PROGRAMMING AND DATA STRUCTURES

1. Consider the following declaration.

```
struct
{
        short P[10];
        union
        {
                short a;
                float b;
                long z;
        } u;
} t;
```

Assume that objects of the type short, float and long occupy 2 bytes, 4 bytes and 8 bytes respectively. The memory requirements for variable 't' and 'u' ignoring alignment considerations respectively are _____.

(a) 34, 14 (b) 28, 14
(c) 28, 8 (d) 20, 14

2. The function delete (head, element) is used to delete a node from the linked list by finding the node value with a given element. The parameter head is the first node of the list. Find the missing statements A and B in the following "delete" function to delete the node? (Assume all elements are distinct in the list and the function returns pointers that point to the first node of the list).

```
Node delete (Node head, int element)
{
        Node x = head;
        if (x.data = = element) return head.next;
        while (x.next ! = NULL)
        {
           if    (_____A_____)
           {
                 _____B_____;
                 return head;
```

```
            }
            x = x.next;
        }
}
```

(a) □: □.□□□□ == □□□□□□□□ □: □.□□□□ == □.□□□□.□□□□ (b)
□: □.□□□□.□□□□ == □□□□□□□□ □: □.□□□□ == □.□□□□.□□□□

(c) □: □.□□□□ == □□□□□□□□ □: □.□□□□.□□□□ == □.□□□□ (d)
□: □.□□□□.□□□□ == □□□□□□□□ □: □.□□□□.□□□□ == □.□□□□

3. Consider the following code

```
Node *find (Node * head)
{
        Node * P1 = head, *P2 = head;
        while (P2)
        {
           P1 = P1 → next;
           P2 = (P2 → next)? P2 → next → next : NULL;
        }
           printf ("%d", P1 → value);
}
```

Assume Node is the structure type with two members: 'value' and 'next'. Identify the node value printed by the above code if non-empty linked list header is passed to the function find?

(a) First element of the list [i.e., value of the first node]
(b) Second element of the list
(c) Middle element of the list
(d) Last element of the list

4. In delete operation of binary search tree, we need inorder successor (or predecessor) of a node when a node to be deleted where it has both left and right child. Which of the following is true about inorder successor needed in delete operation?

(a) Inorder successor is always either leaf node or a node with empty right child.
(b) Inorder successor maybe an ancestor of the node.

(c) Inorder successor is always a leaf node.
(d) Inorder successor is always either a leaf node or a node with empty left child.

5. What will be the output printed by the following C program?

```
void main ( )
{
        int x = 1, i, y = 2;
        for (i = 0; i < 5; i++)
        {
                x << 1;
                y = x + i;
        }
        printf("%d, %d", x, y);
}
```

(a) 1, 5
(b) 32, 5
(c) 1, 72
(d) 32, 72

6. Consider the following function declaration

```
int* f(int *);
```

Which of the following is correct about the declaration?

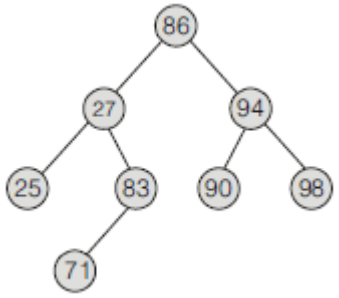
(a) f is a function which takes integer pointer as argument and returns integer.
(b) f is a function which takes integer pointer as an argument and returns address of an integer.
(c) f is a pointer to a function which takes integer pointer as an argument and returns integer.
(d) f is a pointer to a function which takes integer pointer as an argument and returns address of an integer.

7. Which of the following is NOT true about linked list implementation of queue?

(a) In enqueue operation, if new nodes are inserted at the beginning of linked list, then in dequeue operation nodes must be removed from end.
(b) In enqueue operation, if new nodes are inserted at the end, then in dequeue nodes must be removed from the beginning.

(c) Both (a) and (b)
(d) None of the above

8. Consider the following AVL tree.



Which of the following order of elements are inserted into an empty AVL tree, so that it is possible to get the above AVL tree?

(a) 94, 71, 86, 25, 98, 83, 27, 90
(b) 98, 94, 90, 83, 86, 25, 71, 94
(c) 86, 25, 98, 83, 27, 90, 71, 94
(d) None of these

9. Find the output of the following program.

```
main ( )
{
        extern int i ;
        i = 20;
        printf (“%d”, i);
}
```

(a) Linked error
(b) 20
(c) Compiler error
(d) None of these

10. Consider the following procedure struct.

```
gate (root)
{
        if (root = = null) return 0;
        if (root → leftchild = = null && root → rightchild = = null) return 1;
```

```
        else return (maximum (gate(root → leftchild), gate(root → rightchild)) + 1);
}
```

What is the functionality of above function?

(a) Returns the height of binary tree
(b) Returns number of leaf nodes in the binary tree
(c) Returns number of levels in the binary tree
(d) None of these

11. A 3-ary tree is a tree in which every internal node has exactly 3 children. The number of leaf nodes in such a tree with 19 internal nodes will be _____.

12. Consider the following code.

```
void main( )
{
        static int i = 5;
        if ( – – i)
        {
           main ( );
           printf("%d", i);
        }
}
```

The number of zero's printed in the output are _____.

13. Consider a two-dimensional array with elements stored in the form of lower triangular matrix. The elements must be crossed to read A[4, 2] from the array A[–6, …, + 8, – 6, …, + 8] whose base address 1000 is _____. (Assume elements are stored in row major order).

14. Consider the following program

```
int main ( )
{
```

```
        char *str = "Gate2015"
        printf ("%d", ravindra (str));
        return 0;
}

int ravindra (chat *P1)
{
        char *P2 = P1;
        while (*++P1);
        return (P1 – P2);
}
```

The output of the above program will be _____.

15. The sum of the minimum and maximum number of nodes in the AVL tree of height 5 is _____. (Assume root node is present at height zero)

16. Consider the following program.

```
int main ( )
{
        int x = 016;
        printf ("%d", x);
        return 0;
}
```

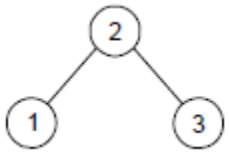
The output of the above program will be _____.

17. Consider the following program.

```
void find (struct Node *node)
{
        struct Node *ptr, *q;
        if (node = = NULL) return;
        find (node → left);
        find (node → right);
```

```
        ptr = node → left;
        node → left = newNode (node → data);
        node → left → left = ptr;
}
```

If the root of following tree is passed to the above function, what is the level order traversal of output tree produced by above function? (newNode is a function which creates new node)



(a) 2 2 3 3 1 1
(b) 2 2 3 1 3 1
(c) 2 3 2 3 1 1
(d) 2 3 2 3 2 1

18. Which of the following is correct output for the program code given below?

```
main ( )
{
        void pr( );
        pr ( );
        pr ( );
        pr ( );
}

void pr ( )
{
        static int i = 1;
        printf ("%c", (65 + i++));
}
```

(a) 66, 67, 68
(b) 66, 66, 66
(c) 67, 68, 69
(d) None of these

19. Which of the following are equivalent to the statement?

```
int k = (i <<3) + (j >> 2)
```

(a) int k = i * 8 + j/4;
(b) int k = i * 3 + j * 2;
(c) int k = i * 3 + j/2;
(d) int k = i/8 + j * 4;

20. Consider the following foo function and identify the return value of foo function.

```
int foo (unsigned int n)
{
        int c, x = 0;
        while (n! = 0)
        {
                if (n & 01) x++;
                n >>= 1;
        }
        return c;
}
```

(a) It counts the total number of bits set in an unsigned integer.
(b) It counts the number of bits which are zero.
(c) It counts the number of occurrences of 01.
(d) It returns the same value as 'n'.

21. Which of the following are the number of assignments, number of additions and number of subtractions respectively required for swapping 2 variables without the help of 3rd variable?

(a) 3, 2, 2
(b) 3, 1, 2
(c) 3, 3, 2
(d) 2, 2, 2

22. Consider the AVL tree T in which left subtree contains half of the maximum number of nodes possible in the balanced AVL tree of height h and right subtree consists of one 3rd of the maximum number of nodes possible in AVL tree of height 'h'.

Assume that tree T may or may not be height balanced at present. What is the total maximum possible number of nodes in T?

(a) $\frac{5}{6}(2^{h+1} - 1) - 1$
(b) $\frac{5}{6}(2^{h+1} - 1) + 1$
(c) $\frac{3}{2}(2^{h+1} + 1)$
(d) $\frac{3}{2}(2^{h+1} + 1) - 1$

23. The minimum size that an array may require to store a binary tree with 'n' nodes is _____.

(a) $2^{[\square\square\square 2(\square+1)]} - 1$
(b) $2^{\square} - 1$
(c) $2^{\square} - \square + 1$
(d) $\square + 1$

24. Consider the following program.

```
variable l;
procedure My (K: integer)
begin
        K = K + 1;
        Print (K);
end

procedure R ( )
var l;
begin
        l = 5;
        My (l);
        print (l);
end;
begin
        l = 3;
        My (l);
        R ( );
        print (l);
end
```

Find the output produced by above program using dynamic scoping, and all functions uses call by value.

(a) 4, 6, 6, 4
(b) 4, 6, 5, 3
(c) 4, 5, 6, 4
(d) 3, 6, 6, 3

25. Consider the following C program.

```
struct listnode
```

```
{
        int data;
        struct listnode *next;
};

void fun (struct listnode *head)
{
        if (head = = NULL || head → next = = NULL) return;
        struct listnode *tmp = head → next;
        head → next = tmp → next;
        free (tmp);
        fun (head → next);
}
```

What is the functionality of the above function?

(a) It reverses the linked list
(b) It deletes the linked list
(c) Alternate nodes will be deleted
(d) It reverses the linked list and delete alternate nodes

26. Consider the following function.

```
void f (int n)
{
        if (n ≤ 0) return;
        else
        {
                print (n);
                f (n – 2);
                print (n);
                f (n – 1);
        }
}
```

Let f(n) be the number of values printed. What is the number of values printed by above function?

(a) f(n – 1) + f(n – 2) (b) f(n – 1) + f(n – 2) + 1

(c) f (n – 1) + f(n – 2) + 2 (d) f (n – 2) + f(n – 3)

27. What is the number of additions in the fibonacci series of n which uses following recursive function.

fib (n) = fib (n – 1) + fib (n – 2)

(a) f (n – 1) + f (n – 2) (b) f (n – 1) + f (n – 2) + n
(c) f (n – 1) + f (n – 2) + 1 (d) f (n – 1) + f (n – 2) + 2n

28. Consider the following code.

```
int x = 0, i;
for (i = 0; i < 10, i++)
        if (i%2 && x++)
                x += 2;
```

What will be the value of x?

(a) 11 (b) 13
(c) 15 (d) 17

29. Consider the following infix expression which is to be converted to postfix expression using stack.

(((P + Q) * (R + S)) /T) + (A * (B + C))

The sum of all unique possible heights of stack when converting from infix to postfix is _____.

30. The sum of outputs printed by running the following program is _____.

```
int main ( )
{
        int i;
        for (i = 3; i <= 6; i++)
                printf("%d", f1(i));
}
```

```
int f1 (int n)
{
        if (n < 2) return n;
        else return (f1(n – 1) + f2(n – 2));
}

int f2 (int n)
{
        if (n <= 1) return n;
        else return (2 * f1 (n – 2) + 1);
}
```

31. The key 14, 4, 6, 16, 32, 50 in the order are inserted into an initially empty AVL tree. The total numbers of rotations to make AVL with the given keys are _____. Assume "single rotation = 1 rotation" and "double rotation = 1 rotation".

32. Consider the following postorder and Inorder traversals of binary tree.

Post order: 1, 2, 5, 4, 7, 6, 3, 9, 11, 10, 8
In order: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

The total number of nodes that have height greater than the height of node 6 are _____. Assume root is at lowest height.

33. Consider the following recursive function.

```
int g(int e)
{
        if (e > 4)
        return (2 + g(e – 5) + g(e – 2));
        return 1;
}
```

The value returned from the g(15) is _____.

34. A priority queue can efficiently implemented using which of the following data structures? Assume that the number of insert and peek (operation to see the current highest priority item)

and extraction (remove the highest priority item) operations are almost same.
(a) Array
(b) Linked List
(c) Heap Data Structures like Binary Heap, Fibonacci Heap
(d) None of the above

35. A Priority-Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is given below:

10, 8, 5, 3, 2

Two new elements ”1‘ and ”7‘ are inserted in the heap in that order. The level-order traversal of the heap after the insertion of the elements is:
(a) 10, 8, 7, 5, 3, 2, 1 (b) 10, 8, 7, 2, 3, 1, 5
(c) 10, 8, 7, 1, 2, 3, 5 (d) 10, 8, 7, 3, 2, 1, 5