Computer Science I Final Exam **Indian Statistical Institute**
November 2018
Total Marks: 100; Time: 3 Hours

Good Luck!

Part I - Answer the following - 2 marks each

1. #include <filename> is processed by the ……..

2. malloc() and calloc() are functions found in ……

3. Calling a function by using the address of a variable is called ……

4. To use a function declared in a different source file use the …… qualifier.

5. A 2x2 matrix can be implemented in C using …… arrays.

6. To retain the value of a variable in a recursive function across all calls, declare it as …….

7. int i, i << 2 multiplies i by ……

8. The format specifier for printing a long double is …….

9. In what order does one add and delete from a Queue?

10. Sorting a list of numbers by finding the minimum value in successive iterations is the algorithm for ……..

Part II Answer the following - 2 marks each

True or False ?

11. Insertion Sort splits an array successively and sorts the elements before merging them back.
12. Every node in a Binary Tree has a minimum of 2 children.
13. A Stack can be accessed through Front and Rear pointers
14. Breath First Search algorithm searches all nodes on the current level before accessing nodes at the next level
15. Two matrices can be multiplied only if the number of columns of the first is equal to the number of rows of the second.

Part III - Assume int to be 4 bytes. Answer the following - 3 marks each

16. Consider the code

```
x = 8; y = 2;
int *ptr = &x;
y = (*ptr)++ * y;
printf("%d %d", x, y);
```

Output is …….

17. What is printed?

```
union student {
    unsigned int id;
    char gender;
    int marks[5];
};
union student st1;
st1.id = 1000;
printf("%d\n", sizeof(st1));
```

18. Consider the statement,

*const char *cptr = "I find that the harder I work, the more luck I seem to have.";*

***(**cptr+=18) dereferences to …… character.

19. How many times does the loop below execute?

```
for (int i =0; i < 5; i++)
    if (i == 4)
        printf("%d\n", —i);
```

20. An unsorted binary tree is in the following order
23-1-45-34-9-66-12-26-321-17-82-33-56-21
what is the order in which nodes are visited to search for node 321 using depth-first-search.

21. Consider the list of numbers 4, 6, 19, 2, 8, 3, 0, 10 from left to right, on which I perform the following
    1. enqueue(), enqueue(), enqueue(), enqueue(), dequeue(), dequeue(), enqueue(), enqueue(), dequeue(), enqueue()
    2. what remains in the queue?

Answer the following - 5 marks each

22. Write a function that receives two integers by reference and swaps the integer values. The function returns void.

23. Convert the following while loop into a recursive function

```
int i = 1, f  = 1;
while (i < 10)  {
        f = f * i++;
}
```

24. Every string in C terminates with a '\0' character. Write a function to reverse a string using a Stack data structure. Assume that the functions v*oid push(Stack S, char c), char pop(Stack S)* and *char peek(Stack S) are already implemented.*

25. Given a binary tree B with key values stored in ID and left and right children LC and RC and a queue Q, write the pseudocode to perform breadth-first-search on the tree.

Part IV - Answer the following - 10 marks each

26. Write a program to implement a doubly linked list. Follow the step-wise instructions below : -
    1. Write the steps to include necessary header files **- 1 mark**
    2. Declare global pointers called head and tail and initialise them to point to nothing. **- 1 mark**
    3. Declare a struct to define a node called node_t and typedef it. Each node must contain placeholders for an integer id and pointers to previous and next nodes. **- 2 marks**
    4. Declare and define a function called CreateNode that takes an integer value as parameter and returns a pointer to node_t. **- 4 marks**
        1. Define the body of CreateNode to allocate memory for a node and initialise its elements with appropriate values. previous and next pointers must be set appropriately.
        2. The function must return a pointer to the newly created node
    5. Define a driver function that calls createNode with 10, 20, and 30 values. **- 2 marks**

27. Consider the expression x * (x+ y) - z * a ^ a ^ 3 - b + 21 / y.
    1. Deduce the postfix expression showing the stack trace. The associativity of operators +, -, × is left-to-right and that of operator ^ is from right-to-left. The precedence of operators (from highest to lowest) is ^, * , +, -. **8 marks**
    2. Substitute values x = 4, y = 3, z = 1, a = 2, b = 5 and evaluate the resulting postfix expression **2 marks**

28. Sort the array containing 7 19 10 45 33 20 61 2 54 16 using Insertion Sort and show the visualisation of the algorithm. **10 marks**

Neatness: 2 marks