# INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

| EXAMINATION ( Mid Semester ) | | SEMESTER ( Autumn ) | |
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| Roll Number | | | | | | | Section | | Name | |
|---|---|---|---|---|---|---|---|---|---|---|

| Subject Number | C | S | 1 | 1 | 0 | 0 | 1 | Subject Name | | *Programming and Data Structures* |
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| Department / Center of the Student | | Additional sheets | 0 |
|---|---|---|---|

## Important Instructions and Guidelines for Students

1. You must occupy your seat as per the Examination Schedule/Sitting Plan.

2. **Mobile phones or any such electronic gadgets, even in the switched off mode, are strictly banned.**

3. Loose papers, class notes, books or any such materials must not be in your possession, even if they are irrelevant to the subject you are taking examination.

4. Data book, codes, graph papers, relevant standard tables/charts or any other materials are allowed only when instructed by the paper-setter.

5. Use of instrument box, pencil box and non-programmable calculator is allowed during the examination. However, exchange of these items or any other papers (including question papers) is not permitted.

6. Write on both sides of the answer script and do not tear off any page. **Use last page(s) of the answer script for rough work.** Report to the invigilator if the answer script has torn or distorted page(s).

7. It is your responsibility to ensure that you have signed the **Attendance Sheet**. Keep your **Admit Card/Identity Card** on the desk for checking by the invigilator.

8. You may leave the examination hall for wash room or for drinking water for a very short period. Record your absence from the Examination Hall in the register provided. Smoking and the consumption of any kind of beverages are strictly prohibited inside the Examination Hall.

9. Do not leave the Examination Hall without submitting your answer script to the invigilator. **In any case, you are not allowed to take away the answer script with you.** After the completion of the examination, do not leave the seat until the invigilators collect all the answer scripts.

10. During the examination, either inside or outside the Examination Hall, gathering information from any kind of sources or exchanging information with others or any such attempt will be treated as '**unfair means**'. Do not adopt unfair means and do not indulge in unseemly behavior.

*Violation of any of the above instructions may lead to severe punishment.*

**Signature of the Student**

| To be filled in by the examiner | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Question Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| Marks Obtained | | | | | | | | | | | |

| Marks obtained (in words) | Signature of the Examiner | Signature of the Scrutineer |
|---|---|---|
| | | |

1. (a) Convert the decimal integers 148 and $-148$ in $2's$ complement binary representation. **Marks: 3**

   (b) What will be printed when the following C program segment executes? **Marks: 5**
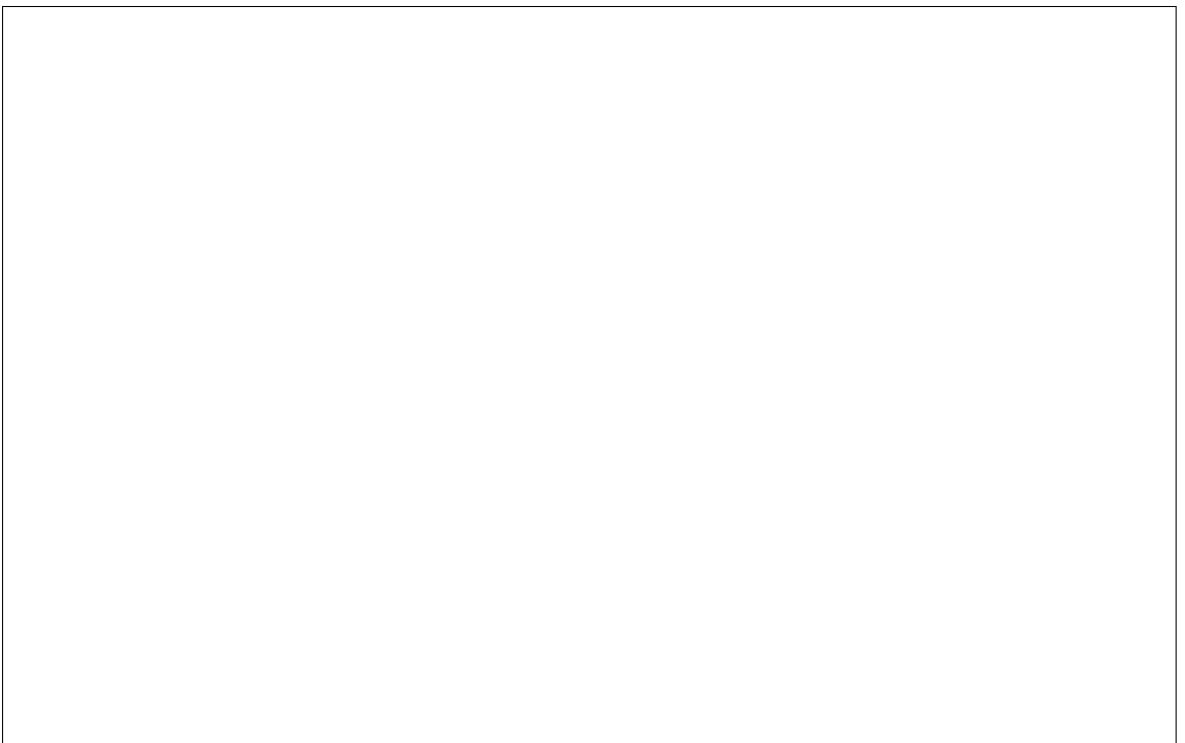
```c
#include <stdio.h>
int x=5, y=10;
int print_values(int a,int b)
{
  printf("x=%d y=%d sum=%d \n", x, y, a+b);
  return(a+b);
}

int main()
{
  int x,y,z;
  x = 25%3;
  y = x/3;
  printf ("x = %d, y=%d \n", x,y) ;
  z = print_values(x,y);
  printf ("x = %d, y=%d, z=%d \n", x,y, z) ;
  return 0;
}
```

2. (a) Write a function which takes an array of integers $A$, number of elements in the array $N$, and an integer number $x$ as arguments. The function will return the array index of the first occurrence of $x$ (if exists), else it returns $-1$.    **Marks: 4**

(b) Define a function named **compare()** which takes two floating point numbers $x$ and $y$ as arguments, and returns 1 (if $x$ is greater than $y$) or 0 (if $x$ is equals to $y$), or $-1$ (if $x$ is less than $y$).    **Marks: 4**

(c) Write a C program to read an array of characters named *S* of maximum length 100. Print the number of occurrences of the character $'a'$ in it using a *while* loop. **Marks: 4**

3. Consider the following program segment. Write the sequence of function calls with arguments and the output of the program. **Marks: 5+5=10**

```c
#include <stdio.h>
int fn(int m, int n)
{
  if(m==n)
      return(m);
  if(n==0)
      return (1);
  else if(n==1)
      return (m);
      else
          return(fn(m-1,n)+fn(m-1,n-1));
}

void main()
{
  printf("value=%d \n",fn(5,3));
}
```

Sequece of function calls with arguments:

Output of the program:

4

4. Let us assume $x^n$ is defined as follows:

$$x^n = \begin{cases} x^{\frac{n}{2}} \times x^{\frac{n}{2}} & \text{if } n \text{ is even} \\ x \times x^{\frac{n}{2}} \times x^{\frac{n}{2}} & \text{if } n \text{ is odd} \end{cases}$$

(a) Write a recursive C function to compute $x^n$ based on the following definition. Clearly mention suitable base cases. **Marks: 7**

(b) Find out how many function calls are made to compute $x^{16}$ using your function. **Marks: 3**

5. Write a C function named **concat()** which takes three strings *A*, *B*, and *C* as arguments. The function appends *C* after *B* and stores in *A*. Finally it prints the content of *A*. **DO NOT** use any string library function. **Marks: 10**

6. There is an array *A* that contains *N* number of integer numbers in the sorted order. Write a C function to insert an integer *x* into *A* without using an extra array such that *A* will remain in the same sorted order after the insertion of *x*. Print *A* after inserting *x*. Your function should take *A*, *N* and *x* as arguments. **Marks: 10**

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