Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous College Affiliated to University of Mumbai)

End Semester Examination
July 2019

Max. Marks: 60 | **Duration: 3 Hrs**
Class: S.E. | **Semester: IV**
Course Code: IT41 / CE41 | **Branch: IT/COMP**
Name of the Course: Design And Analysis of Algorithm

Instructions:
(1) **All Questions are Compulsory.**
(2) **Draw neat diagrams.**
(3) **Assume suitable data if necessary.**

Question No.	Question	Max. Marks	CO
Q. 1 a)	i. For each function f(n) along the left side of the table, and for each function g(n) across the top, write O, Ω, or Θ in the appropriate space, depending on whether f(n) = O(g(n)), f(n) = Ω(g(n)), or f(n) = Θ(g(n)). If more than one such relation holds between f(n) and g(n), write only the strongest one. The first row is a demo solution for $f(n) = n^2$.	03	CO1
	ii. Strategy in which problem can be solved by combining solutions of non-overlapping sub problems, strategy is called _____.	01	
Q.1.b)	i. Use the substitution method to solve the given recurrence equation: $T(n)= 2T(n/2) + n$	02	CO1
	ii. Solve the given recurrences using master method $T(n)= 4T(n/2) + n^3$	02	
Q. 1 c)	Write an algorithm to perform binary search using divide and conquer strategy. Apply it to search a given number say 63 on following array. Also derive its time complexity. 5, 13, 27, 30, 50, 57, 63, 76	06	CO2

		g(n)		
		n	n log n	n^2
f(n)	n^2	Ω	Ω	θ
	n^4			
	log n			

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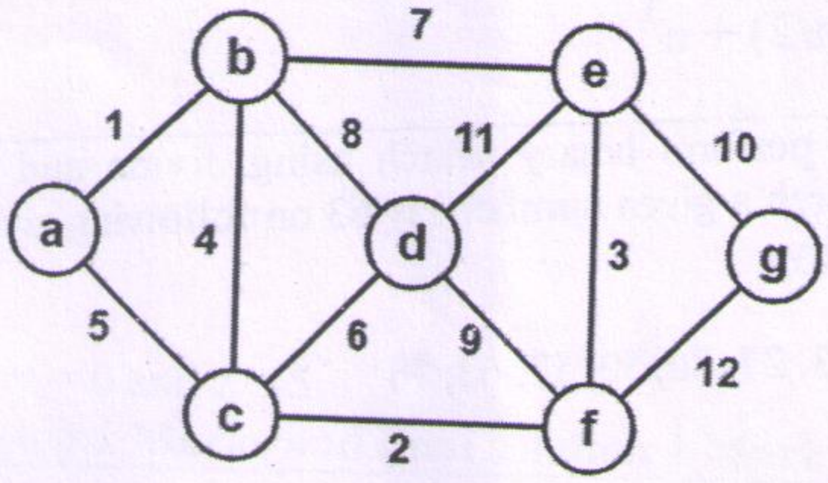
<table>
<tr><td>Q. 2 a)</td><td>i. Write a program in C for finding k^{th} smallest element from an array using divide and conquer approach. Show the output of your program for the given set of inputs to find 5^{th} smallest element :
22 13 -5 -8 15 60 17 31 47

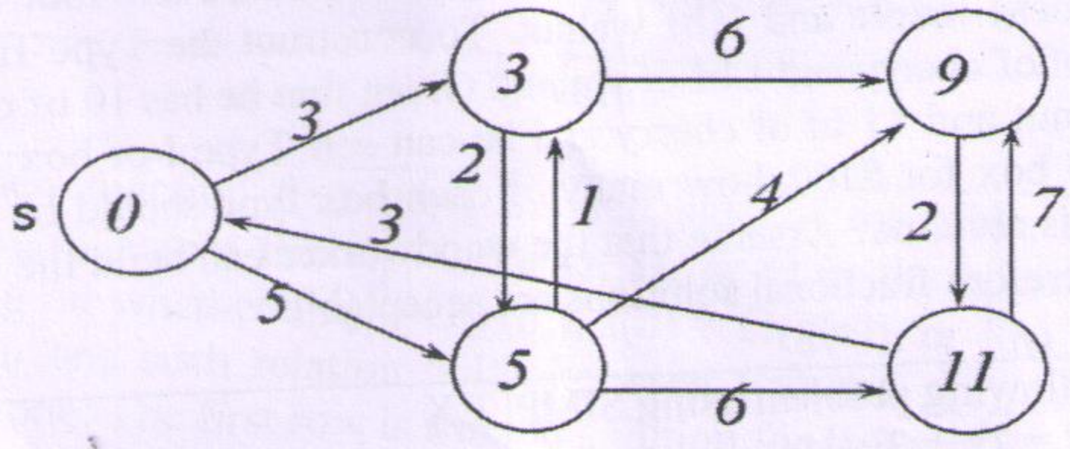
ii. Analyze it's time complexity by stating its recurrence relation.</td><td>04

02</td><td>CO2</td></tr>
<tr><td>Q2. b)</td><td>i. State the steps to be followed to develop a dynamic programming solution for 0/1 knapsack problem
ii. Apply the Dynamic Programming approach to find Optimal solution for following 0/1 knapsack problem. Capacity of knapsack is 8 .
<table><tr><th>Item i</th><th>Value v_i</th><th>Weight w_i</th></tr><tr><td>1</td><td>15</td><td>1</td></tr><tr><td>2</td><td>10</td><td>5</td></tr><tr><td>3</td><td>9</td><td>3</td></tr><tr><td>4</td><td>5</td><td>4</td></tr></table>OR
i. State and apply the steps to be followed to develop a dynamic programming solution to the Longest common Subsequence
ii. Apply the Dynamic Programming approach to find LCS for following two strings.
X = ABCAB and Y = AABACA.</td><td>03

03

03

03</td><td>CO3</td></tr>
<tr><td>Q .3a)</td><td>Explain branch and bound strategy in general and how it can be used to find solution of TSP along with example</td><td>06</td><td>CO4</td></tr>
<tr><td>Q.3 b)</td><td>Construct the minimum spanning tree (MST) for the given graph using Prim's Algorithm. Assume starting node is 'a'
  </td><td>06</td><td>CO3</td></tr>
</table>

	OR		
	i. Write an algorithm for Single source shortest path.	*03*	
	ii. Apply Single source shortest path algorithm to find shortest path from source node **'s'**	*03*	
			
Q.4 a)	i. Construct the string matching automaton for the given pattern and show the sequences of states it enters in for the given text and also show occurrences of pattern in the text Pattern : a b c a b c a Text : a a a b a b c a b c a a b a a b	*03*	**CO5**
	ii. Compute KMP prefix function for the given pattern and check if it is present in given text. Pattern = a b c a b d a Text = a b c a b c a b d a b a b a b	*03*	
Q.4 b)	i. Explain the Back tracking strategy and explain the N queen problem and its algorithm and solve it for 4 queens. Derive the condition for checking if placing the queen is safe or not?	*06*	**CO4**
	OR		
	i. Write a backtracking algorithm for sum of subsets problem.	*02*	
	ii. Apply the backtracking algorithm for solving sum of subset problem. Let n=6, M=13 and W(1…5)=(1,2,3,5,8,13). Find all possible subsets of W that Sum to M.	*02*	
	iii. Draw the portion of state space tree for fixed tuple size solution.	*02*	

Q.5a)	Formulate a linear programming model and identify the objective function and constraints and also formulate it into it's standard form: A woodworker builds and sells band-saw boxes. He manufactures two types of boxes using a combination of three types of wood, maple, walnut and cherry. To construct the Type I box, the carpenter requires 2 board foot (bf) (The board foot is a specialized unit of measure for the volume of lumber. It is the volume of a one-foot length of a board one foot wide and one inch thick) maple and 1 bf walnut. To construct the Type II box, he requires 3 bf of cherry and 1 bf of walnut. Given that he has 10 bf of maple, 5 bf of walnut and 11 bf of cherry and he can sell Type I of box for $120 and Type II box for $160, how many of each box type should he make to maximize his revenue? Assume that the woodworker can build the boxes in any size, therefore fractional solutions are acceptable	*04*	**CO6**
Q.5. b)	Solve the following problem using SIMPLEX maximize: $P = 2x + 3y + 4z$ subject to: $3x + 2y + z \leq 10$ $2x + 5y + 3z \leq 15$ $x, y \geq 0$	*06*	**CO6**