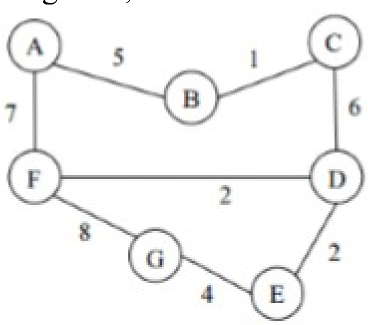
Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

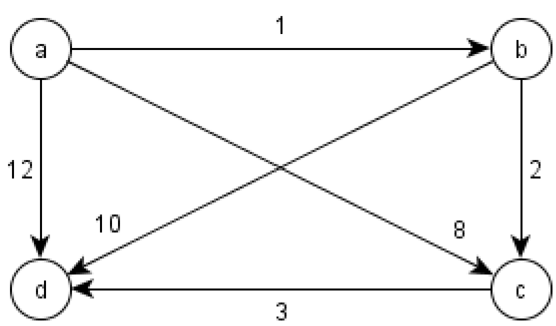
Course: Algorithm Design and Analysis (CSEG7001) **Semester: 1**
Programme: M.Tech (CSE)
Time: 03 hrs. **Max. Marks: 100**
Instructions:

SECTION A
(All Questions are Compulsory, Each Question Carries 4 Marks)

S. No.		Marks	CO
Q 1	Write the control abstract for divide and conquer algorithms.	**4**	**CO1**
Q2	What is overlapping sub problems explain it through an example	**4**	**CO3**
Q3	Using the below graph, If Kruskal's algorithm is used to construct Minimum Spanning Tree, which of the following edges will not be included:  **a)** FG **b)** DE **c)** CB **d)** BA	**4**	**CO2**
Q4	Show the following equalities are correct: a) $5n^2 - 6n = \phi(n^2)$ b) $N! = O(n^n)$	**4**	**CO1**
Q5	How can you prove that a problem P is NP-Complete	**4**	**CO4**

SECTION B
(All Questions are Compulsory, Each Question Carries 10 Marks)

Q 6	Find an optimal Huffman code for the following a set of frequencies: a:50 b:25 c:15 d:40 e:75	**10**	**CO3, CO2**
Q 7	Consider the problem of Fibonacci series (a) Devise Brute force algorithm (b) Devise Divide and Conquer algorithm (c) Compare (a) & (b) algorithms with respect to space complexity	**10**	**CO1**

Q 8	let G = (V, E) where V = {1, 2, 3, 4} and E = {(1, 2),(2, 3),(2, 4),(3, 4)} and suppose that k = 3, devise an algorithm such that adjacent nodes get different colors.	**10**	**CO2, CO3**
Q 9	Binomial coefficients are coefficients of the binomial formula: $(a+b)^n = C(n,0)a^nb^0 + \ldots + C(n,k)a^{n-k}b^k + \ldots + C(n,n)a^0b^n$ C(n, k), the number of combinations of k elements from an n-element set ($0 \le k \le n$), Compute C(6, 3) by applying the dynamic programming algorithm **(OR)** Consider the travelling salesperson problem given by following cost matrix $\begin{bmatrix} 0 & 20 & 30 & 10 & 11 \\ 15 & \infty & 16 & 4 & 2 \\ 3 & 5 & \infty & 2 & 4 \\ 19 & 6 & 18 & \infty & 3 \\ 16 & 4 & 7 & 16 & \infty \end{bmatrix}$ Obtain the optimum tour using dynamic reduction method. Draw a portion of state space tree using LCBB.	**10**	**CO3, CO4**
SECTION-C **(All Questions are Compulsory, Each Question Carries 20 Marks)**			
Q 10	Compute All Pairs Shortest Path for the following graph. 	**20**	**CO2, CO3**
Q 11	You are given two sorted arrays of lengths m and n. give a O(log m + log n) time algorithm for computing the k-th smallest element in the union of the two arrays. Keep in mind that the elements may be repeated. **(OR)** Let T be a text of length n, and let P be a pattern of length m. Describe an O(n+m) time method for finding the longest prefix of P that is a substring of T.	**20**	**CO2, CO3**

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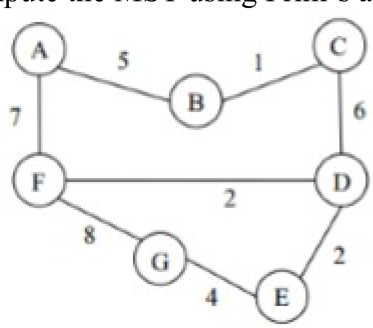
SECTION A
(All Questions Compulsory, Each Question Carries 4 Marks)

S. No.		Marks	CO
Q 1	How do you justify that divide and conquer algorithms takes less time complexity in comparison with brute force algorithms.	**4**	**CO1**
Q2	Explain optimal substructure through an example	**4**	**CO3**
Q3	Compute the MST using Prim's algorithm for the following graph 	**4**	**CO2**
Q4	Explain time-space trade off and growth functions.	**4**	**CO1**
Q5	Discuss any two problems where approximation algorithms are needed	**4**	**CO4**

SECTION B
(All Questions Compulsory, Each Question Carries 10 Marks)

S. No.		Marks	CO
Q 6	Solve the following recurrence relations using recursion tree method a) $T(n)=8T(n/2)+n^2$ b) $T(n)=4T(n/2)+n$	**10**	**CO1**
Q 7	Devise an algorithm and explain to determine bi-connected Components. Prove the theorem that two bi-connected components can have at most one vertex as common and this vertex is an articulation point.	**10**	**CO2, CO3**

<table>
<tr><td>Q 8</td><td>Consider the following items with their weights and profits and knapsack capacity as 5. Apply the Greedy strategy to fill the knapsack with maximum benefit,

<table>
<tr><th>Item</th><th>Weight</th><th>Profit</th></tr>
<tr><td>1</td><td>1</td><td>15</td></tr>
<tr><td>2</td><td>5</td><td>10</td></tr>
<tr><td>3</td><td>3</td><td>9</td></tr>
<tr><td>4</td><td>4</td><td>5</td></tr>
</table></td><td>10</td><td>CO3, CO2</td></tr>
<tr><td>Q 9</td><td>Draw the state space tree for 4 queen's problem
(OR)
Consider the travelling salesperson problem given by following cost matrix
$$\begin{bmatrix} 0 & 20 & 30 & 10 & 11 \\ 15 & \infty & 16 & 4 & 2 \\ 3 & 5 & \infty & 2 & 4 \\ 19 & 6 & 18 & \infty & 3 \\ 16 & 4 & 7 & 16 & \infty \end{bmatrix}$$
Obtain the optimum tour using dynamic reduction method. Draw a portion of state space tree using LCBB.</td><td>10</td><td>CO3, CO4</td></tr>
<tr><td colspan="4">SECTION-C
(All Questions Compulsory, Each Question Carries 20 Marks)</td></tr>
<tr><td>Q 10</td><td>Find an optimal parenthesization of a matrix-chain product for 4X10, 10X3, 3X12, 12X20 and 20X7. Justify dynamic programming solution takes less time complexity for this problem when we compare with brute force approach.</td><td>20</td><td>CO2, CO3</td></tr>
<tr><td>Q 11</td><td>Let m=31 and w= {7,11,13,24} draw a portions of state space tree using algorithm sum_subset(). Clearly show the solutions obtained.

(OR)

Let T be a text of length n, and let P be a pattern of length m. Describe an O(n+m) time method for finding the longest prefix of P that is a substring of T.</td><td>20</td><td>CO2, CO3</td></tr>
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