Data Structure, Algorithm & Programming Methodology

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1 Basics, Array, Stack, Queue and Link Lists

1. A one dimensional array A has indices 1 .... 75. Each element is a string and takes up three memory words. The array is stored at location 1120 decimal. The starting address of A[49] is
(a) 1267 (b) 1164
(c) 1264 (d) 1169
[ISRO-2009]

2. The five items: A, B, C, D and E are pushed in a stack, one after the other starting from A. The stack is popped four times and each element is inserted in a queue. Then two elements are deleted from the queue and pushed back on the stack. Now one item is popped from the stack. The popped item is
(a) A (b) B
(c) C (d) D
[ISRO-2009]

3. Adjacency list is preferred over adjacency matrix when the graph is
(a) Planar (b) Dense
(c) Clique (d) None of the above
[DRDO-2008]

4. What is the minimum number of stacks of size n required to implement a queue of size n?
(a) one (b) two
(c) three (d) four
[GATE-2001]

5. Consider the following declaration of a two-dimensional array in C.
char a[100][100];
Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a [40][50] is
(a) 4040 (b) 4050
(c) 5040 (d) 5050
[GATE-2002]

6. Suppose you are given an array s[1...n] and a procedure reverse (s, i, j) which reverse the order of elements between positions i and j (both inclusive). What does the following sequence do, where $1 \le k \le n$.
reverse (s, 1, k);
reverse (s, k + 1, n);
reverse (s, 1, n);
(a) rotates s left by k positions
(b) leaves s unchanged
(c) reverses all elements of s
(d) none of the above
[GATE-2000]

7. The following C declarations
struct node{
int i;
float j;
};
struct node *s[10];
define s to be
(a) an array, each element of which is a pointer to a structure of type node
(b) a structure of 2 fields, each field being a pointer to an array of 10 elements
(c) a structure of 3 fields: an integer, a float, and an array of 10 elements
(d) an array, each element of which is a structure of type node
[GATE-2000]

8. Assume that there are two lower triangular matrices A and B of size n × n. If matrix A and transpose of B are fit into a rectangular matrix C of size n × (n + 1), then
(a) B[i, j] = C[i, j + 1] (b) B[i, j] = C[j + 1, i]
(c) B[i, j] = C[j, i + 1] (d) None of the above
[JNUEE-2009]

9. Assume that a lower triangular matrix A[0.. n – 1, 0.. n – 1] is stored in a linear array $B\left[0..\frac{1}{2}n(n+1)-1\right]$ in row-by-row order. For n = 100, if A[0, 0] is stored in B[0], where is A[90, 80] stored in B array?
(a) 4175 (b) 0
(c) 4165 (d) 4160
[JNUEE-2009]

10. The side effect in programming language aries due to
(a) I/P statement
(b) assignment statement
(c) conditional statement
(d) goto statement
[JNUEE-2007]

11. Aliasing in the context of programming languages refers to
(a) multiple variables having the same memory location
(b) multiple variables having the same value
(c) multiple variables having the same identifier
(d) multiple use of same variable
[JNUEE-2008]

12. If a file of size n = 1000 takes 10 ms for sorting using randomized Quicksort Algorithm, then approximately how much time would it take to sort a file size n = 10000000000? (Assume that all data are available in the main memory)
(a) 30 ms (b) 1000000 ms
(c) 30000000 ms (d) None of the above
[JNUEE-2006]

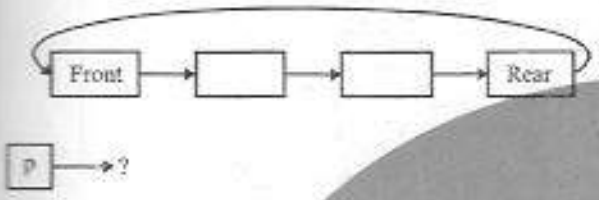
13. To evaluate an expression without any embedded function calls
(a) one stack is enough
(b) two stacks are needed
(c) as many stacks as the height of the expression tree are needed
(d) a turning machine is needed in the general case
[GATE-2002]

14. Let S be a stack of size n ≤ 1. Starting with the empty stack, suppose we push the first n natural numbers in sequence, and then perform n pop operations. Assume that push and pop operations take X seconds each, and Y seconds elapse between the end of one such stack operation and the start of the next operation. For m ≤ 1, define the stack-life of m as the time elapsed from the end of push(m) to the start of the pop operation that removes m from S. The average stack-life of an element of this stack is
(a) n (X + Y) (b) 3Y + 2X
(c) n(X + Y) – X (d) Y – 2X
[GATE-2003]

15. The goal of structured programming is to
(a) have well indented programs
(b) be able to infer the flow of control from the compiled code
(c) be able to infer the flow of control from the program text
(d) avoid the use of GOTO statements
[GATE-2004]

16. A single array A [1...MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables top 1 and top 2 (top 1 < top 2) point to the location of the topmost element in each of the stacks. If the space is to be used efficiently, the condition for "stack full"is
(a) (top 1 = MAXSIZE/2) and (top 2 = MAXSIZE/2 + 1)
(b) top 1 + top 2 = MAXSIZE
(c) (top 1 = MAXSIZE/2) or (top 2 = MAXSIZE)
(d) top 1 = top 2 – 1
[GATE-2004]

17. A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. To which node should p point such that both the operations EnQueue and DeQueue can be performed in constant time?



(a) rear node
(b) front node
(c) not possible with a single pointer
(d) node next to front

[GATE-2004]

18. An Abstract Data Type (ADT) is
(a) same as an abstract class
(b) a data type that cannot be instantiated
(c) a data type for which only the operations defined on it can be used, but none else
(d) all of the above

[GATE-2005]

19. A common property of logic programming languages and functional languages is
(a) both are procedural languague
(b) both are based on λ-calculus
(c) both are declarative
(d) all of the above

[GATE-2005]

20. Which of the following are essential features of an object-oriented programming languages?
1. Abstraction and encapsulation
2. Strictly-typedness
3. Type-safe property coupled with sub-type rule
4. Polymorphism in the presence of inheritance

(a) 1 and 2 only (b) 1 and 4 only
(c) 1, 2 and 4 only (d) 1, 3 and 4 only

[GATE-2005]

21. A program P reads in 500 integers in the range (0, 100) representing the scores of 500 students. It then prints the frequency of each score above 50. What would be the best way for P to store the frequencies?
(a) An array of 50 numbers
(b) An array of 100 numbers
(c) An array of 500 numbers
(d) A dynamically allocated array of 550 numbers

[GATE-2005]

22. An implementation of a queue Q, using two stacks S1 and S2, is given below

```
void insert (Q, x) {
push (S1, x);
}
void delete (Q, x) {
if (stack-empty (S2)) then
        if (stack-empty (S1)) then {
        print ("Q is empty");
        return;
}
        else while (! (stack-empty) (S1))) {
x = pop (S1);
push (S2, x);
}
x = pop (S2);
}
```

Let n insert and m (≤ n) delete operations be performed in an arbitrary order on an empty queue Q. Let x and y be the number of push and pop operations performed respectively in the processes. Which one of the following is true for all m and n?
(a) $n + m \le x < 2n$ and $2m \le n + m$
(b) $n + m \le x < 2n$ and $2m \le y \le 2n$
(c) $2m \le x < 2n$ and $2m \le y \le n + m$
(d) $2m \le x < 2n$ and $2m \le y \le 2n$

[GATE-2006]

23. The following C function takes a singly-linked list of integers as a parameter and rearranges the elements of the list. The function is called with the list containing the integers 1, 2, 3, 4, 5, 6, 7 in the given order. What will be the contents of the list after the function completes execution?

```
struct node {
    int value;
    struct node *next;
};
void rearrange (struct node *list) {
    struct node *p, *q ;
    int temp ;
    if (! list || ! list -> next ) return;
    p = list ; q = list -> next;
    while (q) {
        temp = p -> value ; p -> value
        = q -> value ;
        q -> value = temp ; p = q ->
        next ;
        q = p? p -> next : 0 ;
    }
}
```

(a) 1, 2, 3, 4, 5, 6, 7 (b) 2, 1, 4, 3, 6, 5, 7
(c) 1, 3, 2, 5, 4, 7, 6 (d) 2, 3, 4, 5, 6, 7, 1

[GATE-2008]

24. Consider the label sequences obtained by the following pairs of traversals on a labeled binary tree. Which of these pairs identify a tree uniquely?

1. preorder and postorder
2. inorder and postorder
3. preorder and inorder
4. level order and postorder

(a) 1 only (b) 2 and 3
(c) 3 only (d) 4 only.

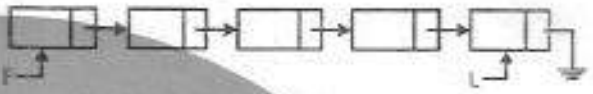
[GATE-2004]

25. Suppose each set is represented as a linked list with elements in arbitrary order. Which of the operations among union, intersection, membership, cardinality will be the solwest?

(a) union only
(b) intersection, membership
(c) membership, cardinality
(d) union, intersection

[GATE-2004]

26. Consider a singly linked list of the form as given in the figure below, where F is a pointer to the first element in the list and L is a pointer to the last element in the list. For which of the following operations, the corresponding time depends on the length of the list?



(a) Add an element after the last element of the list
(b) Delete the last element of the list
(c) Add an element before the first element
(d) Interchange the first two elements of the list

[JNUEE-2007]

27. Define $A_{ij}^{(k)} = \min(A_{ij}^{(k-1)}, A_{ik}^{(k-1)} + A_{kj}^{(k-1)}$, for all i, j, k n.

$A_{ij}^{(0)}$ = ∞ if $b_{ij} = 1$; ∞ if $b_{ij} = 0$, $i \neq j$; 0 if $b_{ij} = 0$, $i = j$.

Given b_{ij} for $i, j \leq n$, we need to compute $A_{ij}^{(n)}$, if $i, j \leq n$. If we design a dynamic programming algorithm with memorization, what will be its time complexity?

(a) $\theta(n^3)$ (b) $\theta(3^n)$
(c) $\theta(2^n)$ (d) $\theta(n^2)$

[DRDO-2008]

28. To remove recursion from a program we have to use the following data structures

(a) Array (b) Stack
(c) Queue (d) List

[DRDO-2008]

29. The expression 1 * 2 ^ 3 * 4 ^ 5 * 6 will be evaluated as

(a) 32^{30} (b) 162^{30}
(c) 49152 (d) 173458

[ISRO-2009]

30. A data structure is comprised of nodes each of which has exactly two pointers to other nodes with no null pointers. The following C program is to be used to count the number of nodes accessible from a given node. It uses a mark field assumed to be initially zero for all nodes. There is a statement missing from this code.

```
struct test {int info, mark; struct test * p, *q}
int nodecount (struct test *a)
{
        if (a → mark) return 0;
        return nodecount (a → p) + nodecount
        (a → q) + 1;
}
```

Select from the following the change that should make the program work property

(a) Add a → mark = 1; as the first statement
(b) Add a → mark = 0; after the if-statement
(c) Add a → mark = 1; as the if-statement
(d) Add a → mark = 0; as the last statement

[JNUEE-2005]

31. A doubly-linked list facilitates the determination of the predecessor of a given item. Which of the following operations utilizes this property of a doubly-linked list to its greatest advantage?

(a) accessing an item
(b) recovering a lost pointer
(c) copying a list
(d) merging two lists

[JNUEE-2004]

32. Consider the following C code:

```
int f(int x)
{    if (x < 1) return 1;
     else return f(x – 1) + g(x);
}
int g (int x)
{    if (x < 2) return 1;
     else return f(x – 1) + g(x/2);
}
```

Of the following, which best describes the growth of f(x) as a function of x?

(a) logarithmic (b) quadratic
(c) linear (d) exponential

[JNUEE-2004]

33. What would be the contents of queue Q1 after the following code is executed and the following data are entered?

```
1. Q1 = create Queue
2. S1 = create Stack
3. loop (not end of file)
   1 read number
   2. if (number not 0)
      1 pushStack (S1, number)
   3. else
      1 popStack (S1, x)
      2 popStack (S1, x)
      3 loop (not emply S1)
        1 popStack (S1, x)
        2 enqueue(Q1, x)
```

The data are

5, 7, 12, 4, 0, 4, 8, 67, 34, 23, 5, 0, 44, 33, 22, 6, 0

The enqueue operation inserts an element at the rear of the queue

(a) 7 34 67 8 5 0 6
(b) 5 12 67 23 44 6 22 34
(c) 12 7 23 67 34
(d) 7 5 34 67 8 4 33 44

[JNUEE-2003]

34. Assume that an upper triangular matrix a[0... n – 1, 0 ... n – 1] is stored in a linear array $b\left[0 \ldots \frac{1}{2}n(n+1)-1\right]$ in lexicographical order. If a[0, 0] is stored in b[0], where is a[800, 900] stored in array b for n = 1000?

(a) b[490500] (b) b[480501]
(c) b[500499] (d) none of the above

[JNUEE-2007]

35. Consider the polynominal $p(x) = a_0 + a_1x + a_2x^2 + a_3x^3$, where $a_i \neq 0$, $\forall i$. The minimum number of multiplications needed to evaluate p on an input x is

(a) 3 (b) 4
(c) 6 (d) 9

[GATE-2006]

36. Absence of terminating condition in a recursing program cause the following with time error:
(a) Array out of bounds (b) Stack overflow
(c) Null Pointer access (d) Division by zero
[DRDO-2008]

37. Given a set of n elements not all distinct, the majority element is the one with frequency ≥ n/2. So majority element is always the
(a) Maximum Element (b) Minimum Element
(c) Mean Element (d) Median Element
[DRDO-2008]

38. What is the maximum size of the operator stack during the conversion of the infix expression A + B*C – D/E to postfix?
(a) 1 (b) 2
(c) 3 (d) 4
[DRDO-2008]

39. What is the maximum size of the operand stack while evaluating the postfix expression 6 2 3 + –3 8 2/+ *?
(a) 1 (b) 2
(c) 3 (d) 4
[DRDO-2008]

40. Assume that the operators x, –, x are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x, +, –. the postfix expression corresponding to the infix expression a + b x c – d ^ e ^ f is
(a) abc x + def ^ ^ –
(b) abc x + de ^ f ^
(c) ab + c x d – e ^ f ^
(d) – + a x bc ^ ^ def
[ISRO-2009]

41. The following C function takes a singly-linked list as input argument. It modified the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```
typedef struct node {
    int value;
    struct node *next;
} Node;
Node *mode_to_front (Node *head) {
    Node *p, *q;
    if ((head == NULL) || (head->next
    == NULL)) return head;
q = NULL; p = head;
while (p->next != NULL) {
        q = p;
        p = p->next;
}
_____
return head;
}
```

Choose the correct alternative to replace the blank line.
(a) q = NULL; p->next = head; head = p;
(b) q->next = NULL; head = p; p->next = head;
(c) head = p; p->next = q; q->next = NULL;
(d) q->next = NULL; p->next = head; head = p;
[GATE-2010]

2 Sorting & Searching

1. For merging two sorted lists of sizes m and n into a sorted list of size m + n, we required comparisons of
   (a) O(m) (b) O(n)
   (c) O(m + n) (d) O(logm + logn)
   [GATE-1995]

2. Which of the following exemplies Divide and Conquer?
   (a) Heapsort (b) Insertion sort
   (c) Bubble sort (d) Merge sort
   [DRDO-2008]

3. Consider a sequence A of length n which is sorted except for one item that appears out of order. Which of the following can sort the sequence in O(n) time?
   (a) Heapsort (b) Quicksort
   (c) Merge sort (d) Insertion sort
   [DRDO-2008]

4. Which of the following is FALSE?
   (a) The average case time complexities of Quicksort and Heapsort are O(n log n)
   (b) The worst case time complexities of Quicksort and Heapsort are $O(n^2)$
   (c) The average case time complexities of Quick of Mergesort and Insertion sort are $O(n^2)$
   (d) The worst case time complexities of Quicksort and Mergesort are O(n log n)
   [DRDO-2008]

5. Binary search can be carried out on a set of ordered data items stored in a
   (a) Array (b) Stack
   (c) Queue (d) List
   [DRDO-2008]

6. The minimum number of comparisons required to sort 5 elements is
   (a) 4 (b) 5
   (c) 6 (d) 7
   [DRDO-2008]

7. The worst case time complexity of Quicksort for n elements when the median is selected as the pivot is:
   (a) $O(n^2)$ (b) $O(n^2)$
   (c) $\theta(n \log n)$ (d) $o(n \log n)$
   [DRDO-2008]

8. The most appropriate matching for the following pairs:
   X : depth first search 1 : heap
   Y : breadth-first search 2 : queue
   Z : sorting 3 : stack
   (a) X-1, Y-2, Z-3 (b) X-3, Y-1, Z-2
   (c) X-3, Y-2, Z-1 (d) X-2, Y-3, Z-1
   [GATE-2000]

9. Consider the following algorithm for searching for a given number x in an unsorted array A[1..n] having n distinct values:
   1. Choose an i uniformly at random from 1..n
   2. If A[i] = x then Stop else Goto 1;
   Assuming that x is present A, what is the expected number of comparisons made by the algorithm before it terminates?
   (a) n (b) n – 1
   (c) 2n (d) $\frac{n}{2}$
   [GATE-2002]

10. Randomized quicksort is an extension of quicksort where the pivot is chosen randomly. What is the worst case complexity of sorting n numbers using randomized quicksort?
(a) O(n) (b) O(nlogn)
(c) $O(n^2)$ (d) O(n!)
[GATE-2001]

11. Consider any array representation of an n element binary heap where the elements are sorted from index 1 to index n of the array. For the element sorted at index i of the array ($i \le n$), the index of the parent is
(a) i – 1 (b) $\left\lfloor \frac{i}{2} \right\rfloor$
(c) $\left\lceil \frac{i}{2} \right\rceil$ (d) $\frac{(i+1)}{2}$
[GATE-2001]

12. The usual $\Theta(n^2)$ implementation of insertion sort to sort an array uses linear search to identify the position where an element is to be inserted into the already sorted part of the array. If, instead, we use binary search to identify the position, the worst case running time will
(a) remain $\Theta(n^2)$
(b) become $\Theta(n (\log n)^2)$
(c) become $\Theta(n \log n)$
(d) become $\Theta(n)$
[GATE-2003]

13. Let A be a sequence of 8 distinct integers sorted in ascending order. How many distinct pairs of sequences, B and C are there such that (i) each is sorted in ascending order, (ii) B has 5 and C has 3 elements, and (iii) the result of merging B and C gives A?
(a) 2 (b) 30
(c) 56 (d) 256
[GATE-2003]

14. A sort method is said to be stable if the relative order of keys is the same after the sort as it was before the sort. In which of the following pairs both sorting algorithms are stable?
(a) Quick-sort and Insertion-sort
(b) Insertion-sort and Bubble-sort
(c) Quick-sort and Heap-sort
(d) Quick-sort and Bubble-sort
[DRDO-2009]

15. In a heap with n elements with the smallest element at the root, the 7th smallest element can be found in time
(a) $\Theta(n \log n)$ (b) $\Theta(n)$
(c) $\Theta(\log n)$ (d) $\Theta(1)$
[GATE-2003]

16. The minimum element in a max-heap represented by an array can be computed in time
(a) $\theta(n \log n)$ (b) O(n)
(c) $\theta(n^2)$ (d) O(1)
[DRDO-2009]

Data for Q. 17 & Q. 18 are given below. Solve the problems and choose the correct answers.
We are given 9 tasks T_1, T_2 ... T_9. The execution of each task requires one unit of time. We can execute one task at a time. T_i has a profit P_i and a deadline d_i. Profit P_i is earned if the task is completed before the end of the d_i^{th} unit of time.

Task	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

17. Are all tasks completed in the schedule that gives maximum profit?
(a) All tasks are completed
(b) T_1 and T_6 are left out
(c) T_1 and T_8 are left out
(d) T_4 and T_6 are left out
[GATE-2005]

18. What is the maximum profit earned?
(a) 147 (b) 165
(c) 167 (d) 175
[GATE-2005]

3 Trees & Graph

1. A weight-balanced tree is a binary tree in which for each node, the number of nodes in the let sub tree is at least half and at most twice the number of nodes in the right sub tree. The maximum possible height (number of nodes on the path from the root to the furthest leaf) of such a tree on n nodes is best described by which of the following?

(a) $\log_2 n$ (b) $\log_{\frac{4}{3}} n$

(c) $\log_3 n$ (d) $\log_{\frac{3}{2}} n$

[GATE-2002]

2. A binary search tree is used to locate the number 43. Which of the following probe sequences are possible and which are not?

(a) 61 52 14 17 40 43
(b) 2 3 50 40 60 43
(c) 10 65 31 48 37 43
(d) 81 61 52 14 41 43
(e) 17 77 27 66 18 43

[GATE-1996]

3. Let LASTPOST, LASTIN and LASTPRE denote the last vertex visited in a postorder, inorder an preorder traversal. Respectively, of a complete binary tree. Which oi the following is always tree?

(a) LASTIN = LASTPOST
(b) LASTIN = LASTPRE
(c) LASTPRE = LASTPOST
(d) none of the above

[GATE-2000]

4. The number of leaf nodes in a rooted tree of n nodes, with each node having 0 or 3 children is

(a) $\frac{n}{2}$ (b) $\frac{(n-1)}{3}$

(c) $\frac{(n-1)}{2}$ (d) $\frac{(2n+1)}{3}$

[GATE-2002]

5. Consider an undirected unweighted graph G. Let a breadth-first traversal of G be done starting from a node r. Let d(r, u) and d(r, v) be the lengths of the shortest paths from r to u and v respectively in G. If u is visited before v during the breadth-first traversal, which of the following statements is correct?

(a) $d(r, u) < d(r, v)$
(b) $d(r, u) > d(r, v)$
(c) $d(r, u) \leq d(r, v)$
(d) none of the above

[GATE-2001]

6. How many undirected graphs (not necessarily connected) can be constructed out of a given set $V = \{v_1, v_2, ..., v_n\}$ of n vertices?

(a) $\frac{n(n-1)}{2}$ (b) 2^n

(c) $n!$ (d) $2^{\frac{n(n-1)}{2}}$

[GATE-2001]

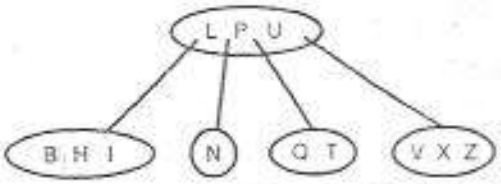
7. Let G be an undirected connected graph with distinct edge weight. Let e_{max} be the edge with maximum weight and e_{min} with minimum weight. Which of the following statements is false?
   (a) every minimum spanning tree of G must contain e_{min}
   (b) If e_{max} is in a minimum spanning tree, then its removal must disconnect G
   (c) no minimum spanning tree contains e_{max}
   (d) G has a unique minimum spanning tree
   [GATE-2000]

8. Let G be an undirected graph. Consider a depth-first traversal of G, and let T be the resulting depth-first search tree. Let u be a vertex in G and let v be the first new (unvisited) vertex visited after visiting u in the traversal. Which of the following statements is always true?
   (a) {u, v} must be an edge in G, and u is a descendant of v in T
   (b) {u, v} must be an edge in G, and v is a descendant of u in T
   (c) If {u, v} is not an edge in G then u is a leaf in T
   (d) If {u, v} is not an edge in G then u and v must have the same parent in T
   [GATE-2000]

9. Let T(n) be the number of different binary search trees on n distinct elements. Then $T(n) = \sum_{k=1}^{n} T(k-1)T(x)$, where x is
   (a) n – k + 1 (b) n – k
   (c) n – k – 1 (d) n – k – 2
   [GATE-2003]

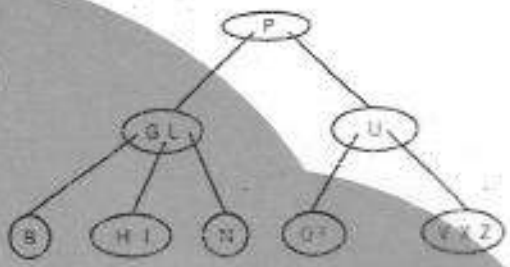
10. Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in that order into an initially empty binary search tree. The binary search tree uses the usual ordering on natural numbers. What is the in-order traversal sequence of the resultant tree?
    (a) 7 5 1 0 3 2 4 6 8 9 (b) 0 2 4 3 1 6 5 9 8 7
    (c) 0 1 2 3 4 5 6 7 8 9 (d) 9 8 6 4 2 3 0 1 5 7
    [GATE-2003]

11. Consider the following 2-3-4 tree (i.e., B-tree with a minimum degree of two) in which each data item is a letter. The usual alphabetical ordering of letters is used in constructing the tree.

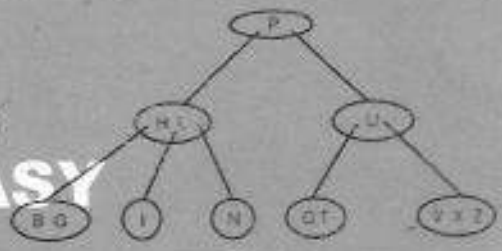


What is the result of inserting G in the above tree?

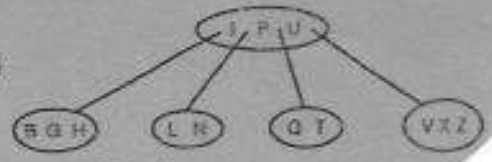
(a)



(b)



(c)



(d) none of the above
[GATE-2003]

12. Let G = (V, E) be an undirected graph with a subgraph $G_1 = (V_1, E_1)$. Weights are assigned to edges of G as follows.

$$w(e) = \begin{cases} 0 \text{ if } e \in E_1 \\ 1 \text{ otherwise} \end{cases}$$

A single-source shortest path algorithm is executed on the weighted graph (V, E, w) with an arbitrary vertex v_1 of V_1 as the source. Which of the following can always be inferred from the path costs computed?

(a) the number of edges in the shortest paths from v_1 to all vertices of G
(b) G_1 is connected
(c) V_1 forms a clique in G
(d) G_1 is a tree

[GATE-2003]

13. Maximum number of edges in a n-node undirected graph without self loops is

(a) n^2 (b) $\frac{n(n-1)}{2}$

(c) $n - 1$ (d) $\frac{(n+1)(n)}{2}$

[GATE-2002]

14. Let G = (V, E) be a directed graph with n vertices. A path from v_i to v_j in G is a sequence of vertices $(v_i, v_{i+1}, \ldots, v_j)$ such that $(v_k, v_{k+1}) \in E$ for all k in i through j – 1. A simple path is a path in which no vertex appears more than once.

Let A be an n x n array initialized as follows.

$$A[j, k] = \begin{cases} 1 \text{ if } (j, k) \in E \\ 0 \text{ otherwise} \end{cases}$$

Consider the following algorithm.

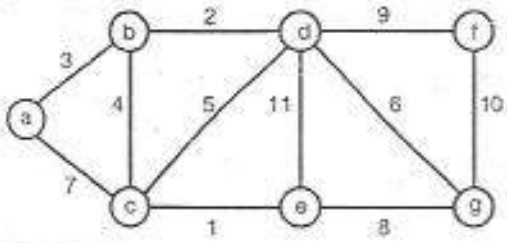
```
for i = 1 to n
    for j = 1 to n
        for k = 1 to n
            A[j, k] = max(A[j, k], A[j, i]
            + A[i, k]);
```

Which of the following statements is necessarily true for all j and k after termination of the above algorithm?

(a) $A[j, k] \leq n$
(b) if $A[j, j] \geq n - 1$, then G has a Hamiltonian cycle
(c) if there exists a path from j to k, A[j, k] contains the longest path length from j to k
(d) if there exists a path from j to k, every simple path from j to k contains at most A[j, k] edges

[GATE-2003]

15. Consider the following weighted graph.



If Prim's and Kruskal algorithm are used for generating minimum spanning tree of the above graph then in which case we get lower cost and what is the percentage decrease in cost? If needed consider starting vertex as "g".

(a) Prim's, 25%
(b) Kruskal, 10%
(c) Kruskal, 7.3%
(d) none of the above

16. Among the following statements, identify the false statement.

(a) We must balance a left-of-left unbalanced AVL tree by rotating the out-of-balance node to the right.
(b) The inorder traversal of a binary search tree produces an ordered list.
(c) When a module calls a subroutine recursively, in each call, all of the information is popped in the same order when subroutines are terminated one after another and finaly the control is returned to the calling module.
(d) A recursion algorithm has two elements : Each call either solves only part of the problem or it reduces the size of the problem.

[JNUEE-2003]

17. A full binary tree with a leaves contains

(a) n nodes (b) $\log_2 n$ nodes
(c) 2n – 1 (d) 2^n nodes

[ISRO-2009]

18. Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in the order into an initially empty binary search tree. The binary search tree uses the usual ordering on natural numbers. What is the inorder traversal sequence of the resultant tree?
(a) 7 5 1 0 3 2 4 6 8 9 (b) 0 2 4 3 1 6 5 9 8 7
(c) 0 1 2 3 4 5 6 7 8 9 (d) 9 8 6 4 2 3 0 1 5 7
[ISRO-2009]

19. A data structure is required for storing a set of integers such that each of the following operations can be done in (log n) time, where n is the number of elements in the set.
1. Deletion of the smallest element.
2. Insertion of an element if it is not already present in the set.
Which of the following data structures can be used for this purpose?
(a) A heap can be used but not a balanced binary search tree
(b) A balanced binary search tree can be used but not a heap
(c) Both balanced binary search tree and heap can be used
(d) Neither balanced binary search tree nor heap can be used
[ISRO-2009]

20. The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?
(a) 2 (b) 3
(c) 4 (d) 6
[ISRO-2009]

21. Binary search can be carried out on a set of ordered data items stored in a
(a) Array (b) Stack
(c) Queue (d) List
[DRDO-2008]

22. Which one of the following arrays satisfied max-heap property?
(a) 16, 10, 12, 8, 3, 5 (b) 16, 8, 5, 10, 12, 3
(c) 16, 12, 8, 3, 5, 10 (d) 10, 16, 12, 8, 5, 3
[DRDO-2008]

23. The number of NULL links in a binary tree with n nodes is:
(a) n – 1 (b) n
(c) n + 1 (d) 2n
[DRDO-2008]

24. What is the maximum possible height of an AVL tree with 20 nodes?
(a) 4 (b) 5
(c) 6 (d) 7
[DRDO-2008]

25. Let T be a B-tree of order m and height h. If n is the number of key elements in T then the maximum value of n is:
(a) $(m-1)^h - 1$ (b) $(m-1)^{h-1} + 1$
(c) $m^h - 1$ (d) $m^{h+1} - 1$
[DRDO-2008]

26. What is the number of edge disjoint Hamiltonian cycles in a complete graph G = (V, E) where |V| = n and n is odd?
(a) n (b) [n/2]
(c) (n – 1)/2 (d) n^2
[DRDO-2008]

27. A binary tree can be uniquely reconstructed from the following traversal(s):
(a) Preorder
(b) Postorder
(c) Preorder and Postorder
(d) Inorder and Preorder [DRDO-2008]

28. Insert keys 4, 12, 8, 16, 6, 18, 14, 7 into an initially empty binary search tree. Delete the node having the key 6. The preorder traversal after deletion is
(a) 4, 12, 7, 8, 24, 18, 16
(b) 4, 12, 8, 7, 16, 18, 24
(c) 4, 12, 8, 7, 24, 18, 16
(b) 4, 12, 7, 8, 16, 18, 24
[DRDO-2009]

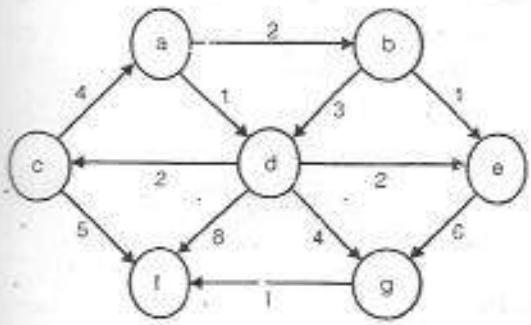
29. Let T be a B-tree of order m and height h. Let $d = \left\lceil \frac{m}{2} \right\rceil$ and let n be the number of elements in T. Then which of the following is TRUE?
(a) $m^h - 1 \le n$
(b) $2d^{h-1} - 1 \le n$
(c) $h \le \log_m (n + 1)$
(d) $\log_d \left(\frac{n+1}{2} \right) + 1 \le h$ [DRDO-2009]

30. Postorder traversal of a binary search tree is given as follows: 35, 40, 55, 60, 50, 100. Then the given tree is:
(a) Minheap tree (b) Maxheap true
(c) Strict binary tree (d) None

31. What is the total number of Hamiltonian Cycles in a complete graph of n vertices?
(a) n! (b) (n – 1)!
(c) $\left[\frac{n-1}{2} \right]$ (d) $\frac{(n-1)!}{2}$ [DRDO-2009]

32. In a graph G = (V, E) the feedback edge set is the set of the minimum number of edges whose removal will make the resultant graph acyclic. Then the cardinality of the feedback edge set for an undirected graph G is
(a) |E| – |V| + 1 (b) |E| – |V|
(c) |E| – 1 (d) |V| – 1 [DRDO-2009]

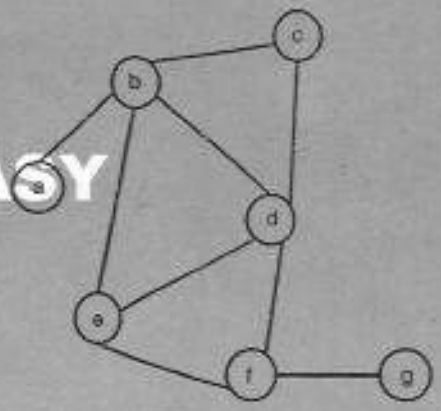
33. Consider the following graph:



The shortest distances from the vertex a to b, c, d, e, f and g respectively are:
(a) 2, 7, 1, 3, 9, 5 (b) 2, 3, 1, 3, 9, 5
(c) 2, 3, 1, 3, 6, 5 (d) 2, 7, 1, 3, 6, 5 [DRDO-2009]

34. Consider the underlying undirected graph corresponding to Question 33. and compute its minimum spanning tree. Then the sum of the edge weights of the minimum spanning tree is
(a) 10 (b) 11
(c) 12 (d) 15 [DRDO-2009]

35. Consider te following graph:



A possible Depth First Search (DFS) sequence for the above graph is
(a) d, e, b, a, c, f, g (b) b, a, e, c, d, f, g
(c) d, b, a, e, f, c, g (d) b, c, d, e, f, a, g [DRDO-2009]

36 What is the upper bound on the number of edge disjoint spanning trees in a complete graph of n vertices?
(a) n (b) n – 1
(c) $\left[\frac{n}{2} \right]$ (d) $\left[\frac{n}{3} \right]$ [DRDO-2009]

37. Given 2-sorted arrays each of n-elements. How much time it will take to find middle element of the union array?
(a) O(1) (b) O (log n)
(c) O(n) (d) none

38. The best data structure to check whether an arithmetic expression has balanced parentheses is a
(a) queue (b) stack
(c) tree (d) list
[GATE-2004]

39. Postorder traversal of a given binary search tree, T produces the following sequence of keys
10, 9, 23, 22, 27, 25, 15, 50, 95, 60, 40, 29
Which one of the following sequences of keys can be the result of an inorder traversal of the tree T?
(a) 9, 10, 15, 22, 23, 25, 27, 29, 40, 50, 60, 95
(b) 9, 10, 15, 22, 40, 50, 60, 95, 23, 25, 27, 29
(c) 29, 15, 9, 10, 25, 22, 23, 27, 40, 60, 50, 95
(d) 95, 50, 60, 40, 27, 23, 22, 25, 10, 0, 15, 29
[GATE-2004]

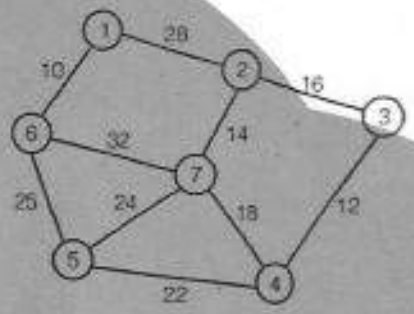
Data for Q.40 and Q.41 are given below. Solve the problems and choose the correct answers.

A 3-ary max heap is like a binary max heap, but instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array as follows: The root is stored in the first location, a [0], nodes in the next level, from left to right, is stored from a [1] to a [3]. The nodes from the second level of the tree from left to right are stored from a [4] location onward. An item x can be inserted into a 3-ary heap containing n items by placing x in the location a [n] and pushing it up the tree to satisfy the heap property.

40. Which one of the following is a valid sequence of elements in an array representing 3-ary max heap?
(a) 1, 3, 5, 6, 8, 9 (b) 9, 6, 3, 1, 8, 5
(c) 9, 3, 6, 8, 5, 1 (d) 9, 5, 6, 8, 3, 1
[GATE-2006]

41. Suppose the elements 7, 2, 10, and 4 are insetrted, in that order, into the valid 3-ary max heap found in the above question, Q. 40. Which one of the following is the sequence of items in the arrary representing the resultant heap?
(a) 10, 7, 9, 8, 3, 1, 5, 2, 6, 4
(b) 10, 9, 8, 7, 6, 5, 4, 3, 2, 1
(c) 10, 9, 4, 5, 7, 6, 8, 2, 1, 3
(d) 10, 8, 6, 9, 7, 2, 3, 4, 1, 5
[GATE-2006]

42. Consider the following graph where the numbers denotes the weight of the particular edge



Now, calculate the minimum cost spanning tree of the above graph using either prim's or Kruskal's algorithm.
(a) 92 (b) 99
(c) 102 (d) 123

43. Suppose a binary tree has only three nodes A, B, and C and you are given that the post-order traversal for the tree is B-A-C. The exact pre-order traversal for the tree is,
(a) C-A-B
(b) A-B-C
(c) C-B-A
(d) a definite pre-order traversal cannot be determined from the information given

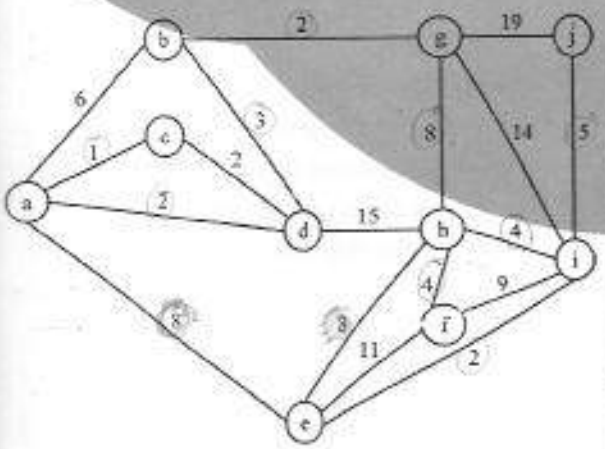
44. In a simple connected undirected graph with n nodes (where $n \geq 2$) the maximum number of nodes with distinct degrees is
(a) n – 1 (b) n – 2
(c) n – 3 (d) 2
[DRDO-2008]

45. The concatenation of 2-lists is to be performed in O(1) time. Which one of the following implements?
(a) Single linked list
(b) Doubly linked list
(c) Circular doubly linked list
(d) None of these

46. A file contains characters a, e, i, o, u, s and t with frequencies 10, 15, 12, 34, 13 and 1 respectively. If we use Huffman Coding for data compression then the average code length will be:
(a) $\frac{140}{58}$ (b) $\frac{146}{58}$
(c) $\frac{150}{58}$ (d) $\frac{174}{58}$
[DRDO-2009]

47. If in a graph G there is one and only one path between every pair of vertices then G is a
(a) Path (b) Walk
(c) Tree (d) Circuit
[DRDO-2009]

48. What is the weight of a minimum spanning tree of the following graph?



(a) 29 (b) 31
(c) 38 (d) 41
[GATE-2003]

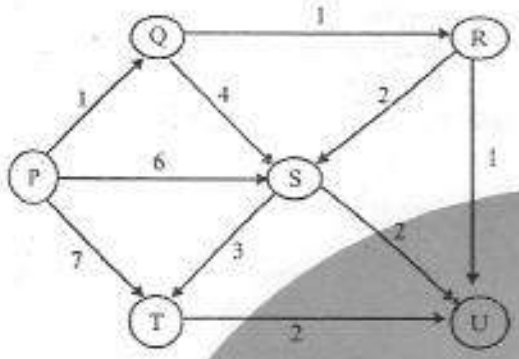
49. Given 2-arrays of numbers $a_1, a_2, a_3 \ldots a_n$ and $b_1, b_2, b_3 \ldots b_n$ where each number is 0 or 1.
The fastest algo to find the largest span (i, j) such that $a_i, a_{i+1} \ldots a_j = b_i, b_{i+1} \ldots b_j$ or report that there is no such span.
(a) Takes $O(3^n)$
(b) Takes $O(n^3)$
(c) Takes $O(n)$
(d) Takes $O(\sqrt{n})$ times

50. Level order traversal of a rooted tree can be done by starting from the root and performing
(a) preorder traversal
(b) inorder traversal
(c) depth first search
(d) breadth first search
[GATE-2004]

51. Consider the label sequences obtained by the following pairs of traversals on a labeled binary tree. Which of these pairs identify a tree uniquely?
1. preorder and postorder
2. inorder and postorder
3. preorder and inorder
4. level order and postorder
(a) 1 only (b) 2 and 3
(c) 3 only (d) 4 only
[GATE-2004]

52. The following are the starting and ending times of cetivities A, B, C, D E, F, G, and H respectively in chronological order: "a_s b_s a_s a_e d_s a_e e_s f_s b_e d_e g_s e_e f_e h_s g_e h_e" Here, x_s denotes the starting time and x_e denotes the ending time of activity X. W need to schedule the activities in a set of rooms available to us. An activity can be scheduled in a room only if the room is reserved for the activity for its entire duration. What is the minimum number of rooms required?
(a) 3 (b) 4
(c) 5 (d) 6
[GATE-2003]

53. Suppose we run Dijkstra's single source shortest-path algorithm on the following edge-weighted directed graph with vertex P as as the source.



In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized?

(a) P, Q, R, S, T, U (b) P, Q, R, U, S, T
(c) P, Q, R, U, T, S (d) P, Q, T, R, U, S

[GATE-2004]

54. A complete n-ary tree is a tree in which each node has n children or no children. Let I be the number of internal nodes and L be the number of leaves in a complete n-ary tree. If L = 41, and I = 10, what is the value of n

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

[GATE-2007]

Common Data for Question 55 and 56:

A sub-sequence of a given sequence is just the given sequence with some elements (possibly none or all) left out. We are given two sequences X[m] and Y[n] of lengths m and n, respectively, with indexes of X and Y starting from 0.

55. We wish to find the length of the longest common sub-sequence (LCS) of x [m] and Y[n] as $l(m, n)$, where an incomplete recursive definition for the function $l(i, j)$ to compute the length of the LCS of X[m] and Y[n] is given below:

$l(i, j)$ = 0, if either i = 0 or j = 0
= expr1, if i, j > 0 and X[i –1] = Y [j –1]
= expr2, if i, j>0 and X[i–1] ≠Y[j –1]

Which one of the following options is correct?

(a) expr1 = $l(i–1, j) + 1$
(b) expr1 = $l(i, j –1)$
(c) expr2 = max ($l(i–1, j)$, $l(i, j–1)$)
(d) expr2 = max ($l(i–1, j–1)$, $l(i, j)$)

[GATE-2009]

56. The values of $l(i,j)$ could be obtained by dynamic programming based on the correct recursive definition of $l(i, j)$ of the form given above, using an array L [M, N], where M = m + 1 and N = n + 1, such that L[i,j] = $l(i, j)$.

Which one of the following statements would be TRUE regarding the dynamic programming solution for the recursive definition of $l(i, j)$?

(a) All elements of L should be initialized to 0 for the values of $l(i,j)$ to be properly computed
(b) The values of $l(i, j)$ may be computed in a row major order or column major order of L [M, N]
(c) The values of $l(i, j)$ cannot be computed in either row major order or column major order of L [M, N]
(d) L [p, q] needs to be computed before L [r, s] if either p < r or q<s

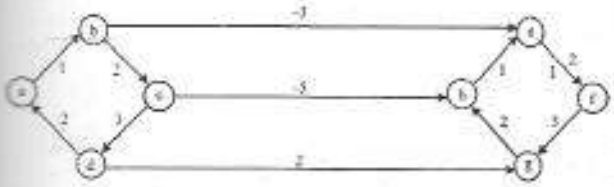
[GATE-2009]

57. Let G (V, E) an undirected graph with positive edge weights. Dijkstra's single source-shortes path algorithm can be implemented using the binary heap data structure with time complexity?

(a) O ($|V|^2$)
(b) O ($|E|$) + $|V|$ log $|V|$)
(c) O ($|V|$ log $|V|$)
(d) O (($|E|$ + $|V|$) log $|V|$)

[GATE-2005]

58.



Dijkstra's single source shortest path algorithm when run from vertex a in the above graph, computes the corrects shortest path distance to

(a) only vertex a
(b) only vertices a, e, f, g, h
(c) only vertices, a, b, c, d
(d) all the vertices

[GATE-2008]

59. The height of a binary tree is the maximum number of edges in any root to leaf path. The maximum number of nodes is a binary tree of height h is

(a) 2^h (b) $2^{h-1}-1$
(c) $2^{h+1}-1$ (d) 2^{h+1}

[GATE-2007]

60. The maximum number of binary trees that can be formed with three unlabeled nodes is

(a) 1 (b) 5
(c) 4 (d) 3

[GATE-2007]

61. The inorder and preorder traversal of a binary tree are

d b e a f c g and a b d e c f g respectively

The postorder traversal of the binary tree is

(a) d e b f g c a (b) e d b g f c a
(c) e d b f g c a (d) d e f g b c a

[GATE-2007]

62. The weight of a sequence $a_0, a_1, \ldots, a_{n-1}$ of real numbers is defined as $a_0 + a_1/2 + \ldots a_{n-1}/2^{n-1}$. A subsequence of a sequence is obtained by deleting some elements from the sequence, keeping the order of the remaining elements the same. Let X denote the maximum possible weight of a subsequence of $a_0, a_1, \ldots, a_{n-1}$ and Y the maximum possible weight of a subsequence of $a_1, a_2, \ldots, a_{n-1}$. Then X is equal to

(a) $\max(Y, a_0 + Y)$ (b) $\max(Y, a_0 + Y/2)$
(c) $\max(Y, a_0 + 2Y)$ (d) $a_0 + Y/2$

[GATE-2010]

Common Data for Questions 63 and 64:

Consider a complete undirected graph with vertex set {0, 1, 2, 3, 4}. Entry W_{ij} in the matrix W below is the weight of the edge {i, j}.

$$W = \begin{pmatrix} 0 & 1 & 8 & 1 & 4 \\ 1 & 0 & 12 & 4 & 9 \\ 8 & 12 & 0 & 7 & 3 \\ 1 & 4 & 7 & 0 & 2 \\ 4 & 9 & 3 & 2 & 0 \end{pmatrix}$$

63. What is the minimum possible weight of a spanning tree T in this graph such that vertex 0 is a leaf node in the tree T?

(a) 7 (b) 8
(c) 9 (d) 10

[GATE-2010]

64. What is the minimum possible weight of a path P from vertex 1 to vertex 2 in this graph such that P contains at most 3 edges?

(a) 7 (b) 8
(c) 9 (d) 10

[GATE-2010]

○○○

4 Algorithm

1. Consider the following three claim
   1. $(n + k)^m = \Theta(n^m)$ where k and m are constants
   2. $2^{n+1} = O(2^n)$
   3. $2^{2n+1} = O(2^n)$

   Which of these claim are correct?
   (a) 1 and 2 (b) 1 and 3
   (c) 2 and 3 (d) 1, 2 and 3
   [GATE-2003]

2. The running time of the following algorithm
   Procedure A(n)

   If n < = 2 return(1) else return $\left(A\left(\lceil \sqrt{n} \rceil\right)\right)$;

   (a) O(n) (b) O(logn)
   (c) O(loglogn) (d) O(1)
   [GATE-2002]

3. Let $f(n) = n^2 \log n$ and $g(n) = n(\log n)^{10}$ be two positive functions of n. Which of the following statements is correct?
   (a) $f(n) = O(g(n))$ and $g(n) \neq O(f(n))$
   (b) $g(n) = O(f(n))$ and $f(n) \neq O(g(n))$
   (c) $f(n) \neq O(g(n))$ and $g(n) \neq O(f(n))$
   (d) $f(n) = O(g(n))$ and $g(n) = O(f(n))$
   [GATE-2001]

4. Consider the following functions
   $f(n) = 3n^{\sqrt{n}}$ $g(n) = 2^{\sqrt{n}\log_2 n}$
   $h(n) = n!$
   Which of the following is true?
   (a) h(n) is O(f(n)) (b) h(n) is O(n))
   (c) g(n) is not O(n)) (d) f(n) is O(g(n))
   [GATE-2000]

5. Let F_k denote the k^{th} Fibonacci number with $F_k = F_{k-1} + F_{k-2}$ for $k \geq 2$, $F_0 = F_1 = 1$. Consider the following variation of an merge sort, which assumes that the number of elements in its list argument L is a Fibonacci number F_k.

```
Algorithm FibMergeSort(L)
L is a list of items from a totally ordered
set,whose length is a Fibonacci number Fk:
{
if L contains only 1 element, then return L;
else{
    divide L into L1 (the first Fk-1 items) and
    L2 (the remaining Fk-2 items)
    sorted L1 := FibMergeSorte(L1)
    sorted L2 := FibMergeSort (L2)
    sorted L := Merge(sortedL1, sortedL2)
    return sortedL;
}
}
```

Assuming that the "divide" step in FibMergeSort takes constant time (no comparisons) and Merge behaves similar to the merge in the normal merge sort. Identify which of the following exp[ressions most closely matches the total number of comparisons performed by FibMergeSort when initially given a list of F_k elements?
(a) $O(k \log^k)$ (b) $O(K^2)$
(c) $O(k F_k)$ (d) $O(F_k \log^k)$

6. If $T_1 = O(1)$, match List-I with List-II select the correct answer using the codes given below the Lists:

List-I	List-II
A. $T_n = T_{n-1} + n$	1. $T_n = O(n)$
B. $T_n = T_{n/2} + n$	2. $T_n = O(n^2)$
C. $T_n = T_{\frac{n}{2}} + n\log n$	3. $T_n = O(n \log n)$
D. $T_n = T_{n-1} + \log n$	4. $T_n = O(n^3)$

Codes:

	A	B	C	D
(a)	2	1	3	4
(b)	3	1	4	2
(c)	2	3	4	1
(d)	3	1	2	4

[GATE-1999]

7. Let s be a sorted array of n integers. Let t(n) denote the time taken for the most efficient algorithm to determined if there are two elements with sum less than 1000 in s. Which of the following statements is true?

(a) t(n) is O(1) (b) $n \le t(n) \le n\log_2 n$

(c) $n\log_2 n \le t(n) < \left(\frac{n}{2}\right)$ (d) $t(n) = \left(\frac{n}{2}\right)$

[GATE-2000]

8. Match List-I with List-II select the correct answer using the codes given below the Lists:

List-I
A. All pairs shortest paths
B. Quick sort
C. Minimum weight spanning tree
D. Connected components

List-II
1. Greedy
2. Depth-first search
3. Dynamic programming
4. Divide and conquer

Codes:

	A	B	C	D
(a)	2	4	1	3
(b)	3	4	1	2
(c)	3	4	2	1
(d)	4	1	2	3

[GATE-1997]

9. The cube root of a natural number n is defined as the larger natural number m such that $m^3 \le n$. The complexity of computing the cube root of n(n is represented in binary notation) is
(a) O(n) but not $O(n^{0.5})$
(b) $O(n^{0.5})$ but not $O((\log n)^k)$ for any constant $k > 0$
(c) $O((\log n)^k)$ for some constant $k > 0$, but not $O((\log\log n)^m)$ for any constant $m > 0$
(d) $O((\log\log n)^k)$ for some constant $k > 0.5$, but not $O((\log\log n)^{0.5})$

[GATE-2003]

10. Which one of the following statements is false?
(a) optimal binary search tree construction can be performed efficiently using dynamic programming
(b) breadth-first search cannot be used to find converted components of a graph
(c) given the prefix and postfix walks over a binary tree, the binary tree cannot be uniquely constructed
(d) depth-first search can be used to find connected components of a graph

[GATE-1994]

11. State whether the following problems are P or NP-complete?

1. Shortest path	2. Eulerian circuit
3. Longest path	4. Hamiltonian circuit
5. Edge cover	6. Vertex cover

(a) P, P, NP, NP, P, NP (b) NP, NP, P, P, NP, P
(c) P, NP, P, NP, P, NP (d) P, P, NP, P, NP, P

12. Consider the following function

$$F(m, n) = \begin{cases} n+1 : \text{if } m = 0, n > 0 \\ F(m-1, 1) : \text{if } n = 0, m > 0 \\ F(m-1, F(m, n-1)) : \text{if } m > 0, n > 0 \end{cases}$$

Then the value of F(2, 1) will be
(a) 3 (b) 4
(c) 5 (d) 6

13. Match List-I with List-II select the correct answer using the codes given below the Lists:

List-I

A. Strassen's matrix multiplication
B. Kruskal's minimum spanning tree
C. Bi-connected components algorithm
D. Floyd's shortest path

List-II

1. Greedy method
2. Dynamic programming
3. Divide and Conquer
4. Depth first search

Codes:

	A	B	C	D
(a)	3	1	4	2
(b)	3	4	1	2
(c)	2	4	1	3
(d)	2	1	4	3

14. Let T(n) be the function defined by

$$T(n) = \begin{cases} T(1) \text{ for } n = 1 \\ 7T(n/2) + 18n^2 \text{ for } n \geq 2 \end{cases}$$

Now which of the following statement is true?

(a) $T(n) = \Theta(\log_2 n)$ (b) $T(n) \Theta\left(n^{\log_2 7}\right)$

(c) $T(n) = O\left(n^{\log_2 n}\right)$ (d) none of the above

15. Give a big-O estimate for the function,
$f(n) = 3n \log(n!) + (N^2 + 3) \log n$

(a) $O(n \log n)$ (b) $O(n^2 \log n)$
(c) $O(n^3 \log n)$ (d) none of the above

[JNUEE-2003]

16. An algorithm runs a given input of size n. If n is 4096, the run time is 512 milliseconds. If n is 16384 the run time is 2048 milliseconds. What is the complexity of the algorithm in big-O notation?

(a) $O(n^{1/2})$ (b) $O(n)$
(c) $O(n \log n)$ (d) $O(n^2)$

[JNUEE-2003]

17. What does the following algorithm approximate? (Assume $m > 1$, $\epsilon > 0$).

```
x = m ;
y = 1;
while (x – y > ϵ)
        |   x = (x + y) / 2;
            y = m / x;
        }
print (x);
```

(a) log m (b) m^2
(c) $m^{1/2}$ (d) $m^{1/3}$

[GATE-2004]

18. Consider these two functions and two statements S1 and S2 about them.

```
int work1(int* a,int(int j))
{
    int x=a[i+2];
    a[i]=x+1;
    return a[i+2]@3;}
}
```

```
intwork2(int* a,int(int j))
{
    int t1=i+2;
    int t2=a[t1];
    a[i] = t2 + 1;
    return t2@3;
}
```

S1 : The transformation from work 1 to work 2 is valid, i.e., for any program state and input arguments, work 2 will compute the same output and have the same effect on program state as work 1

S2 : All the transformations applied to work 1 to get work 2 will always improve the performance (i.e. reduce CPU time) of work 2 compared to work 1

(a) S1 is false and S2 is false
(b) S1 is false and S2 is true
(c) S1 is true and S2 is false
(d) S1 is true and S2 is true

[GATE-2006]

19. Consider the following segment of C-code

```
int, J, n;
    j = 1;
while (j < = n)
    j = j* 2;
```

The number of comparisons made in the execution of the loop for any $n > 0$ is

(a) $[\log_2 n] + 1$ (b) n

(c) $[\log_2 n]$ (d) $\lfloor \log_2 n \rfloor + 1$

[GATE-2007]

20. If $T(n) = 3T(n/2) + n$, if $n > 1$, $T(1) = 1$. Then $T(n) = ?$

(a) $\theta(n)$ (b) $\theta(n^{\log_2 3})$

(c) $\theta(n^{3/2})$ (d) $\theta(n^{\log_2 3} \log_2 n)$

[DRDO-2008]

21. Let $S_1 = \sum_{r=0}^{\log n - 1} \frac{nr}{2^r}$, and $S_2 = \sum_{r=0}^{\log n - 1} r2^r$

Which of the following is true?

(a) $S_1 = \theta(n \log n)$, $S_2 = \theta(n \log n)$

(b) $S_1 = \theta(n)$, $S_2 = \theta(n \log n)$

(c) $S_1 = \theta(n \log n)$, $S_2 = \theta(n)$

(d) $S_1 = \theta(n)$, $S_2 = \theta(n)$

[DRDO-2008]

22. Which one of the following statements are correct regarding Bellman-Ford shortest path algorithm?

P: Always finds a negative edge weight cycle if one exists.

Q. Find whether any negative edge weight cycle reachable from the source.

(a) P only (b) Q only

(c) Both P and Q (d) Neither P nor Q

23. We have the following recurrence relation:

$$T(n) = \begin{cases} 1 & n \le 5 \\ T(n/5) + T(3n/4) + n & n > 5 \end{cases}$$

Then which of the following statement is TRUE?

(a) $T(n) \in \theta(n^2)$ (b) $T(n) \in \Omega(\sqrt{n})$

(c) $T(n) \in \theta(n)$ (d) $T(n) \in \theta(n \log n)$

[DRDO-2009]

24. We have the following recurrence relation:

$$T(n) = \begin{cases} 1 & n = 1 \\ 7T(n/2) + n^2 & n > 1 \end{cases}$$

Then which of the following statements is TRUE?

(a) $T(n) \in O(n)$ (b) $T(n) \in \theta(n^{\log_2 7})$

(c) $T(n) \in \theta(n^2)$ (d) $T(n) \in \theta(n^3)$

[DRDO-2009]

25. Let A, B and C be languages corresponding to decision problems Π_A, Π_B and Π_C respectively. Let A be NP-Complete. Then which of the following is NOT TRUE?

(a) $A \in NP$.

(b) $\forall L \in NP$, $L <_p A$.

(c) If $C \in NP$ and $A <_p C$ then C is NP-Complete.

(d) If $B \in NP$ and $B <_p A$ then B is NP-Copmplete.

[DRDO-2009]

26. We are given a sequence of n-numbers $a_1, a_2, a_3 \ldots a_n$, we will assume that all the number are distinct. We say two indices $i < j$ form an inversion if $a_i > a_j$.

How much time it will take to find total number of inversions in the given array ?

(a) $O(n^2)$ (b) $O(n \log n)$

(c) $O(n)$ (d) None of these

27. An array A[1 .... n] contains all the integers from 0 to n, except one element. How much time it will take to determine the missing integer?

(a) $O(n)$ (b) $O(\log n)$

(c) $O(n^2)$ (d) None

28. You are given an infinite array A in which the first n-cells contains integers in sorted order and the rest of the cells are filled with ∞. If you are not given the value of n, find time complexity of an algorithm that takes an integer X as input and find the position of element X in the given array A.

(a) $O(n)$ (b) $O(\log n)$

(c) $O(n^2)$ (d) none

29. The tightest lower bound on the number of comparisons, in the worst case, for comparison-based sorting is
(a) O(n) (b) $O(n^2)$
(c) $\Omega(n\log n)$ (d) $\Omega(n\log^2 n)$

30. Let A [1,..., n] be an array storing a bit (1 or 0) at each location, and f(m) is a function whose time complexity is θ(m). Consider the following program fragment written in a C like language:

```
counter = 0;
for (i = 1; i < n; i++)
{ if (A [i] = = 1) counter ++;
else {f (counter); counter = 0;}
}
```

The complexity of this program fragment is
(a) $\Omega(n^2)$
(b) $\Omega(n \log n)$ and $O(n^2)$
(c) θ(n)
(d) O(n)

[GATE-2004]

31. The recurrence equation
T(1) = 1
T(n) = 2T(n–1) + n, n ≥ 2
evaluates to
(a) $2^{n+1} - n - 2$ (b) $2^n - n$
(c) $2^{n+1} - 2n - 2$ (d) $2^n + n$

[GATE-2004]

32. A program takes as input a balanced binary search tree with n leaf nodes and computes the value of a function g(x) for each node x. If the cost of computing g(x) is min (number of leaf-nodes in left-subtree of x, number of leaf-nodes in right-subtree of x) then the worst case time complexity of the program is
(a) θ(n) (b) O(n log n)
(c) $O(n)^2$ (d) $O(2^n)$

[GATE-2004]

33. Let G (V, E) an undirected graph with positive edge weights. Dijkstra's single source -shortes path algorithm can be implemented using the binary heap data structure with time complexity?
(a) $O(|V|^2)$
(b) $O(|E|) + |V| \log |V|)$
(c) $O(|V| \log |V|)$
(d) $O((|E| + |V|) \log |V|)$ [GATE-2005]

34. In a complete k-ary, every internal node has exactly k childern. The number of leaves in such a tree with n internal nodes is
(a) n k (b) (n – 1) k +1
(c) n(k – 1) + 1 (d) n (k –1)

[GATE-2005]

35. Suppose there are log n sorted lists of n/log n elements each. The time complexity of producing a sorted list of all these elements is: (Hint : Use a heap data structure)
(a) O(n log log n) (b) θ(n log n)
(c) Ω(n log n) (d) $\Omega(n^{3/2})$

[GATE-2005]

Data for Q. 36 & Q. 37 are given below. Solve the problems and choose the correct answers.

Consider the following C - function:

```
double foo (int n){
    int i;
double sum;
if (n = = 0) return 1.0;
else {
sum = 0.0;
for (i = 0; <n ; i +)
sum + = foo (i);
return sum;
}}
```

36. The space complexity of the above function is
(a) O(1) (b) O(n)
(c) O(n!) (d) $O(n^n)$

[GATE-2005]

37. The space complexity of the above function is foo () and store the values of foo (i), 0 < = i < n, as and when they are computed. With this modification, the time complexity for function foo() is significantly reduced. The space complexity of the modified function would be:
(a) O(1) (b) O(n)
(c) $O(n^2)$ (d) O(n!)

[GATE-2005]

38. Consider a weighted complete garph G on the vertex set $(v_1, v_2, \ldots, v_n)$ such that the weight of the edge (v_i, v_j) is $2|i-j|$. The weight of a minimum spanning tree of G is

(a) $n-1$ (b) $2n-2$

(c) $\left(\frac{n}{2}\right)$ (d) n^2

[GATE-2006]

39. Consider the following C-program fragment in which i, j, and n are integer variables.

for (i = n, j = 0; i > 0; i / = 2, j + = i);

Let Val (j) = denote the value stored in the variable j after termination of the for loop. Which one of the following is true?

(a) val (j) = θ (log n) (b) val (j) = θ ($\sqrt{n}$)

(c) val (j) = θ (n) (d) val (j) = θ (n log n)

[GATE-2006]

40. What is the time complexity of the following recursive function :

```
int DoSomething ( int n) {
if  n < = 2)
    return 1;
else
return (DoSomething (floor (sqrt (n))
) + n);
}
```

(a) $\Theta(n^2)$ (b) $\Theta(n \log_2 n)$

(c) $\Theta(\log_2 n)$ (d) $\Theta(\log_2 \log_2 n)$

[GATE-2007]

41. Let *w* be the minimum weight among all edge weights in an undirected connected graph. Let e be a specific edge of weight **w**. Which of the following is FALSE?

(a) There is a minimum spanning tree containing e.

(b) If e is not in a minimum spanning tree T, then in the cycle formed by adding e to T, all edges have the same weight.

(c) Every minimum spanning tree has an edge of weight w

(d) e is present in every minimum spanning tree

[GATE-2007]

42. Consider the following C code segment:

```
int  IsPrime (n)
{
    int i, n;
    for (i = 2; i < = sqrt (n); i ++)
        if (n & i = = 0)
    print ("Not Prime\n");
                return 0;)
    return 1;
}
```

Let T(n) denote the number of times the for loop is executed by the program on input n. Which of the following is TRUE?

(a) $T(n) = O\sqrt{n}$ and $T(n) = \Omega\sqrt{n}$

(b) $T(n) = O\sqrt{n}$ and $T(n) = \Omega(1)$

(c) $T(n) = O(n)$ and $T(n) = \Omega\sqrt{n}$

(d) None of these

[GATE-2007]

43. The most efficient algorithm for finding the number of connected components in an undirected graph on n vertices and m edges has time complexity

(a) $\Theta(n)$ (b) $\Theta(m)$

(c) $\Theta(m+n)$ (d) $\Theta(mn)$

[GATE-2007]

44. Suppose you have k-sorted arrays, each with n-elements and you want to combine those k-sorted arrays into a single sorted array of kn elements. How much time it will take?

(a) O(kn) (b) O(kn log n)

(c) $O(k^2)$ (d) none

○○○

5 Hasing & Indexing

1. Let h(k) = k mod7. Calculate the number of collisions with linear probing for insertion of the following keys.
29 36 16 30
(a) 2 (b) 3
(c) 4 (d) 5
[GATE-2000]

2. Which of the following is the best choice as m in the hash function, h(k) = k mod m?
(a) 61 (b) 701
(c) 81 (d) 1031
[GATE-2000]

3. Let s be a sorted array of n integers. Let t(n) denote the time taken for the most efficient algorithm to determined if there are two elements with sum less than 1000 in s. Which of the following statements is true?
(a) t(n) is O(1) (b) $n \le t(n) \le n\log_2 n$
(c) $n\log_2 n \le t(n) < \left(\frac{n}{2}\right)$ (d) $t(n) = \left(\frac{n}{2}\right)$
[GATE-2000]

4. Choosing the hash function randomly from a class of hash functions such that it is independent of the keys to be stored, is termed as:
(a) perfect hashing
(b) simple uniform hashing
(c) universal hashing
(d) none of the above
[GATE-2000]

5. Given the hash function h(k, i) = $(h'(k) + i + i^2)$ mod 11 and h'(k) = k mod 11.
What is the number of collisions to store the following keys?
Following keys : 23 12 19 11 33 16 46 37
(a) 3 (b) 2
(c) 11 (d) none of these
[GATE-2000]

Common data Q. 6 and 7.

6. Consider an open address hash table with a total of 10,000 slots, containing 9900 entries. What is the expected number of probes in a successful search?
(a) 2 (b) 3
(c) 4 (d) 4.5
[GATE-2000]

7. In above problem, what is the expected number of probes in unsuccessful search?
(a) 4 (b) 10
(c) 20 (d) 50
[GATE-2000]

8. The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and linear probing. What is the resultant hash table?

(a)

0	
1	
2	2
3	23
4	
5	15
6	
7	
8	18
9	

(b)

0	
1	
2	12
3	13
4	
5	5
6	
7	
8	18
9	

(c)

0	
1	
2	12
3	13
4	2
5	3
6	23
7	5
8	18
9	15

(d)

0	
1	
2	12,2
3	13,3,23
4	
5	5,15
6	
7	
8	18
9	

[GATE-2009]

9. Consider a hash table consisting of M = 11slots (numbering of slots start from 0), and suppose integer key values are hashed into the table using the hash function h1:

```
int h1 (int key) {
    int x;
    x = (key + 5) * (key + 5);
    x = x/16;
    x = x + key;
    x = x % 11;
    return x;
}
```

Suppose that collisions are resolved using linear probing. The probe sequence is given therefore by $(h^1(k) + i) \pmod{11}$ (i starts from 0)

The integer key values listed below are to be inserted, in the order given. What are the final contents of the hash table after the following key values have been inserted in the given order:

43, 23, 1, 0, 15, 31, 4, 7, 11, 3

(a)

43	0	31	1		23	15	7	11	3	4

(b)

43	0	1	31		7	15	23	11	4	3

(c)

43	0	31	1		7	23	15	11	4	3

(d) none of the above

10. A B- tree of order 4 is built from scratch by 10 successing insertions. What is the maximum number of nodes spliting operations that may take place?

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

Linked Answer Questions

Statement for Linked Answer Q.11 and Q.12

A has table of length 10 uses open addressing with hash function h(k) = k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below.

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

11. Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

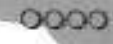
(a) 46, 42, 34, 52, 23, 33
(b) 34, 42, 23, 52, 33, 46
(c) 46, 34, 42, 23, 52, 33
(d) 42, 46, 33, 23, 34, 52

[GATE-2010]

12. How many different insertion sequences of the key values using the same hash function and linear probing will result in the hash table shown above?
(a) 10 (b) 20
(c) 30 (d) 40
[GATE-2010]

13. Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and the hash function x mod 10, which of the following statements are true?
1. 9679, 1989, 4199 hash to the same value
2. 1471, 6171 hash to the same value
3. All elements hash to the same value
4. Each element hashes to a different value
(a) 1 only (b) 2 only
(c) 1 and 2 only (d) 3 and 4 only
[GATE-2003]

14. Consider the hash table of size 7, with starting index 0, and a has function (3x + 4) mod 7. Assuming the hash table is initially empty, which of the following is the contents of the table, when the sequence 1, 3, 8, 10 is inserted into the table using closed hashing (Linear probing) ?
(a) 8, -, -, -, -, -, 10 (b) 1, 8, 10, -, -, -, 3
(c) 1, -, -, -, -, -, 3 (d) 1, 10, 8, -, -, -, 3
[GATE-2007]



6 Programming Methodology

1. Consider the following C function.

```
float f, (float x, int y) {
    float p, s; int i;
    for (s = 1, p = 1, i = 1; i < y; i++){
    p * = x/i;
    s + = p;
    }
    return s;
}
```

For large values of y, the return value of the function f best approximates

(a) X^y (b) e^x

(c) $\ln(1 + x)$ (d) X^x

[GATE-2003]

2. Assume the following C variable declaration

```
int * A[10], B[10] [10];
```

Of the following expressions

1. A[2] 2. A[2][3]
3. B[1] 4. B[2] [3]

Which will not give compile-time errors if used as left hand sides of assignment statements in a C program?

(a) 1, 2 and 4 only (b) 2, 3 and 4 only

(c) 2 and 4 only (d) 4 only

[GATE-2003]

3. The C language is:

(a) a context free language

(b) a context sensitive language

(c) a regular language

(d) parsable fully only by a turing machine

[GATE-2002]

4. What is printed by the print statements in the program P1 assuming call by reference parameter passing?

```
Program P1()
{
    x = 10;
    y = 3;
    func1(y, x, x);
    print x;
    print y;
}
func1(x, y, z)
{
    y = y + 4;
    z = x + y + z;
}
```

(a) 10, 3 (b) 31, 3

(c) 27, 7 (d) none of the above

[GATE-2001]

5. Consider the following three C functions.

```
[P1]    int * g(void)
        {
            intx = 10;
            return(&x);
        }

        int * g(void)
[P2]
        {
            int * px;
            *px = 10;
            return px;
        }
[P3]    int * g(void)
        {
            int * px
            px = (int*) malloc (size of (int));
            *px = 10;
            return px;
        }
```

Which of the above three functions are not likely to cause problems with pointers?

(a) only P3 (b) only P1 and P3
(c) only P1 and P2 (d) P1, P2 and P3

[GATE-2001]

6. Consider the following program

```
Program P2
    var n:int;
    procedure W(var x:int)
    begin
        x = x + 1;
        print x;
    end
    Procedure D
    begin
        var n:int;
        n = 3;
        W(n);
    End
begin                \\beginP2
    n = 10;
    D;
end
```

If the language has dynamic scoping and parameters are passed by reference. What will be printed by the program?

(a) 10 (b) 11
(c) 3 (d) none of the above

[GATE-2001]

7. In the C language

(a) at most one activation record exists between the current activation record and the activation record for the main
(b) the number of activation records between the current activation record and the activation record for the main depends on the actual function calling sequence
(c) the visibility of global variables depends on the actual function calling sequence.
(d) recursion requires the activation record for the recursive function to be saved on a different stack before the recursive fraction call be called

[GATE-2002]

8. Aliasing in the context of programming languages refers to

(a) multiple variables having the same memory location
(b) multiple variables having the same value
(c) multiple variables having the same identifier
(d) multiple uses of the same variable

[GATE-2000]

9. The value of j at the end of the execution of the following C program

```
int incr (int i)
{
    static int count = 0
    count = count + i;
    return (count);
}
main ( ) ;
    int i, j;
    for (i = 0; i < = 4; i++)
        j = incr (i);
}
```

is

(a) 10 (b) 4
(c) 6 (d) 7

[GATE-2000]

10. Consider the following C declaration

```
struct {
    short s [5]
    union {
    float y;
    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 requirement for variable t, ignoring alignment considerations, is

(a) 22 bytes (b) 14 bytes
(c) 18 bytes (d) 10 bytes

[GATE-2000]

11. Consider the following program in a language that has dynamic scooping:

```
var x: real;
procedure show:
        begin print (x); end;
procedure small;
        var x: real;
            begin x := 0.125; show; end;
begin x := 0.25;
        show; small
        end.
```

Then the output of the program is

(a) 0.125 0.125 (b) 0.25 0.25
(c) 0.25 0.125 (d) 0.125 0.25

[GATE-1999]

12. An unrestricted use of the "goto" statement is harmful because

(a) it makes it more difficult to varify programs
(b) it increases the running time of the programs
(c) it increases the memory required for the programs
(d) it results in the compiler generating longer machine code

[GATE-1994]

13. What is printed by the following C program?

```
int f ( int x, int *py, int ** ppz)
{
    int y, z;
    **ppz += 1; z = **ppz ;
    *py += 2; y = *py;
    x += 3;
    return x + y + z;
}
void main ( )
{
    int c, *b, **a;
    c = 4; b = &c;
    a = & b;
    printf ("% d", f
    (c, b, a));
}
```

(a) 18 (b) 19
(c) 21 (d) 22

[GATE-2008]

14. Consider the following C function:

```
int f (int n){
        static int r = 0;
if      (n < = 0) return 1;
if      (n > 3)
        { r = n;
        return f (n – 2) + 2;
}
return f (n –1) + r;
}
```

What is the value of f (5)?

(a) 5 (b) 7
(c) 9 (d) 18

[GATE-2007]

15. Consider the following C-program

```
void foo (int n, int sum) {
        int k = 0, j = 0;
if (n = = 0) return;
k = n % 10, j = n / 10;
        sum = sum + k;
        foo ( j, sum);
printf ("% d", k);
        }
        int main () {
int a = 2048, sum = 0;
        foo (a, sum);
printf ("% d/n", sum);
        }
```

What does the above program print?

(a) 8, 4, 0, 2, 14 (b) 8, 4, 0, 2, 0
(c) 2, 0, 4, 8, 14 (d) 2, 0, 4, 8, 0

[GATE-2005]

16. Consider the following C program

```
main  ( )
{     int  x, y, m, n;
      scan f ("% d %d", & x , &y);
      / * Assume x > 0 and y > 0* /
      m = x;          n = y;
      while   (m! = n)
              {       if (m > n)
                      m = m – n;
                      else
                      n = n – m;
```

```
        }
    print f ("% d", n);
    }
```

The program computes

(a) x ÷ y, using repeated subtraction

(b) x mod y using repeated subtraction

(c) the greatest common divisor of x and y

(d) the least common multiple of x and y

[GATE-2004]

17. Consider the following C function

```
int    f (int n)
{ static int i = 1 ·
    if (n > = 5) return n ;
    n = n + i ;
    i ++;
    return f (n) ;
}
```

The value returned by f(1) is

(a) 5 (b) 6

(c) 7 (d) 8

[GATE-2004]

18. Consider the following program:

```
void f (nt x, int & y, const int & z)
{
    x + = z;
    y + = z;
void main ( )
{
    int a = 22, b = 33, c = 44;
    f (a, b, c);
    f (2 * a – 3, b, c);
    print f ("a=%d b=%d c=%d/n", a, b, c);
}
```

What will be the output of the above program?

(a) a = 41 b = 3 c = 44

(b) a = 22 b = 33 c = 44

(c) a = 41 b = 121 c = 44

(d) a = 22 b = 121 c = 44

[DRDO-2009]

19. Consider the following C-function:

```
int f (int a, int b)
{
    if (b > a) return (f (b, a) );
    else if (b==0) return (a);
            else return (f (b, a%b) );
}
```

Which of the following will be returned by the function call f(18, 30)?

(a) 2 (b) 3

(c) 6 (d) 8

[DRDO-2009]

20. Consider the following C-function:

```
float f(float x, float y)
{
    int i; float z;
    if (x==0.0) return 0.0;
    if (y==0.0) return 1.0;
    z=1.0;
    for (i=0; i<y; i++)
      z* = x;
    for (i=0; i>y; i – –)
      z / = x;
    return z;
}
```

Which value will be returned by the function call f(2.0, – 3.0)?

(a) – 6.0 (b) – 1.0

(c) 0.125 (d) 1.5

[DRDO-2009]

21. Consider the following program:

```
void main ( )
{
int m = 44;
int *p = &m'
int &r=m;
int n = (*p)++;
int *q = p – 1;
r = – –* (p) + 1;
++*q;
print ("m=%d, n=%d, r=%d/n", m, n, r); )
```

What will be the output of the above program?

(a) m = 44, n = 46, r = 45

(b) m = 45, n = 44, r = 45

(c) m = 46, n =44, r = 46

(d) m = 46, n = 43, r = 46 [DRDO-2009]

22. In a C program how many bytes are required to store the string "john" in a charater array"
(a) 2 (b) 3
(c) 4 (d) 5
[DRDO-2009]

23. Consider a declaration
int a = 5, *b = & a;
printf ("%d", a*b);
The output is
(a) 25 (b) garbage
(c) 5 * address of b (d) error message
[JNUEE-2009]

24. Consider the following program segment:
int x[3] [5] = {{1, 2, 3, 4, 5}, {6, 7, 8, 10}, {11, 12, 13, 14}}; *n = & x;
Value of *(*(x + 2) + 1) is
(a) 3 (b) 12
(c) 6 (d) None of the above
[JNUEE-2009]

25. Main ()
{
void *vp;
char ch = 'g'
char *cp = "goofy";
int j = 20;
vp = &ch;
printf("%c", * (char *) vp);
vp = &j;
printf("%d", *(int *) vp);
vp = cp;
printf("%s", (char *) vp + 3);
}
(a) g20fy (b) goofy
(c) go2fy (d) none of these

26. What does the following program segment print?
main( )
{
int i
int iarray[4] = {1, 2, 3, 4};
# define SIZE (size of (iarray) / size of (int))
for (i = 0; i < SIZE, ++i)
{
irray[i]+ = 2;
printf("Value is %d\n" iarray[3]);
}
}
(a) 3 (b) 6
(c) Compilation error (d) None of the above
[JNUEE-2009]

27. For the following program
main( )
{
inc( ); inc( ); inc( );
}
inc( )
{
static int x;
printf("%d", ++x);
}
the output
(a) prints 0, 1, 2
(b) prints 1, 2, 3
(c) prints 3 consecutive but unpredictable numbers
(d) prints 111
[JNUEE-2009]

28. Main ()
{
int i = 258;
int * iptr = &i;
printf("%d%d",*((char *) iptr), *((char *) iptr + 1));
}
(a) 2,1 (b) 2, 5
(c) 1, 2 (d) 5, 2

29. What is the output of the following program?
include <stdio.h>
main ( )
{
int a, *b = &a, **c = &b;
a = 2
**c = 2;
b = (int *)**c;
printf ("A = %d, B = %d", a, b);
return (0);
}
(a) A = 2, B = 1 (b) A = 2, B = 2
(c) A = 2, B = 0 (d) Error
[JNUEE-2007]

30. Main ()
{
int i = 300
char *ptr = &i;
*++ptr = 2;
printf("%d", i);
}
(a) 556 (b) 300
(c) 655 (d) 003

31. What does the following program print?
#include < stdio.h>
void f(int *p, int *q) {
p = q;
*p = 2;
}
int i = 0, j = 1;
int main () {
f(&i, &j);
printf ("%d %d\n", i, j);
return 0;
}
(a) 2 2 (b) 2 1
(c) 0 1 (d) 0 2

[GATE-2010]

32. What is the value printed by the following C program?
#include < stdio.h>
int f(int *a, int n)
{
if (n <= 0) return 0;
else if (*a % 2 = = 0) return *a + f(a + 1, n – 1);
else return *a – f(a + 1, n – 1);
}
int main ( )
{
int a [] = {12, 7, 13, 4, 11, 6};
print f("%d", f(a, 6));
return 0;
}
(a) –9 (b) 5
(c) 15 (d) 19

[GATE-2010]

33. The following program is to be tested for statement coverage:
begin
if (a = = b) {S1; exit;}
else if (c = = d) {S2;}
else {S3; exit;}
S4;
end
The test cases T1, T2, T3 and T4 given below are expressed in terms of the properties satisfied by the values of variables a, b, c and d. The exact values are not given.
T1 : a, b, c and d are all equal
T2 : a, b, c and d are all distinct
T3 : a = b and c != d
T4 : a !=b and c = d
Which of the test suites given below ensures coverage of statements S1, S2, S3 and S4?
(a) T1, T2, T3 (b) T2, T4
(c) T3, T4 (d) T1, T2, T4

[GATE-2010]