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RAMAIAH Institute of Technology

(Autonomous Institute, Affiliated to VTU)
(Approved by AICTE, New Delhi & Govt. of Karnataka)
Accredited by NBA & NAAC with 'A+' Grade

SUPPLEMENTARY SEMESTER EXAMINATIONS – JULY 2023

Program	:	**B.E. – Computer Science and Engineering**	**Semester**	:	**IV**
Course Name	:	**Design and Analysis of Algorithms**	**Max. Marks**	:	**100**
Course Code	:	**CS42(OO)**	**Duration**	:	**3 Hrs**

Instructions to the Candidates:

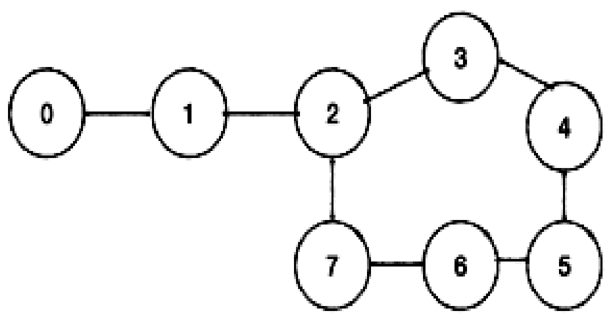
- Answer one full question from each unit.

UNIT – I

1. a) Let f be a polynomial of degree k, in which the coefficient a_K is positive. Prove the properties of asymptotic growth rates f= $O(n^K)$ CO1 (06)

   b) Write the Gale Shapely algorithm for perfect stable matching. CO1 (05)

   c) What is a Bipartite graph? Using Breadth-First Search Algorithm check for the bipartite-ness in the given graph. Comment on the time and space complexity. CO1 (09)



2. a) Compare and rank orders of growth using asymptotic notations with a neat diagram. CO1 (06)

   b) Suppose given n points in a plane, each specified by (x,y) coordinates, write the algorithm to find the pair of points that are closest together and calculate the running time of the algorithm. CO1 (05)

   c) CO1 (09)

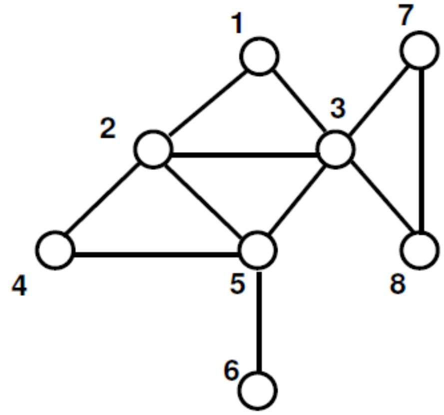
Men's Preference List						Women's Preference List				
	1	2	3	4			1	2	3	4
A	W	X	Y	Z		W	D	C	B	A
B	W	X	Y	Z		X	D	C	B	A
C	W	X	Y	Z		Y	D	C	B	A
D	W	X	Y	Z		Z	D	C	B	A

Identify the stable matching set of men and women for the above-given preference list. Show the steps of men's proposal and women's rejection while creating the stable match.

UNIT – II

3. a) Define the Graph, its type, path, cycle, and applications of graphs. CO2 (08)

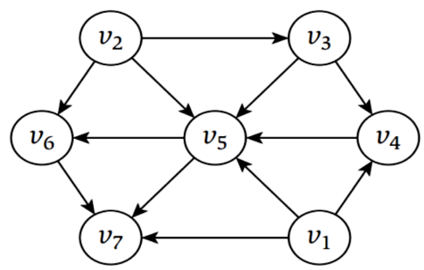
b) CO2 (08)



Write the DFS algorithm and show the working of DFS over the given graph. Show the stack implementation of the same.

c) Compare DFS and BFS algorithm's efficiency in terms of space and Time. CO2 (04)

4. a) Apply the Topological ordering algorithm over the given graph. Comment on the running time of the algorithm. Illustrate the improvisation of the running time of the algorithm. CO2 (08)



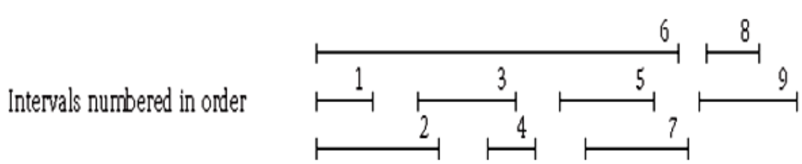
b) What is the algorithm strategy used by the merge sort algorithm? Write the merge sort algorithm and show its working principle. CO2 (08)

c) For the given Input: arr[] = {8, 4, 2, 1}, give the Inversion count in Array using Merge Sort. CO2 (04)

UNIT – III

5. a) Design an Optimal caching algorithm to prove SFF incurs no more misses than any other schedule $S*$ and hence is optimal. Illustrate the optimizing cache misses with the following values. a, b, c, d, a, d, e, a, d, b, c , k=3. CO3 (08)

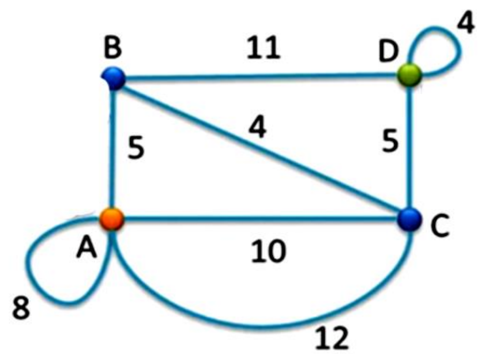
b) CO3 (06)



Apply the Greedy Interval Scheduling algorithm with Smallest Finish Time over the intervals given above in order.

c) Consider the string ABRACADABRA. Construct the Huffman tree and generate the codes for the given string. CO3 (06)

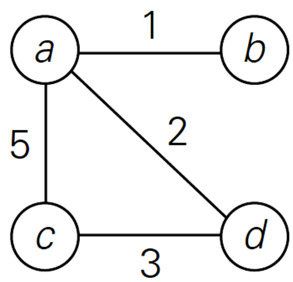
6. a) CO3 (08)



For the given graph, design a single-source shortest-paths algorithm to find the shortest path. Show the step-by-step execution of Dijkstra's algorithm using a table.

b) For all indices $r \leq k$ we have $f(i_r) \leq f(j_r)$ prove this statement by induction by analyzing the greedy algorithm. CO3 (06)

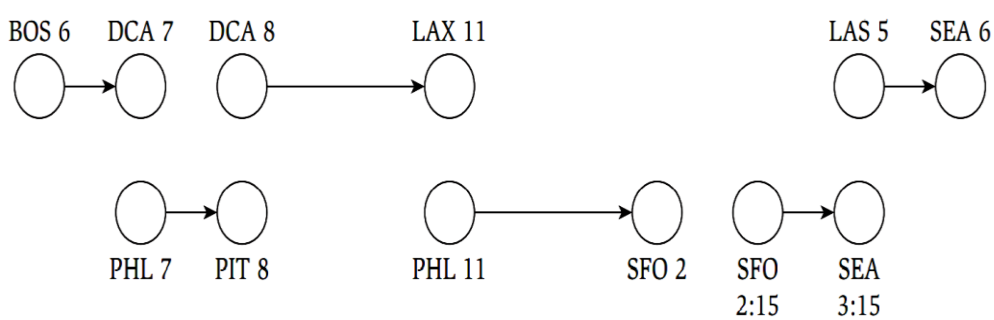
c) Define Spanning tree and Minimum Spanning Tree. For the given graph construct the possible MST. CO3 (06)



graph

UNIT – IV

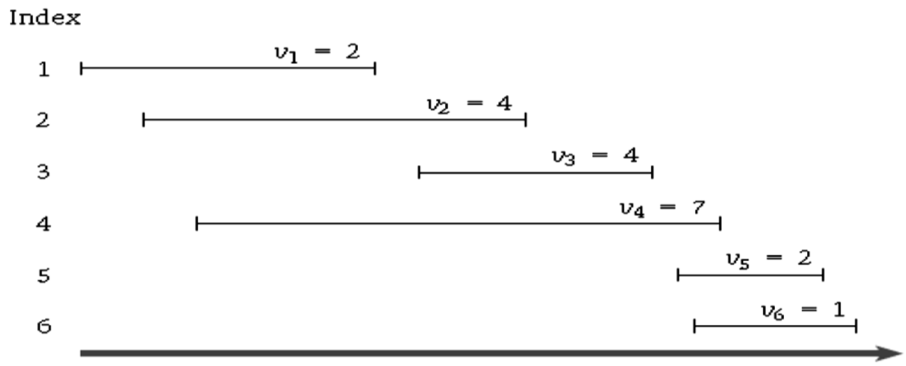
7. a) Given a small instance of simple Airline Scheduling Problem below prove that there is a way to perform all flights using at most k planes if and only if there is a feasible circulation in the network G. CO4 (08)



b) Prove that the graph G' with 0 demand, and the capacities and lower bounds given, has a feasible circulation if and only if there is a feasible way to design the survey. CO4 (06)

c) Given a flow network, write an algorithm to find a flow of the maximum possible value. CO4 (06)

8. a) Given the array M of the optimal values of the sub-problems, prove that Find_Solution( ) returns an optimal solution in O(n) time. Illustrate the proof with this example. CO4 (08)



b) CO4 (06)

Objects	1	2	3	4	5	6	7
Profit	5	10	15	7	8	9	4
Weight	1	3	5	4	1	3	2

Knapsack size = 15

For the above-given detail, find the number of objects that have the largest value to fit in the knapsack.

c) Given a flow network G, and a flow f on G, define the residual graph G_f of Gwith respect to f. CO4 (06)

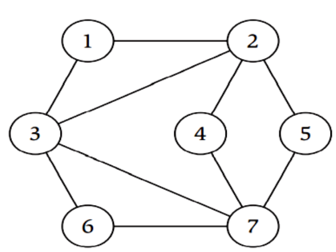
UNIT -V

9. a) Define Circuit Satisfiability Problem. Using F=X+YZ prove CO5 (08)
i) SAT≤ρ 3CNF SAT ii) 3CNF≤ρ SAT iii) 3CNF ϵ NPC.

b) Given a new problem X, give the general strategy for proving it is NP complete. CO5 (06)

c) For the given input: graph[][] = {{0, 1, 1, 0, 0, 1}, {1, 0, 1, 0, 1, 1}, {1, 1, 0, 1, 0, 0}, {0, 0, 1, 0, 1, 0}, {0, 1, 0, 1, 0, 1}, {1, 1, 0, 0, 1, 0}}, construct a graph and print all the possible Hamilton cycles. CO5 (06)

10. a) Given a graph G and a number k, does G contain an independent set of size at least k? CO5 (08)



b) List the problems that can be solved using algorithms in polynomial time and nonpolynomial time. Comment on its time complexity. CO5 (08)

c) Suppose Y ≤P X. Prove that, If X can be solved in polynomial time, then Y can be solved in polynomial time. CO5 (04)

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