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S.E. (Information Technology) (Sem-IV) (Revised Course 2016-2017)
EXAMINATION Nov/Dec 2019
Design and Analysis of Algorithms

[Duration : Three Hours]

[Total Marks : 100]

Instructions:

- 1) Attempt two questions from Part –A two questions from Part-B and one from Part-C.
- 2) Figures to the right indicate marks.
- 3) Make suitable assumptions wherever necessary.

Part - A

Q.1 a) What are the criteria for designing efficient algorithm? **[4]**

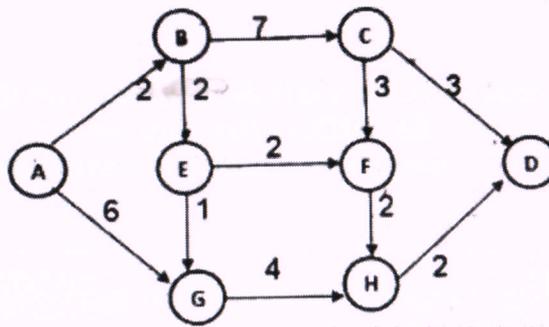
b) Solve the following Recurrence Relations:- **[8]**
 $T(n)=9 T (n/3)+n^2 \log n$ by Master Method
 $T(n)=0$ for $n=1$
 $= n+2 T (n/2)$ for $n>1$ by Iteration Method

c) Define Time Complexity of an algorithm. Given the following algorithm, compute step count using **any 1 method** and use it to determine the complexity of the Algorithm in terms of Big Oh (O) Notation: **[8]**
 Algorithm Add (a, b, c, m, n)
 {
 fori:= 1 to m do
 for j : = 1 to p do
 c[i, j] := a[i , j] + b[i , j];
 }
 }

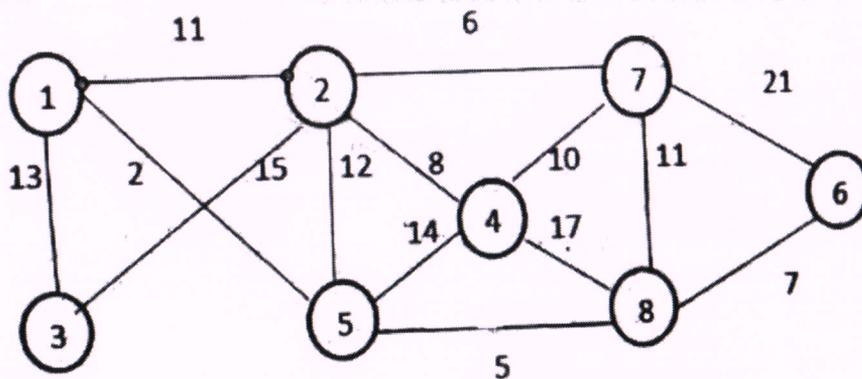
Q.2 a) Write an algorithm for Quick Sort. Write its best-case, worst-case and average –case time complexity. **[6]**

b) There are 7 Jobs whose profits are (P1, P2, P3, P4,P5, P6, P7)= (3, 5, 18, 20, 6, 1 ,38) and corresponding deadlines are (d1, d2, d3, d4, d5, d6, d7)=(1,3,3,4,1,2,1). Find the optimal solution that maximizes profit. What is the profit achieved? **[6]**

c) Using Dijkstra’s shortest path algorithm, find out the shortest path from A to all other vertices in the given graph below. **[8]**



- Q.3 a) Compute minimum cost spanning tree for the following graph using: [8]
- Prim's Algorithm
 - Kruskal's Algorithm
- Show the stepwise construction of trees in both cases. Give the minimum cost in each case.



- b) Prove the following: [6]
- $5n^2 - 6n = \Theta(n^2)$
 - $n^3 2^n + 6n^2 3^n = O(n^3 2^n)$
- c) Giving a suitable example, compare recursion and iteration algorithms. [6]

Part-B

- Q.4 a) Use dynamic programming to find the optimal solution for the 0/1 knapsack problem where $n=3$, [5]
 $m = 5$, $(p_1, p_2, p_3) = (25, 24, 15)$ and $(w_1, w_2, w_3) = (3, 2, 3)$
- b) Explain the multi-stage graph problem. Write an algorithm to solve the problem corresponding [6]
 forward approach.
- c) Define pre-emptive schedule and non-pre-emptive schedule. [2]
- d) Find the shortest path between all the pairs of the directed weighted graph $G=(V,E,W)$ where [7]
 $V=\{1,2,3,4\}$, $E=\{\langle 1,2 \rangle, \langle 1,4 \rangle, \langle 4,3 \rangle, \langle 4,2 \rangle, \langle 2,3 \rangle, \langle 3,1 \rangle\}$ and $W=\{5,4,1,3,6,3\}$.

- Q.5**
- a) State what is backtracking. Show how backtracking is used to solve the m-coloring problem. [6]
 - b) Solve the following sum of subsets problem to find all possible subsets of W that sum to m where $W = \{12, 19, 2, 3, 13, 6, 18\}$ and $m = 25$. [8]
 - c) Explain NP hard code optimization problem. [6]
- Q.6**
- a) Explain the knapsack decision problem. Write the non-deterministic algorithm for the knapsack decision problem. [7]
 - b) What is the matching problem? Explain how the Rabin-Karp algorithm solves the problem. [7]
 - c) Explain depth first search and breadth first search of a graph with an example. [6]

Part –C

- Q.7**
- a) What is Recursion? Write a recursive algorithm for tower of Hanoi Problem. Show the tracing with $n = 3$ disks. [7]
 - b) Formally state the fractional knapsack problem. Find the optimal solution to the fractional knapsack instance: $n = 4$, $m = 11$, profits $(p_1, p_2, p_3, p_4) = (6, 10, 12, 13)$ and weights $(w_1, w_2, w_3, w_4) = (2, 4, 6, 7)$ [7]
 - c) Describe the flow shop scheduling problem. Define finish time of a job and finish time of a schedule. [6]
- Q.8**
- a) Explain the following with suitable examples: leaf dag, level one dag. [6]
 - b) Identify the articulation points in the undirected graph $G = (V, E)$ where $V(G) = \{1, 2, 3, 4, 5, 6, 7, 8\}$ and $E(G) = \{ \langle 1, 2 \rangle, \langle 1, 3 \rangle, \langle 3, 5 \rangle, \langle 5, 6 \rangle, \langle 5, 4 \rangle, \langle 4, 6 \rangle, \langle 3, 7 \rangle, \langle 3, 8 \rangle \}$. Draw the biconnected components. [6]
 - c) Write an algorithm for recursive Binary Search. Trace the algorithm for following set of elements to find an element 50. [8]
 (10, 20, 30, 40, 50, 60, 70)
 What is the time complexity of this algorithm?