BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

UG

Name: …… Roll No.: ……..

Branch: …… Signature of Invigilator: ……

Semester: VIth Date: 09/05/2022 (MORNING)

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

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

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: VI**
BRANCH: ALL **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 30 Multiple Choice Questions.
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

[1X30=30Marks]

1. From a practical perspective, the first thing you need to do before designing an algorithm is to understand completely the problem given. This step is followed by "Decision on computational means, exact versus approximation solving, data structure(s), algorithm design technique" . Arrange the following sequence of steps, which are to be followed the steps, in their correct order.
   Step-A: Design an algorithm
   Step-B: Prove correctness
   Step-C: Analyse the algorithm
   Step-D: Code the algorithm
   a) A-B-C-D b) A-C-B-D c) A-D-C-B d) D-A-B-C

2. Consider the following C-function:

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

The space complexity of the above function is:
   a) $O(n^2)$ b) O(n) c) O(nlgn) d) O(1)

3. G is a graph on n vertices and 2n-2 edges. The edges of G can be partitioned intotwo edge-disjoint spanning trees. Which of the following is NOT true for G?

   a. There are two vertex-disjoint paths between every pair of vertices

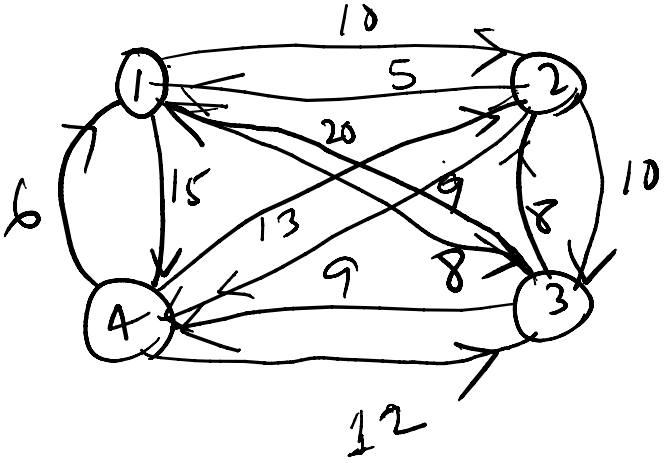
b. The minimum cut in G has at least two edges

c. There are two edge-disjoint paths between every pair of vertices

d. For every subset of k vertices, the induced subgraph has at most 2k-2 edges.

4. Average successful search time taken by binary search on a sorted array of 10items is
   a) 5.5 b) 3.2 c) 2.9 d) 1.0
5. Which algorithm technique is popularly used to find solution for n- Queen problem?
   a) Dynamic Programming b) Greedy c) Incremental Approach d) Backtracking
6. A non-deterministic algorithm is said to be non-deterministic polynomial if the time-efficiency of its verification stage is non-polynomial.
   a) TRUE b) FALSE c) Cannot Say d) May be
7. The running time of an algorithm is represented by the following recurrence relation:
   if (n <= 3) then T(n) = n
   else
   T(n) = T(n/3) + cn
   Which of the following represents the time complexity of the code?
   a) lg_3 n (Log n base 3) c)log n base 2
   b) n d)lgn
8. You are given a knapsack that can carry a maximum weight of 60. There are 4 items with weights {20, 30, 40, 60} and values {70, 80, 90, 150}. What is the maximum value of the items you can carry using the knapsack?
   a) 90 b) 160 c)150 d)170

9. What will be global optimal return for Rod Cutting problem for the following given pairs: {<1: 3>, <2:5>, <3:8>} for rod of length n=3.
   a) 9 b) 8 c) 5 d) 3
10. Kruskal' s algorithm is better for the sparse graphs than the prim' s algorithm.
    a) True b) False c) Never d) Cannot Say
11. Consider the following segment of C-code:
    int j, n; j = 1;
    while (j <= n) j = j*2;
    The number of comparisons made in the execution of the loop for any n > 0 is:
    a) Celling (lgn+2) b) Floor(lgn+2) c)Celling(lgn) d) Floor(lgn)+1
12. Solve the given TSP problem. Start city is 1. The cost of the optimum tour is:



a) 35 b) 38 c) 40 d) 27

13. What is the time complexity of the brute force algorithm used to solve the Knapsack problem?
    a) O(n!) b) $O(n^3)$ c) $O(n^2)$ d) $O(2^n)$
14. The profit generated by the dynamic programming-based solution to 0/1 knapsack problem is always greater than the profit generated by the greedy method on the same instance.
    a) TRUE b) FALSE c) Cannot Say d) Not at ALL
15. A fully binary tree with n non-leaf nodes contains
    a) 2n nodes b) 2n-2 nodes c) 3n nodes d) 2n+1 nodes
16. Consider a graph G=(V,E), where V is set of vertices and E is set of edges. On that graph, what will be the time complexity of Kruskal's algorithm?
    a) O(lgv) b) O(Elgv) c)$O(ElgE^2)$ d) $O(Elgv^3)$

17. Momoization refers to maintaining an entry in a table for the solution to the final optimal solution out of the subproblems during dynamic programming
    a) TRUE b) FALSE c) Cannot Say d) Not at All
18. Which of the following statement (s) is / are correct regarding Bellman-Ford shortest path algorithm?
    P. Always finds a negative weighted cycle, if one exists.
    Q. Finds whether any negative weighted cycle is reachable from the source.
    a) P Only b) Q Only c) P and Q both d) Neither P nor Q
19. Consider a graph G = (V, E), where V = {v1, v2, , v100},
    E = {(vi, vj) | 1 ≤ i < j ≤ 100}, and weight of the edge (vi, vj) is |i - j|.
    The weight of the minimum spanning tree of G is?
    a) 101 b) 100 c) 99 d) 98
20. Solution to the recurrence relation $T(n) = 2T(\sqrt{n}) + \lg n$ is:
    a) O(lgn lglgn) b) O(n) c) O(nlgn) d) $O(n^2)$
21. Let S be a sorted array of n integers. Let T(n) denote the time taken for the most efficient algorithm to determine if there are two elements with a sum less than 1000 in S. Which of the following statements is true?
    a) T(n)=O(n) b)T(n)=O(n/2) c)T(n)=O(lgn) d)T(n)=O(1)
22. Consider the problem of computing min-max in an unsorted array where min and max are minimum and maximum elements of array. Algorithm A1 can compute min-max in a1 comparisons using divide and conquer. Algorithm A2 can compute min-max in a2 comparisons by scanning the array linearly. What could be the relation between a1 and a2 considering the worst-case scenarios?
    a) Depends on input b) a1=a2 c) a1<a2 d) a1>a2
23. What is the global optimal solution to following instance of 0/1 knapsack problem m = 7 kg, (w1, w2, w3, w4) = (3,4,6,2), (p1, p2, p3, p4) = (10,20,32,15)
    a) 1100 b)1010 c)0101 d)1001
24. A machine took 200 sec to sort 200 names, using bubble sort. In 800 sec it can approximately sort
    a)1800 Names b)800 Names c) 1200 Names d) 400 Names

25. The depth of a complete binary tree with 'n' nodes is
    a) lg(n+1)-1 b) lgn+1 c) lg(n-1)-1 d)lgn

26. Which of the following problems is equivalent to the 0-1 Knapsack problem?
    a) You are given infinite coins of denominations {v1, v2, v3,….., vn} and a sum S. You have to find the minimum number of coins required to get the sum S
    b) You are studying for an exam, and you have to study N questions. The questions take {t1, t2, t3,…., tn} time(in hours) and carry {m1, m2, m3,…., mn} marks. You can study for a maximum of T hours. You can either study a question or leave it. Choose the questions in such a way that your score is maximized.
    c) You are given a suitcase that can carry a maximum weight of 15kg. You are given 4 items which have a weight of {10, 20, 15,40} and a value of {1, 2, 3,4}. You can break the items into smaller pieces. Choose the items in such a way that you get the maximum value.
    d) You are given a bag that can carry a maximum weight of W. You are given N items which have a weight of {w1, w2, w3,…., wn} and a value of {v1, v2, v3,…., vn}. You can break the items into smaller pieces. Choose the items in such a way that you get the maximum value.
27. Dijkstra's Algorithm cannot be applied on-
    a) Directed and weighted graph c) Undirected and unweighted graphs
    b) Unweighted graphs d) Graphs having negative weight function
28. How many different spanning trees can be obtained from a complete graph of 5 vertices?
    a) 16 b) 32 c) 125 d) 8
29. Average successful search time for sequential search on n items is
    a) (n-1)/2 b) (n+1)/2 c) nxn d) n/2
30. A machine needs a minimum of 100 sec to sort 1000 names by quick sort. The minimum time needed to sort 1000 names by quick sort. The minimum time needed to sort 100 names will be approximately
    a) 10 sec b) 72.7 sec c) 11.2 sec d) 6.7 sec

SECTION B

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

Q.1(a) Solve the recurrence $T(n)=9T(n/2)+n^2$. [2]

Q.1(b) Prove that $(n+a)^b=\Theta(n^b)$. [3]

Q.2(a) Write an algorithm to delete an element from the BST? [2]

Q.2(b) Why do we use divide and conquer algorithm paradigm? Discuss with an example. [3]

Q.3(a) Write the basic characteristics of Dynamic programming. [2]

Q.3(b) Write an algorithm for FLOYD WARSHALL and analyze its time complexity asymptotically. [3]

Q.4(a) Write Short notes on Branch and Bound Techniques. [2]

Q.4(b) Write the Dijkstra' s algorithm for the single source shortest path and analyze it' s time complexity. [3]

Q.5(a) What makes algorithm nondeterministic. [2]

Q.5(b) Prove that Hamiltonian Cycle problem for the undirected Graph is NP Complete. [3]

:::::09/05/2022:::::