Indian Statistical Institute

Computer Science I – Final Examination

Part I:

Answer the following questions on paper.

1. Provide a declaration of a structure in C that will declare a complex number x+iy. Use this declaration to write a function that will check if the product of two complex numbers (defined as (x + yi)(u + vi) = (xu – yv) + (xv + yu)i) is a real number or not. (10 marks)

2. Consider swap function defined below. (5 marks)

```
void swap(int *px, int *py)
{
      int temp;

      temp = *px;
      *px = *py;
      *py = temp;
}
```

   Assuming appropriate declarations, what will be the value of variable y after the following three statements are executed?

```
x = 5, y = 0;
swap(&x, &y);
y++;
```

3. Consider the program below. Explain the working of program on the given input and give details of the generated output. What does the function filter do? Explain in detail. You can refer to the text book used in class to understand the functions typedef and malloc, if required. (10 marks)

```
#include<stdio.h>
#include<stdlib.h>

typedef struct cell{
   int data;
   struct cell *next;
} listcell;
```

```c
listcell *filter(listcell *inlist, int (*pred)(int)){
    listcell *outlist = NULL;
    listcell *inptr = inlist;
    listcell *outptr = outlist;
    listcell *tmp;
    while (inptr != NULL) {
        if ((*pred)(inptr->data)){
            tmp = malloc(sizeof(listcell));
            tmp->data = inptr->data;
            tmp->next = NULL;
            if (outptr == NULL) {
                outlist = tmp;
                outptr = tmp;
            }
            else {
                outptr->next = tmp;
                outptr = tmp;
            }
        }
        inptr = inptr->next;
    }
    return outlist;
}

int odd (int x) {
    return (x%2);
}

void printlist (listcell *list) {
    listcell *listptr = list;
    while (listptr != NULL) {
        printf("%d ", listptr->data);
        listptr = listptr->next;
    }
    printf("\n");
}
```

```
main(){
    listcell cell1, cell2, cell3;
    listcell *list = &cell1;
    listcell *newlist;

    cell1.data = 11;
    cell1.next = &cell2;
    cell2.data = 6;
    cell2.next = &cell3;
    cell3.data = 13;
    cell3.next = NULL;

    newlist = filter(list,&odd);
    printlist(newlist);
}
```

Part II

Write programs in C to answer the following questions.

1. A string is said to be a palindrome if it is of the form wxw^r, where w is a string, w^r the string obtained by reversing w and x is a letter such that x does not occur in w. MALAYALAM, REFER are two examples of palindromes. Write a C program using stacks that will take a string as input and output 'yes' if it is a palindrome and 'no' otherwise. (10 marks)

2. Write a C program that takes an array of numbers as input and outputs the minimum number in the array using recursion. (10 marks)

3. Write a C program that will output the number that is the second maximum in a binary search tree. You can use the functions on binary search trees as library functions. (5 marks)