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

1. a What is the output of the following C Program? Explain your answer. [5]

```
#include<stdio.h>
int mystery(int,int,int);
main(){
int x=1,y=2,z=0;
z=mystery(x,y,z);
printf("z=%d\n",z);
if(z!=3)
printf("STRANGE\n");
else
printf("FUNNY\n");
}
int mystery(int a,int b,int c){
c=a+b;
return b-a;
}
```

b Write an implementation for the C function described by the following function prototype.

```
void crazy(char s[ ]);

/* Before the call to the function s is a null terminated ('\0') string of zero or more
characters. After the function has been executed, lower case alphabetic character in s
have been replaced by # and upper case alphabetic character have been replaced by &.
Example: if z[ ]="c=+AB3Y4 prQ", then after crazy(z) has been executed, z[ ] will be
"#=+&&3&4##&". */
```

[5]

2. a Complete the following program so that it accepts a sequence of integer inputs from the user, continuing as long as the user enters positive numbers. Once a negative number is entered, the program stops accepting input. The program must compute the average of all the inputs, as a "double" value, and print that out. You should not use an array or any other variable in this program. [5.]

```
#include <stdio.h>
main()
{
int sum, input, count;
double average;
⋮
⋮
}
```

b The nonzero elements of a tridiagonal matrix $A[1:n, 1:n]$ are stored in an 1-D array $B[1:3n-2]$ in the following order: main diagonal→lower diagonal→upper diagonal. Find A_{pq} in terms of B_r where $|p-q| \leq 1$. [5]

3. Write a function to determine whether a year in the Gregorian calender is a leap year. The function returns integer 1 if it is a leap year else 0. (Hint. A year is a leap year if it is divisible by 4 but not divisible by 100 or divisible by 400.) Using this function write another function to return the number of days in a given month (input in terms of 1–12) and year of the Gregorian calendar. [10]

4. a Write a recursive function with prototype that takes an integer argument n and returns the power of two i.e. 2^n. We shall assume that $2^0 = 1$. [5]

b Create a binary search tree with the nodes G,D,I,B,F,J,H,A,C,E. Generate the output of the postorder traversal. Suppose the node D is deleted; construct the new binary search tree. [5]

5. Let $\uparrow$ denote the power operator i.e. $a \uparrow b = a^b$. Construct an extended B tree with the following algebraic expression. [10]

$$(a^3 + b^2)/(c + d * a - 3^4) * (a - b)^3 + a/b/c * d^3$$

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

6. Consider an array with elements 10,9,8,7,1,5,4,3,2,6. Verify whether it satisfies heap property. Illustarte heap sort on this array pictorially. [10]

7. Illustarte the construction of an AVL binary search tree with the elements 22, 20, 14, 16, 6, 18, 4, 12, 10, 8, 2. [10]

8. Using *calloc()/malloc()*, create vectors x and c each of order 5 and a two dimensional matrix a of order 10×5. Write a function with prototype that performes matrix-vector multiplication ax and store the result in c i.e. $c = ax$. [10]

9. Write a program that reads a string of maximum 100 characters from the user, then modifies it by removing all the vowels and prints the result out. Use only one array of characters. [10]

10. Let a be a positive real number, and let the sequence of real numbers x_i be given by

$$x_0 = 1, \quad x_{i+1} = \frac{1}{2}\left(x_i + \frac{a}{x_i}\right) \quad \text{for } i = 0, 1, 2, 3, \cdots$$

It can be shown $x_i \to \sqrt{a}$ as $i \to \infty$. Write a program that calculates the square roots of $1, 3, 5, 7, \cdots, 21$. The program should print the number, the square root of the number and the number of iterations needed to compute it. We shall assume that the iteration converges to the root when $|a - x_i^2| < 10^{-5}$. [10]