BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

UG

Name: …… Roll No.: ……..

Branch: …… Signature of Invigilator: ……

Semester: IVth Date: 29/04/2022 (MORNING)

Subject with Code: **CS206 DESIGN AND ANALYSIS OF ALGORITHM**

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER: IV**
BRANCH: CSE/IT **SESSION: SP/22**

SUBJECT: CS206 Design and Analysis of Algorithms

TIME: 2Hrs **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper is having two sections Section A [30 Marks] and Section B [20 Marks].
2. Section A is having 40 Multiple Choice Questions. 20 Questions of Mark 1 and 20 Questions of Mark 0.5
3. Section B contain 5 Questions and Candidates may attempt any 4 questions of 20 marks.
4. The missing data, if any, may be assumed suitably.
5. Before attempting the question paper, be sure that you have got the correct question paper.

SECTION-A

[Q[1-20]X1=20Marks]
[Q[21-40]X0.5=10Marks]

1. Solve the recurrence relation T(n)=2T(n/2) + k n where k is constant then T(n) is
   a) O(lgn) b) O(nlgn) c) O(n) d) ($O(n^2)$)
2. What is the time complexity of the given code?
   void f(int n)
   {
   if (n>0)
   f(n/2):
   }
   a) ϴ(n) b) ϴ(nlgn) c) ϴ(lgn) d) ϴ(n^2)
3. Apply Quicksort on a given sequence 6,10,13,5,8,3,2,11. What is the sequence after first phase of partition? Where Pivot is the first element.
   a) 5,3,2,6,10,8,13,11 b) 5,2,3,6,8,13,10,11 c) 6,5,13,10,8,3,2,11 d) 6,5,3,2,8,13,10,11
4. Selection sort is applied on a given sequence: 89,4568,90,29,34,17. What is the sequence after 2 iterations?
   a) 17,29,68,90,45,34,89 b) 17,45,68,90,29,34,89 c)17,68,45,90,34,29,89
   d) 17,29,68,90,34,45,89
5. In a binary max heap containing 'n' numbers, the smallest element can be found in time
   a) O(lgn) b) O(nlgn) c) O(n) d) O(1)
6. The best-case analysis of Quicksort is if partition splits the array of size n into
   a) n/2:n/m b)n/2:n/2 c)n/3:n/2 d)n/4:n/2
7. What is the time complexity of powering a number, by using divide and conquer methodology?
   a) ϴ(n) b) ϴ(nlgn) c) ϴ(lgn) d) ϴ(n^2)
8. The value you are searching is called
   a) Binary Value b) Search Argument c) Key d) Serial Value
9. The minimum number of comparisons required to find the minimum and the maximum of 100 numbers is
   a) 158 b) 138 c)148 d) 128
10. What is the number of Swaps required to sort n elements using selection sort, in the worst case?
    a) ϴ(n) b) ϴ(nlgn) c) ϴ(lgn) d) ϴ(n^2)

11. Construct a Binary Search Tree with the given list of elements:
300,210,400,150,220,370,450,100,175,215,250. Which element is the parent node of 250?
a)220 b)150 c)370 d)215

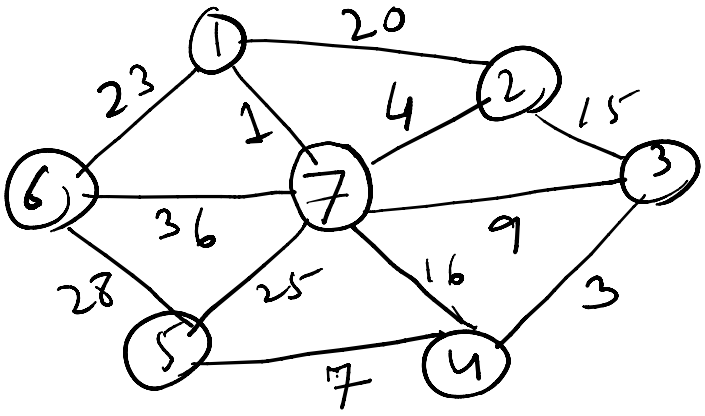
12. A MST is a Subgraph of a Graph that contains all the
a) Vertices b) Edges c) Both d) Few Edges and Few Vertices

13. Kruskal' s algorithm is a
a) Divide and Conquer b) Greedy c) Dynamic Programming d) Branch and Bound

14. TSP belongs to
a) NP class b) P class c) NP Hard d) NP Complete

15. Optimal Substructure property is exploited by
a) Dynamic Programming b) Greedy c) Incremental Approach d) Randomised

16. Find the total cost of the following Spanning TREE using Kruskal' s Algorithm.



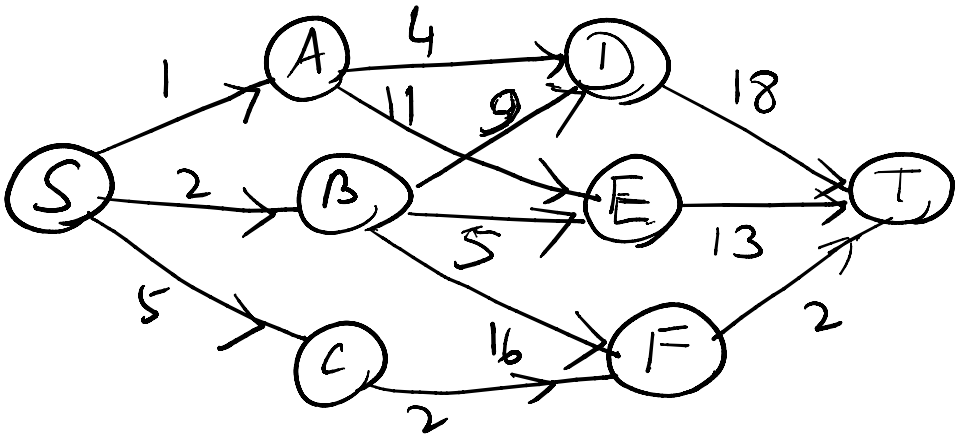
a) 57 b)37 c)47 d)39

17. A thief enters to a store and sees the following, his knapsack can hold 4 Kg, what should he steal to maximum profit?

A	B	C
100Rs	80Rs	120Rs
2Kg	2Kg	3Kg

a) A and B b) A and C
b) B and C d) A, B and C

18. Consider the below graph, calculate the shortest distance from 'S' to 'T' ?



a) 23 b) 9 c) 20 d) 22

19. Calculate the maximum profit, using greedy strategy, 0-1 knapsack capacity is 50. The data is given below: n=3, (w_1, w_2, w_3) = (10,20,30) and (P1, P2, P3) = (60,100,120)

a) 180 b) 220 c) 240 d) 260

20. Let C1, C2, C3, C4 represent coins. C1=25 paisa, C2=10 Paisa, C3=5 Paisa, C4=1 Paisa. To represent 48 Paisa, what is the minimum number of coins used, using greedy approach?

a)6 b)7 c)8 d)9

21. If there are n integers to sort, each integer has d digits, and each digit is in the set {1, 2, …, k}, radix sort can sort the numbers in:

a) O (k (n + d)) b) O (d (n + k)) c) O ((k+n)logd) d) O ((n + d)logk)

22. Consider the following array of elements {89,19,50,17,12,15,2,5,7,11,6,9,100}. The maximum number of interchanges needed to convert it into a max heap is

a) 4 b) 5 c) 2 d) 3

23. Two alternative packages A and B are available for processing a database having 10 to the power k records. Package A requires 0.0001 n square time units and package B requires 10nlogn (log is base 10) time units to process n records. What is the smallest value k for which package B will be preferred over A?

a) 12 b) 10 c) 6 d) 5

24. Consider the following C code. Assume that unsigned long int type length 64 bits.

```
Unsigned long int fun (unsigned long int n)
{
unsigned long int i,j=0, sum =0;
for(i=n;i>1;i=i/2)
j++;
for(;j>1;j=j/2)
sum++;
return(sum);
}
```

The value returned when we call fun with the input 2 to the power 40 is ?

a) 4 b) 5 c) 10 d) 40

25. Two alternative packages A and B are available for processing a database having 10 to the power k records. Package A requires 0.0001 n square time units and package B requires 10nlogn (log is base 10) time units to process n records. What is the smallest value k for which package B will be preferred over A?

a) 12 b) 10 c) 5 d) 6

26. What is the minimum number of nodes in an AVL tree of height 3?

a) 4 b) 5 c) 6 d) 7

27. For rebalancing an AVL tree with a Zig-Zig imbalance we should apply:

a) Single left rotation c) Double left right rotation

b) Single right rotation d) Double right left rotation

28. Consider a max heap, represented by the array: 40, 30, 20, 10, 15, 16, 17, 8, 4. Now consider that a value 35 is inserted into this heap. After insertion, the new heap is

a) 40, 30, 20, 10, 15, 16, 17, 8, 4, 35 c) 40, 35, 20, 10, 30, 16, 17, 8, 4, 15

b) 40, 30, 20, 10, 35, 16, 17, 8, 4, 15 d) 40, 35, 20, 10, 15, 16, 17, 8, 4, 30

29. Given an input arr = {2,5,7,99,120}; key = 120; What is the level of recursion?

a) 5 b) 2 c) 3 d) 4

30. The total number of comparisons required to merge 4 sorted files containing 16, 4, 10, 8 records into a single sorted file is

a) 37 b) 38 c) 41 d) 55

31. A binary search tree is generated by inserting in order the following integers: 40 60 50 33 55 11 The number of nodes in the left subtree and right subtree of the root respectively is?

a) (2,3) b) (3,3) c) (3,2) d) (4,3)

32. What is the time and space complexity of the given code?

```
int count (struct node *p)
{
int c=0;
while(p!=0)
{
c++;
p=p->next;
}
return(c);
}
```

a) O(n), O(1) b) O(1), O(n) c) O(n), O(n) d) O(1), O(1)

33. In theoretical analysis of an algorithm key operation to determine its complexity is the one that is

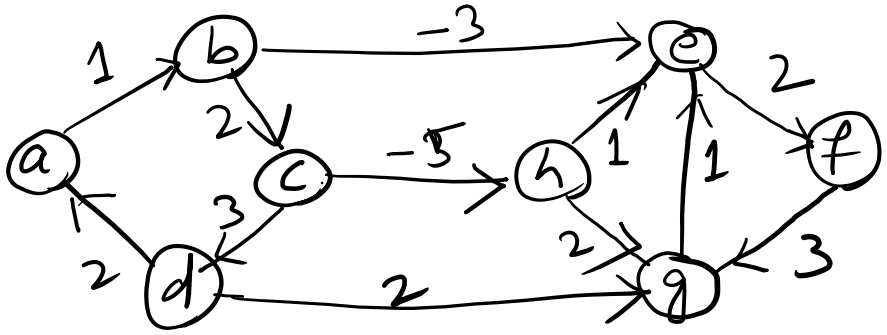
a) Most frequent operation. c) Most costly operation.

b) Any operation. d) Weighted sum of all operations.

34. Let G be a complete undirected Graph of 4 vertices, having 6 edges with weights being 1,2,3,4,5 and 6. The Maximum possible weight that a minimum weight spanning tree of G can have is

a) 4 b) 5 c) 6 d) 7

35. Dijkstra's single source shortest path algorithm when run from vertex a in the below graph, computes the correct shortest path distance to



a) Only Vertex a b) Only vertices a,e,f,g,h c) Only vertices a,b,c,d d)All the Vertices

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

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

What is the minimum possible weight of a spanning Tree T in this Graph such vertex 0 is a leaf node in the Tree T?

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

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

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

38. A problem is in NP, and as hard as any problem in NP. Then given problem is

a) NP Hard b) NP Complete c) NP d) NP Hard ∩ NP Complete

39. If P1 is NP Complete and there is a polynomial time reduction of P1 to P2 then P2 is

a) NP Complete c) Not Necessarily Np Complete

b) Cannot be NP Complete d) None of these

40. Problems that can be solved in polynomial time are called

a) Tractable b) Undecidable c) Untractable d) Unsolvable

SECTION B

[To Answer choose **Any Four** Questions out of Five 4X5=20 Marks]

Q.1(a) Write the algorithm of Insertion sort and analyses its' average time complexity. Explain with an Example. [2]

Q.1(b) Solve the recurrence using Master Theorem $T(n)= 2T(n/2) +n^{1/2}$. [3]

Q.2(a) Write an algorithm to search an element in a BST? [2]

Q.2(b) Write the algorithm for Quicksort and Analyze it' s time complexity through examples. [3]

Q.3(a) Write the algorithm for LCS and explain through examples. [2]

Q.3(b) Write an algorithm for All Pair Shortest Path and analyze its time complexity asymptotically. [3]

Q.4(a) List the difference between 0-1 knapsack and fractional knapsack problems. [2]

Q.4(b) Explain LC search for branch and bound with an Example. [3]

Q.5(a) Write short notes on Vertex Cover problem and show how this is belongs to NP. [2]

Q.5(b) Prove that Clique problem is NP Complete. [3]

:::::29/04/2022:::::