Sardar Patel Institute of Technology

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

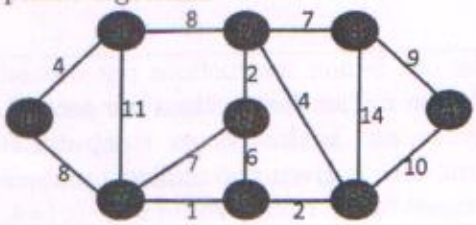
End Semester Examination

May 2022

Max. Marks: 60 Duration: 120 Mins
Class: B.Tech. Semester: IV
Course Code: CS205/IT205 Branch: Computer Engineering/IT
Name of the Course: Design and Analysis of Algorithms

Instruction:
(1) All questions are compulsory
(2) Draw neat diagrams
(3) Assume suitable data if necessary

Q No.		Max. Marks	CO
Q.1 (A)	Suppose computer A executes one billion instructions per second and computer B executes only ten million instructions per second. On computer A running insertion sort against slower computer B running merge sort. Each Computer is given two million numbers to sort. Computer A is 100 times faster than computer B (c1=4, c2=50). How much time is taken by both the computers? Justify the answer by comparing the time required on both machine.	03	CO1
Q.1 (B)	Use definition of θ notations, show that $\frac{1}{2}n^2$ -3n = $\theta(n^2)$.	02	CO1
Q.1 (C)	Write a strassen's matrix multiplication algorithm. Derive it's time complexity? Use Strassen's algorithm to compute the matrix product. $\begin{pmatrix}1 & 3\\7 & 5\end{pmatrix}\begin{pmatrix}6 & 8\\4 & 2\end{pmatrix}$ OR Prove the master theorem: Let $a \geq 1$ and $b > 1$ be constants, and let f(n) be a nonnegative function defined on exact power of b. Define T(n) on exact power of b by the recurrence $$T(n) = \begin{cases}\Theta(1) & \text{if } n = 1,\\ aT(n/b) + f(n) & \text{if } n = b^i\end{cases}$$ where i is a positive integer. Then $$T(n) = \Theta(n^{\log_b a}) + \sum_{j=0}^{\log_b n - 1} a^j f(n/b^j)$$	10	CO2

<table>
<tr><td>Q.2(A)</td><td>Find an optimal parenthesization of matrix-chain product whose sequence of dimensions is (5,10,3,12,5,50,6)</td><td>09</td><td>CO3</td></tr>
<tr><td>Q.2(B)</td><td>Given the jobs, their deadlines and associated profits as given below:-
<table><tr><td>Jobs</td><td>J1</td><td>J2</td><td>J3</td><td>J4</td><td>J5</td><td>J6</td></tr><tr><td>Deadlines</td><td>5</td><td>3</td><td>3</td><td>2</td><td>4</td><td>2</td></tr><tr><td>Profits</td><td>200</td><td>180</td><td>190</td><td>300</td><td>120</td><td>100</td></tr></table>Answer the following questions:-
i) Write the optimal schedule that gives maximum profit.
ii) Are all the jobs completed in the optimal schedule?
iii) What is the maximum earned profit?</td><td>06</td><td>CO3</td></tr>
<tr><td>Q.3(A)</td><td>Write a Prim's Algorithm for Minimum spanning tree. Analysis the complexity of prim's algorithms using Greedy approach? Find the cost of Minimum spanning tree of a given graph by using prim's algorithm.
  </td><td>08</td><td>CO3</td></tr>
<tr><td>Q.3(B)</td><td>What is sum-of-subsets problem? Analysis the time complexity of sum-of-subsets problem? Consider the sum-of-subsets problem, n=4, sum=13,w1=3,w2=4,w3=5,w4=6. find a solution to the problem using backtracking. show the state-space tree leading to the solution. Also, number the nodes in the tree in the order of recursion calls.</td><td>07</td><td>CO4</td></tr>
<tr><td>Q.4(A)</td><td>What is the difference between Branch-N-Bound and Backtracking? Explain the travelling saleperson problem using branch and bound. Solve the travelling saleperson problem for the following cost adjacency matrix using least cost Branch-N-Bound Technique.
$\begin{bmatrix} \infty & 20 & 30 & 10 & 11 \\ 15 & \infty & 16 & 4 & 2 \\ 3 & 5 & \infty & 2 & 4 \\ 19 & 6 & 18 & \infty & 3 \\ 16 & 4 & 7 & 16 & \infty \end{bmatrix}$</td><td>10</td><td>CO4</td></tr>
<tr><td>Q.4 (B)</td><td>Construct the string-matching automaton for the pattern P=aabab and illustrate its operation on the text string T=aaababaabaababaab.

OR

Differentiate between NP-hard and NP-complete problems. Give an approximation algorithm for the set covering problem and justify its approximation ratio with example</td><td>05</td><td>CO5</td></tr>
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