United College of Engineering and Research, Allahabad

Department of Computer Science & Engineering

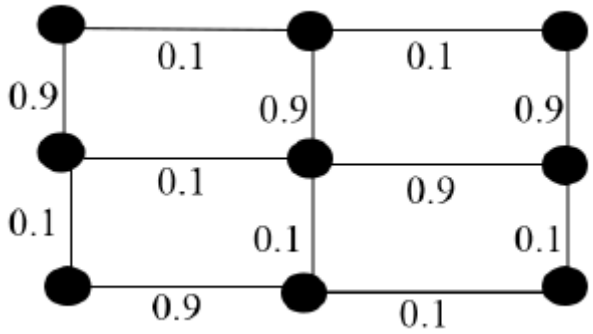
B.Tech CSE- V Semester

Set-2

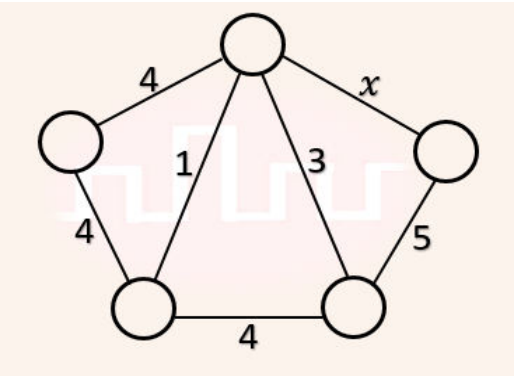
Course Name: Design and Analysis of Algorithm **AKTU Course Code:** KCS-503

Q. No.	Questions
1	The correct matching for the following pairs is (A) 0/1 Knapsack (1) Greedy (B) Quick sort (2) Depth-first search (C) Minimum weight (3) Dynamic programming (D) Connected Components (4) Divide and conquer (A) A-2 , B-4 , C-1, D-3 (B) A-3 , B-4 , C-l , D-2 (C) A-3 , B-4 , C-2 , D-1 (D) A-4 , B-1 , C-2 , D-3
2	Consider the following ANSI C function: `int SomeFunction (int x, int y)` `{` `if ((x == 1) || (y == 1)) return 1;` `if (x == y) return x;` `if (x > y) return SomeFunction (x-y, y);` `if (y > x) return SomeFunction (x, y-x);` `}` The value returned by SomeFunction (15, 255) is _____.
3	Consider the following statements. S1:The sequence of procedure calls corresponds to a preorder traversal of the

	activation tree. S2:The sequence of procedure returns corresponds to a postorder traversal of the activation tree. Which one of the following options is correct? **(A)** S1 is false and S2 is true **(B)** S1 is false and S2 is false **(C)** S1 is true and S2 is false **(D)** S1 is true and S2 is true
4	A binary search tree T contains n distinct elements. What is the time complexity of picking an element in T that is smaller than the maximum element in T? **(A)** Θ(logn) **(B)** Θ(nlogn) **(C)** Θ(1) **(D)** Θ(n)
5	Consider the following three Functions $f_1 = 10^n$ $f_2 = n^{logn}$ $f_3 = n^{\sqrt{n}}$ Which one of the following options arranges the functions in the increasing order of asymptotic growth rate? **(A)** f_2, f_1, f_3 **(B)** f_3, f_2, f_1 **(C)** f_2, f_3, f_1 **(D)** f_1, f_2, f_3
6	Let P be an array containing n integers. Let t be the lowest upper bound on the number of comparisons of the array elements, required to find the minimum and maximum values in an arbitrary array of n elements. Which one of the following choices is correct? **(A)** $t > 2n - 2$

	(B) $t > 3\left\lceil \frac{n}{2} \right\rceil and \quad t \leq 2n - 2$ **(C)** $t > n \; and \; t \leq 3\lceil \frac{n}{2} \rceil$ **(D)** $t > \lceil \log_{2(n)} \rceil \; and \; t \leq n$
7	Consider the following undirected graph with edge weights as shown:  The number of minimum-weight spanning trees of the graph is _____
8	What is the worst-case number of arithmetic operations performed by recursive binary search on a sorted array of size n? **(A)** $\theta(n)$ **(B)** $\theta(\sqrt{n})$ **(C)** $\theta(\log_2(n))$ **(D)** $\theta(n^2)$
9	Let G = (V, E) be a weighted undirected graph and let T be a Minimum Spanning Tree(MST) of G maintained using adjacency lists. Suppose a new weighted edge (u,v) ∈ V×V is added to G. The worst case time complexity of determining if T is still an MST of the resultant graph is

	(A) $\theta(|E||V|)$ **(B)** $\theta(|E|+|V|)$ **(C)** $\theta(|V|)$ **(D)** $\theta(|E| \log |V|)$
10	Consider a graph G = (V, E), where V = {v_1, v_2, …, v_{100}}, E = {(vi, vj) | 1 ≤ i < j ≤ 100}, and weight of the edge (v_i, v_j) is $\|i - j\|$. The weight of the minimum spanning tree of G is _____.
11	Consider a sequence of 14 elements: A = [-5, -10, 6, 3, -1, -2, 13, 4, -9, -1, 4, 12, -3, 0]. The subsequence sum **S(i,j)=** $\sum_{k=i}^{n} k[k]$ Determine the maximum of S(i,j), where 0 ≤ i ≤ j < 14. (Divide and conquer approach may be used)_____.
12	There are n unsorted arrays: A_1, A_2, …, A_n. Assume that n is odd. Each of A_1, A_2, …, A_n contains n distinct elements. There are no common elements between any two arrays. The worst-case time complexity of computing the median of the medians of A_1, A_2, …, A_n is **(A)** $O(n^2)$ **(B)** $\Omega(n^2 \log n)$ **(C)** $O(n)$ **(D)** $O(n \log n)$
13	Consider the weights and values of items listed below. Note that there is only one unit of each item. **Item number** / **Weight (in Kgs)** / **Value (in rupees)** 1 / 10 / 60 2 / 7 / 28 3 / 4 / 20 4 / 2 / 24 The task is to pick a subset of these items such that their total weight is no more than 11 Kgs and their total value is maximized. Moreover, no item may be split. The total value of items picked by an optimal algorithm is denoted by V_{opt}. A greedy algorithm sorts the items by their value-to-weight ratios in descending order and packs them greedily, starting from the first item in the ordered list. The total value of items picked

	by the greedy algorithm is denoted by V_{greedy}. The value of $V_{opt} - V_{greedy}$ is __ .
14	Consider the following undirected graph G:  Choose a value for x that will maximize the number of minimum weight spanning trees (MWSTs) of G. The number of MWSTs of G for this value of x is _____.
15	Consider the following table: **Algorithms** / **Design Paradigms** (P) Kruskal / (i) Divide and Conquer (Q) Quicksort / (ii) Greedy (R) Floyd-Warshall / (iii) Dynamic Programming Match the algorithm to design paradigms they are based on: **(A)** (P)↔(ii), Q↔(i), (R)↔(iii) **(B)** (P)↔(ii), Q↔(iii), (R)↔(i) **(C)** (P)↔(i), Q↔(ii), (R)↔(iii) **(D)** (P)↔(iii), Q↔(i), (R)↔(ii)
16	Consider the following functions from positives integers to real numbers $10, \sqrt{n}, n, log_2 n, \frac{100}{n}$ The CORRECT arrangement of the above functions in increasing order of asymptotic complexity is: **(A)** $log_2 n, \frac{100}{n}, 10, \sqrt{n}, n$ **(B)** $\frac{100}{n}, 10, log_2 n, \sqrt{n}, n$

	(C) $10, \frac{100}{n}, \sqrt{n}, log_2 n, n$ **(D)** $\frac{100}{n}, log_2 n, 10, \sqrt{n}, n$
17	Let G = (V, E) be any connected undirected edge-weighted graph. The weights of the edges in E are positive and distinct. Consider the following statements: (I) Minimum Spanning Tree of G is always unique. (II) Shortest path between any two vertices of G is always unique. Which of the above statements is/are necessarily true? **(A)** (II) only **(B)** (I) only **(C)** neither (I) nor (II) **(D)** both (I) and (II)
18	Match the algorithms with their time complexities: **Algorithm** / **Time complexity** (P) Towers of Hanoi with *n* disks — (i) $\Theta(n^2)$ (Q) Binary search given *n* stored numbers — (ii) $\Theta(n \log n)$ (R) Heap sort given n numbers at the worst case — (iii) $\Theta(2^n)$ (S) Addition of two n×n matrices — (iv) $\Theta(\log n)$ **(A)** P→(iv), Q→(iii), R→(i), S→(ii) **(B)** P→(iv), Q→(iii), R→(ii), S→(i) **(C)** P→(iii), Q→(iv), R→(ii), S→(i) **(D)** P→(iii), Q→(iv), R→(i), S→(ii)
19	Consider the recurrence function $T(n) = \begin{cases} 2T(\sqrt{n}) + 1, & n > 2 \\ 2, & 0 < n \leq 2 \end{cases}$

	Then T(n) in terms of Θ notation is **(A)** Θ(n) **(B)** Θ(√n) **(C)** Θ(logn) **(D)** Θ(loglogn)
20	Consider the following C function. `int fun (int n)` `{` `  int i, j;` `  for (i = 1; i <= n; i++)` `  {` `  for (j = 1; j < n; j += i)` `  {` `  printf("%d %d",i,j);` `  }` `  }` `}` Time complexity of **fun** in terms of Θ notation is **(A)** $\Theta(n^2 \log n)$ **(B)** Θ(n log n) **(C)** $\Theta(n^2)$ **(D)** Θ(n√n)
21	Let ***H*** be a binary min-heap consisting of n elements implemented as an array. What is the worst case time complexity of an optimal algorithm to find the maximum element in ***H***? **(A)** $\theta(n)$ **(B)** $\theta(n \log n)$ **(C)** $\theta(1)$

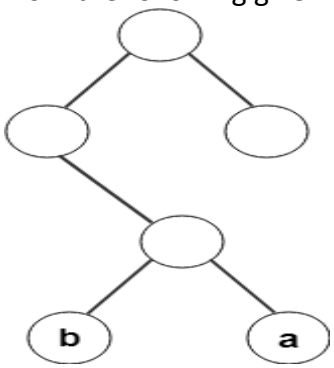
	(D) $\theta(\log n)$
22	Consider a complete binary tree with 7 nodes, Let A denote the set of first 3 elements obtained by performing Breadth-First Search (BFS) starting from the root. Let B denote the set of first 3 elements obtained by performing Depth-First Search (DFS) starting from the root. The value of |A – B| is _____.
23	Consider a double hashing scheme in which the primary hash function is $h_1(k) = k \bmod 23$, and the secondary hash function is $h_2(k) = 1 + (k \bmod 19)$. Assume that the table size is 23. Then the address returned by probe 1 in the probe sequence (assume that the probe sequence begins at probe 0) for key value k=90 is _____.
24	In a balanced binary search tree with n elements, what is the worst case time complexity of reporting all elements in range [a,b]? Assume that the number of reported elements is k. **(A)** θ(k log n) **(B)** θ(log n) **(C)** θ(n log k) **(D)** θ(log n + k)
25	Let G = (V,E) be a directed, weighted graph with weight function w:E → R. For some function f:V → R, for each edge (u,v) ∈ E, define w'(u,v) as w(u,v) + f(u) – f(v). Which one of the options completes the following sentence so that it is TRUE? "The shortest paths in G under w are shortest paths under w' too, _____". **(A)** if and only if ∀u ∈ V, f(u) is negative **(B)** for every f: V→R **(C)** if and only if ∀u ∈ V, f(u) is positive **(D)** if and only if f(u) is the distance from s to u in the graph obtained by adding a new vertex s to G and edges of zero weight from s to every vertex of G
26	

	Consider the following C program: `#include <stdio.h>` `int jumble (int x, int y)` `{` `  x = 2 * x + y ;` `  return x ;` `}` `int main ( )` `{` `  int x=2, y=5 ;` `  y = jumble (y, x) ;` `  x = jumble (y, x) ;` `  printf ("%d \n", x) ;` `  return 0 ;` `}` The value printed by the program is __.
27	Consider the following C program: `#include <stdio.h>` `int r()` `{` `  static int num=7 ;` `  return num-- ;` `}` `int main ()` `{` `  for (r(); r (); r())` `  printf ("%d", r());` `  return 0 ;` `}` Which one of the following values will be displayed on execution of the programs? **(A)** 52 **(B)** 630 **(C)** 41 **(D)** 63
28	Consider the following C function:

	`` void convert (int n) { if (n < 0) printf ("%d", n); else { convert (n/2); printf ("%d", n%2); } } ``` Which one of the following will happen when the function convert is called with any positive integer n as argument? **(A)** It will print the binary representation of n and terminate. **(B)** It will print the binary representation of n in the reverse order and terminate. **(C)** It will print the binary representation of n but will not terminate. **(D)** It will not print anything and will not terminate.
29	Consider the following statements: I. The smallest element in a max-heap is always at a leaf node. II. The second largest element in a max-heap is always a child of the root node. III. A max-heap can be constructed from a binary search tree in Θ(n) time. IV. A binary search tree can be constructed from a max-heap in Θ(n) time. Which of the above statements are TRUE? **(A)** I, II and III **(B)** I, III and IV **(C)** II, III and IV **(D)** I, II and IV
30	Consider the following C program:

	``c #include <stdio.h> int main() { int a[] = {2, 4, 6, 8, 10} ; int i, sum = 0, *b = a + 4 ; for (i = 0; i < 5; i++) sum = sum + (*b - i) - *(b - i) ; printf ("%d\n", sum) ; return 0 ; } ``` The output of the above C program is _____.
31	Consider the matrices P, Q and R which are 10 x 20, 20 x 30 and 30 x 40 matrices respectively. What is the minimum number of multiplications required to multiply the three matrices? a) 18000 b) 12000 c) 24000 d) 32000
32	Consider the matrices P, Q, R and S which are 20 x 15, 15 x 30, 30 x 5 and 5 x 40 matrices respectively. What is the minimum number of multiplications required to multiply the four matrices? a) 6050 b) 7500 c) 7750 d) 12000
33	Which of the following methods can be used to solve the longest common subsequence problem? a) Recursion b) Dynamic programming c) Both recursion and dynamic programming d) Greedy algorithm
34	Consider the strings “PQRSTPQRS” and “PRATPBRQRPS”. What is the length of the longest common subsequence? a) 9 b) 8 c) 7 d) 6
35	What is the time complexity of the brute force algorithm used to find the longest common subsequence?

	a) O(n) b) $O(n^2)$ c) $O(n^3)$ d) $O(2^n)$
36	Which of the following is the longest common subsequence between the strings "hbcfgmnapq" and "cbhgrsfnmq" ? a) hgmq b) cfnq c) bfmq d) fgmna
37	You are given a knapsack that can carry a maximum weight of 60. There are 4 items with weights {20, 30, 40, 70} and values {70, 80, 90, 200}. What is the maximum value of the items you can carry using the knapsack? a) 160 b) 200 c) 170 d) 90
38	What is the time complexity of the brute force algorithm used to solve the Knapsack problem? a) O(n) b) O(n!) c) $O(2^n)$ d) $O(n^3)$
39	Fractional knapsack problem is solved most efficiently by which of the following algorithm? a) Divide and conquer b) Dynamic programming c) Greedy algorithm d) Backtracking
40	Time complexity of fractional knapsack problem is _____ a) O(n log n) b) O(n) c) $O(n^2)$ d) O(nW)
41	Given items as {value,weight} pairs {{40,20},{30,10},{20,5}}. The capacity of knapsack=20. Find the maximum value output assuming items to be divisible. a) 60

	b) 80 c) 100 d) 40
42	Given items as {value,weight} pairs {{60,20},{50,25},{20,5}}. The capacity of knapsack=40. Find the maximum value output assuming items to be divisible and nondivisible respectively. a) 100, 80 b) 110, 70 c) 130, 110 d) 110, 80
43	From the following given tree, what is the code word for the character 'a'?  a) 011 b) 010 c) 100 d) 101
44	Which of the problems cannot be solved by backtracking method? a) n-queen problem b) subset sum problem c) hamiltonian circuit problem d) travelling salesman problem
45	What happens when the backtracking algorithm reaches a complete solution? a) It backtracks to the root b) It continues searching for other possible solutions c) It traverses from a different route d) Recursively traverses through the same route
46	In n-queen problem, how many values of n does not provide an optimal solution? a) 1 b) 2 c) 3

	d) 4
47	Which of the following methods can be used to solve n-queen's problem? a) greedy algorithm b) divide and conquer c) iterative improvement d) backtracking
48	How many possible solutions exist for an 8-queen problem? a) 100 b) 98 c) 92 d) 88
49	Of the following given options, which one of the following does not provides an optimal solution for 8-queens problem? a) (5,3,8,4,7,1,6,2) b) (1,6,3,8,3,2,4,7) c) (4,1,5,8,6,3,7,2) d) (6,2,7,1,4,8,5,3)
50	Floyd Warshall Algorithm can be used for finding _____ a) Single source shortest path b) Topological sort c) Minimum spanning tree d) Transitive closure

Answer

1-b	2-15	3-d	4-c	5-c	6-c	7- 3	8-c	9-c	10-99
11-29	12-a	13-16	14-4	15-a	16-b	17- b	18-c	19-c	20-b
21-a	22-1	23-13	24-d	25-b	26-26	27- a	28-d	29-a	30-10
31-a	32-c	33-c	34-c	35-d	36-d	37- a	38-c	39-c	40-a
41-a	42-d	43-a	44-d	45-b	46-b	47- d	48-c	49-b	50-d