

# **QUESTION BANK**

**MCA**

**SEMESTER II**

**VOL. I**

**FOR PRIVATE CIRCULATION**

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# **QUESTION BANK**

## **DATA AND FILE STRUCTURES**

**MCA 102**

**QUESTION BANK**  
**DATA AND FILE STRUCTURES– MCA 102**  
**MCA II**

**UNIT - I**

**I Test Your Skills:**

**(a) State Whether the Following Statements are True or False:**

- 1 When several stacks and queues co-exist, there is no efficient way to represent them sequentially.
- 2 The storage pool contains all nodes that are not currently being used.
- 3 A relation,  $\equiv$ , over a set  $s$ , is said to be an equivalence relation over  $S$  iff it is symmetric, reflexive and transitive over  $S$ .
- 4 A doubly linked list must be circular.
- 5 in a multiprocessing computer environment, several programs reside in memory at the same time.
- 6 Big O notation is used to represent average case running time of algorithm.
- 7  $f(n) = \theta(g(n))$  and  $g(n) = \theta(h(n))$  imply  $f(n) = \theta(h(n))$ .
- 8 The definition of  $\theta(g(n))$  requires that every member  $f(n) \in \theta(g(n))$  be asymptotically non-negative.
- 9 Backtracking problem is a method of exhaustive search using divide and conquer
- 10 Recursive code is shorter and easier to write than iterative code

Ans. (1)(T), (2)(T), (3)(T), (4)(F), (5)(T), (6)(T), (7)(T), (8)(T), (9)(T), (10)(T)

**(b) Multiple Choice Questions:**

- 1 Sparse matrices have
  - (a) Many zero entries
  - (b) Many non-zero entries
  - (c) Higher dimension
  - (d) None of the above
- 2 Two main measures for the efficiency of an algorithm are
  - (a) Processor and memory
  - (b) Complexity and capacity
  - (c) Time and space
  - (d) Data and space
- 3 Stack is useful for implementing
  - (a) Radix sort
  - (b) BFS
  - (c) Recursion

- (d) None of the above
- 4 The time factor when determining the efficiency of algorithm is measured by
- (a) Counting microseconds
  - (b) Counting the number of key operations
  - (c) Counting the number of statements
  - (d) Counting the kilobytes of algorithm
- 5 Stack's can't be used to:
- (a) Evaluate an arithmetic expression into postfix form
  - (b) Implement recursion
  - (c) Allocate resources by the operating system
  - (d) Convert a given arithmetic expression in infix form to its equivalent postfix form
- 6 The complexity of linear search algorithm is
- (a)  $O(n)$
  - (b)  $O(\log n)$
  - (c)  $O(n^2)$
  - (d)  $O(n \log n)$
- 7 The concept of order(Big O) is important because It can be used to decide the best algorithm that solves a given problem
- (a) It determines the maximum size of a problem that can be solved in a given system in a given account of time
  - (b) It is the lower bound of the growth rate of the algorithm
  - (c) None of the above
- 8 An algorithm is made up of 2 modules M1 and M2. If order of M1 is  $f(n)$  and M2 is  $g(n)$  then the order of the algorithm is
- (a)  $\text{Max}(f(n),g(n))$
  - (b)  $\text{Min}(f(n),g(n))$
  - (c)  $f(n)+g(n)$
  - (d)  $f(n) \times g(n)$
- 9 The elements of an array are stored successively in memory cells because
- (a) By this way computer can keep track only the address of the first element and the addresses of other elements can be calculated
  - (b) The architecture of computer memory does not allow arrays to store other than serially
  - (c) Both of above
  - (d) None of above
- 10 Which data structure allows deleting data elements from front and inserting at rear?
- (a) Stacks
  - (b) Queues

- (c) Deques
  - (d) Binary search tree
- 11 Identify the data structure which allows deletions at both ends of the list but insertion at only one end.
- (a) Input-restricted deque
  - (b) Output-restricted deque
  - (c) Priority queues
  - (d) None of above
- 12 Which of the following data structure is non-linear type?
- (a) Strings
  - (b) Lists
  - (c) Stacks
  - (d) None of above
- 13 Which of the following data structure is linear type?
- (a) Strings
  - (b) Lists
  - (c) Queues
  - (d) All of above
- 14 To represent hierarchical relationship between elements, which data structure is suitable?
- (a) Deque
  - (b) Priority
  - (c) Tree
  - (d) All of above
- 15 There is an extra element at the head of the list called a .....
- (a) Antinel
  - (b) Sentinel
  - (c) List header
  - (d) List head
- 16 The advantage of ..... is that they solve the problem if sequential storage representation. But disadvantage in that is they are sequential lists.
- (a) Lists
  - (b) Linked Lists
  - (c) Trees
  - (d) Queues
- 17 What will be the value of top, if there is a size of stack STACK\_SIZE is 5?
- (a) 5
  - (b) 6
  - (c) 4
  - (d) None

- 18 The OS of a computer may periodically collect all the free memory space to form contiguous block of free space. This is called
- (a) Concatenation
  - (b) Garbage collection
  - (c) Collision
  - (d) Dynamic Memory Allocation
- 19 A mathematical-model with a collection of operations defined on that model is called
- (a) Data Structure
  - (b) Abstract Data Type
  - (c) Primitive Data Type
  - (d) Algorithm
- 20 The data structure required to check whether an expression contains balanced parenthesis is
- (a) Stack
  - (b) Queue
  - (c) Tree
  - (d) Array
- 21 What data structure would you mostly likely see in a non-recursive implementation of arecursive algorithm?
- (a) Stack
  - (b) Linked list
  - (c) Queue
  - (d) Trees
- 22 The process of accessing data stored in a serial access memory is similar to manipulating data on a
- (a) Heap
  - (b) Queue
  - (c) Stack
  - (d) Binary tree
- 23 A linear collection of data elements where the linear node is given by means of pointer is called
- (a) Linked list
  - (b) Node list
  - (c) Primitive list
  - (d) None of these
- 24 Representation of data structure in memory is known as:
- (a) Recursive
  - (b) Abstract data type
  - (c) Storage structure
  - (d) File structure

- 25 If the address of  $A[1][1]$  and  $A[2][1]$  are 1000 and 1010 respectively and each element occupies 2 bytes then the array has been stored in \_\_\_\_\_ order.
- (a) Row major
  - (b) Column major
  - (c) Matrix major
  - (d) None of these
- 26 An ADT is defined to be a mathematical model of a user-defined type along with the collection of all \_\_\_\_\_ operations on that model.
- (a) Cardinality
  - (b) Assignment
  - (c) Primitive
  - (d) Structured
- 27 An algorithm is made up of two independent time complexities  $f(n)$  and  $g(n)$ . Then the complexities of the algorithm is in the order of
- (a)  $f(n) \times g(n)$
  - (b)  $\text{Max}(f(n), g(n))$
  - (c)  $\text{Min}(f(n), g(n))$
  - (d)  $f(n) + g(n)$
- 28 Time complexities of three algorithms are given. Which should execute the slowest for large values of  $N$ ?
- (a)  $(12) O N$
  - (b)  $O(N)$
  - (c)  $O(\log N)$
  - (d) None of these
- 29 The best average behavior is shown by
- (a) Quick Sort
  - (b) Merge Sort
  - (c) Insertion Sort
  - (d) Heap Sort
- 30  $O(N)$  (linear time) is better than  $O(1)$  constant time.
- (a) True
  - (b) False
  - (c) Both True
  - (d) Both false
- 31 The memory address of the first element of an array is called
- (a) floor address
  - (b) foundation address
  - (c) first address
  - (d) base address



- 32 The indirect change of the values of a variable in one module by another module is called
- internal change
  - inter-module change
  - side effect
  - Side-module update
- 33 Given two sorted lists of size  $m$  and  $n$  respectively. The number of comparisons needed in the worst case by the merge sort algorithm will be?
- $Mn$
  - $\text{Max}(m,n)$
  - $\text{Min}(m,n)$
  - $m+n-1$
- 34 What is the running time of the following code fragment?
- ```
for(int i=0; i<10; i++)
for(int j=0; j<N; j++)
for(int k=N-2; k<N+2; k++)
cout<< i << " " << j <<endl;
```
- $O(\log N)$
  - $O(N \log N)$
  - $O(N)$
  - $O(N^2)$
- 35 Suppose we have two classes, one of which extends the other:
- ```
class Base { ... };
class Derived: public Base { ... };
```
- Now suppose we execute the following program:
- ```
line 1 int main( ) {
line 2 Base* b;
line 3 Derived* d = new Derived;
line 4 b = d;
line 5 delete d;
line 6 return 0;
line 7
}
```
- What is the static type of variable  $b$  after line 4 has been executed and before line 5 is executed?
- Base \*
  - Base &
  - Derived \*
  - Derived &
- 36 Suppose we're debugging a quicksort implementation that is supposed to sort an array in ascending order. After the first partition step has been completed, the contents of the array are in the following order:
- 3 9 1 14 17 24 22 20

Which of the following statements is correct about the partition step?

- (a) The pivot could have been either 14 or 17
- (b) The pivot could have been 14, but could not have been 17
- (c) The pivot could have been 17, but could not have been 14
- (d) Neither 14 nor 17 could have been the pivot

37 Are there any dynamic memory management errors in the following code?

```
int *p = new int;
int *q = new int;
int *r;
*p = 17;
r = q;
*q = 42;
p = q;
delete r;
```

- (a) No, there are no errors
- (b) Yes, a memory leak
- (c) Yes, misuse of a dangling pointer
- (d) Yes, both a memory leak and misuse of a dangling pointer

38 Which of the following sequences of code could be used in the destructor `~List()` to correctly delete all of the nodes in the list? (Which ones are legal, even if the style is atrocious?)

- I. 

```
for (ListNode *n = head; head != NULL; head = n) {
    n = head->next;
    delete head;
}
```
- II. 

```
for (ListNode *n = head; n != NULL; n->next) {
    delete n;
}
```
- III. 

```
ListNode* n;
while (head != NULL) {
    n = head->next;
    delete head;
    head = n;
}
```

- (a) I and II only
- (b) II and III only
- (c) I and III only
- (d) III only

39 Suppose you were implementing a data structure to store information about the paintings on display at an art dealer's showroom. Of the following data structures, which one is the right one to use?

- (a) Unordered array
- (b) Sorted array

- (c) Linked list  
 (d) Binary search tree  
 (e) It depends
- 40 What is the complexity of the following code expressed in  $O()$  notation? If more than one answer is correct, choose the smallest one.
- ```

for (int j = n; j > 0; j--) {
for (int k = 1; k < j; k = k+k) {
cout<<j+k<< " ";
}
cout<<endl;
}

```
- (a)  $O(\log n)$   
 (b)  $O(n)$   
 (c)  $O(n \log n)$   
 (d)  $O(n^2)$   
 (e)  $O(2n)$
- 41 Which of the following case does not exist in complexity theory?
- (a) Best case  
 (b) Worst case  
 (c) Average case  
 (d) Null case
- 42 What will be the postfix expression for following infix expression  $b * c + d / e$
- (a)  $bc*de+ /$   
 (b)  $bc*de/+$   
 (c)  $b*cde/+$   
 (d)  $bcd*e+$
- 43 Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and the hash function  $x \bmod 10$ , which of the following statements are true? i. 9679, 1989, 4199 hash to the same value ii. 1471, 6171 has to the same value iii. All elements hash to the same value iv. Each element hashes to a different value
- (a) i only  
 (b) ii only  
 (c) i and ii only  
 (d) iii or iv
- 44 Consider a hash table with 100 slots. Collisions are resolved using chaining. Assuming simple uniform hashing, what is the probability that the first 3 slots are unfilled after the first 3 insertions?
- (a)  $(97 \times 97 \times 97) / 100^3$

- (b)  $(99 \times 98 \times 97) / 100^3$   
 (c)  $(97 \times 96 \times 95) / 100^3$   
 (d)  $(97 \times 96 \times 95) / (3! \times 100!)$
- 45 Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for  $i$  ranging from 0 to 2020?  
 (a)  $h(i) = i^2 \bmod 10$   
 (b)  $h(i) = i^3 \bmod 10$   
 (c)  $h(i) = (11 * i^2) \bmod 10$   
 (d)  $h(i) = (12 * i) \bmod 10$
- 46 The recurrence relation capturing the optimal time of the Tower of Hanoi problem with  $n$  discs is  
 (a)  $T(n) = 2T(n-2) + 2$   
 (b)  $T(n) = 2T(n-1) + n$   
 (c)  $T(n) = 2T(n/2) + 1$   
 (d)  $T(n) = 2T(n-1) + 1$
- 47 Which of the given options provides the increasing order of asymptotic complexity of functions  $f_1, f_2, f_3$  and  $f_4$ ?  
 $f_1(n) = 2^n$   
 $f_2(n) = n^{3/2}$   
 $f_3(n) = n \log n$   
 $f_4(n) = n^{\log n}$
- (a)  $f_3, f_2, f_4, f_1$   
 (b)  $f_3, f_2, f_1, f_4$   
 (c)  $f_2, f_3, f_1, f_4$   
 (d)  $f_2, f_3, f_4, f_1$
- 48 What is the output of following function for start pointing to first node of following linked list? 1->2->3->4->5->6
- ```
void fun(struct node* start)
{
    if(start == NULL)
        return;
    printf("%d ", start->data);

    if(start->next != NULL )
        fun(start->next->next);
    printf("%d ", start->data);
}
```
- (a) 1 4 6 6 4 1  
 (b) 1 3 5 1 3 5  
 (c) 1 2 3 5  
 (d) 1 3 5 5 3 1

- 49 In the worst case, the number of comparisons needed to search a singly linked list of length  $n$  for a given element is
- (a)  $\log_2 n$
  - (b)  $n/2$
  - (c)  $\log_2 n - 1$
  - (d)  $n$
- 50 Which of the following is true about linked list implementation of stack?
- (a) In push operation, if new nodes are inserted at the beginning of linked list, then in pop operation, nodes must be removed from end.
  - (b) In push operation, if new nodes are inserted at the end, then in pop operation, nodes must be removed from the beginning.
  - (c) Both of the above
  - (d) None of the above
- 51 ..... is very useful in situation when data have to stored and then retrieved in reverse order.
- (a) Stack
  - (b) Queue
  - (c) List
  - (d) Link list
- 52 Which data structure allows deleting data elements from and inserting at rear?
- (a) Stacks
  - (b) Queues
  - (c) Dequeues
  - (c) Binary search tree
- 53 Which of the following data structure can't store the non-homogeneous data elements?
- (a) Arrays
  - (b) Records
  - (c) Pointers
  - (d) Stacks
- 54 A ..... is a data structure that organizes data similar to a line in the supermarket, where the first one in line is the first one out.
- (a) Queue linked list
  - (b) Stacks linked list
  - (c) Both of them
  - (d) Neither of them
- 55 Which of the following is non-linear data structure?
- (a) Stacks
  - (b) List

- (c) Strings
- (d) Trees

56 Herder node is used as sentinel in .....

- (a) Graphs
- (b) Stacks
- (c) Binary tree
- (d) Queues

57 Which data structure is used in breadth first search of a graph to hold nodes?

- (a) Stack
- (b) Queue
- (c) Tree
- (d) Array

58 Identify the data structure which allows deletions at both ends of the list but insertion at only one end.

- (a) Input restricted dequeue
- (b) Output restricted dequeue
- (c) Priority queues
- (d) Stack

59 Which of the following data structure is non linear type?

- (a) Strings
- (b) Lists
- (c) Stacks
- (d) Graph

60 Which of the following data structure is linear type?

- (a) Graph
- (b) Trees
- (c) Binary tree
- (d) Stack

Ans. (1)(a), (2)(c) (3)(c), (4)(b), (5)(d),(6)(a), (7)(a,b), (8)(a), (9)(a), (10)(b), (11)(a) (12)(d), (13)(d), (14)(c), (15)(b), (16)(b), (17)(c), (18)(b), (19)(b), (20)(a), (21)(a), (22)(c), (23)(a), (24)(b), (25)(a), (26)(c), (27)(b), (28)(b), (29)(a), (30)(b), (31)(d), (32)(a), (33)(d), (34)(c), (35)(a), (36)(a), (37)(b), (38)(a), (39)(e), (40)(c), (41)(d), (42)(b), (43)(c), (44)(a), (45)(b), (46)(d), (47)(a), (48)(d), (49)(d), (50)(d), (51)(a), (52)(b), (53)(a), (54)(a), (55)(d), (56)(c), (57)(b), (58)(a), (59)(d), (60)(d).

(c) **Fill in the Blanks:**

1 In a circularly linked list organization, insertion of record involves the modification of .....pointers

- 2 The order of an algorithm that finds whether a given Boolean function of 'n' variables, produces as 1 is.....
- 3 There are 4 different algorithms A1, A2, A3, A4 to solve a given problem with the order  $\log(n)$ ,  $\log\log(n)$ ,  $n\log(n)$ ,  $n/\log(n)$  respectively. ....is the best algorithm
- 4 The running time  $T(n)$ , where 'n' is the input size of a recursive algorithm is given as follows:  
 $T(n)=c+T(n-1)$ , if  $n>1$   
 $D$ , if  $n\leq 1$   
 The order of the algorithm is.....
- 5 The running time  $T(n)$ , where 'n' is the input size of a recursive algorithm is given as follows  
 $T(n)=8T(n/2)+qn$ , if  $n>1$   
 $p$ , if  $n=1$  where  $p,q$  are constants.The order of the algorithm is.....
- 6 The Ackermann's function .....solved iteratively
- 7  $f(n)$  is asymptotically smaller than  $g(n)$  if.....
- 8 Stack is a.....(LIFO/FIFO).
- 9 ..... and.....are the two stack operations.

Ans. (1)(two), (2)(exponential), (3)(A2), (4)(n), (5)(n raised to power3), (6)(can't be), (7) ( $f(n) = O(g(n))$ ), (8)(LIFO), (9)(push and pop)

## II Short Answer Type Questions:

- 1 Give the structure of Queue model.
- 2 What is a Queue?
- 3 What are the basic operations of Queue ADT?
- 4 What is Enqueue and Dequeue?How would you ensure enqueue and dequeue operations on a linked queue, are performed in  $O(1)$ ?Explain.
- 5 Give the applications of Queue.
- 6 What is the use of stack pointer?
- 7 What is an array?
- 8 What is doubly linked list?
- 9 Swap two adjacent elements by adjusting only the pointers (and not the data) using singly linked list.
- 10 What are the advantages of doubly linked list over singly linked list?
- 11 What is a circularly linked list?
- 12 What is a linear list?
- 13 How will you delete a node from a linked list?
- 14 What is linear pattern search?
- 15 What is recursive data structure?
- 16 For searching operation which is better ARRAY or LINKED LIST?
- 17 What are the differences between pointers to constants and constants to pointers? Discuss with the help of suitable examples.
- 18 Convert the following infix expression to its equivalent prefix and postfix expression:  
 $(A - B) / ((D + E) * F)$
- 19 Explain Big O notation and its significance.

- 20 Convert the following expression in reverse polish notation showing the stack operations.  
(A \* [B + C \* (D + E)]) / [F (G + H)]
- 21 What is the Difference between null array and an empty array?
- 22 Why always array index starts with 0?
- 23 What is null macro?
- 24 Difference between static and dynamic list?
- 25 What is the difference between null and void pointers?
- 26 What is a CONST pointer?
- 27 What is the difference between FIFO and LIFO?
- 28 What is the static List? How is it implemented?
- 29 What do you mean by time and space complexity of an algorithm?
- 30 Compare stack and queue data structure?
- 31 Convert the following infix expression to its equivalent prefix and postfix expression (A + B) / ((D - E) \* F)?
- 32 Compare the advantages and disadvantages of representing polynomials using linked lists and arrays respectively?
- 33 Evaluate and compare the average case time complexity of Binary Search and Linear Search?
- 34 Give an example situation where a doublestack can be utilized more efficiently than two separate stacks.
- 35 What are Priority Queue and their applications?
- 36 Evaluate the following Postfix expression  
12, 7, 3, -, /, 2, 1, 5, +, \*, +
- 37 Write the algorithm for converting a given Infix expression to its postfix notation using stacks.
- 38 Explain the working to store any postfix notations.
- 39 Explain the representation of Sparse matrices as Row Major and Column Major?
- 40 Explain the application of Stacks and Queue?
- 41 Write a program in C which implements two stacks using single array.
- 42 Write an algorithm that evaluates a postfix expression using stacks.
- 43 Write equivalent postfix expression for  $2*5+7-4^2*6+23*(24/4+8)$ .
- 44 Write advantages of circular link list over linear linked list.
- 45 Differentiate between recursive and iterative algorithms.
- 46 How do you measure the algorithm running time?
- 47 Describe best case, average case and worst case efficiency of an algorithm.
- 48 Define the term Data abstraction.
- 49 Define the term algorithm and state of complexity.
- 50 Define sparse matrix and its representation with example.

### III Long Answer Type Questions:

- 1 Explain the implementation of stack using Linked List.
- 2 Explain Prefix, Infix and postfix expressions with example.
- 3 Explain the operations and the implementation of list ADT.
- 4 Give a procedure to convert an infix expression  $a+b*c+(d*e+f)*g$  to postfix notation



- 5 Design and implement an algorithm to search a linear ordered linked list for a given alphabetic key or name.
- 6 What is a stack? Write down the procedure for implementing various stack operations.
- 7 Explain the various application of stack?
- 8 Given two sorted lists L1 and L2 write a procedure to compute L1 - L2 using only the basic operations
- 9 Write a routine to insert an element in a linked list
- 10 What is a queue? Write an algorithm to implement queue with example.
- 11 Translate the infix expression  $A \times (B+C) / D-E \times (F+G/H-K)$  into postfix expression in showing the position of stack after each operation.
- 12 Using a Boolean variable to discuss between a circular queue being empty or full, write insert and delete procedures.
- 13 Give applications of double stacks, queues, multiqueues and dequeues.
- 14 Write an algorithm to delete an element from doubly-linked list:
  - (a) At the beginning of the list.
  - (b) At the end of the list.
  - (c) After a node P.
- 15 Write algorithm to implement multiplication of two polynomial P1 and P2.
- 16 Compare queues, dequeues and multiqueues with their applications.
- 17 Define and give example of the following:
  - (a) Sparse matrix
  - (b) Row major order expression
  - (c) Column major order expression
- 18 Write a procedure to reverse a singly linked list while traversing it only once.
- 19 Discuss the concept of circular queues in detail along with examples.
- 20 Write a program to implement stack operation push and pop with pointer?
- 21 Convert infix expression to its equivalent prefix expression  $(x + y - z)/(h + k) - z$ ?
- 22 Write a program to implement queue containing eight elements and perform the insertion and deletion operation?
- 23 Convert the following prefix expression into a postfix expression  $// * + ABCDE$
- 24 What is the difference between singly and doubly linked lists? Write an algorithm to create a doubly linked.
- 25 Input a two dimensional array of order  $m \times n$ . Write an algorithm which should this array and another two dimensional array of order  $(m+1) \times (n+1)$  in which the elements of  $(m+1)$  row should be the sum of elements of  $m$  rows and element of  $(n+1)$  column should be the sum of  $n$  columns.
- 26 How can you fix Quick sort so the expected time is  $O(n \log n)$ , if it can be done? You should give a specific suggestion (don't just say something like "be clever and careful"). Explain why your solution will change the expected time to  $O(n \log n)$ .
- 28 What values are automatically assigned to those array elements which are not explicitly initialized?
- 29 Assume that a queue is available for pushing and popping elements. Given an input sequence a,b, c, (c be the first element), give the output sequence of elements if the rightmost element given above is the first to be popped from the queue.
- 30 A two dimensional array TABLE [6] [8] is stored in row major order with base address 351. What is the address of TABLE [3] [4]?

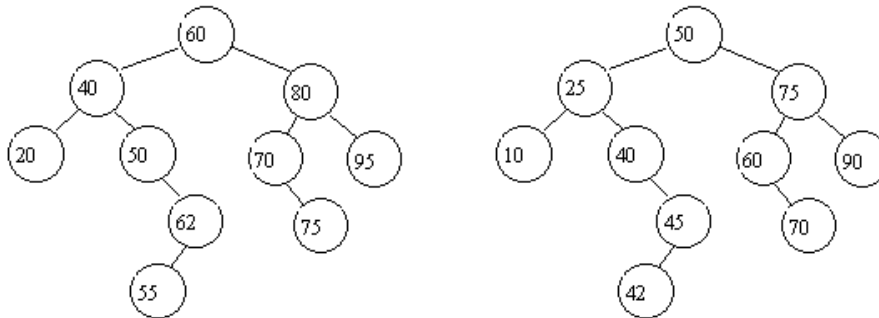
- 31 Explain an efficient way of storing a sparse matrix in memory. Write a module to find the transpose of a sparse matrix stored in this way.
- 32 Explain different types of data structures and the areas where they can be applied.
- 33 What is meant by Transitive closure of a graph? What is its use.
- 34 What is buffering and when is it useful?
- 35 Draw an expression tree for storing the expression  $a+b*c$ .

## UNIT - II

### I Test Your Skills:

#### (a) State Whether the Following Statements are True or False:

- 1 In a linked representation of a binary tree, there are more than nine links than actual pointers.
- 2 Both the trees given below are Binary Search trees?



- 3 A tree is an example of a list.
- 4 A list is an example of a tree.
- 5 A tree is a hierarchical data structure.
- 6 A binary tree of height 3 must contain a minimum of 4 nodes.
- 7 A binary tree of height 3 could contain 12 nodes.
- 8 A binary tree of height 3 could contain 20 nodes.
- 9 When you insert the values 40, 30, 60, 40, and 50 into a binary search tree, and then search for, say, 40, the search will find the second occurrence of 40, not the first.
- 10 Suppose we insert the values 40, 30, 60, 50, and 10 into a binary search tree, and then use the following function:
 

```
void someOrder(Node *p)
{ if (p != 0)
  {   someOrder(p->right);
      cout << p->data << endl; someOrder(p->left);
  }
}
```

 then the output of calling `someOrder(root)` would be: 10, 30, 40, 50, then 60.
- 11 If a recursive function does not have a base case it is likely to result in an infinite loop.

- 12 AVL trees are also known as height balanced trees.
- 13 B-tree is a tree data structure that keeps data sorted and allows searches, sequential access, insertions, and deletions in logarithmic time.
- 14 The heap is one maximally-efficient implementation of an abstract data type called a priority queue.
- 15 Each internal node of a B-tree does not contain a number of keys.

Ans. (1)(T), (2)(F), (3)(F), (4)(F) (5)(T), (6)(T), (7)(T), (8)(F) (9)(F), (10)(F), (11)(T), (12)(T), (13)(T), (14)(T), (15)(F)

**(b) Multiple Choice Questions:**

- 1 Which of the following abstract data type can be used to represent a many to many relation?
  - (a) Tree
  - (b) Graph
  - (c) Queue
  - (d) None of the above
- 2 The number of possible ordered trees with 3 nodes A, B and C is:
  - (a) 16
  - (b) 12
  - (c) 6
  - (d) 10
- 3 Binary search algorithm cannot be applied to
  - (a) sorted linked list
  - (b) sorted binary trees
  - (c) sorted linear array
  - (d) pointer array
- 4 A binary tree in which every non-leaf node has non-empty left and right sub trees is called a strictly binary tree. Such a tree with 10 leaves
  - (a) Cannot have more than 19 nodes
  - (b) Has exactly 19 nodes
  - (c) Has exactly 17 nodes
  - (d) Cannot have more than 17 nodes
- 5 Which of the following is not the required condition for binary search algorithm?
  - (a) The list must be sorted
  - (b) There should be the direct access to the middle element in any sublist.
  - (c) There must be mechanism to delete and/or insert elements in list
  - (d) none of above
- 6 The depth of complete binary tree with 'n' nodes is (log is to the base two)
  - (a)  $\text{Log}(n+1)-1$
  - (b)  $\text{Log}(n)$
  - (c)  $\text{Log}(n-1)+1$

- (d)  $\text{Log}(n)+1$
- 7 A binary tree whose every node has either zero or two children is called
- Complete binary tree
  - Binary search tree
  - Extended binary tree
  - None of above
- 8 The depth of a complete binary tree is given by
- $D_n = n \log_2 n$
  - $D_n = n \log_2 n + 1$
  - $D_n = \log_2 n$
  - $D_n = \log_2 n + 1$
- 9 The post order traversal of a binary tree is DEBFCA. Find out the pre order traversal
- ABFCDE
  - ADBFEC
  - ABDECF
  - ABDCEF
- 10 In a binary tree, certain null entries are replaced by special pointers which point to nodes higher in the tree for efficiency. These special pointers are called
- Leaf
  - branch
  - path
  - thread
- 11 The in order traversal of tree will yield a sorted listing of elements of tree in
- Binary trees
  - Binary search trees
  - Heaps
  - None of above
- 12 In a Heap tree
- Values in a node is greater than every value in left sub tree and smaller than right sub tree
  - Values in a node is greater than every value in children of it
  - Both of above conditions applies
  - None of above conditions applies
- 13 The number of comparisons done by sequential search is .....
- $(N/2)+1$
  - $(N+1)/2$
  - $(N-1)/2$
  - $(N+2)/2$

- 14 In general, the binary search method needs no more than ..... comparisons.
- $\lceil \log_2 n \rceil - 1$
  - $\lceil \log n \rceil + 1$
  - $\lceil \log_2 n \rceil$
  - $\lceil \log_2 n \rceil + 1$
- 15 ..... Is a directed tree in which out degree of each node is  $\leq$ two.
- Unary tree
  - Binary tree
  - Dinary tree
  - Both B and C
- 16 The best average behaviour is shown by
- Quick Sort
  - Merge Sort
  - Insertion Sort
  - Heap Sort
- 17 A binary tree of depth “d” is an almost complete binary tree if
- Each leaf in the tree is either at level “d” or at level “d-1”
  - For any node “n” in the tree with a right descendent at level “d” all the left descendents of “n” that are leaves, are also at level “d”
  - Both (a) & (b)
  - None of the above
- 18 The postfix form of  $A*B+C/D$  is
- $*AB/CD+$
  - $AB*CD/+$
  - $A*BC+/D$
  - $ABCD+/*$
- 19 Let the following circular queue can accommodate maximum six elements with the following data  
front = 2 rear = 4  
queue = \_\_\_\_\_; L, M, N, \_\_\_\_, \_\_\_\_  
What will happen after ADD O operation takes place?
- front = 2 rear = 5  
queue = \_\_\_\_\_; L, M, N, O, \_\_\_\_
  - front = 3 rear = 5  
queue = L, M, N, O, \_\_\_\_
  - front = 3 rear = 4  
queue = \_\_\_\_\_; L, M, N, O, \_\_\_\_
  - front = 2 rear = 4  
queue = L, M, N, O, \_\_\_\_

- 20 The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum
- Three nodes
  - Two nodes
  - One node
  - Any number of nodes
- 21 A BST is traversed in the following order recursively: Right, root, left  
The output sequence will be in
- Ascending order
  - Descending order
  - Bitomic sequence
  - No specific order
- 22 A graph with  $n$  vertices will definitely have a parallel edge or self loop if the total number of edges is
- greater than  $n-1$
  - less than  $n(n-1)$
  - greater than  $n(n-1)/2$
  - less than  $n^2/2$
- 23 A B-tree of minimum degree  $t$  can maximum \_\_\_\_\_ pointers in a node.
- $t-1$
  - $2t-1$
  - $2t$
  - $t$
- 24 A BST is traversed in the following order recursively: Right, root, left  
The output sequence will be in
- Ascending order
  - Descending order
  - Bitomic sequence
  - No specific order
- 25 The pre-order and post order traversal of a Binary Tree generates the same output. The tree can have maximum
- Three nodes
  - Two nodes
  - One node
  - Any number of nodes
- 26 Which of the following sorting methods would be most suitable for sorting a list which is almost sorted?
- Bubble Sort
  - Insertion Sort
  - Selection Sort
  - Quick Sort

- 27 The number of leaf nodes in a complete binary tree of depth  $d$  is
- (a)  $2d$
  - (b)  $2d-1+1$
  - (c)  $2d+1+1$
  - (d)  $2d+1$
- 28 In a linked list with  $n$  nodes, the time taken to insert an element after an element pointed by some pointer is
- (a)  $O(1)$
  - (b)  $O(\log n)$
  - (c)  $O(n)$
  - (d)  $O(n \log n)$
- 29 The total number of comparisons required to merge 4 sorted files containing 15, 3, 9 and 8 records into a single sorted file is
- (a) 66
  - (b) 39
  - (c) 15
  - (d) None of the above
- 30 One can convert a binary tree into its mirror image by traversing it in
- (a) inorder
  - (b) preorder
  - (c) postorder
  - (d) any order
- 31 The in-order traversal of tree will yield a sorted listing of elements of tree in .....
- (a) binary trees
  - (b) binary search trees
  - (c) heaps
  - (d) binary heaps
- 32 In a binary tree, certain null entries are replaced by special pointers which point to nodes higher in the tree for efficiency. These special pointers are called.....
- (a) Leaf
  - (b) Branch
  - (c) Path
  - (d) Thread
- 33 If node  $N$  is a terminal node in a binary tree then its .....
- (a) Right tree is empty
  - (b) Left tree is empty
  - (c) Both left & right sub trees are empty
  - (d) Root node is empty
34. In threaded binary tree ..... points to higher nodes in tree.
- (a) Info

- (b) Root
  - (c) Threads
  - (d) Child
- 35 A graph is said to be ..... if every node  $u$  in  $G$  is adjacent to every other node  $v$  in  $G$ .
- (a) Absolute
  - (b) Entire
  - (c) Inclusive
  - (d) Complete
- 36 If every node  $u$  in  $G$  adjacent to every other node  $v$  in  $G$ , A graph is said to be
- (a) isolated
  - (b) complete
  - (c) finite
  - (d) strongly connected
- 37 Three standards ways of traversing a binary tree  $T$  with root  $R$ .....
- (a) Prefix, infix, postfix
  - (b) Pre-process, in-process, post-process
  - (c) Pre-traversal, in-traversal, post-traversal
  - (d) Pre-order, in-order, post-order
- 38 In-order traversing a tree resulted E A C K F H D B G; the pre-order traversal would return.
- (a) FAEKCDBHG
  - (b) FAEKCDHGB
  - (c) EAFKHDCBG
  - (d) FEAKDCHBG
- 39 A connected graph  $T$  without any cycles is called.
- (a) a tree graph
  - (b) free tree
  - (c) a tree
  - (d) All of above
- 40 In linked representation of Binary trees LEFT[ $k$ ] contains the..... of at the node  $N$ , where  $k$  is the location.
- (a) Data
  - (b) Location and left child
  - (c) Right child address
  - (d) Null value
- 41 The preorder traversal sequence of a binary search tree is 30, 20, 10, 15, 25, 23, 39,35,42. Which one of the following is the postorder traversal sequence of the same tree
- (a) 10, 20, 15, 23, 25, 35, 42, 39, 30
  - (b) 15, 10, 25, 23, 20, 42, 35, 39, 30



- (c) 15, 20, 10, 23, 25, 42, 35, 39, 30  
 (d) 15, 10, 23, 25, 20, 35, 42, 39, 30
- 42 What is the worst case time complexity for search, insert and delete operations in a general Binary Search Tree?  
 (a)  $O(n)$  for all  $n$   
 (b)  $O(\log n)$  for all  $n$   
 (c)  $O(\log n)$  for search and insert  $O(n)$  for delete  
 (d)  $O(\log n)$  for search, and  $O(n)$  for insert and delete
- 43 Which of the following points is/are true about Linked List data structure when it is compared with arrays  
 (a) Arrays have better cache locality that can make them better in terms of performance  
 (b) It is easy to insert and delete elements in Linked List  
 (c) Random access is not allowed in a typical implementation of Linked Lists  
 (d) The size of array has to be pre-decided, linked lists can change their size any time  
 (e) All of the above
- 44 Which of the following is a true about Binary Trees  
 (a) Every binary tree is either complete or full.  
 (b) Every complete binary tree is also a full binary tree.  
 (c) Every full binary tree is also a complete binary tree.  
 (d) No binary tree is both complete and full.  
 (e) None of the above
- 45 Consider a node X in a Binary Tree. Given that X has two children, let Y be Inorder successor of X. Which of the following is true about Y  
 (a) Y has no right child  
 (b) Y has no left child  
 (c) Y has both children  
 (d) None of the above
- 46 A binary tree T has 20 leaves. The number of nodes in T having two children is  
 (a) 18  
 (b) 19  
 (c) 17  
 (d) Any number between 10 and 20
- 47 The difference between the external path length and the internal path length of a binary tree with  $n$  internal nodes is?  
 (a) 1  
 (b)  $n$   
 (c)  $n + 1$   
 (d)  $2n$

- 48 What is the maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0.
- (a) 2
  - (b) 3
  - (c) 4
  - (d) 5
- 49 What is the worst case possible height of AVL tree?
- (a)  $2\log_2 n$
  - (b)  $1.44\log_2 n$
  - (c) Depends upon implementation
  - (d)  $\Theta(n)$
- 50 Which of the following is a self-adjusting or self-balancing Binary Search Tree
- (a) Splay Tree
  - (b) AVL Tree
  - (c) Red Black Tree
  - (d) All of the above
- 51 The height of a BST is given as  $h$ . Consider the height of the tree as the no. of edges in the longest path from root to the leaf. The maximum no. of nodes possible in the tree is?
- (a)  $2^{h-1} - 1$
  - (b)  $2^{h+1} - 1$
  - (c)  $2^h + 1$
  - (d)  $2^{h-1} + 1$
- 52 The no of external nodes in a full binary tree with  $n$  internal nodes is?
- (a)  $n$
  - (b)  $n+1$
  - (c)  $2n$
  - (d)  $2n + 1$
- 53 The difference between the external path length and the internal path length of a binary tree with  $n$  internal nodes is?
- (a) 1
  - (b)  $n$
  - (c)  $n + 1$
  - (d)  $2n$
- 54 Suppose a binary tree is constructed with  $n$  nodes, such that each node has exactly either zero or two children. The maximum height of the tree will be?
- (a)  $(n+1)/2$
  - (b)  $(n-1)/2$
  - (c)  $n/2 - 1$
  - (d)  $(n+1)/2 - 1$

- 55 Which of the following statement about binary tree is CORRECT?
- (a) Every binary tree is either complete or full
  - (b) Every complete binary tree is also a full binary tree
  - (c) Every full binary tree is also a complete binary tree
  - (d) A binary tree cannot be both complete and full
- 56 Suppose we have numbers between 1 and 1000 in a binary search tree and want to search for the number 363. Which of the following sequence could not be the sequence of the node examined?
- (a) 2, 252, 401, 398, 330, 344, 397, 363
  - (b) 924, 220, 911, 244, 898, 258, 362, 363
  - (c) 925, 202, 911, 240, 912, 245, 258, 363
  - (d) 2, 399, 387, 219, 266, 382, 381, 278, 363
- 57 In full binary search tree every internal node has exactly two children. If there are 100 leaf nodes in the tree, how many internal nodes are there in the tree?
- (a) 25
  - (b) 49
  - (c) 99
  - (d) 101
- 58 Which type of traversal of binary search tree outputs the value in sorted order?
- (a) Pre-order
  - (b) In-order
  - (c) Post-order
  - (d) None
- 59 Suppose a complete binary tree has height  $h > 0$ . The minimum no of leaf nodes possible in term of  $h$  is?
- (a)  $2^h - 1$
  - (b)  $2^{h-1} + 1$
  - (c)  $2^{h-1}$
  - (d)  $2^h + 1$
- 60 If a node having two children is to be deleted from binary search tree, it is replaced by its
- (a) In-order predecessor
  - (b) In-order successor
  - (c) Pre-order predecessor
  - (d) None

Ans. (1)(b), (2)(b), (3)(a), (4)(b), (5)(c), (6)(a), (7)(c), (8)(d), (9)(c), (10)(d), (11)(b), (12)(b), (13)(b), (14)(d), (15)(b), (16)(a), (17)(c), (18)(b), (19)(a), (20)(c), (21)(b), (22)(a), (23)(d), (24)(b), (25)(c), (26)(a), (27)(a), (28)(a), (29)(d), (30)(a), (31)(b), (32)(d), (33)(c), (34)(c), (35)(d), (36)(b), (37)(d), (38)(b), (39)(d), (40)(a), (41)(d), (42)(a), (43)(e), (44)(e), (45)(b), (46)(b), (47)(d), (48)(b), (49)(b), (50)(d), (51)(b), (52)(b), (53)(d), (54)(b), (55)(c), (56)(c), (57)(c), (58)(b), (59)(c), (60)(b).

**(c) Fill in the Blanks:**

- 1 The minimum number of edges in a connected cyclic graph on  $n$  vertices is.....
- 2 A binary tree  $T$  has  $n$  leaf nodes. The number of nodes of degree 2 in  $T$  is.....
- 3 ..... number of colors are needed to color a graph of  $n(>3)$  vertices and 2 edges
- 4 .....number of binary trees with 3 nodes which when traversed in post-order gives the sequence A,B,C.
- 5 Preorder is nothing but .....order.
- 6 The number of possible ordered trees with 4 nodes is.....
- 7 A B-tree is kept balanced by requiring that all ..... are at the same depth.
- 8 Heaps are used for ..... allocation.

Ans. (1)( $n$ ), (2)( $n-1$ ), (3)(2), (4)(5), (5)(depth-first order), (6)(14), (7)(leaf nodes), (8)(dynamic memory)

**II Short Answer Type Questions:**

- 1 Explain Tree concept?
- 2 What is meant by traversal?
- 3 What is meant by depth first order?
- 4 What is in order traversal?
- 5 What is Pre order traversal?
- 6 What is Post order traversal?
- 7 Define Binary tree.
- 8 What is meant by BST?
- 9 Define AVL trees.
- 10 Give example for single rotation and double rotation.
- 11 What is meant by Binary Heap?
- 12 Mention some applications of Priority Queues.
- 13 Define complete binary tree.
- 14 How a binary tree is represented using an array? Give an example
- 15 Define (i) inorder (ii) preorder (iii) postorder traversal of a binary tree.
- 16 What is an expression tree?
- 17 How do you insert an element in a binary search tree?
- 18 Show that for the perfect binary tree of height  $h$  containing  $2^{h+1}-1$  nodes, the sum of the heights of the nodes  $2^{h+1}-1-h$ .
- 19 Give the prefix, infix and postfix traversal algorithm.
- 20 Explain in detail (i) Single rotation (ii) double rotation of an  
(a) AVL tree.
- 21 Explain the efficient implementation of the priority queue  
(a) ADT
- 22 Explain detail about Deletion in Binary Search Tree.
- 23 Give representation of threaded binary tree.
- 24 Give an example of AVL tree.

- 25 Write a routine to perform insertion into a B-tree.
- 26 Write a routine to perform deletion from a B-Tree. When a key is deleted, is it necessary to update information in the internal nodes?
- 27 Write the advantages of using threaded trees.
- 28 Show the results of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially binary search tree and show the results of deleting the root.
- 29 What are B trees?
- 30 What are threaded binary trees?
- 31 Write a function that returns the height of an AVL Tree?
- 32 Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty binary search tree?
- 33 Write an algorithm that takes only a pointer to the root of a binary tree T and computes the number of nodes in T?
- 34 Show that the maximum number of nodes in a binary tree of height H is  $2^{H+1}-1$ ?
- 35 What is advantage of a Threaded tree over a simple BST? What is the overhead?
- 36 Write a C function to insert a node in a right in-threaded tree.
- 37 What are expression trees? Represent the following expression using a tree.  
Comment on the result that you get when this tree is traversed in Preorder, Inorder and postorder.  $(a-b) / ((c*d)+e)$
- 38 How do you rotate a Binary Tree? Explain right and left rotations with the help of an example.
- 39 Write a C function that inserts node in a max heap.
- 40 Generate a binary tree for which following traversals are given:  
Preorder :  $+*/ABCDE$   
Inorder:  $A/B*C*D+E$
- 41 What do you mean by a spanning tree? Is it unique for a binary tree?
- 42 How B-tree is different from a binary tree. Write its 2 advantages.
- 43 Draw a full binary tree with at least 6 nodes.
- 44 Explain how a binary tree be stored as an array with example.
- 45 State any two applications of generating minimum spanning tree for a graph.

### III Long Answer Type Questions:

- 1 A full node is a node with two children. Prove that the number of full nodes plus one is equal to the number of leaves in a non empty binary tree.
- 2 Suppose that we replace the deletion function, which finds, return, and removes the minimum element in the priority queue, with find min, can both insert and find min be implemented in constant time?
- 3 Give the prefix, infix and postfix traversal algorithm.
- 4 Explain the operation and implementation of Binary Heap.
- 5 Explain how to find a maximum element and minimum element in BST?
- 6 Show that in a binary tree of N nodes, there are N+1 NULL pointers representing children.
- 7 Write the procedure to implement AVL single and double rotations.
- 8 Write a non-recursive function to insert into a AVL tree.
- 9 Describe a method to perform an insertion into a B\* tree.
- 10 Arrange the months in a year in an AVL tree. Show all rotations.

- 11 Explain RR imbalance and the process of resolving it using AVL rotations.
- 12 Demonstrate (construct the tree and show the links and threads) threading for a right-in-threaded tree built using the input 12, 3,23,4,2,21.
- 13 Define a B-tree. Draw a B-tree of order 5 when the keys arrive in the following order. a,f,g,k,b,h,d,j,m,s,e,r,i,c,x,n,l,u,t,p. and then delete the keys in the reverse order of arrival.
- 14 Demonstrate the insertion of the key (1,2,3,4,8,7,6,5,9,10,11,12,16,15,14,13) in a B-tree of order 5
- 15 Write a C function to evaluate an expression tree.
- 16 Given a set of input representing the nodes of a binary tree, write a nonrecursive algorithm that must be able to output the three traversal orders. Write an algorithm for checking validity of the input, i.e., the program must know if the input is disjoint, duplicated and has a loop.
- 17 What is a Binary Search Tree (BST)? Make a BST for the following sequence of numbers.  
45, 36, 76, 23, 89, 115, 98, 39, 41, 56, 69, 48  
Traverse the tree in Preorder, Inorder and postorder.
- 18 Discuss the representation and working of a threaded binary tree with the help of an example.
- 19 What is advantage of a Threaded tree over a simple BST? What is the overhead?
- 20 Write pseudo code / algorithm steps for Kruskal's algorithm for finding out minimum spanning tree.
- 21 Discuss the utility of multi way search trees in general. Explain degree and order of a B-tree. Illustrate insertion and deletion into a B-tree with the help of an example and hence explain splitting and merging of nodes
- 22 Name any two  $O(\log_2 n)$  searching algorithms and explain.

### UNIT - III

#### I Test Your Skills:

##### (a) State Whether the Following Statements are True or False:

- 1 Weighting Rule for opinion (i,j). If the number of nodes in tree I is less than the number in tree j, then make j the parent of i, otherwise make i the parent of i.
- 2 Warshall's Algorithm: A directed graph G with M nodes is maintained in memory by its adjacency matrix A. This algorithm finds the boolean path matrix P of the graph G.
- 3 The path matrix P tells us whether or not there are paths between the nodes.
- 4 Sorting refers to the operation of finding the location of a given item in a collection of items.
- 5 Data modification refers to the operation of inserting deleting and updating.
- 6 Flasing is a scarcuing technique.
- 7 The main disadvantage of linear probing method is that records tend to cluster.
- 8 Running time for both Prim's and Kruskal's is same.
- 9 For a dense graph, adjacency list representation is preferred.
- 10 A predecessor subgraph produced by DFS may be composed of several trees.
- 11 Time complexity for Floyd-Warshall algorithm is  $\theta(n^3)$ .

12 For finding out strongly connected components of a graph, we don't need to calculate transpose of graph.

Ans. (1)(F), (2)(T), (3)(T), (4)(F), (5)(F), (6)(T), (7)(T), (8)(T), (9)(F), (10)(T), (11)(T), (12)(F)

**(b) Multiple Choice Questions:**

1 The way a card game player arranges his cards as he picks them up one by one, is an example of:

- (a) Bubble sort
- (b) Selection sort
- (c) Insertion sort
- (d) Merge sort

2 We want to check whether a given set of items is sorted or not. Which of the following sorting method will be the most efficient if it is already in sorted order?

- (a) Bubble sort
- (b) Selection sort
- (c) Insertion sort
- (d) Merge sort

3 The average number of comparisons performed by the merge sort algorithm, in merging two sorted lists of length 2 is

- (a)  $8/3$
- (b)  $8/5$
- (c)  $11/7$
- (d)  $11/6$

4 Which of the following sorting method will be the best if number of swapping done, is the only measure of efficiency?

- (a) Bubble sort
- (b) Selection sort
- (c) Insertion sort
- (d) Merge sort

5 We are asked to sort 15 randomly. We should prefer

- (a) Bubble sort
- (b) Selection sort
- (c) Insertion sort
- (d) Merge sort

6 The order of binary search algorithm is

- (a)  $\log n$
- (b)  $N \log n$
- (c)  $N$
- (d) None of the above

- 7 The average successful search time taken by binary search on a sorted array of 10 items is  
(a) 2.6  
(b) 2.7  
(c) 2.8  
(d) 2.9
- 8 The average successful search time for sequential search on 'n' items is  
(a)  $n/2$   
(b)  $(n-1)/2$   
(c)  $(n+1)/2$   
(d)  $\text{Log}(n) + 1$
- 9 Which of the following algorithms solves the all-pair shortest path problem?  
(a) Floyd's algorithm  
(b) Dijkstra's algorithm  
(c) Prim's algorithm  
(d) Warshall's algorithm
- 10 In a graph if  $e = [u, v]$ , Then u and v are called  
(a) endpoints of e  
(b) adjacent nodes  
(c) neighbors  
(d) all of above
- 11 A connected graph T without any cycles is called  
(a) a tree graph  
(b) free tree  
(c) a tree  
(d) All of above
- 12 In a graph if  $e = (u, v)$  means  
(a) u is adjacent to v but v is not adjacent to u  
(b) e begins at u and ends at v  
(c) u is processor and v is successor  
(d) both b and c
- 13 If every node u in G is adjacent to every other node v in G, A graph is said to be  
(a) isolated  
(b) complete  
(c) finite  
(d) strongly connected
- 14 A directed graph is ..... if there is a path from each vertex to every other vertex in the digraph.  
(a) Weakly connected



- (b) Strongly Connected
  - (c) Tightly Connected
  - (d) Linearly Connected
- 15 A ..... is a graph that has weights of costs associated with its edges.
- (a) Network
  - (b) Weighted graph
  - (c) Both A and B
  - (d) None A and B
- 16 A graph is said to be ..... if the vertices can be split into two sets V1 and V2 Such that there are no edges between two vertices of V1 or two vertices of V2.
- (a) Partite
  - (b) Bipartite
  - (c) Rooted
  - (d) Bisects
- 17 The quick sort algorithm exploits \_\_\_\_\_ design technique
- (a) Greedy
  - (b) Dynamic programming
  - (c) Divide and Conquer
  - (d) Backtracking
- 18 The minimum number of multiplications and additions required to evaluate the polynomial  
 $P = 4x^3 + 3x^2 - 15x + 45$  is
- (a) 6 & 3
  - (b) 4 & 2
  - (c) 3 & 3
  - (d) 8 & 3
- 19 The maximum degree of any vertex in a simple graph with n vertices is
- (a)  $n-1$
  - (b)  $n+1$
  - (c)  $2n-1$
  - (d)  $n$
- 20 A graph with n vertices will definitely have a parallel edge or self loop of the total number of edges are
- (a) More than n
  - (b) More than  $n+1$
  - (c) More than  $(n+1)/2$
  - (d) More than  $n(n-1)/2$

- 21 In a circular linked list
- Components are all linked together in some sequential manner.
  - There is no beginning and no end.
  - Components are arranged hierarchically.
  - Forward and backward traversal within the list is permitted.
- 22 An undirected graph  $G$  with  $n$  vertices and  $e$  edges is represented by adjacency list. What is the time required to generate all the connected components?
- $O(n)$
  - $O(e)$
  - $O(e+n)$
  - $O(2)$
- 23 Consider a linked list of  $n$  elements. What is the time taken to insert an element after an element pointed by some pointer?
- $O(1)$
  - $O(\log_2 n)$
  - $O(n)$
  - $O(n \log_2 n)$
- 24 Which of the following sorting algorithms does not have a worst case running time of  $O(n^2)$ ?
- Insertion sort
  - Merge sort
  - Quick sort
  - Bubble sort
- 25 A sort which relatively passes through a list to exchange the first element with any element less than it and then repeats with a new first element is called
- Insertion sort.
  - Selection sort.
  - Heap sort.
  - Quick sort.
- 26 A full binary tree with  $n$  leaves contains
- $n$  nodes.
  - $\log_2 n$  nodes.
  - $2n - 1$  nodes.
  - $n^2$  nodes.
- 27 What is the postfix form of the following prefix expression  $-A/B*C$DE$
- ABCDE\$\*/-
  - A-BCDE\$\*/-
  - ABC\$ED\$\*/-
  - A-BCDE\$\*/

- 28 A binary tree in which if all its levels except possibly the last, have the maximum number of nodes and all the nodes at the last level appear as far left as possible, is known as
- (a) Full binary tree.
  - (b) AVL tree.
  - (c) Threaded tree.
  - (d) Complete binary tree.
- 29 If a node in a BST has two children, then its inorder predecessor has
- (a) No left child
  - (b) No right child
  - (c) Two children
  - (d) No child
- 30 A full binary tree with  $2n+1$  nodes contain
- (a)  $n$  leaf nodes
  - (b)  $n$  non-leaf nodes
  - (c)  $n-1$  leaf nodes
  - (d)  $n-1$  non-leaf nodes
- 31 An undirected graph  $G$  with  $n$  vertices and  $e$  edges is represented by adjacency list. What is the time required to generate all the connected components?
- (a)  $O(n)$
  - (b)  $O(e)$
  - (c)  $O(e+n)$
  - (d)  $O(2)$
- 32 The total number of comparisons required to merge 4 sorted files containing 15, 3, 9 and 8 records into a single sorted file is
- (a) 66
  - (b) 39
  - (c) 15
  - (d) 33
- 33 Which of the following sorting methods would be most suitable for sorting a list which is almost sorted?
- (a) Bubble Sort
  - (b) Insertion Sort
  - (c) Selection Sort
  - (d) Quick Sort
- 34 If  $h$  is any hashing function and is used to hash  $n$  keys in to a table of size  $m$ , where  $n \leq m$ , the expected number of collisions involving a particular key  $x$  is :
- (a) less than 1.
  - (b) less than  $n$ .
  - (c) less than  $m$ .
  - (d) less than  $n/2$ .

- 35 An adjacency matrix representation of a graph cannot contain information of :
- nodes
  - edges
  - direction of edges
  - parallel edges
- 36 An ADT is defined to be a mathematical model of a user-defined type along with the collection of all \_\_\_\_\_ operations on that model.
- Cardinality
  - Assignment
  - Primitive
  - Structured
- 37 An algorithm is made up of two independent time complexities  $f(n)$  and  $g(n)$ . Then the complexities of the algorithm is in the order of
- $f(n) \times g(n)$
  - $\text{Max} ( f(n),g(n))$
  - $\text{Min} (f(n),g(n))$
  - $f(n) + g(n)$
- 38 The goal of hashing is to produce a search that takes
- $O(1)$  time
  - $O(n^2)$  time
  - $O(\log n)$  time
  - $O(n \log n)$  time
- 39 The best average behaviour is shown by
- Quick Sort
  - Merge Sort
  - Insertion Sort
  - Heap Sort
- 40 Quick sort is also known as
- merge sort
  - heap sort
  - bubble sort
  - none of these
- 41 The number of elements that can be sorted in  $\Theta(\log n)$  time using heap sort is
- $\Theta(1)$
  - $\Theta(\sqrt{\log n})$
  - $\Theta(\log n / (\log \log n))$
  - $\Theta(\log n)$
- 42 Which of the following statements is/are TRUE for an undirected graph?  
P: Number of odd degree vertices is even  
Q: Sum of degrees of all vertices is even

- (a) P Only
  - (b) Q Only
  - (c) Both P and Q
  - (d) Neither P nor Q
- 43 Consider an undirected random graph of eight vertices. The probability that there is an Edge between a pair of vertices is  $1/2$ . What is the expected number of unordered cycles of length three
- (a)  $1/8$
  - (b) 1
  - (c) 7
  - (d) 8
- 44 What is the time complexity of Floyd–Warshall algorithm to calculate all pair shortest path in a graph with  $n$  vertices?
- (a)  $O(n^2 \log n)$
  - (b)  $\Theta(n^2 \log n)$
  - (c)  $\Theta(n^4)$
  - (d)  $\Theta(n^3)$
- 45 Which of the following is an advantage of adjacency list representation over adjacency matrix representation of a graph?
- (a) In adjacency list representation, space is saved for sparse graphs.
  - (b) DFS and BSF can be done in  $O(V + E)$  time for adjacency list representation. These operations take  $O(V^2)$  time in adjacency list representation. Here is  $V$  and  $E$  are number of vertices and edges respectively.
  - (c) Adding a vertex in adjacency list representation is easier than adjacency matrix representation.
  - (d) All of the above
- 46 The time complexity of computing the transitive closure of a binary relation on a set of  $n$  elements is known to be:
- (a)  $O(n)$
  - (b)  $O(n \log n)$
  - (c)  $O(n^{3/2})$
  - (d)  $O(n^3)$
- 47 How many undirected graphs (not necessarily connected) can be constructed out of a given set  $V = \{V_1, V_2, \dots, V_n\}$  of  $n$  vertices ?
- (a)  $n(n-1)/2$
  - (b)  $2^n$
  - (c)  $n!$
  - (d)  $2^{n(n-1)/2}$

- 48 Suppose we have a  $O(n)$  time algorithm that finds median of an unsorted array. Now consider a QuickSort implementation where we first find median using the above algorithm, then use median as pivot. What will be the worst case time complexity of this modified QuickSort.
- $O(n^2 \text{ Log}n)$
  - $O(n^2)$
  - $O(n \text{ Log}n \text{ Log}n)$
  - $O(n \text{ Log}n)$
- 49 Which of the following is not a stable sorting algorithm in its typical implementation.
- Insertion Sort
  - Merge Sort
  - Quick Sort
  - Bubble Sort
- 50 Given a sorted array of integers, what can be the minimum worst case time complexity to find ceiling of a number  $x$  in given array? Ceiling of an element  $x$  is the smallest element present in array which is greater than or equal to  $x$ . Ceiling is not present if  $x$  is greater than the maximum element present in array. For example, if the given array is  $\{12, 67, 90, 100, 300, 399\}$  and  $x = 95$ , then output should be 100.
- $O(\text{Log} \text{Log}n)$
  - $O(n)$
  - $O(\text{Log}n)$
  - $O(\text{Log}n * \text{Log}n)$
- 51 In a graph if  $e=[u, v]$ , Then  $u$  and  $v$  are called
- endpoints of  $e$
  - adjacent nodes
  - neighbors
  - all of above
- 52 A connected graph  $T$  without any cycles is called
- a tree graph
  - free tree
  - a tree
  - All of above
- 53 In a graph if  $e=(u, v)$  means
- $u$  is adjacent to  $v$  but  $v$  is not adjacent to  $u$
  - $e$  begins at  $u$  and ends at  $v$
  - $u$  is processor and  $v$  is successor
  - both b and c
- 54 If every node  $u$  in  $G$  is adjacent to every other node  $v$  in  $G$ , A graph is said to be
- isolated
  - complete
  - finite

- (d) strongly connected
- 55 In a graph if  $e=(u,v)$  means .....
- u is adjacent to v but v is not adjacent to u.
  - e begins at u and ends at v
  - u is node and v is an edge.
  - both u and v are edges.
- 56 A binary tree whose every node has either zero or two children is called .....
- Complete binary tree
  - Binary Search tree
  - Extended binary tree
  - E2 tree
- 57 If every node u in G is adjacent to every other node v in G, A graph is said to be .....
- isolated
  - complete
  - finite
  - strongly connected.
- 58 The post order traversal of a binary tree is DEBFCA. Find out the pre order Traversal.
- ABFCDE
  - ADBFEC
  - ABDECF
  - ABDCEF
- 59 In a graph if  $e=[u,v]$ , then u and v are called
- endpoints of e
  - adjacent nodes
  - neighbours
  - all of the above
- 60 In-order traversing a tree resulted E A C K F H D B G; the pre-order traversal would return.
- FAEKCDHBG
  - FAEKCDHGB
  - EAFKHDCBG
  - FEAKDCHBG

**Ans.** (1)(c), (2)(c), (3)(a), (4)(b), (5)(a), (6)(a), (7)(d), (8)(c), (9)(a), (10)(d), (11)(d), (12)(d), (13)(b), (14)(b), (15)(c), (16)(b), (17)(c), (18)(c), (19)(b), (20)(d), (21)(b), (22)(c), (23)(b), (24)(b), (25)(d), (26)(c), (27)(a), (28)(a), (29)(b), (30)(b), (31)(c), (32)(d), (33)(a), (34)(a), (35)(d), (36)(c), (37)(b), (38)(a), (39)(a), (40)(d), (41)(c), (42)(c), (43)(c), (44)(d), (45)(d), (46)(d), (47)(d), (48)(d), (49)(c), (50)(c), (51)(d), (52)(d), (53)(d), (54)(b), (55)(b), (56)(c), (57)(b), (58)(c), (59)(d), (60)(b).

**(c) Fill in the Blanks:**

- 1 As a part of the maintenance work, you are entrusted with the work of rearranging the library books in a shelf in proper order, at the end of the day. The ideal choice would be.....sort
- 2 The maximum number of comparisons needed to sort 7 items using radix sort is.....(assume each item is a 4 digit decimal number)
- 3 .....sorting algorithm has the worst time complexity of  $n \log n$
- 4 .....sorting method sorts a given set of items that is already in order or reverse order with equal speed
- 5 The number of swapping needed to sort the numbers 8,22,7,9,31,195,13 in ascending order, using bubble sort is .....
- 6 .....algorithm for finding minimum spanning tree excludes cycles.
- 7 The running time for Prim's algorithm is.....
- 8 .....algorithm discovers all vertices at distance 'k' from source before discovering any vertices at distance k+1.
- 9 Every vertex in DFS is blackened when it is .....
- 10 A .....of a directed acyclic graph is a linear ordering of all its vertices.

Ans. (1)(Insertion sort), (2)(280), (3)(Heap sort), (4)(Quick sort), (5)(14), (6) (Kruskal's), (7) (O (E lg V)), (8) (BFS), (9) (finished), (10) (topological sorting)

**II Short Answer Type Questions:**

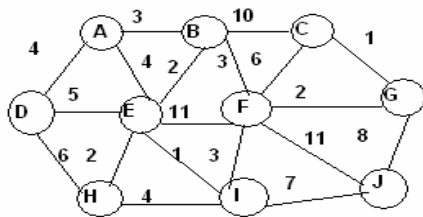
- 1 What is meant by sorting?
- 2 Mention the preliminaries of sorting.
- 3 What are the types of sorting?
- 4 What is the difference between bubble sort and selection sort?
- 5 Give example for insertion sort.
- 6 Mention the Running time for insertion sort.
- 7 What is meant by heap sort?
- 8 What is meant by Quick sort?
- 9 What is the advantage of Quick sort over Merge sort?
- 10 Mention the Best case n worst care of the quick sort.
- 11 What is meant by external sorting?
- 12 Determine the average running time of quick sort.
- 13 What is the principle of radix sort?
- 14 What is insertion sort?
- 15 What is shell sort?
- 16 Define the worst case analysis of shell sort
- 17 What is merge sort?
- 18 What is meant by external sorting?
- 19 What is multiway merge?
- 20 Sort the sequence 3, 1, 4,7,5,9,2,6,5 using Insertion sort.
- 21 Explain the operation and implementation of Insertion sort and shell sort.
- 22 Explain the operation and implementation of merge sort.
- 23 Explain the operation and implementation of external sorting.



- 24 Write quick sort algorithm and explain.
- 25 Differentiate between TRAVERSING, SEARCHING, AND SORTING.
- 26 Define Graph.
- 27 What is meant by directed graph?
- 28 Give a diagrammatic representation of an adjacency list representation of a graph.
- 29 What is meant by topological sort?
- 30 What is meant by acyclic graph?
- 31 What is meant by Shortest Path Algorithm?
- 32 What is meant by Single-Source Shortest path problem?
- 33 What is minimum spanning tree?
- 34 Mention the types of algorithm.
- 35 What is space requirement of an adjacency list representation of a graph
- 36 What is breadth-first search?
- 37 Define undirected graph
- 38 What is depth-first spanning tree
- 39 What is Euler Circuit?
- 40 What is a directed graph?
- 41 What is meant by 'Hamiltonian Cycle'?
- 42 Define: (i) indegree (ii) outdegree
- 43 Explain the application of DFS.
- 44 Mention two techniques for Internal and External Sorting.
- 45 Define Hashing.
- 46 Define Double Hashing.
- 47 Explain Floyd Technique to calculate shortest path.
- 48 Give Warshall's Algorithm for shortest path.
- 49 Explain the implementation of different Hashing techniques.
- 50 Explain the concept of chaining.
- 51 Open addressing hash table using quadratic probing (refer to Q 3)
- 52 Open addressing hash table with second hash function  $h_2(X) = 7(X \bmod 7)$ . (refer to Q 3)
- 53 Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function  $h(X) = X \bmod 10$ , show the resulting: Separate chaining table.
- 54 How can we find strongly connected components in a graph?
- 55 What do you mean by complete graph?
- 56 What is sorting and how is sorting essential for data base applications?
- 57 Explain the working of Tree Sort ?
- 58 Difference between tree and graph?
- 59 Write a C program to add an edge to an undirected graph. The input provided to the program is the labels of the starting and the ending node of the edge.
- 60 Give the average case time complexities of the following sorting algorithms. Also state the situation when these algorithms are not suitable to be used:
- Quick Sort
  - Merge Sort
  - Radix Sort
  - Bubble Sort

## II Long Answer Type Questions:

- 1 Trace the steps of insertion sort – 12,19,33,26,29,35,22. Find the total number of comparison made
- 2 Trace the quick sort algorithm for the following list of numbers: 90,77,60,99,55,88,66.
- 3 Write down the merge sort algorithm and give its worst case, best case and average case analysis.
- 4 Show how heap sort processes the input:  
142,543,123,65,453,879,572,434,111,242,811,102.
- 5 Sort the sequence 3, 1, 4,7,5,9,2,6,5 using Insertion sort.
- 6 Explain the operation and implementation of Insertion sort and shell sort.
- 7 Explain the operation and implementation of merge sort.
- 8 Explain the operation and implementation of external sorting.
- 9 Write quick sort algorithm and explain.
- 10 Describe the algorithm of Bubble sort. Trace it using following number: 25, 57, 48, 37, and 72.
- 14 Explain Prim's &Kruskal's Algorithm with an example.
- 15 Describe Dijkstra's algorithm with an example.
- 16 Explain how to find shortest path using Dijkstra's algorithm with an example.
- 17 Explain in detail the simple topological sort pseudocode.
- 18 Write notes on NP-complete problems
- 19 Find a minimum spanning tree for the graph using both Prim's and Kruskal's algorithms.

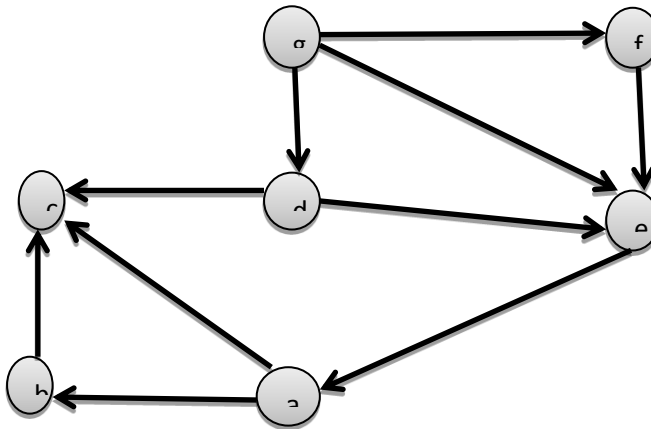


- 20 Write kruskal's Algorithm and give its analysis.
- 21 Compare Dijkstra's and Floyd warshall's algorithm.
- 22 Compare the following with suitable example
  - (a) K-way merge sort
  - (b) Balanced merge sort
  - (c) Polyphase merge sort
- 23 Give an example to illustrate graph coloring and its applications.
- 24 Give an example to illustrate topological sort.
- 25 Compare the following:
  - (a) Radix sort
  - (b) Shell sort
  - (c) Selection sort
- 26 consider the list:  
50, 40, 20, 60, 80, 35, 90, 45  
Sort the given list using quick sort. Give sequence of steps also.
- 27 Explain the implementation of different Hashing techniques.
- 28 Compare Warshall's basic algorithm with its modified version.

- 29 Sort the sequence 4, 8, 11, 6, 2, 1, 15, 26, 3 using insertion sort. What is the running time of insertion sort if all keys are equal?
- 30 Show how heap sort processes the input – 85, 500, 300, 250, 186, 225, 175.
- 31 Write the algorithm to find a maximum cost spanning tree. Is this harder than finding a minimum cost spanning tree?
- 32 Write a program to count the number of nodes of a graph?
- 33 What is topological sorting of a graph? Show the working of the topological sorting algorithm ( clearly stating the output after each pass) for the graph whose adjacency matrix is given below:

|   |   |   |   |   |
|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 0 | 0 |

- 34 Compare Dijkstra's and Floyd Warshall's algorithm.
- 35 Demonstrate Topological Sorting on the following graph:-



- 36 How many collisions occur if the hash addresses are generated using the modulo division method, if the size of table is 1000?
- 37 Insert the following keys in an array of size 17 using the modulo division method. Use quadratic probing to resolve collisions: 94, 38, 67,22,34,102,63,115.
- 38 What are the different factors for resolving Collisions?
- 39 What do you mean by analysis binary tree sort? What is the use of pivot element in Quick Sort. Describe it with example?
- 40 Design an algorithm that finds cycles in a graph.
- 41 Suggest a low computation algorithm that finds a number lying between 1 to 700.

## UNIT – IV

### I Test Your Skills:

#### (a) State Whether the Following Statements are True or False:

- 1 A file is a collection of records where each record consists of one or more fields.
- 2 A combination of key values specified for retrieval will be termed a query.
- 3 The mode of retrieval in query tuples may be either real time or batched.
- 4 A directory is a collection of indexes.
- 5 The simplest type of index organization is the cylinder-surface index.
- 6 The principles involved in maintaining hash indexes are not same as those for hash tables.
- 7 If the index has N entries then a B-tree of order  $m=N+1$  would have only one level.
- 8 In trie Indexing, the trie contains two type of nodes, the first type is called a branch node and the second an information node.
- 9 In trie indexing, a blank is used to terminate a key value.
- 10 Insertion into a trie is not straight forward.

Ans. (1)(T), (2)(T), (3)(T), (4)(T), (5)(T), (6)(F), (7)(T), (8)(T), (9)(T), (10)(F)

#### (b) Multiple Choice Questions:

- 1 Which of the following remarks about Trie Indexing are true?
  - (a) It is an m-ary tree
  - (b) It is a search tree of order m
  - (c) Unsuccessful searches may terminate at any level of the tree structure
  - (d) All the above
- 2 Which of the following remarks about Trie Indexing are true?
  - (a) It is efficient in dealing with strings of variable leng. It is efficient if there are few number of data items
  - (b) It can handle insertions and deletions dynamically and efficiently
  - (c) All the above
- 3 A hash function f defined as  $f(\text{key})=\text{key} \bmod 7$ , with linear probing, is used to insert the keys 37, 38, 72, 48, 98, 11, 56, into a table indexed from 0 to 6.11 will be sorted in the location:
  - (a) 3
  - (b) 4
  - (c) 5
  - (d) 6
- 4 6 files F1,F2,F3,F4,F5 and F6 have 100,200,50,80,120,150 number of records respectively. In what order should they be sorted so as to optimize access time. Assume each file is accessed with the same frequency.
  - (a) F3,F4,F1,F5,F6,F2

- (b) F2,F6,F5,F1,F4,F3  
 (c) F1,F2,F3,F4,F5,F6  
 (d) Ordering is immaterial as all files are accessed with the same frequency
- 5 In the above question average access time will be  
 (a) 268 units  
 (b) 256 units  
 (c) 293 units  
 (d) 210 units
- 6 A chained hash table has an array size of 512. What is the maximum number of entries that can be placed in the table?  
 (a) 256  
 (b) 511  
 (c) 512  
 (d) 1024  
 (e) There is no maximum.
- 7 What is the best definition of a collision in a hash table?  
 (a) Two entries are identical except for their keys.  
 (b) Two entries with different data have the exact same key.  
 (c) Two entries with different keys have the same exact hash value.  
 (d) Two entries with the exact same key have different hash values.
- 8 The memory address of fifth element of an array can be calculated by the formula  
 (a)  $LOC(\text{Array}[i]) = \text{Base}(\text{Array}) + w(i - \text{lower bound})$ , where  $w$  is the number of words per memory cell for the array  
 (b)  $LOC(\text{Array}[i]) = \text{Base}(\text{Array}[i]) + (i - \text{lower bound})$ , where  $w$  is the number of words per memory cell for the array  
 (c)  $LOC(\text{Array}[i]) = \text{Base}(\text{Array}[i]) + (i - \text{Upper bound})$ , where  $w$  is the number of words per memory cell for the array  
 (d) None of above
- 9 If  $h$  is any hashing function and is used to hash  $n$  keys in to a table of size  $m$ , where  $n \leq m$ , the expected number of collisions involving a particular key  $x$  is :  
 (a) less than 1.  
 (b) less than  $n$ .  
 (c) less than  $m$ .  
 (d) less than  $n/2$ .
- 10 Let  $A$  be an adjacency matrix of a graph  $G$ . The  $t_{ij}$  entry in the matrix  $K A$ , gives  
 (a) The number of paths of length  $K$  from vertex  $V_i$  to vertex  $V_j$ .  
 (b) Shortest path of  $K$  edges from vertex  $V_i$  to vertex  $V_j$ .  
 (c) Length of a Eulerian path from vertex  $V_i$  to vertex  $V_j$ .  
 (d) Length of a Hamiltonian cycle from vertex  $V_i$  to vertex  $V_j$ .

- 11 The OS of a computer may periodically collect all the free memory space to form contiguous block of free space. This is called
- (a) Concatenation
  - (b) Garbage collection
  - (c) Collision
  - (d) Dynamic Memory Allocation
- 12 We need to sort a list L consisting of a sorted list followed by a few “random” elements. Which of the following sorting methods would be especially suitable for such a task?
- (a) Bubble sort
  - (b) Selection sort
  - (c) Quick sort
  - (d) Insertion sort
- 13 The complexity of multiplying two matrices of order  $m*n$  and  $n*p$  is
- (a)  $mnp$
  - (b)  $mp$
  - (c)  $mn$
  - (d)  $np$
- 14 Which of the following statement is false?
- (a) Arrays are dense lists and static data structure
  - (b) Data elements in linked list need not be stored in adjacent space in memory
  - (c) Pointers store the next data element of a list
  - (d) Linked lists are collection of the nodes that contain information part and next pointer
- 15 Which of the following is two way list?
- (a) Grounded header list
  - (b) Circular header list
  - (c) Linked list with header and trailer nodes
  - (d) None of above
- 16 The difference between linear array and a record is
- (a) An array is suitable for homogeneous data but the data items in a record may have different data type
  - (b) In a record, there may not be a natural ordering in opposed to linear array.
  - (c) A record form a hierarchical structure but a linear array does not
  - (d) All of above
- 17 Each data item in a record may be a group item composed of sub-items; those items which are indecomposable are called
- (a) Elementary items
  - (b) Atoms
  - (c) Scalars
  - (d) All of above

- 18 Which of the following is not a limitation of binary search algorithm?
- Must use a sorted array
  - Requirement of sorted array is expensive when a lot of insertion and deletions are needed
  - There must be a mechanism to access middle element directly
  - Binary search algorithm is not efficient when the data elements are more than 000.
- 19 For an undirected graph G with n vertices and e edges, the sum of the degrees of each vertex is
- ne
  - 2n
  - 2e
  - n
- 20 The result of evaluating the postfix expression 5, 4, 6, +, \*, 4, 9, 3, /, +, \* is
- 600.
  - 350.
  - 650.
  - 588.
- 21 Ackerman's function is defined on the non-negative integers as follows  
 $a(m, n) = n + 1$  if  $m = 0$   
 $= a(m - 1, 1)$  if  $m \neq 0, n = 0$   
 $= a(m - 1, a(m, n - 1))$  if  $m \neq 0, n \neq 0$   
 The value of  $a(1, 3)$  is
- 4.
  - 5.
  - 6.
  - 7.
- 22 In binary search, average number of comparison required for searching an element in a list if n numbers is
- $\log_2 n$ .
  - $n / 2$ .
  - n.
  - $n - 1$ .
- 23 What is the result of the following operation?  
 Top (Push (S, X))
- X
  - null
  - S
  - None of these.

- 24 A characteristic of the data that binary search uses but the linear search ignores is the \_\_\_\_\_.
- (a) Order of the elements of the list.
  - (b) Length of the list.
  - (c) Maximum value in list.
  - (d) Type of elements of the list.
- 25 The extra key inserted at the end of the array is called a,
- (a) End key.
  - (b) Stop key.
  - (c) Sentinel.
  - (d) Transposition.
- 26 Which of the following operations is performed more efficiently by doubly linked list than by singly linked list?
- (a) Deleting a node whose location is given
  - (b) Searching of an unsorted list for a given item
  - (c) Inverting a node after the node with given location
  - (d) Traversing a list to process each node
- 27 Which data structure is needed to convert infix notation to postfix notation?
- (a) Branch
  - (b) Queue
  - (c) Tree
  - (d) Stack
- 28 Which of the following is not the required condition for binary search algorithm?
- (a) The list must be sorted
  - (b) There should be the direct access to the middle element in any sub list
  - (c) There must be mechanism to delete and/or insert elements in list
  - (d) None of above
- 29 The elements of an array are stored successively in memory cells because
- (a) By this way computer can keep track only the address of the first element and the addresses of other elements can be calculated
  - (b) The architecture of computer memory does not allow arrays to store other than serially
  - (c) Both of above
  - (d) None of above
- 30 The indirect change of the values of a variable in one module by another module is called
- (a) Internal change
  - (b) Inter-module change
  - (c) Side effect
  - (d) Side-module update



- 31 A machine needs a minimum of 100 sec to sort 1000 names by quick sort. The minimum time needed to sort 100 names will be approximately?
- (a) 50.2 sec
  - (b) 6.7 sec
  - (c) 72.7 sec
  - (d) 11.2 sec
- 32 The average search time of hashing with linear probing will be less if the load factor?
- (a) is far less than one
  - (b) equals one
  - (c) is far greater than one
  - (d) none of above
- 33 A unit of storage that can store one or more records in a hash file organization is denoted as
- (a) Buckets
  - (b) Disk pages
  - (c) Blocks
  - (d) Nodes
- 34 The file organization which allows us to read records that would satisfy the join condition by using one block read is
- (a) Heap file organization
  - (b) Sequential file organization
  - (c) Clustering file organization
  - (d) Hash file organization
- 35 Which of the following algorithm solves the all pair shortest path problem?
- (a) Dijkstra's algorithm
  - (b) Floyd's algorithm
  - (c) Prim's algorithm
  - (d) Warshall's algorithm
- 36 A self contained block of statements that perform a coherent task of some kind is called a?
- (a) Monitor
  - (b) Function
  - (c) Program
  - (d) Structure
- 37 Length of the linear array can be found by using the formula?
- (a)  $UB - LB + 1$
  - (b)  $LB + UB$
  - (c)  $LB - UB$
  - (d)  $LB - UB + 1$

- 38 The number of binary trees with 3 nodes which when traversed in post order gives the sequence A, B, C is?
- (a) 3
  - (b) 9
  - (c) 7
  - (d) 5
- 39 Sparse matrices have?
- (a) many zero entries
  - (b) many non- zero entries
  - (c) higher dimension
  - (d) none of above
- 40 As part of maintenance work, the users are entrusted with the work of rearranging the library books in a shelf in proper order, at the end of each day. The ideal choice will be?
- (a) Bubble sort
  - (b) Insertion sort
  - (c) Selection sort
  - (d) Heap sort
- 41 Let A be a square matrix of size  $n \times n$ . Consider the following program. What is the expected output?
- ```

C = 100
fori = 1 to n do
  forj = 1 to n do
    {
      Temp = A[i][j] + C
      A[i][j] = A[j][i]
      A[j][i] = Temp - C
    }
  }
fori = 1 to n do
  forj = 1 to n do
    Output(A[i][j]);

```
- 42 You have an array of  $n$  elements. Suppose you implement quick sort by always choosing the central element of the array as the pivot. Then the tightest upper bound for the worst case performance is
- (a)  $O(n^2)$
  - (b)  $O(n \log n)$
  - (c)  $\Theta(n \log n)$
  - (d)  $O(n^3)$
- 44 We are given a set of  $n$  distinct elements and an unlabeled binary tree with  $n$  nodes. In how many ways can we populate the tree with the given set so that it becomes a binary search tree?
- (a) 0
  - (b) 1
  - (c)  $n!$
  - (d)  $(1/(n+1)) \cdot 2n C_n$

- 45 How many distinct binary search trees can be created out of 4 distinct keys
- (a) 5
  - (b) 14
  - (c) 24
  - (d) 42
- 46 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
- 47 A data buffer is
- (a) Region of external memory
  - (b) Region of a physical memory storage used to temporarily store data while it is being moved from one place to another.
  - (c) Region of secondary memory
  - (d) None of these
- 48 Which of the following regarding block size is correct
- (a) size of available main memory
  - (b) space reserved for programs (and their internal data space) that use the files
  - (c) size of one component of the block
  - (d) characteristics of the external storage device used
  - (e) All of the above
- 49 Which of the following regarding buffering is true
- (a) Software interface that reconciles blocked components of the file
  - (b) Buffering interface is of one of two types: blocking routine or de-blocking routine
  - (c) Depends on characteristics of the external storage device used
  - (d) None of the above
  - (e) All of the above
- 50 The advantages of sequential file organization are
- (a) Easier to organize and maintain
  - (b) No sorting is required
  - (c) Faster updation
  - (d) Access of records is fast if indexing is done.
- 51 The memory address of the first element of an array is called
- (a) floor address
  - (b) foundation address
  - (c) first address
  - (d) base address

- 52 The memory address of fifth element of an array can be calculated by the formula
- (a)  $LOC(Array[5]) = Base(Array) + w(5 - \text{lower bound})$ , where  $w$  is the number of words per memory cell for the array
  - (b)  $LOC(Array[5]) = Base(Array[5]) + (5 - \text{lower bound})$ , where  $w$  is the number of words per memory cell for the array
  - (c)  $LOC(Array[5]) = Base(Array[4]) + (5 - \text{Upper bound})$ , where  $w$  is the number of words per memory cell for the array
  - (d) None of above
- 53 Which of the following data structures are indexed structures?
- (a) linear arrays
  - (b) linked lists
  - (c) both of above
  - (d) none of above
- 54 Which of the following is not the required condition for binary search algorithm?
- (a) The list must be sorted
  - (b) there should be the direct access to the middle element in any sublist
  - (c) There must be mechanism to delete and/or insert elements in list
  - (d) none of above
- 55 Which of the following is not a limitation of binary search algorithm?
- (a) must use a sorted array
  - (b) requirement of sorted array is expensive when a lot of insertion and deletions are needed
  - (c) there must be a mechanism to access middle element directly
  - (d) binary search algorithm is not efficient when the data elements are more than 1000.
- 56 Two dimensional arrays are also called
- (a) tables arrays
  - (b) matrix arrays
  - (c) both of above
  - (d) none of above
- 57 A variable  $P$  is called pointer if
- (a)  $P$  contains the address of an element in  $DATA$ .
  - (b)  $P$  points to the address of first element in  $DATA$
  - (c)  $P$  can store only memory addresses
  - (d)  $P$  contain the  $DATA$  and the address of  $DATA$
- 58 Which of the following data structure can't store the non-homogeneous data elements?
- (a) Arrays
  - (b) Records
  - (c) Pointers

(d) None

59 Which of the following data structure store the homogeneous data elements?

- (a) Arrays
- (b) Records
- (c) Pointers
- (d) None

60 Each data item in a record may be a group item composed of sub-items; those items which are indecomposable are called

- (a) elementary items
- (b) atoms
- (c) scalars
- (d) all of above

Ans. (1)(d), (2)(d), (3)(c), (4)(a), (5)(b), (6)(d), (7)(c), (8)(a), (9)(a), (10)(b), (11)(b), (12)(d), (13)(a), (14)(c), (15)(d), (16)(d), (17)(d), (18)(d), (19)(c), (20)(b), (21)(b), (22)(a), (23)(a), (24)(a), (25)(c), (26)(a), (27)(d), (28)(c), (29)(a), (30)(c), (31)(b), (32)(a), (33)(a), (34)(c), (35)(b), 36(b), (37)(b), (38)(b), (39)(a), (40)(b), (41)(a), (42)(a), (43)(a), (44)(d), (45)(c), (46)(b), (47)(b), (48)(e), (49)(e), (50)(a), (51)(d), (52)(a), (53)(a), (54)(c), (55)(d), (56)(c), (57)(a), (58)(a), (59)(b), (60)(d).

(c) **Fill in the Blanks:**

- 1 For secondary key processing .....file organization is preferred.
- 2 The average search time of hashing, with linear probing will be less if the load factor is far.....than one.
- 3 a hash table can store a maximum of 10 records. Currently there are records in location 1,3,4,7,8,9,10. The probability of a new record going into location 2, with a hash function resolving collisions by linear probing is .....
- 4 Consider a hashing function that resolves collision by quadratic probing. Assume the address space is indexed from 1 to 8. If a collision occurs at position 4, then .....location will never be probed
- 5 A hash table has space for 100 records.....t is the probability of collision before the table is 10% full?

Ans. (1)(Inverted File organization), (2)( less), (3)(0.6), (4)(2), (5)(0.45)

**II Short Answer Type Questions:**

- 1 Explain the advantages and disadvantages of sequential file organization.
- 2 Explain the advantages and disadvantages of random file organization.
- 3 What do you mean by inverted files?
- 4 Explain the concept of cellular partitions.
- 5 What do you mean by hashed files?
- 6 Explain why data files are needed?

- 7 Compare trie indexing and hashed indexing techniques.
- 8 Mention any three file queries.
- 9 Explain cylindrical surface indexing.
- 10 What are the various operations performed on sequential files?
- 11 Mention advantages and disadvantages of sequential file organization.
- 12 What do you mean by data representation?
- 13 What is block buffering?
- 14 What do you mean by line buffering and no buffering?
- 15 How to handle binary files in C language?
- 16 Give a function to seek a position in a binary file.
- 17 Write C code to write into a binary file and read that data.
- 18 Give C function to position the cursor at particular position in a file.
- 19 Give the difference between balanced and polyphase merge sort.
- 20 Explain the steps to construct a Huffman tree.
- 21 How many key comparisons and assignments an insertion sort makes in its worst case?
- 22 Create a heap with following list of keys:  
8, 20, 9, 4, 15, 10, 7, 22, 3, 12
- 23 What do you mean by fseek function in C.
- 24 Explain double buffering and block buffering.
- 25 How we can handle sequential files in C language.
- 26 Explain error control using parity bits.
- 27 Write a short note on polyphase merge sore.
- 28 What is buffering and when it is useful.
- 29 Classify the Hashing Functions based on the various methods by which the key value is found.
- 30 Write the syntax for multiplication of matrices?

### III Long Answer Type Questions:

- 1 Explain the types of Indices.
- 2 Mention some index properties.
- 3 Explain the types of File Organization.
- 4 Explain some basic algorithms used in selection operation.
- 5 Explain physical storage media with example.
- 6 Explain sequential file organization.
- 7 Explain Trie indexing.
- 8 Explain random file organization.
- 9 What do you mean by cylinder surface indexing? What is the mechanism used for searching a record using the indexing technique.
- 10 Explain the concept of hashed index.
- 11 Explain the following file organization techniques:
  - (a) Random Organization
  - (b) Inverted Organization
  - (c) Cellular partition Organization
- 12 Explain linked file organization and trie indexing techniques.

- 13 What is double buffering? Give the difference between page flipping, triple buffering, and quad buffering.
- 14 What do you mean by k-way merging? Explain with an appropriate example.
- 15 Discuss the differences between k-way merge and polyphase merge taking suitable examples.
- 16 Explain the following types of file organization techniques:
  - a) Sequential file organization
  - b) Indexed Sequential file organization
  - c) Direct File organization
- 17 Difference between K way polyphase merges?
- 18 Differentiate between sequential file access, Random file access and Direct file access and write advantages and disadvantages of one another. Write the situation when which kind of file would be best be use?
- 19 What is console I/O and define its types?
- 20 Explain the usage of cellular partitions for organising file storage. How can this technique be used for improving efficiency of read and write operations?
- 21 While searching a key, how is the number of disk accesses related to the order of a tree in tree based indexes?
- 22 Explain the error control using parity bits?
- 23 Explain the reasons, the situations where sequential files storage is more advantage as compared to other file organisations?
- 24 Bubble sort algorithm is inefficient because it continues execution even after an array is sorted by performing unnecessary comparisons. Therefore, the numbers of comparisons in the best and worst cases are the same. Modify the algorithm in such a fashion that it will not make the next pass when the array is already sorted.
- 25 Explain the method to calculate the address of an element in an array. A  $25 \times 4$  matrix array DATA is stored in memory in 'row-major order'. If base address is 200 and  $w = 4$  words per memory cell. Calculate the address of DATA [12, 3] .
- 26 Explain k-way merge sort using  $K+1$  tapes.
- 27 In RDBMS, what is the efficient data structure used in the internal storage representation?
- 28 Draw the B-tree of order 3 created by inserting the following data arriving in sequence - 92 24 6 7 11 8 22 4 5 16 19 20 78.
- 29 Explain the process of updating a master file on basis of transaction file in case of sequential file organization.
- 30 Explain with reasons, the situations where sequential file storage is more advantageous as compared to file organizations.

# **QUESTION BANK**

## **OBJECT ORIENTED PROGRAMMING IN C++**

**MCA 104**



**QUESTION BANK**  
**OBJECT ORIENTED PROGRAMMING IN C++ - MCA 104**  
**MCA II**

**UNIT - I**

**I Test Your Skills:**

**(a) State Whether the Following Statements are either true or false:**

- 1 In procedure-oriented programming, all data are shared by all functions.
- 2 The main emphasis of procedure-oriented programming is on algorithms rather than on data.
- 3 One of the striking features of object-oriented programming is the division of programs into objects that represent real-world entities.
- 4 Wrapping up of data of different types into a single unit is known as encapsulation.
- 5 One problem with OOP is that once a class is created it can never be changed.
- 6 Inheritance means the ability to reuse the data values of one object by another.
- 7 Polymorphism is extensively used in implementing inheritance.
- 8 Object oriented programs are executed much faster than conventional programs.
- 9 Object oriented systems can scale up better from small to large.
- 10 Object oriented approach cannot be used to create databases.

Ans. (1)(T), (2)(T), (3)(T), (4)(T), (5)(F), (6)(F), (7)(T), (8)(T), (9)(T), (10)(F)

**(b) Multiple Choice Questions:**

- 1 C++ was originally developed by
  - (a) Clocksin and Mellish
  - (b) Donald E. Knuth
  - (c) Sir Richard Hadlee
  - (d) BjarneStroustrup
- 2 Which of the following is/are procedural languages?
  - (a) Pascal
  - (b) Smalltalk
  - (c) C++
  - (d) C
- 3 Reusability is a desirable feature of a language as it
  - (a) Decreases the testing time
  - (b) Lowers the maintenance cost
  - (c) Reduces the compilation time
  - (d) Reduces the execution time

- 4 The statement  
int a=5;  
cout<< "FIRST" << (a<<2) << "SECOND";  
outputs
- (a) FIRST52SECOND
  - (b) FIRST20SECOND
  - (c) SECOND25FIRST
  - (d) an error message
- 5 Choose the correct remarks.
- (a) C++ allows the user to define new operators
  - (b) Some of the existing operators cannot be overloaded
  - (c) Operator precedence cannot be changed
  - (d) All of the above
- 6 Choose the correct statement(s)
- (a) C++ is more strongly typed than C
  - (b) C is more strongly typed than C++
  - (c) Size of literal character in C is that of a character
  - (d) Size of literal character in C++ is that of a character
- 7 C++ encourages structuring a software as a collection of components that are
- (a) Interactive and loosely coupled
  - (b) Not interactive but loosely coupled
  - (c) Interactive and tightly coupled
  - (d) Not interactive but tightly coupled
- 8 Cout stands for
- (a) Class output
  - (b) Character output
  - (c) Console output
  - (d) Call output
- 9 getche () function is declared in which of the following header files?
- (a) iostream.h
  - (b) conio.h
  - (c) fstream.h
  - (d) string.h
- 10 sizeof (char) will return how many bytes?
- (a) 4 bytes
  - (b) 8 bytes
  - (c) 2 bytes
  - (d) 1 byte

- 11 Which is correct with respect to size of the datatypes?  
(a) char>int< float  
(b) int< char > float  
(c) char <int< float  
(d) double < char >int
- 12 Which datatype is used to represent the absence of parameters?  
(a) int  
(b) short  
(c) void  
(d) float
- 13 Which type is best suited to represent the logical values?  
(a) integer  
(b) boolean  
(c) character  
(d) all of the mentioned
- 14 Identify the user-defined types from the following?  
(a) enumeration  
(b) classes  
(c) both a and b  
(d) int
- 15 Which of the following statements are true?  
int f(float)  
(a) f is a function taking an argument of type int and returning a floating point number  
(b) f is a function taking an argument of type float and returning a integer.  
(c) f is a function of type float  
(d) none of the mentioned
- 16 When a language has the capability to produce new data type mean, it can be called as  
(a) overloaded  
(b) extensible  
(c) encapsulated  
(d) reprehensible
- 17 Pick the right option  
Statement 1:Global values are not initialized by the stream.  
Statement 2:Local values are implicitly initialized to 0.  
(a) Statement 1 is true, Statement 2 is false.  
(b) Statement 2 is true, Statement 1 is false.  
(c) Both are false.  
(d) Both are true.

- 18 C++ provides facility to specify that the compiler should match function calls with the correct definition at the run time. This process is called as
- (a) static binding
  - (b) dynamic binding
  - (c) none
- 19 What is deep copy?
- (a) A deep copy creates a copy of the dynamically allocated objects too.
  - (b) A deep copy just copies the values of the data as they are.
  - (c) A deep copy creates a copy of the statically allocated objects too
  - (d) Both b and c above
- 20 The constants are also called as
- (a) const
  - (b) preprocessor
  - (c) literals
  - (d) none of the mentioned
- 21 What are the parts of the literal constants?
- (a) integer numerals
  - (b) floating-point numerals
  - (c) strings and boolean values
  - (d) all of the mentioned
- 22 How the constants are declared?
- (a) const keyword
  - (b) #define preprocessor
  - (c) both a and b
  - (d) None of the mentioned
- 23 Which of the following statement is true about preprocessor directives?
- (a) These are lines read and processed by the preprocessor
  - (b) They do not produce any code by themselves
  - (c) These must be written on their own line
  - (d) They end with a semicolon
- 24 Regarding following statement which of the statements is true?  
const int a = 100;
- (a) Declares a variable a with 100 as its initial value
  - (b) Declares a construction a with 100 as its initial value
  - (c) Declares a constant a whose value will be 100
  - (d) Constructs an integer type variable with a as identifier and 100 as value

- 25 The difference between x and 'x' is
- (a) The first one refers to a variable whose identifier is x and the second one refers to the character constant x
  - (b) The first one is a character constant x and second one is the string literal x
  - (c) Both are same
  - (d) None of the mentioned
- 26 Which operator is having right to left associativity in the following?
- (a) Array subscripting
  - (b) Function call
  - (c) Addition and subtraction
  - (d) Type cast
- 27 Which operator is having the highest precedence?
- (a) postfix
  - (b) unary
  - (c) shift
  - (d) equality
- 28 What is this operator called?  
: ?
- (a) conditional
  - (b) relational
  - (c) casting operator
  - (d) none of the mentioned
- 29 What is the use of dynamic\_cast operator?
- (a) it converts virtual base class to derived class
  - (b) it converts virtual base object to derived objects
  - (c) it will convert the operator based on precedence
  - (d) None of the mentioned
- 30 What is the output of this program?
- ```
1. #include <iostream>
2. using namespace std;
3.     main()
4.     {
5.     double a =21.09399;
6.     float b =10.20;
7.     int c ,d;
8.         c =(int) a;
9.         d =(int) b;
10.    cout<< c <<'t'<< d;
11.    return 0;
12. }
```

- (a) 20 10
  - (b) 10 21
  - (c) 21 10
  - (d) none of the mentioned
31. In structured programming, the problem is divided into various \_\_\_\_\_.
- (a) modules
  - (b) functions
  - (c) structures
  - (d) objects
32. In Object-oriented programming, the problem is divided into \_\_\_\_\_.
- (a) classes & objects
  - (b) functions
  - (c) structures
  - (d) modules
33. A class is \_\_\_\_\_ datatype.
- (a) primitive
  - (b) derived
  - (c) user-defined
  - (d) All of these
34. A class is a collection of \_\_\_\_\_ and \_\_\_\_\_.
- (a) data-members & member functions
  - (b) data-members, member functions and main()
  - (c) data-members, member functions, main() and include statements
  - (d) None of these
35. An object is \_\_\_\_\_
- (a) a variable of class datatype.
  - (b) same as a class.
  - (c) just like a global variable.
  - (d) collection of data-members and member functions.
36. Wrapping up of data & functions together in a class is known as \_\_\_\_\_.
- (a) Overloading
  - (b) Data Abstraction
  - (c) Polymorphism
  - (d) Encapsulation
37. Including only necessary details and ignoring additional details while defining a class is known as \_\_\_\_\_.
- (a) Overloading
  - (b) Data Abstraction
  - (c) Polymorphism
  - (d) Encapsulation

38. Preventing direct access of data-members of the class from outside world is known as \_\_\_\_\_.
- (a) Polymorphism
  - (b) Encapsulation
  - (c) Data Hiding.
  - (d) Scope resolution.
39. What are cin and cout?
- (a) pointers
  - (b) functions
  - (c) operator
  - (d) stream objects
40. Which header file must be included for cin and cout?
- (a) stdio.h
  - (b) conio.h
  - (c) iostream.h
  - (d) Both iostream.h and conio.h
41. Creating a new class using one or more existing classes is known as \_\_\_\_\_.
- (a) Polymorphism
  - (b) Encapsulation
  - (c) Overloading
  - (d) Inheritance
42. Ability of an operator or function call to take different forms is known as \_\_\_\_\_.
- (a) Polymorphism
  - (b) Encapsulation
  - (c) Overloading
  - (d) Inheritance
43. Which of the following is not a valid conditional inclusions in preprocessor directives
- (a) #ifdef
  - (b) #ifndef
  - (c) #endif
  - (d) #elif
44. Dynamic Binding is
- (a) Resolving the function call at compile time
  - (b) Defining binding statically
  - (c) Resolving function call at run time
  - (d) None of the above
45. Value of a in  $a = (b = 5, b + 5)$ ; is
- (a) Junk value
  - (b) Syntax error

- (c) 5
  - (d) 10
46. Which of the following operator cannot be overloaded?
- (a) == (equality operator)
  - (b) -> (row operator)
  - (c) :: (scope resolution operator)
  - (d) both a and b
47. Which of the following operators can be overloaded?
- (a) . (dot or member access operator)
  - (b) & (address-of operator)
  - (c) sizeof operator
  - (d) ?: (conditional operator)
48. Which of the following is not a standard exception built in C++?
- (a) std::bad\_creat
  - (b) std::bad\_alloc
  - (c) std::bad\_cast
  - (d) std::bad\_typeid
49. 92. Minimum number of temporary variable needed to swap the contents of 2 variables is:
- (a) 1
  - (b) 2
  - (c) 3
  - (d) 0
50. Which of the following operators below allow to define the member functions of a class outside the class?
- (a) ::
  - (b) ?
  - (c) :?
  - (d) %
51. In C++ ..... operator is used for Dynamic memory allocation.
- (a) Scope resolution
  - (b) Conditional
  - (c) New
  - (d) Membership access
52. Operators such as ..... cannot be overloaded.
- (a) +
  - (b) ++
  - (c) ::
  - (d) ==



53. The ..... objects have values that can be tested for various error conditions.
- (a) ostream
  - (b) ofstream
  - (c) stream
  - (d) ifstream
54. Which function return the current position of the get or put pointer in bytes.
- (a) tellg( )
  - (b) tellp( )
  - (c) tell( )
  - (d) Both A and B
55. The first index number in an array starts with ..... and the index number of an array of size n will be .....
- (a) 0, n-1
  - (b) 1, n-1
  - (c) 0, n
  - (d) 1, n
56. To overload an operator ..... keyword must be used along with the operator to be overloaded.
- (a) Over
  - (b) Overload
  - (c) Void
  - (d) Operator
57. What is the output of the program
- ```
#include<iostream.h>

void main()
{
    int n=1;
    cout<<endl<<"The numbers are;"<<endl;
    do
        {

    cout <<n<<"\t";
    n++;
        } while (n<=100);
    cout <<endl;
    }

```
- (a) Print natural numbers 0 to 99
  - (b) Print natural numbers 1 to 99
  - (c) Print natural numbers 0 to 100
  - (d) Print natural numbers 1 to 100

58. Everything defined at the program scope level (ie. outside functions and classes) is said to be .....
- (a) local scope
  - (b) regional scope
  - (c) global scope
  - (d) static scope
59. Because the lifetime of a local variable is limited and determined automatically, these variables are also called .....
- (a) automator
  - (b) automatic
  - (c) dynamic
  - (d) static
60. .... allows that a section of a program is compiled only if the defined constant that is specified as the parameter has been defined, independently of its value.
- (a) #ifdef
  - (b) #if
  - (c) #define
  - (d) #ifd

Ans. (1)(d), (2)(a,d), (3)(a,b), (4)(b), (5)(b,c), (6)(a,d), (7)(a), (8)(c), (9)(b), (10)(d), (11)(c), (12)(c), (13)(b), (14)(c), (15)(b), (16)(b), (17)(c), (18)(b), (19)(a), (20)(c), (21)(d), (22)(c), (23)(d), (24)(c), (25)(a), (26)(d), (27)(a), (28)(a), (29)(a), (30)(c),(31) (b), (32)(a), (33)(c), (34)(a), (35)(a), (36)(d), (37)(b), (38)(c), (39)(c), (40)(c), (41)(d), (42)(a), (43)(a), (44)(c), (45)(b), (46)(a), (47)(d), (48)(b), (49)(d), (50)(d), (51)(c), (52)(c), (53)(d), (54)(b), (55)(a), (56)(d), (57)(d), (58)(c), (59)(b), (60)(a).

## **B Fill in the Blanks:**

- 1 In if statement, if the if condition fails, \_\_\_\_\_ part is executed.
- 2 The \_\_\_\_\_ statement can have more than one matching cases.
- 3 The \_\_\_\_\_ statement terminates the execution of the loop.
- 4 \_\_\_\_\_ refers to the act of representing essential features without including the background details.
- 5 \_\_\_\_\_ operator is used to allocate memory in C++.
- 6 In C++, a function contained within a class is called a \_\_\_\_\_ function.
- 7 Endl is a \_\_\_\_\_.
- 8 For loop is an \_\_\_\_\_ controlled loop.
- 9 Enumeration is a \_\_\_\_\_ data type.
- 10 Qualifiers are classified as \_\_\_\_\_ qualifiers and \_\_\_\_\_ qualifiers.

Ans. (1)(else), (2)(Switch), (3)(Break), (4)(abstraction), (5)(new),(6)(Member), (7)(Manipulator), (8)(Entry), (9)(user defined),(10)(size, sign)

## II Short Answer Type Questions:

- 1 Write an object representation (pictorial) of student class.
- 2 Explain multiple views of an object with a suitable example.
- 3 Which is the first object-oriented language? Explain the heritage of C++.
- 4 Define the following terms related to OO paradigm:
  - (a) Encapsulation
  - (b) Data abstraction
  - (c) Inheritance
  - (d) Polymorphism
  - (e) Message Passing
  - (f) Extensibility
- 5 Compare the traditional beginner's Hello World Program written in C and C++.
- 6 In C/C++, why is the main ( ) function popularly called as the driver function?
- 7 What are variables? List rules for variable naming in C++.
- 8 Why output and output are considered as different identifiers?
- 9 What are keywords? List the keywords specific to C++. Can these keywords be used as variables?
- 10 What is new about C++ in terms of the variable definition?
- 11 What is the difference between a character and a character string representation?
- 12 What is an expression? Is this different from a statement? Give reasons.
- 13 List categories of operators supported by C++.
- 14 What are qualifiers? Illustrate them with examples.
- 15 How C++ represents true and false values? Are the expressions! a and a == 0 have the same meaning? Give reasons.
- 16 Illustrate how compound assignment operators allow to write compact expressions?
- 17 What is the effect of the following expressions if i = 1, j = 4?
  - (a) i++ (b) j = j++ (c) j = ++j (d) i+++j
  - (e) i = i+++++j
- 18 What is type conversion? What are the differences between silent and explicit type conversion? Write type conversion steps required for evaluating the statement.  
 $Z = i + b + j - k/4$  (where i and j are ints, b is float, and k is double, and z is long type)
- 19 What are escape sequences? Write a program to output messages in double quotes.
- 20 What is operator precedence? Arrange the following operators in the order of their precedence.  
-, \*, +, ( ), ^, !, ++, --, |, ||, &, /, and &&
- 21 What is the significance of the associativity of operators? What is the order of evaluation of the operator? : in the statement  
 $a = i > j ? i : j;$
- 22 Justify that 'goto statement that cannot be used to transfer control from outside to inside the loop'.
- 23 What is Object Oriented Programming?
- 24 What are Objects?
- 25 Write any four features of OOPS.
- 26 What are the basic concepts of OOPS?
- 27 What is Encapsulation?

- 28 What is an Array?
- 29 What is enumeration?
- 30 Define Message Passing.
- 31 What are arrays? Explain how they simplify programming with suitable examples.
- 32 What are the side effects of the following statements?
- ```

int a[100];
a[0] = 20;
a[100] = 200;
cout<< a[101];
a[-1] = 5;
cout<< a[-1];

```
- 33 Does the compiler reports an error when illegal accesses are made to an array?
- 34 What are multi-dimensional arrays? Explain their syntax and mechanism for accessing their elements.
- 35 Can arrays be initialized at the point of their definition? If yes, explain its syntax with suitable examples?
- 36 What are strings? Are they standard or derived data type. What happens if the end of string character is missing?
- 37 How does a C++ typestringdifferent from a C type string?
- 38 What is a class? Describe the syntax for declaring a class with examples.
- 39 What are the differences between structures and classes in C++?
- 40 What are objects? Describe the syntax for defining objects with examples. Explain how C++ supports encapsulation and data abstraction.
- 41 What are pointers to objects? Explain with example.
- 42 What is a this pointer? Discuss.
- 43 Explain the syntax for defining pointer variables. How different are these from normal variables?
- 44 What is dereferencing of pointers?
- 45 Explain the features of object oriented language.
- 46 Compare memory allocation features in C and C++.
- 47 Explain the following terms:
- Overloading Vs Overriding functions
  - Encapsulation Vs Data Hiding
- 48 Discuss the following:
- Break Vs go to Statements
  - Procedural Vs OOPs Languages
- 49 What is implicit and explicit type conversion?
- 50 What is inheritance in C++ and name the different types of inheritance?

### III Long Answer Type Questions:

- 1 What is object-oriented paradigm? Explain the various features of OO paradigm.
- 2 What are the programming paradigms currently available? Explain their features with programming languages supporting them.
- 3 Compare structured and OO programming paradigms.
- 4 What are the elements of Object-oriented Programming? Explain its key components such as objects and classes with examples.

- 5 What are the steps involved in OO programming? Explain its message communication model.
- 6 List some popular OOP languages and compare their object-oriented features.
- 7 Discuss the merits and demerits of object-oriented methodologies.
- 8 What is a data type? What are the different data types supported by C++?
- 9 Discuss the need of control flow statements in C++.
- 10 What are the differences between break and continue statements? Develop an interactive program, which illustrates the differences.
- 11 Discuss the major differences between C and C++ with examples.
- 12 Explain in details about the concepts of OOPs?
  - (a) Explain in detail about Programming Elements
  - (b) What are Enumeration types? Explain in detail.
- 13 Explain in detail about the following terms with example programs
  - (a) Function Invocation
  - (b) Function Prototypes
- 14 What is meant by Default arguments? Give example program.
- 15 Give any four advantages of OOPS. What are tokens?
- 16 State out in detail the difference between C and C++
- 17 What are keywords? Give the rules for naming the identifiers in C++. What are the operators available in C++? What is a scope resolution operator?
- 18 Discuss how C++ has evolved.
- 19 Explain dynamic memory handling operators in C++.
- 20 What are comments? Explain giving examples the different types of comments in C++.
- 21 Explain the constructs supported by C++ to implement them.
- 22 What are the improvements made to the struct construct in C++? What are the benefits of having functions as a part of the structure declaration?
- 23 How are data and function organized in object oriented program.
- 24 What are the advantages of object oriented programming.
- 25 List four new operators added in C++ which aid OOP.
- 26 What is a reference variable? What are their major used? Write an example to illustrate it.
- 27 Explain OOPS concept along with its characteristics.
- 28 Discuss the statement “reference Variable enjoys the simplicity of value variable and power of pointer variable”.
- 29 Identify two classes from your college. Provide interface for each class for two data members and three member.
- 30 Compare memory allocation features in C and C++.

#### **IV Practical Questions:**

- 1 Write a program to generate Fibonacci series.
- 2 Write a program to find all prime numbers between 1-50.
- 3 Write a program to find the sum of first ‘n’ natural numbers.
- 4 Write a program to check whether a year is a leap year or not.
- 5 Write a program to print the reverse of a number.
- 6 Write a program to find word equivalent of a three-digit number. (Eg- 123→ One Hundred Twenty Three)

- 7 Write a program to show the functioning of ternary operator.
- 8 Write a program. to generate Armstrong numbers.
- 9 Write a program to find whether entered number is a palindrome or not.
- 10 Write a program to find the sum of digits of a number.
- 11 Write a program to find the average of marks of 5 subjects out of 100 entered by the user.
- 12 Assume that you want to generate a table of multiples of any given number. Write a program that allows the user to enter the number and then generates the table, formatting it into 10 columns and 20 lines. Interaction with the program should look like this (only the first three lines are shown):  
 Enter a number: 7  
 7 14 21 28 35 42 49 56 63 70  
 77 84 91 98 105 112 119 126 133 140  
 147 154 161 168 175 182 189 196 203 210
- 13 Write a temperature-conversion program that gives the user the option of converting Fahrenheit to Celsius or Celsius to Fahrenheit.
- 14 Write a program that calculates how much money you'll end up with if you invest an amount of money at a fixed interest rate, compounded yearly. Have the user furnish the initial amount, the number of years, and the yearly interest rate in percent. Interaction with the program should look like this:  
 Enter initial amount: 3000  
 Enter number of years: 10  
 Enter interest rate (percent per year): 5.5  
 At the end of 10 years, you will have 5124.43 dollars

## UNIT - II

### I Test Your Skills:

#### (a) State Whether the Following Statements are true or false:

- 1 Constructors are invoked starting from the top base class to derived class order.
- 2 Destructors are invoked in the reverse order of constructors.
- 3 Class members are private by default.
- 4 Functions cannot return class objects.
- 5 Members declared as public in a class are accessible to all the member functions of that class.
- 6 A C++ array can store values of different data types.
- 7 Not initializing a pointer when it is declared is a syntax error.
- 8 A static function can be invoked using its class name and function name.
- 9 Declarations can appear anywhere in the body of C++ function.
- 10 Constructors may or may not have a return type.

Ans. (1)(T), (2)(T), (3)(T), (4)(F), (5)(T), (6)(F), (7)(F), (8)(T), (9)(T), (10)(F)

**(b) Multiple Choice Questions:**

- 1 A constructor is called whenever
- (a) An object is declared
  - (b) An object is used
  - (c) A class is declared
  - (d) A class is used
- 2 Which of the following remarks about the differences between constructors and destructors are correct?
- (a) Constructors can take arguments but destructors cannot
  - (b) Constructors can be overloaded but destructors cannot be overloaded
  - (c) Destructors can take arguments but constructors cannot
  - (d) Destructors can be overloaded but constructors cannot be overloaded
- 3 The following program fragment
- ```
void main ()
{ int x=10;
int&p=x;
printf(“%u,%u”,&p,&x);
}
```
- (a) Prints 10 and the address of x
  - (b) Results in a run time error
  - (c) Prints the address of x twice
  - (d) Prints the address of p twice
- 4 The declaration
- ```
int x; int&p=x;
```
- is same as the declaration
- ```
int x,*p; p=&x;
```
- This remark is
- (a) True
  - (b) False
  - (c) Sometimes true
  - (d) None of the above
- 5 The following program segment
- ```
const int m=10;
int&n=m;
n=11;
printf(“%d,%d”m,n);
```
- (a) results in compile time error
  - (b) results in run time error
  - (c) prints 11,11
  - (d) prints 10,11

- 6 The following program segment
- ```
int a=10;
int const&b=a;
a=11;
printf ("%d,%d",a,b);
```
- (a) results in compile time error  
(b) results in run time error  
(c) prints 11,11  
(d) none of the above
- 7 Choose the correct statements.
- (a) A destructor is not inherited  
(b) A constructor cannot be virtual  
(c) A destructor cannot be virtual  
(d) A constructor is not inherited
- 8 A class having no name
- (a) Is not allowed  
(b) Cannot have a constructor  
(c) Cannot have a destructor  
(d) Cannot be passed as an argument
- 9 If a method is to be an interface between the outside world and a class, it has to be declared
- (a) private  
(b) protected  
(c) public  
(d) external
- 10 Consider the following program segment
- ```
const char *p1 = "To make the bitter butter better "; //stm1
char *const p2 = "Recommend this book 2 others "; //stm2
p1 = "add some better butter not bitter."; //stm3
p2 = "so that they 2 will get benefited."; //stm4
* (p1+3) = 'A'; //stm5
* (p2+3) = 'A'; //stm6
```
- Which of the statement(s) results in error?
- (a) stm4 and stm5  
(b) stm1 and stm2  
(c) stm1 and stm4  
(d) stm2 and stm3



- 11 What does your class can hold?
- (a) data
  - (b) functions
  - (c) both a & b
  - (d) none of the mentioned
- 12 How many specifiers are present in access specifiers in class?
- (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
- 13 Which is used to define the member of a class externally?
- (a) :
  - (b) ::
  - (c) #
  - (d) none of the mentioned
- 14 Which other keywords are also used to declare the class other than class?
- (a) struct
  - (b) union
  - (c) object
  - (d) both a & b
- 15 What is the output of this program?

```
1.     #include <iostream>
2.     using namespace std;
3.     class rect
4.     {
5.     int x, y;
6.     public:
7.     void val (int, int);
8.     int area ()
9.     {
10.    return (x * y);
11.    }
12.    };
13.    void rect::val (int a, int b)
14.    {
15.    x = a;
16.    y = b;
17.    }
18.    int main ()
19.    {
20.    rectrect;
```

```
21.   rect.val (3, 4);
22.   cout<< "rect area: " <<rect.area();
23.       return 0;
24.   }
```

- (a) rect area:12
  - (b) rect area: 12
  - (c) rect area:24
  - (d) none of the mentioned
- 16 Which of the following is a valid class declaration?
- (a) class A { int x; };
  - (b) class B { }
  - (c) public class A { }
  - (d) object A { int x; };
- 17 The fields in the class in C++ program are by default
- (a) protected
  - (b) private
  - (c) public
  - (d) none of the mentioned
- 18 Constructors are used to
- (a) initialize the objects
  - (b) construct the data members
  - (c) both a & b
  - (d) none of the mentioned
- 19 When struct is used instead of the keyword class means, what will happen in the program?
- (a) access is public by default
  - (b) access is private by default
  - (c) access is protected by default
  - (d) none of the mentioned
- 20 Where does the object is created?
- (a) class
  - (b) constructor
  - (c) destructor
  - (d) attributes
- 21 How to access the object in the class?
- (a) scope resolution operator
  - (b) ternary operator
  - (c) direct member access operator
  - (d) none of the mentioned

- 22 Which of these following members are not accessed by using direct member access operator?
- (a) Public
  - (b) Private
  - (c) Protected
  - (d) Both a & b
- 23 Pick out the other definition of objects.
- (a) member of the class
  - (b) associate of the class
  - (c) attribute of the class
  - (d) instance of the class
- 24 How many objects can present in a single class?
- (a) 1
  - (b) 2
  - (c) 3
  - (d) as many as possible
- 25 What is the output of this program?

```
1.     #include <iostream>
2.     using namespace std;
3.     class sample
4.     {
5.         private:
6.     intvar;
7.         public:
8.         void input()
9.         {
10.    cout<<var;
11.    }
12.         void output()
13.        {
14.    cout<< "Variable entered is ";
15.    cout<<var<< "\n";
16.    }
17.    };
18.    int main()
19.    {
20.        sample object;
21.    object.input();
22.    object.output();
23.    object.var();
24.        return 0;
25.    }
```

- (a) Enter an integer 5  
Variable entered is 5
  - (b) runtime error
  - (c) error
  - (d) none of the mentioned
- 26 In which direction does the assignment operation will take place?
- (a) Left to right
  - (b) Right to left
  - (c) Top to bottom
  - (d) None of the mentioned
- 27 Pick out the compound assignment statement.
- (a)  $a = a - 5$
  - (b)  $a = a / b$
  - (c)  $a -= 5$
  - (d) None of the mentioned
- 28 What is the associativity of add(+);
- (a) right to left
  - (b) left to right
  - (c) both of these
  - (d) None of the mentioned
- 29 What is the name of | operator?
- (a) sizeof
  - (b) or
  - (c) and
  - (d) modulus
- 30 Which operator is having the highest precedence in C++?
- (a) array subscript
  - (b) scope resolution operator
  - (c) static\_cast
  - (d) dynamic\_cast
31. \_\_\_\_\_ is initialized when an object is created.
- (a) Constructor.
  - (b) Destructor.
  - (c) Array.
  - (d) Pointer.
32. \_\_\_\_\_ is automatically created when constructors are used.
- (a) Objects.
  - (b) Destructors.
  - (c) Arrays.

- (d) Reference.
33. \_\_\_\_\_ members are public by default and fully compatible.  
(a) Protected.  
(b) Private.  
(c) Enum.  
(d) Union.
34. A \_\_\_\_\_ defines a class type.  
(a) structure.  
(b) union.  
(c) enumeration.  
(d) type def.
35. \_\_\_\_\_ function is a function that calls itself repeatedly.  
(a) friend.  
(b) inline.  
(c) recursive.  
(d) member.
36. A \_\_\_\_\_ is an alias or synonym for another variable.  
(a) reference.  
(b) structure.  
(c) pointer.  
(d) array.
37. \_\_\_\_\_ is the process of using the same name for two or more functions.  
(a) Function Overloading.  
(b) Operator Overloading.  
(c) Default Function.  
(d) Constructors.
38. \_\_\_\_\_ is used to prevent problems when one object is used to initialize others.  
(a) Default Constructor.  
(b) Parameterized Constructor.  
(c) Copy Constructor.  
(d) Overloading Operator.
39. \_\_\_\_\_ must be predefined in the C++ compiler  
(a) Keywords.  
(b) Variables.  
(c) Identifiers.  
(d) Operators.
40. \_\_\_\_\_ function is not a member of the class which does not have "this" pointer.  
(a) Inline.  
(b) Friend.

- (c) Member.  
(d) Void.
41. The \_\_\_\_\_ function receives the pointer to the region of memory to be free.  
(a) new.  
(b) delete.  
(c) free.  
(d) alloc.
42. Observe following program and answer  

```
class Example{
public: int a,b,c;
Example(){a=b=c=1;} //Constructor 1
Example(int a){a = a; b = c = 1;} //Constructor 2
Example(int a,int b){a = a; b = b; c = 1;} //Constructor 3
Example(int a,int b,int c){ a = a; b = b; c = c;} //Constructor 4
}
```

In the above example of constructor overloading, the following statement will call which constructor  
Example obj = new Example (1,2,3);
- (a) Constructor 2  
(b) Constructor 4  
(c) Constructor 1  
(d) Type mismatch error
43. What is the implicit pointer that is passed as the first argument for nonstatic member functions?  
(a) 'self' pointer  
(b) std::auto\_ptr pointer  
(c) 'Myself' pointer  
(d) 'this' pointer
44. 41. Which of the following correctly describes the meaning of 'namespace' feature in C++?  
(a) Namespaces refer to the memory space allocated for names used in a program  
(b) Namespaces refer to space between the names in a program  
(c) Namespaces refer to space between the names in a program  
(d) Namespaces provide facilities for organizing the names in a program to avoid name clashes
45. How do we declare an abstract class?  
(a) By providing at least one pure virtual method (function signature followed by ==0;) in a class  
(b) By declaring at least one method abstract using the keyword 'abstract' in a class  
(c) By declaring the class abstract with the keyword 'abstract'

- (d) It is not possible to create abstract classes in C++
46. How do we define a constructor?
- a. `x~() {}`
  - B. `X() {}~`
  - C. `X() ~{}`
  - D. `~X() {}`
47. Which of the following cannot be passed to a function?
- Reference variable
  - Arrays
  - Class objects
  - Header files
48. The friend functions are used in situations where
- We want to exchange data between classes
  - We want to have access to unrelated classes
  - Dynamic binding is required
  - We want to create versatile overloaded operators
49. What will be the values of x, m and n after execution of the following statements?
- ```

Int x, m, n;
m=10;
n=15;
x= ++m + n++;

```
- a. x=25, m=10, n=15
  - b. x=27, m=10, n=15
  - c. x=26, m=11, n=16
  - d. x=27, m=11, n=16
50. Which of the following is true about the static member variable in C++.
- It is initialized to zero when the first object of its class is created. Other initialization is also permitted.
  - It is visible only within the class, but its lifetime is the entire program.
- i-True, ii-True
  - ii-False, ii-True
  - i-True, ii-False
  - i-False, iii-False
51. Which language is not a true object-oriented programming language?
- VB.NET
  - VB 6
  - C++
  - C#
  - Java

52. A GUI:
- (a) Uses buttons, menus, and icons.
  - (b) Should be easy for a user to manipulate.
  - (c) Stands for Graphic Use Interaction.
  - (d) Both a and b.
  - (e) All of the above.
53. Visual Studio .NET provides which feature:
- (a) Debugging.
  - (b) Application deployment.
  - (c) Syntax checking.
  - (d) Both a and b.
  - (e) All of the above.
54. What does IDE stand for?
- (a) Integrated Development Environment
  - (b) Integrated Design Environment
  - (c) Interior Development Environment
  - (d) Interior Design Environment
  - (e) None of the above.
55. Which type of project can a developer choose in the New Project dialog box?
- (a) Visual Basic Projects
  - (b) Visual C# Projects
  - (c) Visual C++ Projects
  - (d) Both a and b.
  - (e) All of the above.
56. Which is not a main component of the Visual Studio IDE?
- (a) Solution Explorer
  - (b) Tool Box
  - (c) Start Menu
  - (d) Designer Window
  - (e) Properties Window
57. Which does the solution explorer **not** display?
- (a) Form Properties
  - (b) Reference Folder
  - (c) Form File
  - (d) Assemble File
  - (e) All are part of the solution explorer.
58. Which is true about the name and text property of a control?
- (a) They are the same when the control is first created.
  - (b) The text property changes to match any changes in the name property.
  - (c) The name property changes to match any changes in the text property.



- (d) They are never the same unless the programmer makes it that way.
- (e) They are not allowed to be the same and an error will occur if they are.

59. For which task does the IDE provide multiple ways to accomplish the task?
- (a) Putting a control on the form
  - (b) Running the program
  - (c) Activating the property window for a control
  - (d) Both a and b.
  - (e) All of the above.
60. Which are the standard prefixes for the Button and Combo box controls respectively?
- (a) btn and chb
  - (b) btn and cbo
  - (c) bto and chb
  - (d) bto and cbo
  - (e) cmd and cbo

Ans. (1)(a), (2)(a,b), (3)(c,d), (4)(b), (5)(d), (6)(c), (7)(a,b,d), (8)(b,c,d), (9)(c), (10)(a), (11)(c), (12)(c), (13)(b), (14)(d), (15)(b), (16)(a), (17)(b), (18)(a), (19)(a), (20)(a), (21)(c), (22)(d), (23)(d), (24)(d), (25)(c), (26)(b), (27)(c), (28)(c), (29)(b), (30)(b), (31) (a), (32)(b), (33)(d), (34)(a), (35)(c), (36)(a), (37)(a), (38)(c), (39)(d), (40)(b), (41)(b), (42)(b), (43)(d), (44)(d), (45)(a), (46)(c), (47)(d), (48)(b), (49)(c), (50)(b), (51)(b), (52)(d), (53)(e), (54)(a), (55)(e), (56)(c), (57)(a), (58)(a), (59)(e), (60)(b).

## II Short Answer Type Questions:

- 1 What are the guidelines that need to be followed for deciding whether to make the member functions inline or not?
- 2 Write a short note on “Array of Objects”.  
Discuss memory requirements for classes, objects, data members, member functions, static and non-static data members.
- 3 What is the order of construction and destruction of objects?
- 4 What are the read-only objects? What is the role of constructor in creating such objects?
- 5 What is static data member?
- 6 What is static member function?
- 7 How the class is specified?
- 8 How the member functions are defined?
- 9 Define constructor.
- 10 Define default constructor.
- 11 Define parameterized constructor.
- 12 How many arguments are required in the definition of an overloaded unary operator?
- 13 When used in prefix form, what does the overloaded ++operator do differently from what it does in postfix form?
- 14 Differentiate between a pre and post increment operators while overloading?
- 15 What is the type of “this” pointer? When does it get created?
- 16 When does a class need a virtual destructor?

- 17 What is a pdb file?
- 18 Explain the benefits of proper inheritance.
- 19 What is the real purpose of class
- 20 What are the rules about inlining?
- 21 What are the advantages of using friend classes?
- 22 Differentiate between late binding and early binding. What are the advantages of early binding?
- 23 Explain the need of constructors and destructors in C++?
- 24 Can constructor be static or private?
- 25 Explain the various types of constructor?
- 26 Does destructor ensure de-allocation of memory?
- 27 What are the differences between parameter passing by value and passing by address?
- 28 What are the benefits of pass by reference method of parameter passing over pass by pointer?
- 29 What are default arguments? Give example.
- 30 What are inline functions? Explain with the help of an example.
- 31 What are recursive functions? Discuss.
- 32 List the operators that cannot be overloaded and justify why they cannot be overloaded.
- 33 What is operator function? Describe operator function with syntax and examples.
- 34 What are the limitations of overloading unary increment/decrement operator? How are they overcome?
- 35 Explain the syntax of binary operator overloading. How many arguments are required in the definition of an overloaded binary operator?
- 36 What are the differences between the access specifiers private and protected?
- 37 What is Polymorphism? What are its types?
- 38 What is Function overloading? Give an example.
- 39 What are Overloaded function selection algorithms?
- 40 What is Operator overloading?
- 41 What is the purpose of using Operator function? Write its syntax.
- 42 Explain Access Modifiers used in class definition.
- 43 Explain namespaces and give their scope.
- 44 What is ambiguity resolution using scope resolution operator ?
- 45 What is friend function?
- 46 What is function overloading?
- 47 Explain Inline function?
- 48 What is a function?
- 49 Explain constructor?
- 50 What are the different features of c++?

### **III Long Answer Type Questions:**

- 1 What is the difference between member functions defined inside and outside the body of a class? How are inline member functions defined outside the body of a class?
- 2 What is data hiding? What are the different mechanisms for protecting data from the external users of a class's objects?
- 3 What are empty classes? Can instances of empty class be created? Give reasons.

- 4 Explain the different methods of passing object parameters.
- 5 What are pointers? What are the advantages of using pointers in programming? Explain addressing mode required to access memory locations using pointers.
- 6 Under what situations, the use of pointers is indispensable.
- 7 What is runtime memory management? What support is provided by C++ for this and how does it differ from C's memory management?
- 8 What are the differences between pointers to constants and constant pointers? Give examples.
- 9 What are constructors and destructors? Explain how they differ from normal functions.
- 10 What are the differences between default and parameterized constructors?
- 11 What are copy constructors and explain their need?
- 12 What are abstract classes? Give example.
- 13 Explain garbage collection in C++.
- 14 Explain the use of const and static for a member of a class. Use suitable examples.
- 15 (a) Define Member Function and explain in detail about function inside the class body with example program.  
(b) What is Parameterized constructor? Give syntax and example program
- 16 What is Destructor? Give syntax and example program
- 17 (a) What is Default constructor? Give syntax and example program  
(b) What is Copy constructor? Give syntax and example program
- 18 Define Member Function and explain in detail about function outside the class body with example program.
- 19 What is Operator overloading? Discuss with example. What are the rules of Operator Overloading (Unary and Binary) as member function/friend function?
- 20 Explain with an example the concept of namespaces.
- 21 If three objects of a class are defined, how many copies of that class's data item are stored in memory? How many copies are made of its member function?
- 22 What do you understand by the visibility mode? Explain its types? Give suitable example of each.
- 23 What is a friend function?
- 24 Explain function overloading with the help of program.
- 25 What is the need of overloading a function?
- 26 Write a C++ program to illustrate friend class.
- 27 What is the difference between call by value and call by reference in a user defined function in C++?
- 28 What is preprocessor directive?
- 29 What is the difference between local variable and global variable?
- 30 What is the role of #define in C++?

#### **IV Practical Questions:**

- 1 Write a program to implement selection sort.
- 2 Write a program to implement insertion sort.
- 3 Write a program to implement Binary Search.
- 4 Write a program to print a matrix helically.
- 5 Write a program to create a class, which maintains information about the customer

Customer

Cust\_id

Salary

Show the 3 ways in which the data can be assigned to the data member of the class.

- 6 Update the previous class to include a feature that tells how many objects of the class have been created so far.
- 7 Declare a class to represent bank account of 10 customers with the following data members:
  - (a) -name of the depositor
  - (b) -account no.
  - (c) -type of account-s for saving & c for current.
  - (d) -balance amountThe class also contains following member functions:
  - (a) -to initialize members
  - (b) -to deposit money
  - (c) -for withdrawal of money after checking the minimum balance
  - (d) -to display the data members
- 8 Write a program to perform various operations on a string class without using inbuilt string functions. The operations on the class are:
  - (a) read the string
  - (b) display the string
  - (c) reverse the string
  - (d) copy the string into an empty string
  - (e) concatenate two strings
- 9 Write a program to sort 10 strings.
- 10 Write a program for modifying question 8 above by making use of pointers.
- 11 Write a program to overload an operator using friend function.
- 12 Create a class called time that has separate int member data for hours, minutes, and seconds. One constructor should initialize this data to 0, and another should initialize it to fixed values. Another member function should display it, in 11:59:59 format. The final member function should add two objects of type time passed as arguments. A main() program should create two initialized time objects (should they be const?) and one that isn't initialized. Then it should add the two initialized values together, leaving the result in the third time variable. Finally it should display the value of this third variable. Make appropriate member functions const.
- 13 Create a class called employee that contains a name (an object of class string) and an employee number (type long). Include a member function called getdata() to get data from the user for insertion into the object, and another function called putdata() to display the data. Assume the name has no embedded blanks. Write a main() program to exercise this class. It should create an array of type employee, and then invite the user to input data for up to 100 employees. Finally, it should print out the data for all the employees.
- 14 Write a program to illustrate operator overloading for prefix and postfix operator for user defined complex class of r\_prt, inti\_prt data members.

## UNIT - III

### I Test Your Skills:

#### (a) State Whether the Following Statements are true or false:

- 1 Precedence and associativity of overloaded operators can be changed.
- 2 With overloading binary operator, the left and right operands are explicitly passed.
- 3 A constructor can be used to convert a user-defined data types only.
- 4 Friend function can access members of a class directly.
- 5 The ternary operator cannot be overloaded.
- 6 The compiler reports an error if overloaded + operator performs – operation
- 7 Virtual functions allow to invoke different function with the same statement.
- 8 Both base and derived classes need not have constructors.
- 9 Pure virtual functions postpone implementation of a member function to its derived class.
- 10 Base class constructors cannot be explicitly invoked from the derived class.

Ans. (1)(F), (2)(F), (3)(T), (4)(T), (5)(T), (6)(F), (7)(T), (8)(T), (9)(T), (10)(F)

#### (b) Multiple Choice Questions:

- 1 A function abc is defined as  

```
void abc(int x=0, int y=0)
{ printf(“%d,%d,x,y); }
```

Which of the following functions is/are illegal? (Assume h,g are declared as integers)
  - (a) abc();
  - (b) abc(h);
  - (c) abc(h,h);
  - (d) none of the above
- 2 Function prototyping means
  - (a) Checking if the function is declared before its use
  - (b) Checking if the function has a forward reference
  - (c) Checking if the function call conforms to the declaration in type and number
  - (d) All of the above
- 3 Choose the correct statements regarding inline function.
  - (a) It speeds up the execution
  - (b) It slows down execution
  - (c) It increases the code size
  - (d) It decreases the code size
- 4 If many functions have the same name, which of the following information, if present, will be used by the compiler, to invoke the correct function to be used?
  - (a) The operator::
  - (b) Object pointer
  - (c) Function signature
  - (d) None of the above

- 5 Which of the following operators cannot be overloaded?
- (a) >>
  - (b) ? :
  - (c) .
  - (d) No such operator exists
- 6 Class Dog: public x, public Y is an instance of
- (a) Multiple inheritance
  - (b) Repeated inheritance
  - (c) Linear inheritance
  - (d) None of the above
- 7 The compiler identifies a virtual function to be pure
- (a) By the presence of the keyword pure
  - (b) By its location in the program
  - (b) If it is equated to 0
  - (d) None of the above
- 8 Overloading is otherwise called as
- (a) Virtual polymorphism
  - (b) Transcient polymorphism
  - (b) Pseudo polymorphism
  - (d) Ad-hoc polymorphism
- 9 Which of the following parameter passing mechanism(s) is/are supported by C++, but not by C?
- (a) Pass by value
  - (b) Pass by reference
  - (c) Pass by constant reference
  - (d) All of the above
- 10 Reference is not same as pointer because
- (a) A reference can never be null
  - (b) A reference once establish cannot be changed
  - (c) Reference doesn't need an explicit dereferencing mechanism
  - (d) They are one and the same
- 11 A friend function to a class, C cannot access
- (a) private data members and member functions.
  - (b) public data members and member functions.
  - (c) protected data members and member functions.
  - (d) the data members of the derived class of (c)
- 12 Pure virtual functions
- (a) have to be redefined in the inherited class.
  - (b) cannot have public access specification.

- (c) are mandatory for a virtual class.
  - (d) None of the above.
- 13 Use of virtual functions implies
- (a) overloading.
  - (b) overriding.
  - (c) static binding.
  - (d) dynamic binding.
- 14 Within a switch statement
- (a) Continue can be used but Break cannot be used
  - (b) Continue cannot be used but Break can be used
  - (c) Both Continue and Break can be used
  - (d) Neither Continue nor Break can be used
- 15 Data members which are static
- (a) cannot be assigned a value
  - (b) can only be used in static functions
  - (c) cannot be defined in a Union
  - (d) can be accessed outside the class
- 16 Which of the following is false for cin?
- (a) It represents standard input.
  - (b) It is an object of istream class.
  - (c) It is a class of which stream is an object.
  - (d) Using cin the data can be read from user's terminal.
- 17 It is possible to declare as a friend
- (a) a member function
  - (b) a global function
  - (c) a class
  - (d) all of the above
- 18 In multiple inheritance
- (a) the base classes must have only default constructors
  - (b) cannot have virtual functions
  - (c) can include virtual classes
  - (d) None of the above.
- 19 Declaration of a pointer reserves memory space
- (a) for the object.
  - (b) for the pointer.
  - (c) both for the object and the pointer.
  - (d) none of these.

- 20 Consider the following statements  
char \*ptr;  
ptr = "hello";  
cout<< \*ptr;  
What will be printed?  
(a) first letter  
(b) entire string  
(c) it is a syntax error  
(d) last letter
- 21 Which of the statements is true in a protected derivation of a derived class from a base class?  
(a) Private members of the base class become protected members of the derived class  
(b) Protected members of the base class become public members of the derived class  
(c) Public members of the base class become protected members of the derived class  
(d) Protected derivation does not affect private and protected members of the derived class
- 22 Which of the following statements is NOT valid about operator overloading?  
(a) Only existing operators can be overloaded.  
(b) Overloaded operator must have at least one operand of its class type.  
(c) The overloaded operators follow the syntax rules of the original operator.  
(d) None of the above.
- 23 A pointer to the base class can hold address of  
(a) Only base class object  
(b) Only derived class object  
(c) Base class object as well as derived class object  
(d) None of the above
- 24 The new operator  
(a) Returns a pointer to the variable  
(b) Creates a variable called new  
(c) Obtains memory for a new variable  
(d) Tells how much memory is available
- 25 Consider the following statements:  
int x = 22,y=15;  
x = (x>y) ? (x+y) : (x-y);  
What will be the value of x after executing these statements?  
(a) 22  
(b) 37  
(c) 7  
(d) Error. Cannot be executed



- 26 Which of the following is the valid class declaration header for the derived class d with base classes b1 and b2?
- (a) class d : public b1, public b2
  - (b) class d : class b1, class b2
  - (c) class d : public b1, b2
  - (d) class d : b1, b2
- 27 A library function exit() causes an exit from
- (a) The loop in which it occurs
  - (b) The block in which it occurs
  - (c) The function in which it occurs
  - (d) The program in which it occurs
- 28 RunTime polymorphism is achieved by \_\_\_\_\_
- (a) Friend function
  - (b) Virtual function
  - (c) Operator overloading
  - (d) Function overloading
- 29 A pure virtual function is a virtual function that
- (a) Has no body
  - (b) Returns nothing
  - (c) Is used in base class
  - (d) Both (a) and (c)
- 30 A static function
- (a) should be called when an object is destroyed.
  - (b) is closely connected with and individual object of a class.
  - (c) can be called using the class name and function name.
  - (d) is used when a dummy object must be created.
- 31 Which is used to handle the exceptions in C++?
- (a) catch handler
  - (b) handler
  - (c) exceptional handler
  - (d) none of the mentioned
- 32 Which type of program is recommended to include in try block?
- (a) static memory allocation
  - (b) dynamic memory allocation
  - (c) const reference
  - (d) pointer
- 33 Which statement is used to catch all types of exceptions?
- (a) catch()
  - (b) catch(Test t)

- (c) catch(...)
- (d) none of the mentioned

34 What is the output of this program?

```
1. #include <iostream>
2. using namespace std;
3. int main()
4. {
5.     int x = -1;
6.     try
7.     {
8.         if(x < 0)
9.         {
10.            throw x;
11.        }
12.        else
13.        {
14.            cout << x;
15.        }
16.    }
17.    catch(int x)
18.    {
19.        cout << "Exception occurred: Thrown value is " << x << endl;
20.    }
21.    return 0;
22. }
```

- (a) -1
- (b) 0
- (c) Exception occurred: Thrown value is -1
- (d) error

35 What is the output of this program?

```
1. #include <iostream>
2. #include <typeinfo>
3. using namespace std;
4. class Polymorphic { virtual void Member(){} };
5. int main ()
6. {
7.     try
8.     {
9.         Polymorphic *pb = 0;
10.        typeid(*pb);
11.    }
12.    catch(exception & e)
13.    {
14.        cerr << "exception caught: " << e.what() << endl;
```

```
15.     }
16.     return 0;
17.     }
```

- (a) exception caught: `std::bad_typeid`
- (b) exception caught: `std::bad_alloc`
- (c) exception caught: `std::bad_cast`
- (d) none of the mentioned

36 What is the output of this program?

```
1.     #include <iostream>
2.     #include <exception>
3.     using namespace std;
4.     void myunexpected()
5.     {
6.         cout << "unexpected handler called\n";
7.         throw;
8.     }
9.     void myfunction() throw(int, bad_exception)
10.    {
11.        throw 'x';
12.    }
13.    int main (void)
14.    {
15.        set_unexpected(myunexpected);
16.        try
17.        {
18.            myfunction();
19.        }
20.        catch(int)
21.        {
22.            cout << "caught int\n";
23.        }
24.        catch(bad_exception be)
25.        {
26.            cout << "caught bad_exception\n";
27.        }
28.        catch(...)
29.        {
30.            cout << "caught other exception \n";
31.        }
32.        return 0;
33.    }
```

- (a) unexpected handler called
- (b) caught `bad_exception`
- (c) caught other exception

(d) both a & b

37 What is the output of this program?

```
1. #include <iostream>
2. using namespace std;
3. int main()
4. {
5.     int x = -1;
6.     char* ptr;
7.     ptr = new char[256];
8.     try
9.     {
10.        if(x < 0)
11.        {
12.            throw x;
13.        }
14.        if(ptr == NULL)
15.        {
16.            throw " ptr is NULL ";
17.        }
18.    }
19.    catch(...)
20.    {
21.        cout << "Exception occurred: exiting " << endl;
22.    }
23.    return 0;
24. }
```

- (a) -1
- (b) ptr is NULL
- (c) Exception occurred: exiting
- (d) none of the mentioned

38 What is the output of this program?

```
1. #include <iostream>
2. #include <exception>
3. using namespace std;
4. void myunexpected()
5. {
6.     cout << "unexpected called\n";
7.     throw 0;
8. }
9. void myfunction() throw(int)
10. {
11.     throw 'x';
12. }
13. int main ()
```

```

14.  {
15.  set_unexpected(myunexpected);
16.  try
17.  {
18.  myfunction();
19.  }
20.  catch(int)
21.  {
22.  cout<<"caught int\n";
23.  }
24.  catch(...)
25.  {
26.  cout<<"caught other exception\n";
27.  }
28.  return 0;
29.  }

```

- (a) caught other exception
- (b) caught int
- (c) unexpected called
- (d) both b & d

39 How to handle error in the destructor?

- (a) throwing
- (b) terminate
- (c) both a & b
- (d) none of the mentioned

40 What kinds of exceptions are available in C++?

- (a) handled
- (b) unhandled
- (c) static
- (d) dynamic

41 Which type of program is recommended to include in try block?

- (a) static memory allocation
- (b) dynamic memory allocation
- (c) const reference
- (d) pointer

42 Which is used to handle the exceptions in c++?

- (a) catch handler
- (b) handler
- (c) exception handler
- (d) none of the mentioned

- 43 Which class is used to design the base class?
- (a) abstract class
  - (b) derived class
  - (c) base class
  - (d) virtual class
- 44 Which key word is used to check exception in the block of code?
- (a) catch
  - (b) throw
  - (c) try
  - (d) throws
- 45 Which is used to create a pure virtual function?
- (a) \$
  - (b) =0
  - (c) &
  - (d) !

46 What is the output of this program?

```
1. #include <iostream>
2. usingnamespace std;
3. class sample
4. {
5. public:
6. virtualvoid example()=0;
7. };
8. class Ex1:public sample
9. {
10. public:
11. void example()
12. {
13. cout<<"ubuntu";
14. }
15. };
16. class Ex2:public sample
17. {
18. public:
19. void example()
20. {
21. cout<<" is awesome";
22. }
23. };
24. int main()
25. {
26.     sample*arra[2];
27.     Ex1 e1;
28.     Ex2 e2;
29.     arra[0]=&e1;
```

```
30. arra[1]=&e2;
31. arra[0]->example();
32. arra[1]->example();
33. }
(a) ubuntu
(b) is awesome
(c) ubuntu is awesome
(d) None of the mentioned
```

47 What is the output of this program?

```
1. #include <iostream>
2. using namespace std;
   int main ()
3. {
4.   char first, second;
5.   cout<<"Enter a word: ";
6.       first =cin.get();
7.   cin.sync();
8.       second =cin.get();
9.   cout<< first <<endl;
10.  cout<< second <<endl;
11.  return 0;
12. }
```

a) First  
b) Second  
c) Returns first 2 letter or number from the entered word  
d) Zero

48 Which header file is used for reading and writing to a file?

(a) #include<iostream>  
(b) #include<fstream>  
(c) #include<file>  
(d) None of the mentioned

49 Identify the correct statement about throw(type).

(a) A function can throw any type of exceptions.  
(b) A function can throw an exception of certain type only.  
(c) A function can't throw any type of exception.  
(d) A function can't throw an exception of certain type only.

50 Which operations don't throw anything?

(a) Operations which are reversible.  
(b) Operations which are irreversible.  
(c) Operations which are static.  
(d) Operations which are dynamic.

51. Which are the standard prefixes for the text box and label controls respectively?
- (a) tex and lbl
  - (b) tex and lab
  - (c) txb and lbl
  - (d) txb and lab
  - (e) txt and lab
52. Which task is accomplished in the Code editor?
- (a) Adding forms to the project
  - (b) Adding controls to the form
  - (c) Adding event procedures to the form
  - (d) Both a and b.
  - (e) All of the above.
53. Which is not a feature of a GUI that makes learning a program easy for users?
- (a) Online help
  - (b) WYSIWYG formatting
  - (c) Dialog boxes
  - (d) Detailed key strokes and commands
  - (e) Icons
54. An object is composed of:
- (a) properties.
  - (b) methods.
  - (c) events.
  - (d) Both a and b.
  - (e) All of the above.
55. Which statement about objects is true?
- (a) One object is used to create one class.
  - (b) One class is used to create one object.
  - (c) One object can create many classes.
  - (d) One class can create many objects.
  - (e) There is no relationship between objects and classes.
56. Which is **not** true about forms and controls in Visual Basic?
- (a) They are pre-built.
  - (b) They are graphical objects.
  - (c) New versions of the classes must be created with each project.
  - (d) Buttons can be created with the drag and drop method.
  - (e) All of the above are true.
57. Which is an example of Visual Basic Objects?
- (a) Control objects
  - (b) ASP.NET
  - (c) ADO.NET
  - (d) Both a and b.
  - (e) All of the above.



58. The .Net class library:
- (a) contains over 25,000 classes.
  - (b) uses namespaces to manage all of the classes.
  - (c) has the System.Form namespace for classes used in Windows-based application.
  - (d) Both a and b.
  - (e) All of the above.
59. Which is not a property of the Common control class?
- (a) Show
  - (b) BackColor
  - (c) Font
  - (d) ForeColor
  - (e) Name
60. Which property determines whether a control is displayed to the user?
- (a) Hide
  - (b) Show
  - (c) Visible
  - (d) Enabled
  - (e) Cursor

Ans. (1)(d), (2)(c), (3)(a,c), (4)(a,b,c), (5)(b,c), (6)(a), (7)(c), (8)(d), (9)(b,c), (10)(a,b,c), (11)(d), (12)(a), (13)(d), (14)(b), (15)(b), (16)(c), (17)(d), (18)(c), (19)(b), (20)(a), (21)(c), (22)(d), (23)(c), (24)(c), (25)(b), (26)(a), (27)(d), (28)(b), (29)(d), (30)(c), (31)(c), (32)(b), (33)(c), (34)(c), (35)(a), (36)(d), (37)(c), (38)(d), (39)(b), (40)(b), (41)(b), (42)(c), (43)(a), (44)(c), (45)(b), (46)(c), (47)(c), (48)(b), (49)(b), (50)(b), (51)(c), (52)(c), (53)(d), (54)(e), (55)(d), (56)(c), (57)(e), (58)(d), (59)(a), (60)(c).

**(c) Fill in the Blanks:**

- 1 The keyword \_\_\_\_\_ is used to overload an operator.
  - 2 The \_\_\_\_\_ and \_\_\_\_\_ of operators cannot be changed by overloading them.
  - 3 In protected derivation public members of the base class become \_\_\_\_\_ members of the derived class.
  - 4 Conversion from a basic type to a class type may be achieved using \_\_\_\_\_
  - 5 The process of inheriting features from many base classes is known as \_\_\_\_\_
  - 6 A virtual function can be made pure virtual function by placing \_\_\_\_\_ at the end of its prototype in the class definition.
  - 7 Inheritance represents \_\_\_\_\_ relationship between classes and composition represents \_\_\_\_\_ relationship between classes.
  - 8 A function call resolved at runtime is referred to as \_\_\_\_\_ binding.
  - 9 A \_\_\_\_\_ function causes its class to be abstract.
  - 10 Call by reference is achieved by applying \_\_\_\_\_ operator to the formal parameters.
- Ans. (1)(operator), (2)(syntax and semantics), (3)(private), (4)(constructors), (5)(multiple inheritance), (6)(zero), (7)(kind -of, has-a), (8)(dynamic/late/run-time), (9)(pure virtual),(10)(&)

## II Short Answer Type Questions:

- 1 What are base and derived classes?
- 2 What is a class hierarchy? Explain how inheritance helps in building class hierarchies.
- 3 Can base class, access members of a derived class? Give reasons.
- 4 What are the differences between inheriting a class with public and private visibility mode?
- 5 Explain how base class member functions can be invoked in a derived class if the derived class also has a member function with the same name.
- 6 What are virtual classes? Explain the need for virtual classes while building class hierarchy.
- 7 What are abstract classes? Explain the role of abstract class while building a class hierarchy.
- 8 What is containership or delegation? How does it differ from inheritance?
- 9 What are pure virtual functions? How do they differ from normal virtual functions?
- 10 What are virtual destructors? How do they differ from normal destructors? Can constructors be declared as virtual constructors? Give reasons.
- 11 What are the rules that need to be kept in mind in deciding virtual functions?
- 12 Explain multiple inheritance?
- 13 What are the problems that can arise from multiple inheritance?
- 14 What is the advantage of exception handling?
- 15 Explain terminate() and unexpected() function.
- 16 Illustrate Rethrowing exceptions with an example.
- 17 What is the use of the 'finally' keyword?
- 18 How do define the user-defined exceptions?
- 19 Which exception is thrown by dynamic\_cast?
- 20 Which function is used to position back from the end of file object?
- 21 How many number of objects are used for input and output to a string?
- 22 Which member function is used to determine whether the stream object is currently associated with a file?
- 23 What are file pointers? Describe get-pointers and put-pointers.
- 24 What are the differences between sequential and random files?
- 25 What are the differences between ASCII and binary files?
- 26 What are exceptions? What are the differences between synchronous and asynchronous exceptions?
- 27 What is the syntax for indicating a list of exceptions that a function can raise? What happens if an unspecified exception is raised?
- 28 What happens when a raised exception is not caught by catch-block?
- 29 How does C++'s throwing and catching exceptions differ from C's set jmp () and longjmp ()?
- 30 Compare aggregation and containership. Give an illustration.
- 31 Mention any two parametric and non-parametric manipulators used in C++.
- 32 Define data abstraction and data hiding.
- 33 What is pure virtual functions? Explain with an example.
- 34 What is run-time error, logical error and syntax error?
- 35 What is the role of #include directive in C++?

- 36 What is compiler and linker?
- 37 Why is char often treated as integer data type in C++ ?
- 38 What is type conversion in C++ ?
- 39 What is type casting in C++ ?
- 40 What is the effect of absence of break in switch case in C++ ?

### III Long Answer Type Questions:

- 1 What is modular programming and what are its benefits? Explain the same with a C++ example.
- 2 Explain different components of a C++ program with a suitable example program.
- 3 What are the differences between actual parameters and formal parameters?
- 4 What are caller and callee? List the various components causing the overhead of function invocation.
- 5 What are library functions? Explain how they ease program development. What are the different categories of functions supported by C++ library?
- 6 What is parameter passing? Explain parameter-passing schemes supported by C++.
- 7 What is function overloading? Discuss in detail with examples.
- 8 Define terms: scope and extent. Explain different storage classes supported by C++. Also, explain their scope and extent.
- 9 What is operator overloading? Explain the importance of operator overloading.
- 10 What is inheritance? Explain the need of inheritance with suitable examples.
- 11 What are the different forms of inheritance supported by C++? Explain them with an example.
- 12 What is visibility mode? What are the different inheritance visibility modes supported by C++?
- 13 Describe different methods of realizing polymorphism in C++.
- 14 What is function overriding? Explain with example.
- 15 Explain the concepts of aggregation, composition, and class hierarchies
- 16 (a) Write short notes on Abstract Data Type (ADT) Conversions  
(b) Explain in detail about Unary Operator Overloading with example program.
- 17 (a) Explain in detail about Friend Function with example program.  
(b) Discuss about the Over loadable Operators.
- 18 (a) What are the differences between the accesses specifies private and protected?  
(b) What are base and derived classes? Write a program to use these classes
- 19 (a) What are the different forms of inheritance? Explain with an example.  
(b) What is class hierarchy? Explain how inheritance helps in building class hierarchies.
- 20 (a) Justify the need for virtual functions in C++.  
(b) What are the rules that need to be kept in mind in deciding virtual functions?
- 21 (a) Explain how the compiler process calls to a function template.  
(b) Explain overloaded function templates with suitable example program.
- 22 What is generic programming? What are its advantages and state some of its applications?
- 23 What is a function template? Discuss with the help of an example.  
What is a class template? Explain the syntax of a class template with suitable examples.

- 24 Discuss the exception handling mechanism in C++.
- 25 What are manipulators? How do we implement them?
- 26 Explain what the default assignment operator = does when applied to objects.
- 27 Class D is derived from class (b) The class D does not contain any array member of its own. Does the class D require constructors? If yes, why?
28. Compare structure and class. Give their applications.
29. Write a program to illustrate reference variables and pointer variables.
- 30 Write a program to illustrate the following constructors in C++:-
  - i) Default constructor
  - ii) Copy Constructor
  - iii) Parameterized constructor
- 31 Explain the working of virtual functions in dynamic polymorphism used in C++. Give an illustration.
- 32 In control structure switch-case what is the purpose of default in C++?
- 33 What is the difference between while and do-while loop?
- 34 What are the different forms of inheritance in C++?
- 35 What is virtual base class in C++? What is its significance?
- 36 How are binary files different from text files in C++?
- 37 What is a stream? Name the streams generally used for file I/O.
- 38 Difference between get() and getline().
- 39 Difference between ios::app and ios::out.
- 40 What is pointer arithmetic? How is it performed?

#### **IV Practical Questions:**

- 1 Imagine a publishing company that markets both books & audio cassette versions of its works. Create a class 'publication' that stores the title (a string) & price (float) of a publication. From this class derive two classes. Book, which adds a page count (int) and tape which adds a playing time in minutes (float). Each of these three classes should have a getdata() function to enter the data from the user at the keyboard & the putdata() function to display the data.  
Write main program to test the book & tape classes.
- 2 Write a program to create a class player which is inherited by two classes named as footballer and cricket class. The player class contains the data of both football and cricket class.
- 3 Write a program to Overload Binary operators (+, -, \*) taking an example of a class storing Complex numbers (Real & Imaginary parts).
- 4 Write a Program to overload unary operators(--,++)
- 5 Create a class that concatenates two strings using operator overloading.
- 6 Create a class having a 3\*3 matrix as the private data member. Add into it functions for adding subtracting and multiplying two matrices using operator overloading. Add another function that calculates the transpose of a matrix.
- 7 Create a class for storing dates. Write a program to sort ten dates using operator overloading. (Create operator > function for that).
- 8 Write a program to find the area of at least 4 different geometrical shapes using function overloading.

- 9 Write a program to overload new and delete operators
- 10 Write a program demonstrating the technique of type conversion from one class type to another class type.
- 11 Write a program to demonstrate the use of the template class with two generic data types.
- 12 Write a program to demonstrate the compile time binding of the member function of the class.
- 13 Create two classes, A and B, with default constructors that announce themselves. Inherit a new class called C from A, and create a member object of B in C, but do not create a constructor for C. Create an object of class C and observe the results.
- 14 Create a three-level hierarchy of classes with default constructors, along with destructors, both of which announce themselves to cout. Verify that for an object of the most derived type, all three constructors and destructors are automatically called. Explain the order in which the calls are made.
- 15 Create two classes called Traveller and Pager without default constructors, but with constructors that take an argument of type string, which they simply copy to an internal string variable. For each class, write the correct copy-constructor and assignment operator. Now inherit a class BusinessTraveller from Traveller and give it a member object of type Pager. Write the correct default constructor, a constructor that takes a string argument, a copy-constructor, and an assignment operator.
- 16 Write a program to copy data from a file temp1.dat to other file temp2.dat using C++ file stream functions. Use exception handling to verify the existence of file temp1.dat.

## UNIT - IV

### I Test Your Skills:

#### (a) State Whether the Following Statements are True or False:

- 1 Generic-data type is known at runtime.
- 2 Templates are processed by the compiler.
- 3 A derived class of a template based base class is not necessarily template-derived class.
- 4 The syntax for defining objects of a class template is slightly different from the definition of the normal class's objects.
- 5 Parameters to constructors can be of template type.
- 6 An iterator is a generalized form of pointer.
- 7 One purpose of an iterator is to connect algorithms to containers.
- 8 STL algorithms are member functions of containers.
- 9 The member function end() returns a reference to the last element in the container.
- 10 A map can have two or more elements with the same key value.

Ans. (1)(F), (2)(T), (3)(T), (4)(T), (5)(T), (6)(T), (7)(T), (8)(F), (9)(T), (10)(F)

#### (b) Multiple Choice Questions:

- 1 Which of the following is an associative container?  
(a) list

- (b) queue
  - (c) map
  - (d) none of the above
- 2 Which of the following is a sequence container?
- (a) stack
  - (b) deque
  - (c) queue
  - (d) set
- 3 Which of the following are valid UML diagrams?
- (a) Sequence Diagram
  - (b) Use-Case Diagram
  - (c) Class Diagram
  - (d) All of the above
- 4 Which one is the element of a sequence diagram?
- (a) Message
  - (b) Aggregation
  - (c) Class
  - (d) Things
- 5 Which of the following is not a valid keyword in exception handling mechanism of C++?
- (a) try
  - (b) throw
  - (c) catch
  - (d) finally
- 6 Which of the following statements is false?
- (a) Multiple catch blocks can be associated with a single try block.
  - (b) Exceptions can be re-thrown
  - (c) Exceptions can be classified as synchronous and asynchronous
  - (d) None of the above
- 7 Which file function returns the current position of the get pointer?
- (a) seekg()
  - (b) seekp()
  - (c) tellg()
  - (d) tellp()
- 8 Which file mode opens the file in append mode?
- (a) ios::in
  - (b) ios::out
  - (c) ios::ate
  - (d) ios::app

- 9 Which header file provides a set of functions called manipulators?
- (a) conio.h
  - (b) iostream.h
  - (c) iomanip.h
  - (d) fstream.h
- 10 State chart diagrams do not include:
- (a) Messages
  - (b) Initial State
  - (c) History State
  - (d) Transition
- 11 We can output text to an object of class ostream using the insertion operator<< because
- (a) the ostream class is a stream
  - (b) the insertion operator works with all classes.
  - (c) we are actually outputting to cout.
  - (d) the insertion operator is overloaded in ostream.
- 12 An exception is caused by
- (a) a hardware problem
  - (b) a problem in the operating system
  - (c) a syntax error
  - (d) a run-time error
- 13 The actual source code for implementing a template function is created when
- (a) The declaration of function appears.
  - (b) The function is invoked.
  - (c) The definition of the function appears.
  - (d) None of the above.
- 14 An exception is caused by
- (a) A runtime error.
  - (b) A syntax error.
  - (c) A problem in the operating system.
  - (d) A hardware problem.
- 15 Which of the following statements are true in C++?
- (a) Classes can not have data as public members.
  - (b) Structures can not have functions as members.
  - (c) Class members are public by default.
  - (d) None of these.
- 16 What is the error in the following code?
- ```
class t
{
virtual void print();
```

- ```
}
(a) No error.
(b) Function print() should be declared as static.
(c) Function print() should be defined.
(d) Class t should contain data members.
```
- 17 Maximum number of template arguments in a function template is
- (a) one
  - (b) two
  - (c) three
  - (d) many
- 18 In access control in a protected derivation, visibility modes will change as follows:
- (a) private, public and protected become protected
  - (b) only public becomes protected.
  - (c) public and protected become protected.
  - (d) only private becomes protected.
- 19 What will be the output of the following program?
- ```
#include<iostream.h>
void main()
{
float x=5,y=2;
int result;
result=x % y;
cout<<result;
}
(a) 1
(b) 1.0
(c) Error message
(d) 2.5
```
- 20 Which is used to describe the function using placeholder types?
- (a) template parameters
  - (b) template type parameters
  - (c) template type
  - (d) none of the mentioned
- 21 What can be passed by non-type template parameters during compile time?
- (a) int
  - (b) float
  - (c) constant expression
  - (d) none of the mentioned
- 22 From where does the template class derived?
- (a) regular non-templated C++ class



- (b) templated class
  - (c) a or b
  - (d) none of the mentioned
- 23 What is the Run-Time Type Information?
- (a) Information about an object's datatype at runtime
  - (b) Information about the variables
  - (c) Information about the given block
  - (d) None of the mentioned
- 24 At which time does the static\_cast can be applied?
- (a) Compile-time construct
  - (b) Runtime construct
  - (c) Both a & b
  - (d) None of the mentioned
- 25 What is meant by exception specification?
- (a) A function is limited to throwing only a specified list of exceptions.
  - (b) A catch can catch all types of exceptions.
  - (c) A function can throw any type of exceptions.
  - (d) None of the mentioned
- 26 Identify the correct statement about throw(type).
- (a) A function can throw any type of exceptions.
  - (b) A function can throw an exception of certain type only.
  - (c) A function can't throw any type of exception.
  - (d) None of the mentioned
- 27 What will happen when a programs throws any other type of exception other than specified?
- (a) terminate
  - (b) arise an error
  - (c) run
  - (d) none of the mentioned
- 28 What do you meant by "No exception specification"?
- (a) It throws nothing
  - (b) It can throw anything
  - (c) It can catch anything
  - (d) None of the mentioned
- 29 Which operations don't throw anything?
- (a) Operations which are reversible.
  - (b) Operations which are irreversible.
  - (c) Operations which are static.

(d) Operations which are dynamic.

30 What is the output of this program?

```
1.     #include <iostream>
2.     #include <string>
3.     #include<typeinfo>
4.     using namespace std;
5.     int main( )
6.     {
7.         try
8.         {
9.             string strg1("Test");
10.            string strg2("ing");
11.            strg1.append(strg2, 4, 2);
12.            cout<< strg1 <<endl;
13.        }
14.        catch (exception &e)
15.        {
16.            cout<< "Caught: " <<e.what() <<endl;
17.            cout<< "Type: " <<typeid(e).name() <<endl;
18.        };
19.        return 0;
20.    }
```

- (a) out of range
- (b) bad type\_id
- (c) bad allocation
- (d) none of the mentioned

31 Where does the allocaters are used?

- (a) Allocation of memory
- (b) Deallocation of memory
- (c) Used for pointers
- (d) Both a & b

32 Where does the allocaters are implemented?

- (a) Template library
- (b) Standard library
- (c) C++ code library
- (d) None of the mentioned

33 Which operator is used to allocate the memory?

- (a) =
- (b) +
- (c) new
- (d) free

- 34 Which operator is used to deallocate the memory?
- destroy
  - free
  - empty
  - None of the mentioned
- 35 Which header file is used to manipulate the allocator?
- allocator
  - memory
  - object
  - None of the mentioned
- 36 What is the use of reference member type in allocator?
- Point to an element
  - Quantities of element
  - Reference to an element
  - None of the mentioned
- 37 What is the correct syntax for declaring an allocator?
- template < class T > class allocator;
  - template < class T > class;
  - template class allocator;
  - None of the mentioned
- 38 What is the output of this program?
- ```

1. #include <iostream>
2. #include <memory>
3. #include <algorithm>
4. using namespace std;
5. int main ()
6. {
7.     int numbers[]={1, 5, 4, 5};
8.     pair <int*, ptrdiff_t> result =get_temporary_buffer<int>(4);
9.     if(result.second>0)
10.    {
11.        uninitialized_copy(numbers, numbers +result.second, result.first);
12.        sort (result.first, result.first+result.second);
13.        for(int i =0; i <result.second; i++)
14.            cout<<result.first[i]<<" ";
15.        return_temporary_buffer(result.first);
16.    }
17.    return 0;
18. }

```
- 1 5 5 4
  - 5 5 4 1
  - 1 4 5 5

(d) 1 4 5 2

39 What is the output of this program?

```
1. #include <iostream>
2. #include <memory>
3. #include <string>
4. using namespace std;
5. int main ()
6. {
7.     string numbers[]={"steve", "jobs"};
8.     pair <string*, ptrdiff_t> result =get_temporary_buffer<string>(2);
9.     if(result.second>0)
10.    {
11.        uninitialized_copy( numbers, numbers +result.second, result.first);
12.        for(int i =0; i <result.second; i++)
13.            cout<<result.first[i]<<" ";
14.        return_temporary_buffer(result.first);
15.    }
16.    return 0;
17. }
```

- (a) steve
- (b) jobs
- (c) jobs steve
- (d) steve jobs

40 What is the output of this program?

```
1. #include <iostream>
2. #include <memory>
3. #include <string>
4. using namespace std;
5. int main ()
6. {
7.     pair <string*, ptrdiff_t>
8.     result =get_temporary_buffer<string>(3);
9.     if(result.second>0)
10.    {
11.        uninitialized_fill(result.first, result.first+result.second,
12.        "Hai");
13.        for(int i=0; i<result.second; i++)
14.            cout<<result.first[i];
15.        return_temporary_buffer(result.first);
16.    }
17.    return 0;
18. }
```

- (a) Hai
- (b) HaiHai

- (c) HaiHaiHai
- (d) None of the mentioned

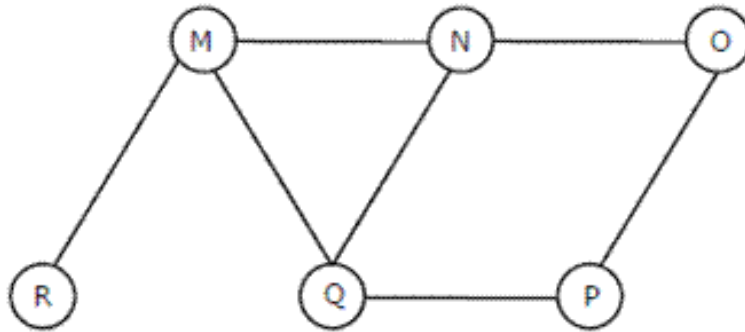
41 Which of the following algorithms can be used to most efficiently determine the presence of a cycle in a given graph?

- (a) Depth First Search
- (b) Breadth First Search
- (c) Prim's Minimum Spanning Tree Algorithm
- (d) Kruskal's Minimum Spanning Tree Algorithm

42 Traversal of a graph is different from tree because

- (a) There can be a loop in graph so we must maintain a visited flag for every vertex
- (b) DFS of a graph uses stack, but inorder traversal of a tree is recursive
- (c) BFS of a graph uses queue, but a time efficient BFS of a tree is recursive.
- (d) All of the above

43 The Breadth First Search algorithm has been implemented using the queue data structure. One possible order of visiting the nodes of the following graph is

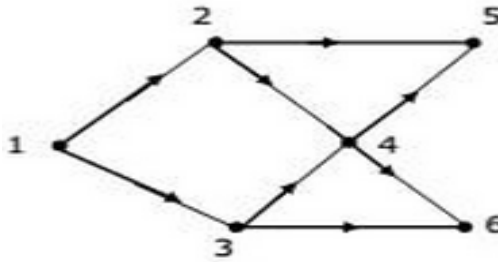


- (a) MNOPQR
- (b) NQMPOR
- (c) QMNPRO
- (d) QMNPOR

44 Make is a utility that automatically builds executable programs and libraries from source code by reading files called makefiles which specify how to derive the target program. Which of the following standard graph algorithms is used by Make.

- (a) Strongly Connected Components
- (b) Topological Sorting
- (c) Breadth First Search
- (d) Dijkstra's Shortest Path

- 45 Consider the DAG with Consider  $V = \{1, 2, 3, 4, 5, 6\}$ , shown below. Which of the following is NOT a topological ordering?



- (a) 1 2 3 4 5 6  
 (b) 1 3 2 4 5 6  
 (c) 1 3 2 4 6 5  
 (d) 3 2 4 1 6 5
- 46 Let  $T$  be a depth first search tree in an undirected graph  $G$ . Vertices  $u$  and  $n$  are leaves of this tree  $T$ . The degrees of both  $u$  and  $n$  in  $G$  are at least 2. which one of the following statements is true?
- (a) There must exist a vertex  $w$  adjacent to both  $u$  and  $n$  in  $G$   
 (b) There must exist a vertex  $w$  whose removal disconnects  $u$  and  $n$  in  $G$   
 (c) There must exist a cycle in  $G$  containing  $u$  and  $n$   
 (d) There must exist a cycle in  $G$  containing  $u$  and all its neighbours in  $G$ .
- 47 The relationship between number of back edges and number of cycles in DFS is,
- (a) Both are equal  
 (b) Back edges are half of cycles  
 (c) Back edges are one quarter of cycles  
 (d) There is no relationship between no. of edges and cycles
- 48 What algorithm technique is used in the implementation of Kruskal solution for the MST?
- (a) Greedy Technique  
 (b) Divide-and-Conquer Technique  
 (c) Dynamic Programming Technique  
 (d) The algorithm combines more than one of the above techniques
- 49 A digraph is strongly connected under what condition?
- (a) A digraph is strongly connected if for every pair of vertices  $u, v \in V$ ,  $u$  can reach  $v$ .  
 (b) A digraph is strongly connected if for every pair of vertices  $u, v \in V$ ,  $u$  can reach  $v$  and vice versa.  
 (c) A digraph is strongly connected if for at least one pair of vertex  $u, v \in V$ ,  $u$  can reach  $v$  and vice versa.  
 (d) A digraph is strongly connected if at least one third pair of vertices  $u, v \in V$ ,  $u$  can reach  $v$  and vice versa.

- 50 The relationship between number of back edges and number of cycles in DFS is,
- (a) Both are equal
  - (b) Back edges are half of cycles
  - (c) Back edges are one quarter of cycles
  - (d) There is no relationship between no. of edges and cycles
- 51 What is the correct value to return to the operating system upon the successful completion of a program?
- (a) A. -1
  - (b) B. 1
  - (c) C. 0
  - (d) D. Programs do not return a value.
- 52 What is the only function all C++ programs must contain?
- (a) A. start()
  - (b) B. system()
  - (c) C. main()
  - (d) D. program()
- 53 What punctuation is used to signal the beginning and end of code blocks?
- (a) A. { }
  - (b) B. -> and <-
  - (c) C. BEGIN and END
  - (d) D. ( and )
- 54 What punctuation ends most lines of C++ code?
- (a) A. . (dot)
  - (b) B. ; (semi-colon)
  - (c) C. : (colon)
  - (d) D. ' (single quote)
- 55 Which of the following is a correct comment?
- (a) A. /\* Comments \*/
  - (b) B. \*\* Comment \*\*
  - (c) C. /\* Comment \*/
  - (d) D. { Comment }
- 56 Which of the following is not a correct variable type?
- (a) A. float
  - (b) B. real
  - (c) C. int
  - (d) D. double
- 57 Which of the following is the correct operator to compare two variables?
- (a) A. :=
  - (b) B. =

- (c) C. equal
- (d) D. ==

58 Which of the following is true?

- (a) A. 1
- (b) B. 66
- (c) C. .1
- (d) D. -1
- (e) E. All of the above

59 Which of the following is the boolean operator for logical-and?

- (a) A. &
- (b) B. &&
- (c) C. |
- (d) D. |&

60 Evaluate !(1 && !(0 || 1)).

- (a) A. True
- (b) B. False
- (c) C. Unevaluatable

Ans. (1)(c), (2)(b), (3)(d), (4)(a), (5)(d), (6)(d), (7)(c), (8)(d), (9)(c), (10)(a), (11)(d), (12)(d), (13)(b), (14)(a), (15)(b), (16)(a), (17)(d), (18)(c), (19)(c), (20)(b), (21)(c), (22)(c), (23)(a), (24)(a), (25)(a), (26)(b), (27)(b), (28)(b), (29)(b), (30)(a), (31)(d), (32)(b), (33)(c), (34)(b), (35)(b), (36)(c), (37)(a), (38)(c), (39)(d), (40)(c), (41)(a), (42)(a), (43)(c), (44)(b), (45)(d), (46)(b), (47)(d), (48)(a), (49)(b), (50)(d), (51)(c), (52)(c), (53)(a), (54)(b), (55)(c), (56)(b), (57)(d), (58)(e), (59)(b), (60)(a).

(c) **Fill in the Blanks:**

- 1 An exception is typically caused by \_\_\_\_\_ error.
- 2 A function template definition begins with the keyword \_\_\_\_\_.
- 3 The three STL container adapters are stack, queue, and \_\_\_\_\_.
- 4 The function \_\_\_\_\_ writes a single character to the associated stream.
- 5 Output operations are supported by the \_\_\_\_\_ class.
- 6 The code that is likely to produce an exception is enclosed in a \_\_\_\_\_ block.
- 7 UML stands for \_\_\_\_\_.
- 8 \_\_\_\_\_ containers are designed to support direct access to elements using keys.
- 9 Opening a file in ios::out mode also opens it in the \_\_\_\_\_ mode by default.
- 10 The three basic elements in a UML use case diagram are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

Ans. (1)(run-time), (2)(template), (3)(priority\_queue), (4)(put), (5)(ostream), (6)(try), (7)(Unified Modelling Language) (8)(Associative), (9)(ios::trunc), (10)(Actors, Use cases, control flow)



## II Short Answer Type Questions:

- 1 List the three types of containers.
- 2 What is the difference between a sequence container and an associative container?
- 3 What is an iterator? What are its characteristics?
- 4 What is UML?
- 5 Compare class diagram and object diagram.
- 6 Discuss the features of UML.
- 7 What are namespaces?
- 8 What are persistent objects?
- 9 Distinguish between the following:
  - a) Lists and vectors
  - b) Sets and Maps
  - c) Maps and Multimaps
  - d) Queue and Dequeue
  - e) Arrays and Vectors
- 10 What are Streams?
- 11 What are C++ streams?
- 12 Why is secondary memory preferred to main memory for permanent storage of programs and data?
- 13 What is a File?
- 14 Explain the various file stream classes needed for File Manipulators.
- 15 What are the steps involving Opening and Closing of Files.
- 16 What is a Binary Search Tree?
- 17 What is a linked list?
- 18 What is a spanning tree?
- 19 What entity is often used to customize the behavior of an algorithm?
- 20 When is a template a better solution than a base class?
- 21 What is a mutable member?
- 22 Describe run-time type identification.
- 23 What are Stacks? Give an example where they are useful.
- 24 Differentiate between an external iterator and an internal iterator? What is the advantage of an external iterator.
- 25 How would you find out if a linked-list is a cycle or not?
- 26 What do you mean by templates in C++?
- 27 Explain how the compiler processes calls to a function template.
- 28 Explain how the compiler processes calls to a class template?
- 29 Distinguish between overloaded functions and function templates.
- 30 Distinguish between the terms class template and template class.
- 31 Explain the role of STL in object oriented programming language.
- 32 How is OOP implement in C++?
- 33 What is abstract class?
- 34 What is concrete class?
- 35 What is a constructor? What are its features?
- 36 What does a destructor do?
- 37 Define inheritance.

### III Long Answer Type Questions:

- 1 What are streams? Explain the features of C++ stream I/O with C's I/O system.
- 2 List C++ predefined streams and explain them with suitable example programs.
- 3 Draw console stream class hierarchy and explain its members.
- 4 Explain the various methods of performing formatted stream I/O operations.
- 5 What is a file? What are the steps involved in manipulating a file in a C++ program?
- 6 Explain the various file stream classes needed for file manipulations?
- 7 Describe different methods of opening a file.
- 8 What are the different types of errors that might pop-up while processing files?
- 9 What are file modes? Describe various file mode options available?
- 10 Explain the exception handling model of C++ with various constructs supported by it.
- 11 What is STL? How is it different from the C++ Standard Library? Why is it gaining importance among the programmers?
- 12 What is an algorithm? How STL algorithms are different from the conventional algorithms?
- 13 Discuss the performance characteristics of the three sequence containers.
- 14 Explain the various operations that can be performed on a linked list.
- 15 What are use cases? Explain with suitable examples.
- 16
  - (a) Draw console stream class hierarchy and explain its members.
  - (b) Explain the various methods of performing formatted stream I/O operations.
- 17 What are manipulators? List the various predefined manipulators supported by c++
  - (a) I/O streams.
  - (b) Explain how standard manipulators are implemented.
- 18
  - (a) What is a File? What are steps involved in manipulating a file in a C++ programs?
  - (b) What are the different types of error that might pop-up while processing files?
- 19 What are file modes? Describe various file mode options available?
- 20
  - (a) What are file pointers? Describe get-pointers and put-pointers?
  - (b) What are the differences between sequential and random access files?
- 21
  - (a) What are Exceptions? What are the differences between synchronous and a synchronous exceptions?
  - (b) Write a program to demonstrate the catching of all exceptions.
- 22 List the ten rules for handling exceptions successfully.
- 23 Explain class diagram in detail. What is the difference between class and object diagram. Draw the class diagram for ATM .
- 24 How do we implement generic stack using class templates?
- 25 What are the various operations that can be performed on a BST?
- 26 A template can be considered as a kind of macro, and then, what is the difference between them.
- 27 Distinguish between the overloaded function and function template. Explain with suitable example.
- 28 Explain the following STL components with any two functions for each.
  - (i) Containers
  - (ii) Iterators
  - (iii) Algorithms
- 29 Define function template and class template.

- 30 Write short notes from any two of the following:
- (i) Graph algorithms using STL
  - (ii) Overloading and overriding of member functions
  - (iii) Limitations of generic programming.
- 31 What is pointer arithmetic? How is it performed?
- 32 Differentiate between static and dynamic allocation of memory.
- 33 What do you understand by memory leaks? How can memory leaks be avoided?
- 34 What is this pointer? What is its Significance?
- 35 What is the full form of LIFO? Give an example of LIFO list?

#### **IV Practical Questions:**

- 1 Write a program to implement the exception handling while pushing an element in the stack.
- 2 Write a program, which implements the given functionalities:  
Make a structure Employee with following fields:  
Emp\_ID, Name and Age  
Get values from the user till user enters 'N'. Store them in a file. Read the values from the file and print them on screen.
- 3 Write a sort program to demonstrate the concept of re-throwing of an exception and multiple catch handlers. You may use any sorting algorithm (name the algorithm).
- 4 W.(a)P. to implement stack operations using templates.
- 5 Draw Sequence diagram for Cash Withdrawal from ATM machine.
- 6 Draw a class and object diagram for the library management system.
- 7 Draw a sequence diagram for the execution of a process by the operating system?
- 8 Write a function template for finding the largest number in a given array. The array parameter must be of generic-data types.
- 9 Write a program to copy the contents of one file to another.
- 10 Write a program illustrating the concept of namespaces.
- 11 Write the program to perform bubble sort using the template function.
- 12 Write a program that applies the sort() algorithm to an array of floating point values entered by the user, and displays the result
- 13 Fill an array with even numbers and a set with odd numbers. Use the merge() algorithm to merge these containers into a vector. Display the vector contents to show that all went well.
- 14 Write a program that copies a source file of integers to a destination file, using stream iterators. The user should supply both source and destination filenames to the program. You can use a while loop approach. Within the loop, read each integer value from the input iterator and write it immediately to the output iterator, then increment both iterators.

# **QUESTION BANK**

## **OPERATING SYSTEM**

### **MCA 106**

**QUESTION BANK**  
**OPERATING SYSTEM - MCA 106**  
**MCA II**

**UNIT - I**

**I Test Your Skills:**

**(a) State Whether the Following Statements are True or False:**

- 1 A multiprogramming system necessarily has multiple processors.
- 2 Multitasking can be achieved only through time-sharing.
- 3 Real time systems are time critical systems.
- 4 Speed of computer operation does not depend on OS.
- 5 Device drivers are extension to the OS.
- 6 A virtual machine must have at least 2 processors.
- 7 UNIX is not a real time OS.
- 8 Multiprogramming is different from multi-tasking.
- 9 A distributed system is fault tolerant.
- 10 Multi-tasking is possible because of time-sharing.
- 11 The operating system acts as an interface between the computer hardware and the human user.
- 12 In a uniprocessor machine, concurrent processes cannot be overlapped; they can only be interleaved.
- 13 Operating System is not a single program but set of programs.
- 14 Real time OS pays more attention on the meeting of the time limits.
- 15 Process state is the part of Inode.

Ans. (1)(F), (2)(F), (3)(T), (4)(F), (5)(T), (6)(F), (7)(F), (8)(T), (9)(T), (10)(T), (11)(T), (12)(T), (13)(T), (14)(T), (15)(F)

**(b) Multiple Choice Questions:**

- 1 Virtual memory is
  - (a) An extremely large main memory
  - (b) An extremely large secondary memory
  - (c) An illusion of an extremely large memory
  - (d) A type of memory used in super computers
  
- 2 Spatial locality refers to the problem that once a location is referenced
  - (a) It will not be referenced again
  - (b) It will be referenced again
  - (c) A nearby location will be referenced soon
  - (d) None of the above

- 3 Page fault occurs when
- (a) The page is corrupted by application software
  - (b) The page is in main memory
  - (c) The page is not in main memory
  - (d) One tries to divide a number by 0
- 4 Overlay is
- (a) A part of an operating system
  - (b) A specific memory location
  - (c) A single contiguous memory that was used in the olden days for running large programs by swapping.
  - (d) Overloading the system with many user files
- 5 Determine the number of page faults when references to pages occur in the order -1, 2, 4, 5, 2, 1, 2,4. Assume that the main memory can accommodate 3 pages and the main memory already has the pages 1 and 2, with page 1 having been brought earlier than page 2. (Assume LRU algorithm is used)
- (a) 3
  - (b) 5
  - (c) 4
  - (d) None of the above
- 6 The page replacement policy that sometimes leads to more page faults when the size of the memory is increased is
- (a) FIFO
  - (b) LRU
  - (c) No such policy exists
  - (d) None of the above
- 7 Fragmentation is
- (a) Dividing the secondary memory into equal sized fragments
  - (b) Dividing the main memory into equal-sized fragments
  - (c) Fragments of memory words used in a page
  - (d) Fragments of memory words unused in a page
- 8 Which of the following are real-time systems?
- (a) An on-line railway reservation system
  - (b) A process control system
  - (c) Aircraft control system
  - (d) Payroll processing system
- 9 In paged memory systems, if the page size is increased, then the internal fragmentation generally
- (a) Becomes less
  - (b) Becomes more
  - (c) Remains constant
  - (d) None of the above

- 10 In a time-sharing operating system, when the time slot given to a process is completed, the process goes from the RUNNING state to the
- (a) BLOCKED state
  - (b) READY state
  - (c) SUSPENDED state
  - (d) TERMINATED state
- 11 If the property of locality of reference is well pronounced in a program
- (a) The number of page faults will be more
  - (b) The number of page faults will be less
  - (c) The number of page faults will remain the same
  - (d) Execution will be faster
- 12 Which of the following will determine your choice of systems software for your computer?
- (a) Is the applications software you want to use compatible with it?
  - (b) Is it expensive?
  - (c) Is it compatible with your hardware?
  - (d) Both 1 and 3
- 13 What is a shell?
- (a) It is a hardware component
  - (b) It is a command interpreter
  - (c) It is a part in compiler
  - (d) It is a tool in CPU scheduling
- 14 A program at the time of executing is called \_\_\_\_\_.
- (a) Dynamic program
  - (b) Static program
  - (c) Binded Program
  - (d) A Process
- 15 The kernel keeps track of the state of each task by using a data structure called \_\_\_\_
- (a) Process control block
  - (b) User control block
  - (c) Memory control block
  - (d) None of the above
- 16 A program in execution is called
- (a) Process
  - (b) Instruction
  - (c) Procedure
  - (d) Function
- 17 Interval between the time of submission and completion of the job is called
- (a) Waiting time

- (b) Turnaround time
  - (c) Throughput
  - (d) Response time
- 18 A scheduler which selects processes from secondary storage device is called
- (a) Short term scheduler.
  - (b) Long term scheduler.
  - (c) Medium term scheduler.
  - (d) Process scheduler.
- 19 The scheduling in which CPU is allocated to the process with least CPU-burst time is called
- (a) Priority Scheduling
  - (b) Shortest job first Scheduling
  - (c) Round Robin Scheduling
  - (d) Multilevel Queue Scheduling
- 20 The term 'page traffic' describes
- (a) Number of pages in memory at a given instant.
  - (b) Number of papers required to be brought in at a given page request.
  - (c) The movement of pages in and out of memory.
  - (d) Number of pages of executing programs loaded in memory.
- 21 The "turn-around" time of a user job is the
- (a) Time since its submission to the time its results become available.
  - (b) Time duration for which the CPU is allotted to the job.
  - (c) Total time taken to execute the job.
  - (d) Time taken for the job to move from assembly phase to completion phase.
- 22 Round robin scheduling is essentially the preemptive version of \_\_\_\_\_.
- (a) FIFO
  - (b) Shortest job first
  - (c) Shortest remaining
  - (d) Longest time first
- 23 To access the services of operating system, the interface is provided by the
- (a) system calls
  - (b) API
  - (c) library
  - (d) assembly instructions
- 24 Which technique was introduced because a single job could not keep both the CPU and the I/O devices busy?
- (a) Time-sharing
  - (b) Spooling
  - (c) Preemptive scheduling



- (d) Multiprogramming
- 25 Routine is not loaded until it is called. All routines are kept on disk in a relocatable load format. The main program is loaded into memory & is executed. This type of loading is called \_\_\_\_\_
- (a) Static loading
  - (b) Dynamic loading
  - (c) Dynamic linking
  - (d) Overlays
- 26 The process related to process control, file management, device management, information about system and communication that is requested by any higher level language can be performed by \_\_\_\_\_.
- (a) Editors
  - (b) Compilers
  - (c) System Call
  - (d) Caching
- 27 Multiprogramming systems \_\_\_\_\_.
- (a) Are easier to develop than single programming systems
  - (b) Execute each job faster
  - (c) Execute more jobs in the same time
  - (d) Are used only on large main frame computers
- 28 Which is not the state of the process?
- (a) Blocked
  - (b) Running
  - (c) Ready
  - (d) Privileged
- 29 The number of processes completed per unit time is known as \_\_\_\_\_.
- (a) Output
  - (b) Throughput
  - (c) Efficiency
  - (d) Capacity
- 30 The state of a process after it encounters an I/O instruction is \_\_\_\_\_.
- (a) Ready
  - (b) blocked/Waiting
  - (c) Idle
  - (d) Running
- 31 If a system contains CPU bound processes then which of the following scheduling algorithm produces maximum efficiency of the CPU :
- (a) FIFO
  - (b) Round Robin

- (c) SJF
  - (d) Priority
- 32 A form of code that uses more than one process and processor, possibly of different type, and that may on occasions have more than one process or processor active at the same time, is known as
- (a) Multiprogramming
  - (b) Multithreading
  - (c) Broadcasting
  - (d) Timesharing
- 33 \_\_\_\_\_ is used to request the OS by the process to take an I/O or initiating child process.
- (a) System call
  - (b) Interrupt
  - (c) Trap
  - (d) Signal
- 34 The number of processes completed per unit time is called\_\_\_\_\_.
- (a) Turn around time
  - (b) Throughput
  - (c) Response time
  - (d) Dispatch latency
- 35 Round robin scheduling is essentially the preemptive version of \_\_\_\_\_.
- (a) FIFO
  - (b) Shortest job first
  - (c) Shortest remaining
  - (d) Longest time first
- 36 A thread
- (a) is a lightweight process where the context switching is low
  - (b) is a lightweight process where the context switching is high
  - (c) is used to speed up paging
  - (d) none of the above
- 37 FIFO scheduling is \_\_\_\_\_.
- (a) Preemptive Scheduling
  - (b) Non Preemptive Scheduling
  - (c) Deadline Scheduling
  - (d) Fair share scheduling
- 38 In process scheduling, \_\_\_\_\_determines which ready process will be executed next by processor.
- (a) long term scheduling
  - (b) medium term scheduling

- (c) short term scheduling
  - (d) none of the above
- 39 ..... Involves treating main memory as a resource to be allocated to and shared among a number of active processes.
- (a) Partition management
  - (b) Memory management
  - (c) Disk management
  - (d) All of the above
- 40 Which of the following are the states of a five state process model?
- i) Running      ii) Ready      iii) New      iv) Exit      v) Destroy
- (a) i, ii, iii and v only
  - (b) i, ii, iv and v only
  - (c) i, ii, iii, and iv only
  - (d) All i, ii, iii, iv and v
- 41 The Process Control Block is :
- (a) Process type variable
  - (b) Data Structure
  - (c) a secondary storage section
  - (d) a Block in memory
- 42 The state of a process is defined by :
- (a) the final activity of the process
  - (b) the activity just executed by the process
  - (c) the activity to next be executed by the process
  - (d) the current activity of the process
- 43 What is a long-term scheduler ?
- (a) It selects which process has to be brought into the ready queue
  - (b) It selects which process has to be executed next and allocates CPU
  - (c) It selects which process to remove from memory by swapping
  - (d) None of these
- 44 If all processes I/O bound, the ready queue will almost always be \_\_\_\_\_, and the Short term Scheduler will have a \_\_\_\_\_ to do.
- (a) full,little
  - (b) full,lot
  - (c) empty,little
  - (d) empty,lot
- 45 What is a medium-term scheduler ?
- (a) It selects which process has to be brought into the ready queue
  - (b) It selects which process has to be executed next and allocates CPU
  - (c) It selects which process to remove from memory by swapping

- (d) None of these
- 46 Complex scheduling algorithms :
- (a) are very appropriate for very large computers
  - (b) use minimal resources
  - (c) use many resources
  - (d) All of these
- 47 The strategy of making processes that are logically runnable to be temporarily suspended is called:
- (a) Non preemptive scheduling
  - (b) Preemptive scheduling
  - (c) Shortest job first
  - (d) First come First served
- 48 There are 10 different processes running on a workstation. Idle processes are waiting for an input event in the input queue. Busy processes are scheduled with the Round-Robin timesharing method. Which out of the following quantum times is the best value for small response times, if the processes have a short runtime, e.g. less than 10ms ?
- (a)  $tQ = 15\text{ms}$
  - (b)  $tQ = 40\text{ms}$
  - (c)  $tQ = 45\text{ms}$
  - (d)  $tQ = 50\text{ms}$
- 49 A solution to the problem of indefinite blockage of low – priority processes is :
- (a) Starvation
  - (b) Wait queue
  - (c) Ready queue
  - (d) Aging
- 50 Which of the following statements are true ?
- i) Shortest remaining time first scheduling may cause starvation
  - ii) Preemptive scheduling may cause starvation
  - iii) Round robin is better than FCFS in terms of response time
- (a) i only
  - (b) i and iii only
  - (c) ii and iii only
  - (d) i, ii and iii
- 51 To access the services of operating system, the interface is provided by the
- (a) System calls
  - (b) API
  - (c) Library
  - (d) Assembly instructions

52. Which one of the following is not true?
- (a) kernel is the program that constitutes the central core of the operating system.
  - (b) kernel is the first part of operating system to load into memory during booting.
  - (c) kernel is made of various modules which can not be loaded in running operating System.
  - (d) kernel remains in the memory during the entire computer session.
53. The main function of the command interpreter is
- (a) to get and execute the next user-specified command
  - (b) to provide the interface between the API and application program
  - (c) to handle the files in operating system
  - (d) none of the mentioned
54. By operating system, the resource management can be done via
- (a) time division multiplexing
  - (b) space division multiplexing
  - (c) both (a) and (b)
  - (d) none of the mentioned
55. Which one of the following is not a real time operating system?
- (a) VxWorks
  - (b) Windows CE
  - (c) RTLinux
  - (d) Palm OS
56. The part of machine level instruction, which tells the central processor what has to be done, is
- (a) Operation code
  - (b) Address
  - (c) Locator
  - (d) Flip-flop
57. A system program that combines the separately compiled modules of a program into a form suitable for execution
- (a) Assembler
  - (b) Linking Loader
  - (c) Cross-compiler
  - (d) Load and go
58. Process is
- (a) program in High level language kept on disk
  - (b) contents of main memory
  - (c) a program in execution
  - (d) a job in secondary memory

59. The storage-to-storage instructions
- (a) have both their operands in the main store.
  - (b) which perform an operation on a register operand and an operand which is located in the main store, generally leaving the result in the register, except in the case of store operation when it is also written into the specified storage location.
  - (c) which perform indicated operations on two fast registers of the machine and have the result in of the registers.
  - (d) all of the above
60. Addressing Structure
- (a) defines the fundamental method of determining effective operand addresses.
  - (b) are variations in the use of fundamental addressing structures, or some associated actions which are related to addressing.
  - (c) performs indicated operations on two fast registers of the machine and leave the result in one of the registers.
  - (d) all of the above

Ans. (1)(c), (2)(c), (3)(c), (4)(c), (5)(c), (6)(a), (7)(d), (8)(b,c), (9)(b), (10)(b), (11)(b,d), (12)(d), (13)(b), (14)(d), (15)(a), (16)(a), (17)(b), (18)(c), (19)(b), (20)(c), (21)(c), (22)(a), (23)(a), (24)(b), (25)(b), (26)(c), (27)(c), (28)(d), (29)(b), (30)(b), (31)(c), (32)(b), (33)(a), (34)(b), (35)(a), (36)(a), (37)(b), (38)( ), (39)(b), (40)(c), (41)(b), (42)(d), (43)(a), (44)(c), (45)(c), (46)(a), (47)(b), (48)(a), (49)(d), (50)(d), (51)(a), (52)(c), (53)(a), (54)(c), (55)(d), (56)(a), (57)(b), (58)(c), (59)(a), (60)(a).

**(c) Fill in the Blanks:**

- 1 A \_\_\_\_\_ system guarantees that critical tasks complete on time.
- 2 The ability to provide services proportional to the level of surviving hardware is called \_\_\_\_\_.
- 3 \_\_\_\_\_ is not a multiprogramming operating system.
- 4 The core of unix operating system is often called its \_\_\_\_\_.
- 5 The layered approach to OS design was first used in \_\_\_\_\_.
- 6 A thread is a \_\_\_\_\_ process.
- 7 A major problem with priority scheduling is \_\_\_\_\_.
- 8 The Hardware mechanism that enables a device to notify the CPU is called \_\_\_\_\_.
- 9 The strategy of allowing processes that are logically runnable to be temporarily suspended is called \_\_\_\_\_.
- 10 A computer cannot "boot" if it does not have the \_\_\_\_\_.
- 11 Which scheduling policy is most suitable for a time-shared operating system
- 12 \_\_\_\_\_ is a technique of temporarily removing inactive programs from the memory of computer system.

Ans. (1)(Hard Real Time), (2)(Graceful Degradation), (3)(DOS), (4)(Kernel), (5)(THE), (6)(Light weight), (7)(Starvation), (8)(Interrupt), (9)(Preemptive scheduling), (10)(Operating system), 11( Round Robin), 12(Swapping)

## II Short Answer Type Questions:

- 1 Explain in brief the concepts of operating system.
- 2 Give the layered mode operating system architecture.
- 3 Explain the statement- 'OS are the programs that make computers operational'.
- 4 Justify the statement- 'OS are computers resource manager'.
- 5 How is API and operating system related to each other?
- 6 How does an operating system act as resource allocator?
- 7 Draw the diagram for extended-machine view of operating system.
- 8 Explain single processing system.
- 9 Write short note on Batch processing systems.
- 10 Differentiate between multi-tasking and multi-programming.
- 11 "Degree of multiprogramming controls the performance of the computing system." – Comment.
- 12 Define threads.
- 13 How does a short-term scheduler work?
- 14 Define turnaround and wait-times.
- 15 How does a process differ from a program?
- 16 Give the layered architecture of operating system.
- 17 Explain context switching.
- 18 Explain multi-threading environment.
- 19 Define Burst-time. Is it different from CPU time?
- 20 How thread creation differs from that of process creation? Briefly explain
- 21 What are the advantages of having different time quantum sizes on different levels of a multilevel queuing system?
- 22 Differentiate between Process and Thread.
- 23 One of the drawbacks of early OS was that users lost the ability to interact their jobs. How was it overcome in next generation operating system?
- 24 What do you mean by Zombie state of a process?
- 25 What is the purpose of command line interpreter? Why it is usually separated from kernel?
- 26 What is parsing?
- 27 What are the typical elements of a process image?
- 28 What is the Translation Lookaside Buffer (TLB)?
- 29 What is the resident set and working set of a process?
- 30 What is cycle stealing?
- 31 What is the difference between a 'thread' and a 'process'?
- 32 How does real time scheduling differs from normal scheduling?
- 33 What is PCB? List out its contents.
- 34 List any three services provided by an operating system. Explain how each provides convenience to the users.
- 35 Compare short-term, medium-term, and long-term schedulers.
- 36 Explain the Little's law. Why is it important?
- 37 How well does FCFS achieve the goals of a scheduler?
- 38 What are short, long and medium-term scheduling?
- 39 Explain the concept of Reentrancy?

40 Explain Belady's Anomaly?

### III Long Answer Type Questions:

- 1 Explain time-sharing systems in detail.
- 2 Give the architecture of parallel systems. Explain the reason behind their popularity.
- 3 A recent trend in computer systems is to distribute computation among several processors. Explain.
- 4 Write short notes on (a) Benefits of Multi – programming; (b) Characteristics of real time operating systems
- 5 Applications programs interact with operating systems through system calls. Is there any other method of interaction between the two?
- 6 For a network transfer of a file, which system calls do you think will be required? In what order? Give an example of passing of parameter as a table.
- 7 Explain and illustrate operating system architecture. Explain UNIX system structure.
- 8 Give a brief summary of virtual machines. Is virtual memory required in case of single user system? Justify.
- 9 'Job scheduling is the process of sequencing jobs'. Explain.
- 10 Define an Operating System. Give its function, architecture and design.
- 11 Explain in detail non-preemptive scheduling.
- 12 Explain in detail process scheduling with queues.
- 13 A process is created through a create system call. Give the process hierarchy.
- 14 Discuss process control block in detail.
- 15 Explain the differences in the degree to which the following scheduling algorithms discriminate in favor of short processes: FCFS, RR, Multilevel feedback queues.
- 16 Explain the layered structure of an operating system by giving typical operations and the objects that are operated in each layer.
- 17 What is multiprogramming? State objective of multiprogramming. Enlist and explain.
- 18 What are the advantages of OS portability from the point of view of
  - (i) Component Manufacturer
  - (ii) Independent Software vendors
  - (iii) Programmers
  - (iv) Users
- 19 Discuss the main difficulties in writing an OS for a real time environment.
- 20 Which algorithm will be used for CPU scheduling in:
  - (i) Batch OS
  - (ii) Interactive OS
  - (iii) Real time OS? Why?
- 21 State whether following are true or false with justification:
  - (i) Multitasking is a kind of multiprogramming.
  - (ii) Multi-user system does not imply multiprogramming.
22. Response times are more predictable in preemptive system than in non-preemptive system.
- 23 Explain the concept of Process. Draw a process transition diagram and explain the various process states.
- 24 What is marshaling? Explain with example.



- 25 How are deadlocks detected in resource allocation graph algorithm? How can you recover a deadlock?
- 26 List the Coffman's conditions that lead to a deadlock.
- 27 Write short notes on:
- Real time systems
  - System design and implementation.
- 28 Assume that there are 10 jobs, each of which takes 100 sec to execute. Compare the average turn around time for the 10 jobs between FIFO and round robin scheduling.
- 29 Explain how the multi level feedback queue attacks both efficiency and response time problems in scheduling.
- 30 What is the purpose of System calls? Briefly explain the types of system calls provided by a typical operating system.
- 31 What are the various process states? Depict process state diagram.
- 32 Differentiate between types of real time systems.
- 33 What are the reasons for providing process cooperation?
- 34 Discuss the following systems:
- Multiprogramming systems
  - Distributed systems
  - Time sharing systems
- 35 Write short notes on any two:
- Producer-consumer Indefinite buffer problem and its solution
  - Process control block
  - Intrusion deletion
- 36 Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

- 37 Consider the following set of processes, with the length of the CPU burst given in milliseconds.

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0.

- Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1).

- (b) What is the turnaround time of each process for each of the scheduling algorithms in part a?
  - (c) What is the waiting time of each process for each of the scheduling algorithms in part a?
  - (d) Which of the algorithms on part a results in the minimum average waiting time (over all processes)?
- 38 Explain the differences in the degree to which the following scheduling algorithms discriminate in favor of short processes:
- (a) First Come First Served
  - (b) Round Robin
  - (c) Multilevel feedback queues
- 39 Consider a variant of the Round Robin (RR) scheduling algorithm in which the entries in the ready queue are pointers to the PCBs.
- (a) What would be the effect of putting two pointers to the same process in the ready queue?
  - (b) What would be major advantages and disadvantages of this scheme?
  - (c) How would you modify the basic RR algorithm to achieve the same effect without the duplicate pointers?
- 40 A multiprocessor with eight processors has 20 attached tape drives. There is a large number of jobs submitted to the system that each require a maximum of four tape drives to complete execution. Assume that each job starts running with only three tape drives for a long period before requiring the fourth tape drive for a short period toward the end of its operation. Also assume an endless supply of such jobs.
- (a) Assume the scheduler in the OS will not start a job unless there are four tape drives available.  
When a job is started, four drives are assigned immediately and are not released until the job finishes. What is the maximum number of jobs that can be in progress at once? What is the maximum and minimum number of tape drives that may be left idle as a result of this policy?
  - (b) Suggest an alternative policy to improve tape drive utilization and at the same time avoid system deadlock. What is the maximum number of jobs that can be in progress at once? What are the bounds on the number of idling tape drives?

## UNIT - II

### I Test Your Skills:

#### (a) State Whether the Following Statements are True or False:

- 1 All CPU's have some number of registers.
- 2 Each thread has its own stack and program counter.
- 3 A child-process has exactly one parent process.
- 4 If all processes are I/O bound, then the ready-queue will always be full.
- 5 The processes are queued up by a scheduler.
- 6 SJF is pre-emptive scheduling algorithm.

- 7 Threads have more overhead than processes.
- 8 A process may have two parent processes.
- 9 A process may have more than one thread associated with it.
- 10 A process may starve in a round robin scheduling.
- 11 The primary reason why context switches are expensive is that the OS must save and load the program's register values.
- 12 The banker's algorithm is used to rectify deadlock.
- 13 Copying a process from memory to disk to allow space of other processes is called swapping
- 14 Bringing a page into memory only when it is needed is called demand paging.
- 15 Page fault occurs when segmentation starts

Ans. (1)(F), (2)(T), (3)(T), (4)(F), (5)(F), (6)(F), (7)(F), (8)(T), (9)(T), (10)(F), (11)(T), (12)(F), (13)(F), (14)(T), (15)(F)

**(b) Multiple Choice Questions:**

- 1 Concurrent processes are processes that
  - (a) Do not overlap in time
  - (b) Overlap in time
  - (c) Are executed by a processor at the same time
  - (d) None of the above
  
- 2 The only state transition that is initiated by the user process itself is
  - (a) Block
  - (b) Dispatch
  - (c) Wakeup
  - (d) None of the above
  
- 3 Critical region is
  - (a) A part of the operating system which is not allowed to be accessed by any process.
  - (b) A set of instructions that access common shared resource which exclude one another in time
  - (c) The portion of the main memory which can be accessed only by one process at a time
  - (d) None of the above
  
- 4 At a particular time, the value of a counting semaphore is 10. It will become 7 after
  - (a) 3 V operations
  - (b) 3 P operations
  - (c) 5 V operations and 2 P operations
  - (d) 13 P operations and 10 V operations
  
- 5 Semaphores are used to solve the problem of
  - (a) Race condition
  - (b) Process synchronization
  - (c) Mutual exclusion

- (d) None of the above
- 6 At a particular time of computation, the value of a counting semaphore is 7. Then 20 operations and 'x' V operations were completed on this semaphore. If the final value of the semaphore is 5, x will be
- (a) 15
  - (b) 22
  - (c) 18
  - (d) 13
- 7 Pre-emptive scheduling, is the strategy of temporarily suspending a running process
- (a) Before the CPU time slice expires
  - (b) To allow starving processes to run
  - (c) When it requests I/O
  - (d) None of the above
- 8 Mutual exclusion problem occurs
- (a) Between two disjoint processes that do not interact
  - (b) Among processes that share resources
  - (c) Among processes that do not use the same resource
  - (d) None of the above
- 9 The first-fit, best-fit and the worst-fit algorithm can be used for
- (a) Contiguous allocation of memory
  - (b) Linked allocation of memory
  - (c) Indexed allocation of memory
  - (d) All of the above
- 10 In a paged memory, the page hit ratio is 0.35. The time required to access a page in secondary memory is equal to 100 ns. The time required to access a page in primary memory is 10 ns. The average time required to access a page is
- (a) 3.0 ns
  - (b) 68.0 ns
  - (c) 68.5 ns
  - (d) 78.5 ns
- 11 The solution to Critical Section Problem is : Mutual Exclusion, Progress and Bounded Waiting. The statement is
- (a) False
  - (b) True
  - (c) Contradictory
  - (d) None of the above
- 12 Demand paged memory allocation
- (a) allows the virtual address space to be independent of the physical memory
  - (b) allows the virtual address space to be a multiple of the physical memory size

- (c) allows deadlock to be detected in paging schemes
  - (d) is present only in Windows NT
- 13 Mutual exclusion
- (a) if one process is in a critical region others are excluded
  - (b) prevents deadlock
  - (c) requires semaphores to implement
  - (d) is found only in the Windows NT operating system
- 14 The principle of locality of reference justifies the use of \_\_\_\_\_.
- (a) Virtual Memory
  - (b) Interrupts
  - (c) Main memory
  - (d) Cache memory
- 15 The section of code which accesses shared variables is called as \_\_\_\_\_.
- (a) Critical section
  - (b) Block
  - (c) Procedure
  - (d) Semaphore
- 16 What is interprocess communication?
- (a) Communication within the process
  - (b) Communication between two process
  - (c) Communication between two threads of same process
  - (d) None of the mentioned
- 17 The address of the next instruction to be executed by the current process is provided by the
- (a) CPU registers
  - (b) Program counter
  - (c) Process stack
  - (d) Pipe
- 18 Which system call returns the process identifier of a terminated child?
- (a) Wait
  - (b) Exit
  - (c) Fork
  - (d) Get
- 19 A process can be terminated due to
- (a) Normal exit
  - (b) Fatal error
  - (c) Killed by another process
  - (d) All of the mentioned

- 20 In Unix, which system call creates the new process?
- (a) Fork
  - (b) Create
  - (c) New
  - (d) None of the mentioned
- 21 Given memory partitions of 100K, 500K, 200K, 300K and 600K (in order) and processes of 212K, 417K, 112K, and 426K (in order), using the first-fit algorithm in which partition would the process requiring 426K be placed?
- (a) 100K
  - (b) 500K
  - (c) 200K
  - (d) 300K
  - (e) 600K
- 22 A page fault means that we referenced a page
- (a) outside the memory boundaries
  - (b) with an incorrect I/O request
  - (c) that was not in secondary storage
  - (d) that was not in main memory
- 23 Which of the following information bits used by the various page replacement policies indicates if the page has been called lately?
- (a) Locality bit
  - (b) Status bit
  - (c) Referenced bit
  - (d) Modified bit
- 24 The simplest way to break a deadlock is to
- (a) Preempt a resource
  - (b) Rollback
  - (c) Kill one of the processes
  - (d) Lock one of the processes
- 25 Process cooperation in a Readers-and-Writers problem requires that the
- (a) Writers always call two procedures
  - (b) Writers perform a Test-and-Set
  - (c) Readers always call two procedures
  - (d) Readers perform a Test-and-Set
- 26 Which environment considers memory, process, and device and file management from a global viewpoint?
- (a) Distributed Operating System (DO/S)
  - (b) Network Operating System (NOS)
  - (c) Multiprogramming Operating System (MOS)
  - (d) None of the above

- 27 The point where multiprogramming is self defeating because the total time spent on a job is equal to the total time that would have been spent on it in a monoprogrammed environment is called
- (a) swapping
  - (b) thrashing
  - (c) delaying
- 28 A portion of the Windows 2000 operating system that is NOT portable is
- (a) processor management
  - (b) user interface
  - (c) device management
  - (d) Virtual Memory Manager
- 29 For multiprogramming systems, most UNIX operating systems use
- (a) swapping
  - (b) demand paging
  - (c) either (a) or (b)
  - (d) neither (a) nor (b)
- 30 A static partitioned memory management system has a total of six partitions. If one is allocated to the operating system, this will allow a total of
- (a) five user jobs
  - (b) six user jobs
  - (c) thirty-two user jobs
  - (d) thirty-six user jobs
  - (e) sixty-four user jobs
- 31 Part of a program where the shared memory is accessed and which should be executed invisibly, is called
- (a) semaphores
  - (b) directory
  - (c) critical section
  - (d) mutual exclusion
- 32 To avoid the race condition, the number of processes that may be simultaneously inside their critical section is
- (a) 8
  - (b) 1
  - (c) 16
  - (d) 0
- 33 Which of the following refers to the associative memory?
- (a) the address of the data is generated by the CPU
  - (b) the address of the data is supplied by the users
  - (c) there is no need for an address i.e. the data is used as an address
  - (d) the data are accessed sequentially

- 34 The strategy of allowing processes that are logically runnable to be temporarily suspended is called
- (a) preemptive scheduling
  - (b) non preemptive scheduling
  - (c) shortest job first
  - (d) first come first served
- 35 The LRU algorithm
- (a) pages out pages that have been used recently
  - (b) pages out pages that have not been used recently
  - (c) pages out pages that have been least used recently
  - (d) pages out the first page in a given area
- 36 The memory allocation scheme subject to "external" fragmentation is
- (a) segmentation
  - (b) swapping
  - (c) pure demand paging
  - (d) multiple contiguous fixed partitions
- 37 In which addressing mode the contents of a register specified in the instruction are first decremented, and then these contents are used as the effective address of the operands?
- (a) index addressing
  - (b) indirect addressing
  - (c) auto increment
  - (d) auto decrement
- 38 Thrashing can be avoided if
- (a) the pages, belonging to the working set of the programs, are in main memory
  - (b) the speed of CPU is increased
  - (c) the speed of I/O processor is increased
  - (d) all of the above
- 39 \_\_\_\_\_ is a high level abstraction over Semaphore.
- (a) Shared memory
  - (b) Message passing
  - (c) Monitor
  - (d) Mutual exclusion
- 40 The Banker's algorithm is used
- (a) to prevent deadlock in operating systems
  - (b) to detect deadlock in operating systems
  - (c) to rectify a deadlocked state
  - (d) none of the above
- 41 The bounded buffer problem is also known as :
- (a) Readers – Writers problem



- (b) Dining – Philosophers problem
  - (c) Producer – Consumer problem
  - (d) None of these
- 42 In the bounded buffer problem, there are the empty and full semaphores that:
- (a) count the number of empty and full buffers
  - (b) count the number of empty and full memory spaces
  - (c) count the number of empty and full queues
  - (d) None of these
- 43 In the bounded buffer problem :
- (a) there is only one buffer
  - (b) there are n buffers ( n being greater than one but finite)
  - (c) there are infinite buffers
  - (d) the buffer size is bounded
- 44 To ensure difficulties do not arise in the readers-writers problem, \_\_\_\_\_ are given exclusive access to the shared object.
- (a) readers
  - (b) writers
  - (c) none of these
  - (d) all of these
- 45 The dining – philosophers problem will occur in case of :
- (a) 5 philosophers and 5 chopsticks
  - (b) 4 philosophers and 5 chopsticks
  - (c) 3 philosophers and 5 chopsticks
  - (d) 6 philosophers and 5 chopsticks
- 46 All processes share a semaphore variable mutex, initialized to 1. Each process must execute wait(mutex) before entering the critical section and signal(mutex) afterward.
- i) Suppose a process executes in the following manner :
- ```

signal(mutex);
.....
critical section
.....
wait(mutex);

```
- In this situation :
- (a) a deadlock will occur
  - (b) processes will starve to enter critical section
  - (c) several processes maybe executing in their critical section
  - (d) all of these
- 47 Spinlocks are:
- (a) CPU cycles wasting locks over critical sections of programs
  - (b) locks that avoid time wastage in context switches
  - (c) locks that work better on multiprocessor systems

- (d) All of these
- 48 The main disadvantage of spinlocks is that :
- (a) they are not sufficient for many process
  - (b) they require busy waiting
  - (c) they are unreliable sometimes
  - (d) they are too complex for programmers
- 49 Spinlocks are :
- (a) CPU cycles wasting locks over critical sections of programs
  - (b) locks that avoid time wastage in context switches
  - (c) locks that work better on multiprocessor systems
  - (d) All of these
- 50 The main disadvantage of spinlocks is that :
- (a) they are not sufficient for many process
  - (b) they require busy waiting
  - (c) they are unreliable sometimes
  - (d) they are too complex for programmers
- 51 The state of a process is defined by :
- (a) the final activity of the process
  - (b) the activity just executed by the process
  - (c) the activity to next be executed by the process
  - (d) the current activity of the process
- 52 Which of the following is not the state of a process?
- (a) New
  - (b) Old
  - (c) Waiting
  - (d) Running
  - (e) Ready
  - (f) Terminated
- 53 The Process Control Block is:
- (a) Process type variable
  - (b) Data Structure
  - (c) a secondary storage section
  - (d) a Block in memory
54. A single thread of control allows the process to perform:
- (a) only one task at a time
  - (b) multiple tasks at a time
  - (c) All of these

55. The objective of multi-programming is to : (choose two)
- (a) Have some process running at all times
  - (b) Have multiple programs waiting in a queue ready to run
  - (c) To minimize CPU utilization
  - (d) To maximize CPU utilization
56. In the bounded buffer problem, there are the empty and full semaphores that :
- (a) count the number of empty and full buffers
  - (b) count the number of empty and full memory spaces
  - (c) count the number of empty and full queues
  - (d) None of these
57. A deadlock free solution to the dining philosophers problem:
- (a) necessarily eliminates the possibility of starvation
  - (b) does not necessarily eliminate the possibility of starvation
  - (c) eliminates any possibility of any kind of problem further
  - (d) None of these
58. Which of the following statements describes properties achieved?
- (a) Mutual exclusion but not progress
  - (b) Progress but not mutual exclusion
  - (c) Neither mutual exclusion nor progress
  - (d) Both mutual exclusion and progress
59. A process having multiple threads of control implies:
- (a) it can do more than one task at a time
  - (b) it can do only one task at a time, but much faster
  - (c) it has to use only one thread per process
  - (d) None of these
60. Resource sharing helps:
- (a) share the memory and resources of the process to which the threads belong.
  - (b) an application have several different threads of activity all within the same address space
  - (c) reduce the address space that a process could potentially use
  - (d) All of these
- Ans. (1)(b), (2)(a), (3)(b), (4)(b,d), (5)(b,c), (6)(c), (7)(a), (8)(b), (9)(a), (10)(c), 11(b), (12)(a), (13)(a), (14)(d), (15)(a), (16)(b), (17)(b), (18)(a), (19)(d), (20)(a), (21)(e), (22)(d), (23)(c), (24)(c), (25)(c), (26)(a), (27)(b), (28)(d), (29)(c), (30)(a), (31)(c), (32)(b), (33)(c), (34)(a), (35)(c), (36)(a), (37)(d), (38)(a), (39)(c), (40)(a), (41)(c), (42)(a), (43)(b), (44)(b), (45)(a), (46)(c), (47)(d), (48)(b), (49)(d), (50)(b), (51)(d), (52)(b), (53)(b), (54)(a), (55)(a & d), (56)(a), (57)(b), (58)(d), (59)(a), (60)(d)

**(c) Fill in the Blanks:**

- 1 \_\_\_\_\_ is a finer abstraction of a process.
- 2 As processes enter the system, they are put into a \_\_\_\_\_.
- 3 A process may be created through a \_\_\_\_\_ system call.
- 4 A process that spends more of its time doing I/O is known as \_\_\_\_\_.
- 5 \_\_\_\_\_ and \_\_\_\_\_ are examples of micro-kernel operating systems.
- 6 A process may be created through the \_\_\_\_\_ system call.
- 7 A \_\_\_\_\_ sometimes called a lightweight process (LWP).
- 8 When CPU is deallocated to another process, it is known as \_\_\_\_\_.
- 9 SJF and FCFS are special cases of \_\_\_\_\_ algorithm.
- 10 \_\_\_\_\_ operating system has micro-kernel architecture.

Ans. (1)(Thread), (2)(Job Queue), (3)(Create), (4)(I/O Bound), (5)(Mach, Chorus), (6)(Create), (7)(Thread), (8)(Preemptive Scheduling), (9)(Non-Preemptive Scheduling), (10)(UNIX)

**II Short Answer Type Questions:**

- 1 How is protection affected in segmentation of memory?
- 2 What is fragmentation?
- 3 How is effective-access time calculated?
- 4 How does demand paging enhance the paging scheme?
- 5 Explain segment number and segment offset.
- 6 How is memory protection implemented?
- 7 How does memory swapping improve the system performance?
- 8 What is extensible nucleus?
- 9 Why are page sizes always powers of 2?
- 10 What is an atomic operation?
- 11 What is the difference between inter-process communication and synchronization?
- 12 What is a race-condition? Explain with an example.
- 13 What is safety property? Give an example.
- 14 Does bakery algorithm assure a bound on the token numbers? Justify your answer.
- 15 What is a resource allocation graph? Give an example.
- 16 What is a safe state of a resource allocation?
- 17 The problem of busy waiting is eliminated completely with the use of semaphore. Comment.
- 18 Define safe and unsafe state. An unsafe state always leads to a dead lock. Comment
- 19 What are the conditions necessary for the deadlock?
- 20 Consider a system having three instances of a resource type and two processes. Each process needs two resources to complete its execution. Can deadlock occur? Explain.
- 21 Explain relocatable partitioned memory management technique with example.
- 22 What are different space allocation strategies?
- 23 What are the differences between user level threads and kernel level threads? Under what circumstances one is better than other?
- 24 Explain dining philosopher problem.

- 25 Explain Bounded buffer problem.
- 26 Explain Reader & Writer problem with algorithm.
- 27 How are the wait/signal operations for monitor different from those for semaphores?
- 28 What is time-stamping?
- 29 In loading programs into memory, what is the difference between load-time dynamic linking and run-time dynamic linking?
- 30 What is page cannibalizing?
- 31 What is a semaphore? Mention its importance in the operating systems.
- 32 Differentiate between global and local page replacement algorithms.
- 33 Give the importance of swap space management.
- 34 Explain in detail how semaphores and monitors are used to solve producer-consumer problem.
- 35 Discuss the methods of deadlock detection and recovery.
- 36 What is thrashing?
- 37 List the Coffman's conditions that lead to a deadlock.
- 38 What is the resident set and working set of a process?
- 39 What are the typical elements of a process image?
- 40 What is the Translation Lookaside Buffer (TLB)?

### **III Long Answer Type Questions:**

- 1 Discuss the effect of heavily multi-programming on demand-page swapping.
- 2 Explain memory segmentation in detail.
- 3 Discuss the structure of page table.
- 4 Define demand paging. Discuss it in detail.
- 5 Explain page replacement in detail.
- 6 Discuss all page replacement algorithms in detail.
- 7 Why are segmentation and paging sometimes combined into one scheme? What are their relative advantages and disadvantages?
- 8 Explain why interrupt based synchronization primitives are not effective in multiprocessor systems.
- 9 Describe monitor. How is it different from an ordinary C++ object?
- 10 What are the requirements of first readers writers problem?
- 11 Solve readers-writer problem using semaphores.
- 12 Write a solution to the sleeping barber problem using a monitor.
- 13 Describe a deadlock prevention approach that ensures that the circular wait condition is never fulfilled in a system.
- 14 Describe different synchronization primitives support at various levels in operating systems.
- 15 Explain how memory is shared between processes in segmentation, paging, and paged segmentation schemes.
- 16 How is TLB different from hardware cache memory used to hold data/ instruction?
- 17 Explain in detail cigarette smoker's problem.
- 18 What is a classical process coordination problem? Explain in detail.
- 19 Write in detail about time dependency, mutual exclusion problem and critical code-section?

- 20 In a multi-programming environment, more than one process exist in the system competing for the resources. This is done through (a) sequential process; (b) concurrent process. Explain.
- 21 Explain the concept of virtual memory.
- 22 When does a page fault occur? How is it handled?
- 23 Discuss the hardware support for demand paging.
- 24 What is thrashing? Explain the approaches that can be used to prevent thrashing.
- 25 Critical section problem can be solved by disabling interrupts. What are the disadvantages of this method?
- 26 Explain system resource allocation graph algorithm in detail
- 27 What has triggered the need for multitasking in PCs?
- 28 What is SMP?
- 29 What is process migration?
- 30 What are the possible threads a thread can have?
- 31 Briefly explain and compare fixed and dynamic memory partitioning schemes.
- 32 Explain how paging supports virtual memory. With a neat diagram explain how logical address is translated into physical address.
- 33 Consider the following page reference string: 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1. How many page faults would occur for the Optimal replacement algorithm, assuming three and four frames.
- 34 Why is synchronization of processes required? Discuss any two classic problems of synchronization in detail.
- 35 What is page fault? Consider the reference string 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5. There are 3 frames allotted in the memory at a time. Apply FIFO, LRU, Optimal page replacement algorithms and find the number of page faults.
- 36 For the following information:

| Job# | Arrival Time | CPU Cycles |
|------|--------------|------------|
| 1    | 0            | 10         |
| 2    | 1            | 2          |
| 3    | 2            | 3          |
| 4    | 3            | 1          |
| 5    | 4            | 5          |

- Find the turn around time for each job using FCFS, SJF and Round Robin (Time Quantum=2)
- 37 What is thread and what are the advantages of thread? Explain multi-threading models in detail.
- 38 What are the differences between Batch processing system and Real Time Processing System and Time sharing System?
- 39 What is a process scheduler? State the characteristics of a good process scheduler?
- 40 Explain time slicing. How its duration affects the overall working of the system.

#### IV Numerical/Practical Questions:

- 1 Consider a logical address space of 8 pages of 1024 words each, mapped onto physical memory of 32
- (a) How many bits are there in the logical address?

- (b) How many bits are there in the physical address?
- 2 Assume we have a demand paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, & 20 milliseconds if the replaced page is modified. Memory access time is 100 ms. Assume that page to be replaced is modified 70% of time. What is maximum accepted page-fault rate for an effective access time of no more than 200 ms?
- 3 Consider a logical address space of eight pages of 1024 words each, mapped onto a physical memory of 32 frames. How many bits are there in the logical address? How many bits are there in the physical address?
- 4 Given the memory partitions of 400K, 100K, 500K, 800K (in order) how would each of the first-fit, best-fit and worst-fit algorithms place processes of 190K, 420K, 171K, 540K (in order)? Which algorithm makes the efficient use of memory?
- 5 Consider the following snapshot of a system:

|       | <u>Allocation</u> |   |   |   | <u>Max</u> |   |   |   | <u>Available</u> |   |   |   |
|-------|-------------------|---|---|---|------------|---|---|---|------------------|---|---|---|
|       | A                 | B | C | D | A          | B | C | D | A                | B | C | D |
| $P_0$ | 0                 | 0 | 1 | 2 | 0          | 0 | 1 | 2 | 1                | 5 | 2 | 0 |
| $P_1$ | 1                 | 0 | 0 | 0 | 1          | 7 | 5 | 0 |                  |   |   |   |
| $P_2$ | 1                 | 3 | 5 | 4 | 2          | 3 | 5 | 6 |                  |   |   |   |
| $P_3$ | 0                 | 6 | 3 | 2 | 0          | 6 | 5 | 2 |                  |   |   |   |
| $P_4$ | 0                 | 0 | 1 | 4 | 0          | 6 | 5 | 6 |                  |   |   |   |

- Answer the following questions using the banker's algorithm:
- (a) How can we avoid deadlock using banker's algorithm.
- (b) What is the content of the matrix Need?
- (c) Is the system in a safe state?
- (d) If a request from process  $P_1$  arrives for (0,4,2,0), can the request be granted immediately ?
- 6 Consider the following page reference string:- 4,6,8,0,4,9,3,2,4,6,2,9,3,0,3,6,4,7. Assume there are four frames. How many page faults will occur for the following replacement algorithms (show computation)? Which one is the best Algorithm?
- (a) LRU Replacement
- (b) FIFO Replacement
- (c) LFU Replacement
- (d) Optimal Page Replacement
- 7 Consider the following system snapshot using data structures in the Banker's algorithm, with resources A, B, C, and D, and process  $P_0$  to  $P_4$ :

|    | Max |   |   |   | Allocation |   |   |   | Need |   |   |   | Available |   |   |   |
|----|-----|---|---|---|------------|---|---|---|------|---|---|---|-----------|---|---|---|
|    | A   | B | C | D | A          | B | C | D | A    | B | C | D | A         | B | C | D |
| P0 | 6   | 0 | 1 | 2 | 4          | 0 | 0 | 1 |      |   |   |   |           |   |   |   |
| P1 | 1   | 7 | 5 | 0 | 1          | 1 | 0 | 0 |      |   |   |   |           |   |   |   |
| P2 | 2   | 3 | 5 | 6 | 1          | 2 | 5 | 4 |      |   |   |   |           |   |   |   |
| P3 | 1   | 6 | 5 | 3 | 0          | 6 | 3 | 3 |      |   |   |   |           |   |   |   |
| P4 | 1   | 6 | 5 | 6 | 0          | 2 | 1 | 2 |      |   |   |   |           |   |   |   |
|    |     |   |   |   |            |   |   |   |      |   |   |   | 3         | 2 | 1 | 1 |

Using Banker's algorithm, answer the following questions.

- How many resources of type A, B, C, and D are there?
- What are the contents of the Need matrix?
- Is the system in a safe state? Why
- If a request from process P4 arrives for additional resources of (1,2,0,0), can the Banker's algorithm grant the request immediately? Show the new system state and other criteria.

Ans. (1) (a- 13 bits, b- 15 bits),

(2) ( $p \approx 0.000006$ ),

- (3) No. of Pages =  $8 = 2^3$   
 Size of page =  $1024 = 2^{10}$   
 Logical address =  $3+10 = 13$ bits  
 No. of frames =  $32 = 2^5$   
 Physical address =  $10+5 = 15$ bits

(4) FIRST FIT

190K is put in 400K Partition  
 420K is put in 500K Partition  
 171K is put in 210K Partition (new partition  $400K - 190K = 210K$ )  
 540K is put in 800K Partition

BEST FIT

190K is put in 400K Partition  
 420K is put in 500K Partition  
 171K is put in 210K Partition (new partition  $400K - 190K = 210K$ )  
 540K is put in 800K Partition

WORST FIT

190K is put in 800K Partition  
 420K is put in 610K Partition (new partition  $800K - 190K = 610K$ )  
 171K is put in 500K Partition  
 540K is put in 400K Partition



Best fit and First fit are both equally efficient in this case.

- (5) (a) The content of the matrix *Need* is defined to be *Max – Allocation* and is

|   | <b>Need<br/>ABCD</b> |
|---|----------------------|
| 0 | 0000                 |
| 1 | 0750                 |
| 2 | 1002                 |
| 3 | 0020                 |
| 4 | 0642                 |

- (b) Yes, we claim that the system is currently in a safe state. The sequence  $\langle P_0, P_2, P_1, P_3, P_4 \rangle$  or  $\langle P_0, P_2, P_3, P_1, P_4 \rangle$  or  $\langle P_0, P_2, P_4, P_3, P_1 \rangle$  and several others satisfy the safety criteria.
- (c) To decide whether this request can be immediately granted, we check that *Request*  $\leq$  *Available*, that is,  $(0\ 4\ 2\ 0) \leq (1\ 5\ 2\ 0)$ , which is true. We then pretend that this request has been fulfilled, and we arrive at the following new state:

| Process | Allocation<br>ABCD | Need<br>ABCD | Available<br>ABCD |
|---------|--------------------|--------------|-------------------|
| P0      | 0012               | 0000         | 1100              |
| P1      | 1420               | 0330         |                   |
| P2      | 1354               | 1002         |                   |
| P3      | 0632               | 0020         |                   |
| P4      | 0014               | 0642         |                   |

We must determine that this new system state is safe. To do so, we execute the safety algorithm and find the sequence  $\langle P_0, P_2, P_3, P_4, P_1 \rangle$  satisfies our safety requirement. Hence, we can immediately grant the request of process P1.

- (6) (a) LRU Replacement - 14 page faults.  
 (b) FIFO Replacement - 14 page faults.  
 (c) LFU Replacement - 10 page faults.  
 (d) Optimal Page Replacement - 10 page faults.
- (7) (a) A-9; B-13; C-10; D-11  
 (b)  $Need[i, j] = Max[i, j] - Allocation[i, j]$  so content of Need matrix is
- |    | A | B | C | D |
|----|---|---|---|---|
| P0 | 2 | 0 | 1 | 1 |
| P1 | 0 | 6 | 5 | 0 |
| P2 | 1 | 1 | 0 | 2 |
| P3 | 1 | 0 | 2 | 0 |
| P4 | 1 | 4 | 4 | 4 |

- (c) The system is in a safe state as the processes can be finished in the sequence P0, P2, P4, P1 and P3.
- (d) If a request from process P4 arrives for additional resources of (1,2,0,0), and if this request is granted, the new system state would be tabulated as follows.

|    | Max |   |   |   | Allocation |   |   |   | Need |   |   |   | Available |   |   |   |
|----|-----|---|---|---|------------|---|---|---|------|---|---|---|-----------|---|---|---|
|    | A   | B | C | D | A          | B | C | D | A    | B | C | D | A         | B | C | D |
| P0 | 6   | 0 | 1 | 2 | 4          | 0 | 0 | 1 | 2    | 0 | 1 | 1 |           |   |   |   |
| P1 | 1   | 7 | 5 | 0 | 1          | 1 | 0 | 0 | 0    | 6 | 5 | 0 |           |   |   |   |
| P2 | 2   | 3 | 5 | 6 | 1          | 2 | 5 | 4 | 1    | 1 | 0 | 2 |           |   |   |   |
| P3 | 1   | 6 | 5 | 3 | 0          | 6 | 3 | 3 | 1    | 0 | 2 | 0 |           |   |   |   |
| P4 | 1   | 6 | 5 | 6 | 1          | 4 | 1 | 2 | 0    | 2 | 4 | 4 | 2         | 0 | 1 | 1 |

After P0 completes P3 can be allocated. 1020 from released 6012 and available 2011(Total 80 23) and <P0, P3, P4, P2, P1> is a safe sequence.

## UNIT - III

### I Test Your Skills:

#### (a) State Whether the Following Statements are True or False:

- 1 A keyboard is a synchronous device.
- 2 Disk scheduling is responsibility of operating system.
- 3 An acyclic graph directory allows files and sub-directories to be shared.
- 4 A distributed file system cannot have many attributes.
- 5 File links are deleted when file is deleted.
- 6 All directories are files but not vice-versa.
- 7 All users other than the owner fall in universe.
- 8 Protection can be provided in many ways.
- 9 Reliability is generally provided by duplicate copies of files.
- 10 Static location transparency provides users with convenient way to share data.

Ans. (1)(F), (2)(T), (3)(T), (4)(T), (5)(F), (6)(T), (7)(F), (8)(T), (9)(T), (10)(T)

#### (b) Multiple Choice Questions:

- 1 Which of the following is an example of a SPOOLED device?
  - (a) The terminal used to enter the input data for a program being executed.
  - (b) The secondary memory device in a virtual memory system.
  - (c) A line printer used to print the output of a number of jobs.
  - (d) None of the above
- 2 Dijkstra's banking algorithm in an operating system solves the problem of
  - (a) Deadlock avoidance
  - (b) Deadlock recovery

- (c) Mutual exclusion
  - (d) Context switching
- 3 An operating system contains 3 user processes each requiring 2 units of resource R. The minimum number of units of R such that no deadlock will ever occur is
- (a) 3
  - (b) 4
  - (c) 5
  - (d) 4
- 4 With a single resource, deadlock occurs
- (a) If there are more than two processes competing for that resource
  - (b) If there are only two processes competing for that resource
  - (c) If there is a single process competing for that resource
  - (d) None of the above
- 5 Necessary conditions for deadlock are
- (a) Non-preemption and circular wait
  - (b) Mutual exclusion and partial allocation
  - (c) Both (a) and (b)
  - (d) None of the above
- 6 Disk scheduling involves deciding
- (a) Which disk should be accessed next
  - (b) The order in which disk access requests must be serviced
  - (c) The physical location where files should be accessed in the disk
  - (d) None of the above
- 7 A state is safe if the system can allocate resources to each process (up to its minimum) in some order and still avoid deadlock.
- (a) Deadlocked state is unsafe.
  - (b) Unsafe state may lead to a deadlock situation
  - (c) Unsafe state must lead to a deadlock situation
  - (d) Deadlocked state is a subset of unsafe state.
- 8 Consider a system having 'm' resources of the same type. These resources are shared by 3 processes A,B,C, which have peak time demands of 3,4,6 respectively. The minimum value of 'm' that ensures that deadlock will never occur is
- (a) 11
  - (b) 12
  - (c) 13
  - (d) 14
- 9 A system has 3 processes sharing 4 resources. If each process needs a maximum of 2 units then, deadlock
- (a) Can never occur

- (b) May occur
  - (c) Has to occur
  - (d) None of the above
- 10 'm' process share 'n' resources of the same type. The maximum need of each process doesn't exceed 'n' and the sum all their maximum needs is always less than  $m + n$ . In this set up deadlock
- (a) Can never occur
  - (b) May occur
  - (c) Has to occur
  - (d) None of the above
- 11 Disk requests come to a disk driver for cylinders in the 10, 22, 20, 2, 40, 6 and 38, at a time when the disk drive is reading from cylinder 20. The seek time is 6 ms per cylinder. The total seek time, if the disk arm scheduling algorithm is first-come-first-served is
- (a) 360 ms
  - (b) 876 ms
  - (c) 850 ms
  - (d) 900 ms
- 12 If the Disk head is located initially at 32, find the number of disk moves required with FCFS if the disk queue of I/O blocks requests are 98,37,14,124,65,67.
- (a) 310
  - (b) 315
  - (c) 324
  - (d) 321
- 13 Which of the following disk scheduling techniques has a drawback of starvation?
- (a) SCAN
  - (b) SSTF
  - (c) FCFS
  - (d) LIFO
- 14 The time taken to bring the desired track/cylinder under the head is \_\_\_\_\_.
- (a) Seek time
  - (b) Latency time
  - (c) Transfer time
  - (d) Read time
- 15 Which of the following is the major activities of an operating system in regard to secondary storage management?
- (a) Free Space Management
  - (b) Storage allocation
  - (c) Disk Scheduling
  - (d) All of the above

- 16 Which of the following is crucial time while accessing data on the disk?
- (a) Seek time
  - (b) Rotational time
  - (c) Transmission time
  - (d) Waiting time
- 17 The host repeatedly checks if the controller is busy until it is not. It is in a loop that status register's busy bit becomes clear. This is called \_\_\_\_\_ and a mechanism for the hardware controller to notify the CPU that it is ready is called \_\_\_\_\_.
- (a) Interrupt and Polling
  - (b) Polling and Spooling
  - (c) Polling and Interrupt
  - (d) Deadlock and Starvation
- 18 Unix Operating System is an \_\_\_\_\_.
- (a) Time Sharing Operating System
  - (b) Multi-User Operating System
  - (c) Multi-tasking Operating System
  - (d) All the Above
- 19 Which of the following memory allocation scheme suffers from External fragmentation?
- (a) Segmentation
  - (b) Pure demand paging
  - (c) Swapping
  - (d) Paging
- 20 Information about a process is maintained in a \_\_\_\_\_.
- (a) Stack
  - (b) Translation Lookaside Buffer
  - (c) Process Control Block
  - (d) Program Control Block
- 21 Distributed OS works on the \_\_\_\_\_ principle.
- (a) File Foundation
  - (b) Single system image
  - (c) Multi system image
  - (d) Networking image
- 22 The problem of fragmentation arises in \_\_\_\_\_.
- (a) Static storage allocation
  - (b) Stack allocation storage
  - (c) Stack allocation with dynamic binding
  - (d) Heap allocation
- 23 Which file system does DOS typically use ?
- (a) FAT16

- (b) FAT32
  - (c) NTFS
  - (d) WNFS
- 24 The program is known as \_\_\_\_\_ which interacts with the inner part of called kernel.
- (a) Compiler
  - (b) Device Driver
  - (c) Protocol
  - (d) Shell
- 25 The time taken by the disk arm to locate the specific address of a sector for getting information is called \_\_\_\_\_.
- (a) Rotational Latency
  - (b) Seek Time
  - (c) Search Time
  - (d) Response Time
- 26 As disks have relatively low transfer rates and relatively high latency rates, disk schedulers must reduce latency times to :
- (a) Ensure high bandwidth
  - (b) Ensure low bandwidth
  - (c) Make sure data is transferred
  - (d) Reduce data transfer speeds
- 27 Servicing requests strictly according to deadline using EDF may result in :
- (a) Lower seek times
  - (b) Lower bandwidth
  - (c) Higher seek time
  - (d) Higher bandwidth
- 28 The hybrid algorithm that combines EDF with SCAN algorithm is known as :
- (a) EDS
  - (b) SDF
  - (c) SCAN-EDF
  - (d) None of these
- 29 If several requests have different deadlines that are relatively close together, then using the SCAN – EDF algorithm :
- (a) The SCAN ordering will service the requests in that batch
  - (b) The EDF ordering will service the requests in that batch
  - (c) The FCFS ordering will service the requests in that batch
  - (d) None of these
- 30 In SCAN – EDF, requests with the same deadlines are ordered according to :
- (a) SCAN policy
  - (b) EDF policy

- (c) FCFS policy
  - (d) FIFO policy
- 31 The total time to prepare a disk drive mechanism for a block of data to be read from it is
- (a) Latency
  - (b) latency plus transmission time
  - (c) latency plus seek time
  - (d) latency plus seek time plus transmission time
- 32 If the Disk head is located initially at 32, find the number of disk moves required with FCFS if the disk queue of I/O blocks requests are 98, 37,14,124,65,67.
- (a) 310
  - (b) 324
  - (c) 315
  - (d) 321
- 33 The methods or algorithms which are used to increase the performance of disk storage sub-system is called.....
- (a) Disk performing
  - (b) Disk scheduling
  - (c) Disk storing
  - (d) Disk extending
- 34 ..... is the time required to move the disk arm to the required track.
- (a) Seek time
  - (b) Rotational delay
  - (c) Latency time
  - (d) Access time
- 35 ..... policy selects the disk I/O request that requires the least movement of the disk arm from its current position.
- (a) FSCAN
  - (b) SSTF
  - (c) SCAN
  - (d) C-SCAN
- 36 The sum of the seek time, and the rotational delay is called the .....
- (a) reached time
  - (b) access time
  - (c) arrived time
  - (d) common time
- 37 The ..... policy segments the disks request queue into sub queues of the length N.
- (a) SCAN
  - (b) C-SCAN

- (c) N-Step SCAN
  - (d) FSCAN
- 38 A .....architecture assigns only a few essential functions to the kernel, including address spaces, Inter process communication (IPC) and basic scheduling.
- (a) Monolithic kernel
  - (b) Micro kernel
  - (c) Macro kernel
  - (d) Mini kernel
- 39 An interrupt handler is a
- (a) Location in memory that keeps track of recently generated interrupts
  - (b) Peripheral device
  - (c) Utility program
  - (d) Special numeric code that indicates the priority of a request
- 40 Which of the following is an example of a spooled device?
- (a) The terminal used to enter the input data for a program being executed.
  - (b) The secondary memory device in a virtual memory system.
  - (c) A line printer used to print the O/P of a number of jobs.
  - (d) One tries to divide a number by 0.
- 41 The three major methods of allocating disk space that are in wide use are :
- (a) contiguous
  - (b) linked
  - (c) indexed
  - (d) hashed
- 42 In contiguous allocation :
- (a) each file must occupy a set of contiguous blocks on the disk
  - (b) each file is a linked list of disk blocks
  - (c) all the pointers to scattered blocks are placed together in one location
  - (d) None of these
- 43 In linked allocation :
- (a) each file must occupy a set of contiguous blocks on the disk
  - (b) each file is a linked list of disk blocks
  - (c) all the pointers to scattered blocks are placed together in one location
  - (d) None of these
- 44 In indexed allocation :
- (a) each file must occupy a set of contiguous blocks on the disk
  - (b) each file is a linked list of disk blocks
  - (c) all the pointers to scattered blocks are placed together in one location
  - (d) None of these



- 45 When device A has a cable that plugs into device B, and device B has a cable that plugs into device C and device C plugs into a port on the computer, this arrangement is called a \_\_\_\_\_.
- (a) port
  - (b) daisy chain
  - (c) bus
  - (d) cable
- 46 The VFS (virtual file system) activates file system specific operations to handle local requests according to their \_\_\_\_\_.
- (a) size
  - (b) commands
  - (c) timings
  - (d) file system types
- 47 The real disadvantage of a linear list of directory entries is the :
- (a) size of the linear list in memory
  - (b) linear search to find a file
  - (c) it is not reliable
  - (d) All of these
- 48 The process of dividing a disk into sectors that the disk controller can read and write, before a disk can store data is known as : (choose all that apply)
- (a) partitioning
  - (b) swap space creation
  - (c) low-level formatting
  - (d) physical formatting
- 49 The header and trailer of a sector contain information used by the disk controller such as \_\_\_\_\_ and \_\_\_\_\_.
- (a) main section
  - (b) error correcting codes (ECC)
  - (c) sector number
  - (d) disk identifier
- 50 The two steps the operating system takes to use a disk to hold its files are \_\_\_\_\_ and \_\_\_\_\_.
- (a) partitioning
  - (b) swap space creation
  - (c) caching
  - (d) logical formatting
51. The heads of the magnetic disk are attached to a \_\_\_\_\_ that moves all the heads as a unit.
- (a) spindle
  - (b) disk arm

- (c) track
  - (d) None of these
52. The time taken for the desired sector to rotate to the disk head is called:
- (a) positioning time
  - (b) random access time
  - (c) seek time
  - (d) rotational latency
53. The host controller is:
- (a) controller built at the end of each disk
  - (b) controller at the computer end of the bus
  - (c) both a and b
  - (d) neither a nor b
54. The disk bandwidth is:
- (a) the total number of bytes transferred
  - (b) total time between the first request for service and the completion on the last transfer
  - (c) the total number of bytes transferred divided by the total time between the first request for service and the completion on the last transfer
  - (d) None of these
55. A scheduling algorithm can use either \_\_\_\_\_ priority or \_\_\_\_\_ priority.
- (a) static, still
  - (b) static, dynamic
  - (c) live, dead
  - (d) None of these
56. Multimedia systems require \_\_\_\_\_ scheduling to ensure critical tasks will be serviced within timing deadlines.
- (a) soft real time
  - (b) hard real time
  - (c) normal
  - (d) None of these
57. The process of dividing a disk into sectors that the disk controller can read and write, before a disk can store data is known as: (choose all that apply)
- (a) partitioning
  - (b) swap space creation
  - (c) low-level formatting
  - (d) physical formatting
58. An unrecoverable error is known as \_\_\_\_\_.
- (a) hard error
  - (b) tough error

- (c) soft error
- (d) None of these

59. Linux \_\_\_\_\_ the use of multiple swap spaces.
- (a) allows
  - (b) does not allow
  - (c) None of these
60. For swap space created in a separate disk partition where no file system or directory structure is placed, \_\_\_\_\_ used to allocate and deallocate the blocks.
- (a) special routines must be
  - (b) normal file system routines can be
  - (c) normal file system routines cannot be
  - (d) swap space storage manager is

Ans. (1)(c), (2)(a), (3)(b), (4)(d), (5)(c), (6)(b), (7)(a,b,d), (8)(a), (9)(a), (10)(a), (11)(d), (12)(d), (13)(b), (14)(a), (15)(d), (16)(a), (17)(c), (18)(d), (19)(a), (20)(c), (21)(b), (22)(d), (23)(a), (24)(d), (25)(b), (26)(a), (27)(c), (28)(c), (29)(a), (30)(a), (31)(c), (32)(d), (33)(b), (34)(a), (35)(b), (36)(b), (37)(c), (38)(b), (39)(c), (40)(c), (41)(a,b,c), (42)(a), (43)(b), (44)(c), (45)(b), (46)(d), (47)(b), (48)(c,d), (49)(b,c), (50)(a,d), (51)(b), (52)(d), (53)(b), (54)(c), (55)(b), (56)(b), (57)(c&d), (58)(a), (59)(a), (60)(d).

**(c) Fill in the Blanks:**

- 1 \_\_\_\_\_ is another name for SCAN Algo.
- 2 FILES with attribute \_\_\_\_\_ set, cannot be deleted.
- 3 UNIX treats every I/O device as \_\_\_\_\_.
- 4 An I/O device gets the operating system's service through \_\_\_\_\_.
- 5 Device driver is a \_\_\_\_\_ ware.
- 6 A \_\_\_\_\_ is hardware interface to a disk.
- 7 An \_\_\_\_\_ allows directories to have shared sub-directories and files.
- 8 There are \_\_\_\_\_ main approaches to naming schemes in a DFS.
- 9 A shared file exists in the file system in \_\_\_\_\_ places.
- 10 Shared directories exist in the \_\_\_\_\_ in multiple places.

Ans. (1)(Elevator Algorithm), (2)(read Only), (3)(File), (4)(I/O Interrupts), (5)(Soft), (6)(Soft Control), (7)(Acyclic graph), (8)(Three), (9)(2 or more), (10)(File System)

**II Short Answer Type Questions:**

- 1 What is formatting a disk?
- 2 How is moving a file different from copying?
- 3 Differentiate between a file and file system.
- 4 Explain small computer systems interface controller.
- 5 What is meant by handshaking?
- 6 Differentiate between synchronous and asynchronous I/O.

- 7 What are the goals of device independent I/O software.
- 8 Write short note on Buffering.
- 9 Explain DMA in brief.
- 10 Write a short note on C-SCAN scheduling.
- 11 How is computer's clock different from real clock?
- 12 Discuss the importance of clock in a digital computer.
- 13 What are various types of interface between users and machine?
- 14 What are advantages of GUI over command line interface?
- 15 Write a short note on symbolic link.
- 16 What is I/O device? Why is it used in computer systems?
- 17 Give examples of input only, output only, and input-output devices.
- 18 What is I/O controller? How is it different from I/O devices?
- 19 How does CPU interact with I/O controllers?
- 20 What is port-mapped and memory-mapped I/O?
- 21 What is address binding? At what time does it take place?
- 22 What is the idea behind combining segmentation and paging? When is it useful?
- 23 What are virtual device?
- 24 Explain channels and control units?
- 25 What is Block multiplexing and buffering?
- 26 Define latency, transfer and seek time with respect to disk I/O.
- 27 Describe the Buddy system of memory allocation.
- 28 What is time-stamping?
- 29 What is meant by arm-stickiness?
- 30 Explain the Allocating Disk Space methods: Contiguous allocation and Linked allocation.
- 31 Explain the Direct Memory Access.
- 32 Discuss in detail about Interprocess communication.
- 33 What are the causes of thrashing? Explain working-set model with an example.
- 34 What are the necessary conditions for the deadlock to exist? How will you prevent and avoid deadlocks?
- 35 Explain macro definition, macro call and macro expansion?
- 36 What are the advantages of code optimization? Explain optimizing transformations?
- 37 Explain the following terms
  - (i) Translated address
  - (ii) Linked address
  - (iii) Load address
 Explain the relationship amongst these.
- 38 Categorize the CPU scheduling algorithms? Explain non-pre-emptive algorithms?
- 39 What is a Deadlock? Write an algorithm for deadlock detection.
- 40 Explain difference between Security and Protection? Describe the scheme of capability lists to implement protection?

### III Long Answer Type Questions:

- 1 Explain 3 modes of DMA transfer.

- 2 What is a device driver? Why are device drivers used in OS? How does the OS access device drivers?
- 3 What are 2 modes of device-driver interaction? Explain their merits and demerits.
- 4 What are the main goals of I/O software? Explain in detail.
- 5 Explain how sector interleaving and skewing improve disk access?
- 6 Explain elevator disk scheduler and compare it with FCFS scheduler.
- 7 Explain various stages of disk formatting.
- 8 Discuss SCAN scheduling and compare it with C-SCAN scheduling.
- 9 Describe the physical organization of a magnetic disk.
- 10 Explain various stages of Disk Formatting.
- 11 Consider a failure that occurs during 2PC for a transaction. For each possible failure, explain how 2PC ensures transaction atomicity despite the failure.
- 12 Explain why interrupt and dispatch latency times must be bounded in a hard-real time system.
- 13 What optimization is used to minimize the discrepancy between CPU and I/O speeds on early computer systems?
- 14 Give in detail the life-cycle of an I/O request. Illustrate using a diagram.
- 15 Write short notes on : (a) Boot Block; (b) BAD Block
- 16 SWAP-SPACE Management is a low-level task of OS. Explain in detail.
- 17 Give RAID structure, RAID levels, and problems with RAID in detail.
- 18 Contrast the various network topologies in terms of the following attributes:
  - (a) Reliability
  - (b) Installation Cost
  - (c) Load Balancing
  - (d) Available Bandwidth for Concurrent Communications
- 19 Explain the concept of virtual memory.
- 20 What are the stipulations of C2 level security?
- 21 When does the condition 'rendezvous' arise?
- 22 What is a trap and trapdoor?
- 23 Explain kernel I/O subsystem in detail?
- 24 Explain and compare FCFS, SSTF, C-SCAN and C-LOOK disk scheduling algorithms with an example.
- 25 Consider a disk queue with requests for I/O to blocks on cylinders, in FIFO order: 98, 183, 37 122, 14, 124, 65, 67. The disk head is currently at cylinder 53.Using FCFS algorithm,
  - (a) Calculate the total head movement and
  - (b) Suggest a mechanism to rearrange the request so that the total head movement is decreased to improve the disk performance.
- 26 Discuss about disk scheduling and its various methods briefly.
- 27 With typical PC bus structure, explain the functions of various I/O hardware components.
- 28 N process share M resource units that can be reserved and released only one at a time. The maximum need of each process does not exceed M, and the sum of all need is less than M+N. Show that a deadlock cannot occur in the system?
- 29 Discuss in detail about file allocation methods.
- 30 What is safe state and unsafe state?
- 31 What is overlay?

32. What are interacting processes? Explain any two methods of implementing interacting processes.
33. Define process. Describe the contents of a Process Control Block (PCB).
34. What are interrupts? How are they handled by the operating system?
35. What is parsing? Give difference between top down parsing and bottom up parsing.
36. What are the fundamental steps in program development? Discuss program testing and debugging in detail.
37. Explain deadlock detection algorithm for single instance of each resource type.
38. Discuss the concept of segmentation? What is the main problem with segmentation?

#### **IV Numerical/Practical Questions:**

1. Consider a Disk queue with requests for I/O to blocks on 98, 183, and 37,122,14,124,65,67 in that order. The disk head is initially at cylinder 53. Using FCFS till the total head movement of cylinder.
2. Solve the above question using
  - (a) SSTF
  - (b) SCAN
3. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is:  
86,1470, 913, 1774, 948, 1509, 1022,1750,130  
Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?
  1. FCFS
  2. SSTF
  3. SCAN
  4. C-SCAN

#### **UNIT - IV**

##### **I Test Your Skills:**

##### **(a) State Whether the Following Statements are True or False:**

1. UNIX uses the concept of time sharing.
2. An OS looks after the management of the devices of the system.
3. UNIX does not offer security to files of a user.
4. The devices are also treated as files in UNIX.
5. Upper case and lower case are treated same in UNIX.
6. Timeout is the most common message lost detection method.
7. Dining philosopher's problem cannot be solved.
8. Bounded capacity is a finite queue.
9. "Access" command is used to determine the accessibility of a file.
10. "Fcntl" command is used to implement file control.

Ans. (1)(T), (2)(T), (3)(F), (4)(T), (5)(F), (6)(T), (7)(F), (8)(F), (9)(T), (10)(T)

**(b) Multiple Choice Questions:**

- 1 Kernel is
  - (a) Considered as the critical part of the operating system
  - (b) The software which monitors the operating system
  - (c) The set of primitive functions upon which the rest of operating system functions are built up.
  - (d) None of the above
  
- 2 In which of the following directory systems, is it possible to have multiple complete paths for a file, starting from the root directory?
  - (a) Single level directory
  - (b) Two level directory
  - (c) Tree structured directory
  - (d) Acyclic graph directory
  
- 3 Consider a computer with 8 Mbytes of main memory and a 128 K cache. The cache block size is 4 K. It uses a direct mapping scheme for cache management. How many different main memory blocks can map onto a given physical cache block?
  - (a) 2048
  - (b) 256
  - (c) 64
  - (d) None of the above
  
- 4 The correct matching for the following pairs is:

|                          |                 |
|--------------------------|-----------------|
| (a) Disk scheduling      | (1) Round robin |
| (b) Batch processing     | (2) SCAN        |
| (c) Time sharing         | (3) LIFO        |
| (d) Interrupt processing | (4) FIFO        |

  - (a) A-3, B-4, C-2 and D-1
  - (b) A-4, B-3, C-2 and D-1
  - (c) A-2, B-4, C-1 and D-3
  - (d) A-2, B-1, C-4 and D-3
  
- 5 When an interrupt occurs, an operating system
  - (a) Ignores the interrupt
  - (b) Always changes the state of the interrupted process after processing the interrupt.
  - (c) Always resumes execution of the interrupted process after processing the interrupt.
  - (d) May change the state of the interrupted process to “blocked” and schedule another process.
  
- 6 Which of the following file format supports windows?
  - (a) NTFS
  - (b) BSD

- (c) EXT
  - (d) All of the above
- 7 Unix Operating system is an
- (a) Multiuser OS
  - (b) Timesharing
  - (c) Multitasking
  - (d) All of the above
- 8 The File System NTFS Stands for
- (a) New type File System
  - (b) Never Terminated File System
  - (c) New Technology File System
  - (d) Non Terminated File System
- 9 Which file system does DOS typically use?
- (a) FAT16
  - (b) FAT32
  - (c) NTFS
  - (d) WNFS
- 10 Which file system does Windows 95 typically use?
- (a) FAT16
  - (b) FAT32
  - (c) NTFS
  - (d) LMFS
- 11 Where does the swap space residable?
- (a) RAM
  - (b) Disk
  - (c) ROM
  - (d) On chip cache
- 12 Which of the following types of terminals is entirely dependent for all its capabilities on the computer system to which it is connected?
- (a) Smart terminal
  - (b) Dumb terminal
  - (c) Micro computer
  - (d) None of these
- 13 The size of the virtual memory depends on the size of the
- (a) Data bus
  - (b) Main memory
  - (c) Address bus
  - (d) None of these



- 14 To protect system, there are how many security levels?  
(a) One  
(b) Two  
(c) Three  
(d) Four
- 15 In one time password  
(a) The password is different in each instance  
(b) The password is same in each instance  
(c) Both A and B  
(d) None of these
- 16 A file sometimes called a  
(a) Collection of input data  
(b) Data set  
(c) Temporary place to store data  
(d) Program
- 17 In one time password  
(a) The password is different in each instance  
(b) The password is same in each instance  
(c) Both A and B  
(d) None of these
- 18 A file sometimes called a  
(a) Collection of input data  
(b) Data set  
(c) Temporary place to store data  
(d) Program
- 19 All of the following are examples of real security and privacy risks except  
(a) Hackers  
(b) Spam  
(c) Viruses  
(d) Identify theft
- 20 Which structure prohibits the sharing of files and directories?  
(a) Tree structure  
(b) One level structure  
(c) Two level structure  
(d) None of these
- 21 Which of the following is the process by which a user's access to physical data in the application is limited, based on his privileges?  
(a) Authorization  
(b) Authentication

- (c) Access Control
  - (d) All of these
- 22 Which structure prohibits the sharing of files and directories?
- (a) Tree structure
  - (b) One level structure
  - (c) Two level structure
  - (d) None of these
- 23 The file structure that redefines its first record at a base of zero uses the term
- (a) Relative organization
  - (b) Key fielding
  - (c) Dynamic reallocation
  - (d) Hashing
- 24 There are no cycles of
- (a) General graph directory
  - (b) Cyclic graph directory
  - (c) One level directory
  - (d) Two level directory
- 25 File attributes are
- (a) Name
  - (b) Type
  - (c) Location
  - (d) All of these
- 26 Trojan horse
- (a) A code segment that misuses its file is called trojan horse
  - (b) Good for file accessing
  - (c) Both A and B
  - (d) None of these
- 27 Optical storage is a
- (a) high-speed direct access storage device.
  - (b) low-speed direct access storage device.
  - (c) medium-speed direct access storage device.
  - (d) high-speed sequential access storage device.
- 28 Which of the following is the principal difference between a monochrome monitor and an RGB monitor?
- (a) Number of electron guns
  - (b) Resolution
  - (c) Size
  - (d) Cost

- 29 Audit log can be used to determine
- (a) How and when the problem occurred
  - (b) What amount of damage was done
  - (c) When security has been violated
  - (d) All of these
- 30 Solution of name collision problem is
- (a) Single level directory
  - (b) Two level directory
  - (c) Tree structure
  - (d) All of these
- 31 A major security problem for operating system is
- (a) Authentication problem
  - (b) Physical problem
  - (c) Human problem
  - (d) None of these
- 32 Memory protection is normally done by the
- (a) Processor and the associated hardware
  - (b) Operating system
  - (c) Compiler
  - (d) User program
- 33 Worm was made up
- (a) One program
  - (b) Two program
  - (c) Three program
  - (d) All of these
- 34 Which of the following topologies consists of multiple CPUs connected by a single communication line running the length of the network?
- (a) Tree
  - (b) Ring
  - (c) Star
  - (d) Bus
- 35 The simplest directory structure is
- (a) Single level directory
  - (b) Two level directory
  - (c) Tree structure directory
  - (d) None of these
- 36 \_\_\_\_\_ is the time required by a sector to reach below read/write head.
- (a) Seek Time
  - (b) Latency Time

- (c) Access time
  - (d) None
- 37 An audit log
- (a) Simply records the time
  - (b) User
  - (c) Type of all access to an object
  - (d) All of these
- 38 Malicious access are
- (a) Unauthorized reading of data
  - (b) Unauthorized modification of data
  - (c) Unauthorized destruction of data
  - (d) All of these
- 39 Which of the following is the process by which a user's privileges ascertained ?
- (a) Authorization
  - (b) Authentication
  - (c) Access Control
  - (d) None of these
- 40 Linux uses \_\_\_\_\_ directory to store system configuration files.
- (a) /bin
  - (b) /dev
  - (c) /boot
  - (d) /etc
- 41 Which directory implementation is used in most Operating System?
- (a) Single level directory structure
  - (b) Two level directory structure
  - (c) Tree directory structure
  - (d) Acyclic directory structure
- 42 A tree structured file directory system
- (a) Allows easy storage and retrieval of file names
  - (b) Is a much debated unnecessary feature
  - (c) Is not essential when we have millions of files
  - (d) None of the above
- 43 Files that can store data in the same format as used in program are called
- (a) Binary files
  - (b) Source file
  - (c) Text file
  - (d) Core

- 44 Which of the following sections of an executable binary file has all uninitialized data items?
- (a) BSS
  - (b) Data
  - (c) Header
  - (d) Symbol
- 45 Which of the following is not a filter?
- (a) cat
  - (b) wc
  - (c) grep
  - (d) sort
- 46 Mounting a file system results in the loading of
- (a) Boot Block
  - (b) Super Block
  - (c) i-node Block
  - (d) All of these
- 47 The directory can be viewed as a \_\_\_\_\_ , that translates file names into their directory entries.
- (a) Symbol Table
  - (b) Partition
  - (c) Swap Space
  - (d) Cache
- 48 In the single level directory:
- (a) all directories must have unique names
  - (b) all files must have unique names
  - (c) all files must have unique owners
  - (d) All of these
- 49 What is not an encryption standard?
- (a) AES
  - (b) TES
  - (c) Triple DES
  - (d) DES
- 50 The following is a multi-user operating system with Xwindows:
- (a) DOS
  - (b) Windows 95
  - (c) Linux
  - (d) None of these

- 51 The \_\_\_\_\_ is used by device controllers to request service.
- (a) non maskable interrupt
  - (b) blocked interrupt
  - (c) maskable interrupt
  - (d) None of these
- 52 A block device transfers:
- (a) bytes one by one
  - (b) block of bytes as a unit
  - (c) with unpredictable response times
  - (d) None of these
- 53 When an attempt is to make a machine or network resource unavailable to its intended users, the attack is called
- (a) denial-of-service attack
  - (b) slow read attack
  - (c) spoofed attack
  - (d) starvation attack
- 54 The internal code of any software that will set of a malicious function when specified conditions are met, is called
- (a) logic bomb
  - (b) trap door
  - (c) code stacker
  - (d) none of the mentioned
- 55 What is a trap door in a program?
- (a) a security hole, inserted at programming time in the system for later use
  - (b) a type of antivirus
  - (c) security hole in a network
  - (d) none of the mentioned
- 56 In asymmetric encryption
- (a) same key is used for encryption and decryption
  - (b) different keys are used encryption and decryption
  - (c) no key is required for encryption and decryption
  - (d) none of the mentioned
- 57 If a process is executing in its critical section
- (a) any other process can also execute in its critical section
  - (b) no other process can execute in its critical section
  - (c) one more process can execute in its critical section
  - (d) none of the mentioned
- 58 According to the ring algorithm, links between processes are
- (a) bidirectional
  - (b) unidirectional

- (c) both (a) and (b)
- (d) none of the mentioned

- 59 If the set of resources available to the process is fixed throughout the process's lifetime then its domain is
- (a) static
  - (b) dynamic
  - (c) neither static nor dynamic
  - (d) none of the mentioned
- 60 For system protection, a process should access
- (a) all the resources
  - (b) only those resources for which it has authorization
  - (c) few resources but authorization is not required
  - (d) all of the mentioned

Ans. (1)(c), (2)(d), (3)(c), (4)(c), (5)(d), (6)(a), (7)(d), (8)(c), (9)(a), (10)(b), (11)(b), (12)(b), (13)(c), (14)(c), (15)(a), (16)(b), (17)(a), (18)(b), (19)(b), (20)(a), (21)(c), (22)(a), (23)(a), (24)(b), (25)(d), (26)(a), (27)(c), (28)(a), (29)(c), (30)(b), (31)(a), (32)(a), (33)(b), (34)(d), (35)(c), (36)(b), (37)(b), (38)(d), (39)(a), (40)(d), (41)(c), (42)(a), (43)(a), (44)(a), (45)(a), (46)(b), (47)(a), (48)(b), (49)(b), (50)(c), (51)(c), (52)(b), (53)(a), (54)(a), (55)(a), (56)(b), (57)(b), (58)(b), (59)(a), (60)(b).

**(c) Fill in the Blanks:**

- 1 Processes can execute in two different modes \_\_\_\_\_ and \_\_\_\_\_.
- 2 Banker's Algorithm is used for \_\_\_\_\_.
- 3 Deadlocks can be expressed by using directed graph known as \_\_\_\_\_ graph.
- 4 The message may be delivered to its destination, but may be \_\_\_\_\_ on the way due to noise in communication line.
- 5 Critical region problem is a problem of \_\_\_\_\_.
- 6 \_\_\_\_\_ forms the core of the UNIX OS.
- 7 \_\_\_\_\_ forms the interface between kernel and the user.
- 8 Password cannot have \_\_\_\_\_ in it.
- 9 Ln is used to \_\_\_\_\_ to another file.
- 10 Ed is a \_\_\_\_\_ editor while vi is a \_\_\_\_\_ editor.

Ans. (1)(Sequential, Concurrent), (2)(Deadlock Prevention), (3)(Precedence), (4)(Scrambled), (5)(Mutual Exclusion Problem), (6)(Kernel), (7)(Shell), (8)(Special Character), (9)(Link), (10)(Line, Screen)

**II Short Answer Type Questions:**

- 1 Who can be a system administrator?
- 2 Who is a super user? How is he different from an ordinary user?
- 3 What are the disadvantages of super user?

- 4 How are processes in UNIX completed?
- 5 Give various options of PS commands? What is the use of PS commands?
- 6 What is a file?
- 7 What is a file system?
- 8 What is a directory? How is it different from regular file?
- 9 What is a superblock? What is its role in file system?
- 10 What is file metadata or file control block? What is its purpose?
- 11 What are rings in Windows NT?
- 12 What is Executive in Windows NT?
- 13 What are the sub-components of I/O manager in Windows NT?
- 14 What level of security does Windows NT meets?
- 15 What are DDks? Name an operating system that includes this feature.
- 16 Discuss the services provided by Kernel I / O subsystem.
- 17 Explain memory management in Linux operating system.
- 18 Explain all the cryptographic techniques used to keep the data secured.
- 19 Explain the file system of Windows XP.
- 20 Explain the concept of directory structure.
- 21 What is a trap and trapdoor?
- 22 Define latency, transfer and seek time with respect to disk I/O
- 23 What is time-stamping?
- 24 In the context of memory management, what are placement and replacement algorithms?
- 25 What are the four layers that Windows NT has in order to achieve independence?
- 26 What is security testing? List the attributes of Security testing?

### III Long Answer Type Questions:

- 1 Write a short note on Directory structure.
- 2 Explain Acyclic-Graph Directories. What are the limitations of acyclic directory structure?
- 3 How is file protection and security implemented on Directory structure? Explain in detail.
- 4 The file systems of computers can be very extensive. Explain the directory structure in detail.
- 5 How can file space allocations be implemented in device management?
- 6 In a multi-user environment, a file is required to be shared among more than one user. How can this be implemented without security risk? Give example.
- 7 Explain file system mounting in detail.
- 8 Write short notes on
  - (a) X-Windows
  - (b) Command Line Interface
  - (c) System Calls
  - (d) File Naming
- 9 In UNIX files can be categorized as the following types:
  - (a) Ordinary Files
  - (b) Directory Files
  - (c) Special Files



(d) FIFO Files

- 10 Explain in detail all disk scheduling algorithms in detail.
- 11 Write about general graph directory in detail. Illustrate using diagram.
- 12 Explain the relative merits and demerits of using hierarchical directory structure over single level and two level directory structures?
- 13 What do you mean file system mounting? How is it performed?
- 14 Explain various file systems in windows?
- 15 Explain various attributes of File?
- 16 Explain the various Operations that can be performed on files.
- 17 What are the various File access methods?
- 18 Discuss various File allocation techniques?
- 19 What are various techniques through which free space management can be implemented?
- 20 Compare and contrast Linux Operating system and Windows XP?
- 21 What are the different types of security attacks?
- 26 Compare and Contrast Windows XP and Linux?
- 27 Differentiate between protection and security. Explain the techniques used for protection of user files.
- 28 What are the differences between user level threads and kernel supported threads
- 29 What are the key object oriented concepts used by Windows NT?
- 30 Is Windows NT a full blown object oriented operating system? Give reasons.
- 31 Explain the issues in designing a file system?
- 32 Explain the file system in Windows XP.
- 33 Explain the linked file allocation method.
- 34 Explain the linked allocation and indexed allocation methods used in file systems.
- 35 What are rings and Executives in Windows NT? What are the sub-components of I/O manager in Windows NT? What level of security does Windows NT meets?
- 36 What is penetration testing? Why penetration testing is important? List various methodologies in security testing?
- 37 Difference between IDS and IPS and firewall. List down some factors that can cause vulnerabilities? List down the seven main types of security testing as per Open Source Security Testing methodology manual?
- 38 What is SOAP and WSDL? List and explain in detail the parameters that define an SSL session connection?
- 39 What are the three classes of intruders? What is port scanning? Describe Network Intrusion Detection system?
- 40 Explain the difference between intrusion and extrusion detection. Describe an adversary pivot, give an example, and explain its importance to intrusion analysis.