

Roll No: -----



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech (CSE)

Subject (Course): Algorithm Design and Analysis

Course Code : CSEG 7001

No. of page/s: 02

Semester – Ist

Max. Marks : 100

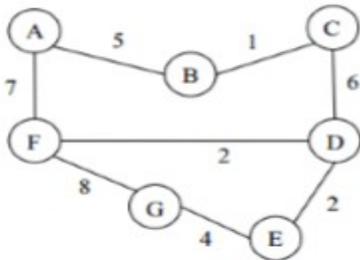
Duration : 3 Hrs

Section-A

(All Questions are Compulsory)

(5X4M=20M)

1. How will you compute the time complexity of a recursive algorithm, discuss it through an example.
2. When will you choose dynamic programming to solve a problem? What are the disadvantages if you wrongly selected dynamic programming technique to give a solution for an unsupported problem of dynamic programming?
3. Assuming $P \neq NP$, which of the following is true
A) $NP\text{-complete} = NP$ B) $NP\text{-complete} \cap P = \phi$ C) $NP\text{-hard} = NP$ D) $P = NP\text{-complete}$
4. Compute the weight of a minimum spanning of the following graph using Kruskal algorithm and show the work



5. Discuss any two problems where approximation algorithms are needed

Section-B

(All Questions are Compulsory)

(4X10M=40M)

6. Show the following equalities are correct:

A) $4n^2 - 5n = \Theta(n^2)$ B) $N! = O(n^n)$ C) $N^3 + 106n^2 = \Theta(n^2)$ D) 2^{n+1} is $O(2^n)$

7. Consider the following items with their weights and profits and knapsack capacity as 20. Items are divisible. Design the solution to get the maximum benefit.

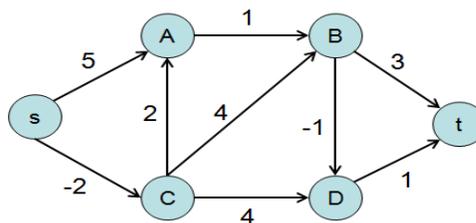
Item	Weight	Profit
1	4	9
2	4	5
3	8	7
4	5	12
5	1	3

8. Devise an algorithm to determine the Sum of Subsets for a given Sum and a Set of numbers as $\{5, 3, 4, 7, 4\}$ with the Sum = 15. Derive all the subsets and represent it in tree notion.
9. How the failure function of KMP algorithm works?

Section-C

(2X20M=40M)

10. What is the best way to multiply a chain of matrices with the dimensions 4×10 10×3 3×12 12×20 20×7 ? Show your work.
11. Find the shortest path from s to t using Bellmanford algorithm.



(OR)

12. 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

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Section-A

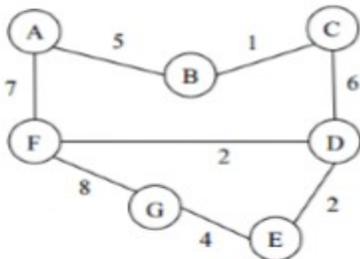
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(5X4M=20M)

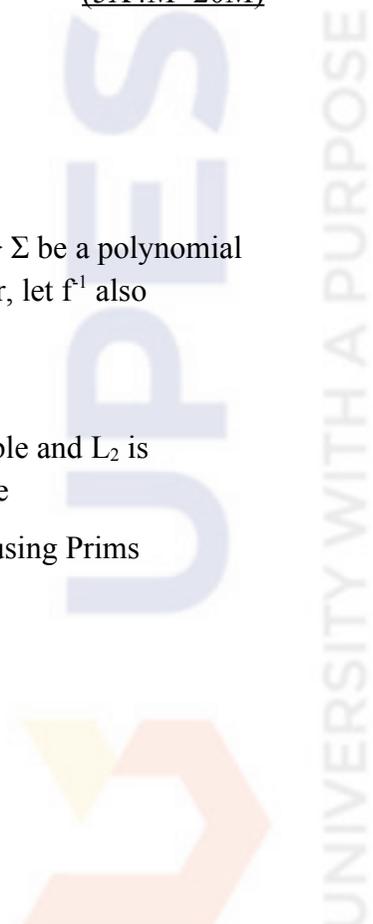
1. Write the control abstract of divide and conquer algorithms.
2. What is overlapping sub problems explain through an example
3. Consider two languages L_1 and L_2 , each on the alphabet Σ . Let $f: \Sigma \rightarrow \Sigma$ be a polynomial time computable bijection such that $(\forall x)[x \in L_1 \text{ iff } f(x) \in L_2]$. Further, let f^{-1} also polynomial time computable.

Which of the following can't be true?

- A) $L_1 \in P$ and L_2 is finite B) $L_1 \in NP$ and $L_2 \in P$ C) L_1 is undecidable and L_2 is decidable D) L_1 is recursively enumerable and L_2 is recursive
4. Compute the weight of a minimum spanning of the following graph using Prims algorithm and show the work



5. How can you prove that a problem P is NP-Complete.



Section-B
(All Questions are Compulsory)

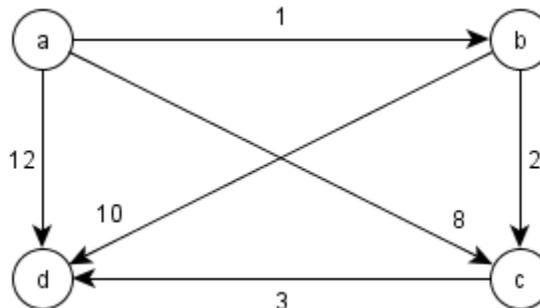
(4X10M=40M)

6. Compute/Prove the following time complexity equations
A) $T(n)=2T(n/2)+n \log n$ B) $T(n)=16T(n/4)+n$ C) $5N^3+106n^2$ is $\Theta(n^2)$
D) 3^{n+1} is $O(3^n)$
7. Suppose we have a file that contains 10 a, 15 e, 12 i, 3 s, 4 t, 13 blanks, one 0 and one newline, using the Huffman algorithm with a binary tree representation : (a) Compute the optimal coding for each character. (b) What is the size of the compressed file?
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.
9. 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 .

Section-C

(2X20M=40M)

10. 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.
11. Compute All Pairs Shortest Path for the following graph.



(OR)

12. Binomial coefficients are coefficients of the binomial formula:
$$(a + b)^n = C(n,0)a^n b^0 + \dots + C(n,k)a^{n-k} b^k + \dots + C(n,n)a^0 b^n$$

 $C(n, k)$, the number of combinations of k elements from an n -element set ($0 \leq k \leq n$)
Compute $C(7, 3)$ by applying the dynamic programming algorithm.