Indian Statistical Institute
Computer Science I (Programming in C)
First Year Students
Back Paper Examination (Jan 2013)

Maximum time: Three hours

Answer Question 1 PLUS any FOUR questions from the rest.

Total Marks: 80

Question 1: [3+3+3+3+1x4]

Consider the following C program:

```
#include <stdio.h>
main()
{
   int i;
   float x=0.56,z;
   char ch='B'; // The constant character 'B' is represented by the number 66
   z=i=x+ch;
   printf("i=%4d\n",i);
   printf("z=%4.4f\n",z);
}
```

a. Explain the purpose of " #include <stdio.h> " in the above program. What kind of error message is likely to be generated if this line is not included. Is the error message likely to be generated during compile time or run time?

b. Explain carefully how the statement "z=i=x+ch; " is executed in C since the statement deals with variables of different data types

c. What will be the output of the above program?

d. What will be the output of the above program if we change the statement "z=i=x+ch;" to "i=z=x+ch;" ?

e. Evaluate the following (remember % has higher precedence than * / which have higher precedence than -+)

i) Value of x in x= 3 + 4 % 5 – 6;

ii) Value of x in x= -3 * 4 % – 6 / 5;

iii) If initially x = 1, then the value of y and x after evaluation of y = x++ -1;

iv) If initially x = 1, then the value of y and x after evaluation of y = ++x -1,

Question 2. [4+12]

a. Write a C program that prints the value of EOF as it output. (Hint:: Your code need not be more than a few lines)

b. Write a C program that accepts a string of characters from the user and generates output to standard output in reverse order (E.g. if the input is "goat", the output will be "taog")

Question 3. [3+3+6+4]

a.) What is a pointer in C? Use an example to explain what the data type of a pointer is and how a pointer is declared.

b.) If ptr is a pointer pointing to an integer variable i which has a current value of 100, what is the value *ptr? If the current value of the variable i is 100, what will be the value of i right after the statement "*ptr +=50;" is executed.

c.) What will be out put of the following program?

```
#include <stdio.h>
int main()
{   int x=25;
    int *ptr=&x;
    int **temp=&ptr; //pointer to pointer
    printf("%d\n",x);
    printf("%d\n",*ptr);
    printf("%d\n",**temp);
    return 0;
}
```

d.) Explain how an object in memory (such as an array or a linked list or a binary tree) is passed to a function using pointers. Explain for example how you will pass a binary tree to a function.

Question 4 [2+3+1+2+8]

a.) Let A[10] be an array of integers containing the numbers 10,20,30,40,50,60,70,80,90,100 in ascending order. Provide one possible way of declaring and initializing the above array. Assume below that no changes are made to these values stored in this array A.

i) What will be the values stored in of A[0}, A[5]. A[9]?

ii) If a pointer ptrA is declared and initialized as

```
int  *ptrA;
ptrA = A;
```

what will be the value of *(ptrA+2) ?

iii) Explain the difference between i = *(ptrA+3); and i = *ptrA+3; where i is a previously declared integer variable.

b.) Write a C function that takes as input two character arrays of equal length and compares them for equality. If they are equal, it returns zero, otherwise it returns the difference in value between the first two non matching characters. Assume that the character arrays have `\0` as the last character.

Question 5. [8+8]

A linked list of integers is declared as follows:

```
typedef  struct node{
        int num;
        struct node *next;

}Node, *NodePtr;
NodePtr  top;
```

a.) Define a function “length” that accepts pointer “top” as parameter and returns the number of nodes in the list.

b.) Define a function makeNode that accepts an integer and creates a single node linked list containing this integer and returns a pointer pointing to the linked list.

Question 6. [5+5+6]

a.) Let A[i] be an unsorted array of n integers. What is the maximum number of steps needed to search for an integer using sequential search? Consider both cases when the integer is found and when the integer is not found. Will your answers change if the array was sorted?

b.) Let A[i] be a sorted array of n integers. What is the maximum number of steps needed to search for an integer using binary search? Consider both cases when the integer is found and when the integer is not found.

c.) Represent the arithmetic expression (12+6)/3-5*4+2 + 6*(4+2) as a binary tree with numbers on leaves and the arithmetic operators (such as /,*,+, -) on nodes that are not leaves. Show that the post order traversal of this tree is the same as the above expression in post fix notation.