x_gms (ii) &gms (iii) 5gms (iv) gms (v) double (vi) x-gms [2]

d What is the output of the following program? [3]

```
#include<stdio.h>
int func(int);
int main(){
int m=4;
printf("%d\n", func(++m));
printf("%d\n", func(++m));
return 0;
}
int func(int n){
int i=5;
i += n;
return (i);
}
```

e Given the following segment of the code.

```
float x[ ]={1.4,2.0,5.6}
```

Write down the output of the following statements. [3]

(i) printf("%f\n",x[1]); (ii) printf("%f\n",*x); (iii) printf("%f\n",*(x+2));

f Given the following declaration.

```
int i=4,j=5;
int *p=&i,*q=&j;
```

Write down the values of the following expressions. [3]

(i) *p+2 (ii) *q-4 (iii) *p**q

g What is the output of the following C Program? [4]

```
#include<stdio.h>
void mystery(int,int,int *);
int main(){
int x=1,y=2,z=0;
mystery(x,y,&z);
printf("z=%d\n",z);
if(x != 0)
printf("STRANGE\n");
else
printf("FUNNY\n");
return 0;
}
void mystery(int a,int b,int *c){
a--;
*c=a+b;
}
```

h Consider the following code segment.

```
char a,b;
int c;
scanf("%c%c%d",&a,&b,&c);
if (a=='a')
{
      if(b=='a')
        printf("%c\n",b);
      else
        printf("%c\",a);
}
else
printf("%d\",c);
```

Write down the output if the input is entered from the keyboard as follows: [4]

(i) ba2 (ii) aa2

2. Write an implementation for the C function which takes a string of characters as its argument and returns 1 if the length of the string exceeds 80 otherwise return 0. [6]

3. Define a structure that can describe a point in two-dimensional cartesian plane. Write a C function to find the midpoint of the line segment joining two points. The function should return a value of type point. [7]

4. The nonzero elements of a lower triangular matrix $A_{n\times n}$ are stored in an 1-D array $B[m]$ in the row major order (i.e. 1st row followed by 2nd row followed by 3rd row etc.). What must be the value of m? Express r as a function of p, q if $A[p][q] = B[r]$ and $p \geq q$. [7]

5. Write a C function using recursion to print numbers from 0 to n. (Thus for example if $n = 5$, the output will be $0\ 1\ 2\ 3\ 4\ 5$). [5]

6. Create a binary search tree with the nodes $7, 1, 14, 5, 9, 11, 24, 3, 2$. Generate the output of the postorder and preorder traversal. [7]

7. Let $\uparrow$ denote the power operator i.e. $a \uparrow b = a^b$. Construct a binary tree with the following algebraic expression. [9]

$$a + \left(b^{3+c-a} + a * b - c\right) - \left(c/d/a^{3^2} * b\right)$$

Find the equivalent postfix expression. Generate the output of the preorder traversal.

8. Consider an array with elements $1, 2, 3, 10, 9, 8, 7, 6, 5, 4$. Represent the array as a complete binary tree and mark the nodes which violate the max-heap property. Build this array in to a *max-heap* (Show the detailed steps pictorially or otherwise). [8]

9. Consider a circular queue Q consisting of an array of 5 integers and two array indexes *front* and *rear*. Illustrate pictorially the results of each of the following operation in sequence: reset(&Q), enqueue(12,&Q), dequeue(&Q), dequeue(&Q), enqueue(22,&Q), enqueue(2,&Q), enqueue(32,&Q), enqueue(42,&Q), enqueue(7,&Q) [7]

10. Write a C function that does the following. It accepts an integer array and an integer denoting the actual size of the array. Then it reverses the elements of the integer array. For example, if the array was originally {0,1,2,3,4,5} is would become {5,4,3,2,1,0} when the function was completed. You must not use any other array. [6]

11. What is the output of the following C code? [5]

```
sum=0;
for(i=1;i<5;i++)
   for(j=10;j<15;j++)
     for(k=0;k<5;k++)
     sum += i+j+k;
printf("%d \n",sum);
```

12. Write a C function called *double Bessel(int n, int x)* which returns the value of the Bessel function of first kind. The Bessel function of first kind, $J_n(x)$, is defined using the following series:

$$J_n(x) = \left(\frac{x}{2}\right)^n \sum_{k=0}^{\infty} \frac{(-x^2/4)^k}{k!(n+k)!}$$

Sum the terms in the series as long as their *magnitude* are greater then 10^{-5}. [8]