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BITS WILP Data Structures and Algorithms Design End-Sem Exam (Regular) 2016-H1

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Birla Institute of Technology & Science, Pilani
Work-Integrated Learning Programmes Division
Second Semester 2015-2016

Comprehensive Examination
(EC-3 Regular)

Course No.   : SS ZG519
Course Title   : DATA STRUCTURES AND ALGORITHM DESIGN
Nature of Exam   : Open Book
Weightage   : 50%
Duration   : 3 Hours
Date of Exam   : 09/04/2016   (AN)
No of pages: 2
No of questions: 6
Note:
1.   Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2.   All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3.   Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1.   Let A[1…n] be an array of **n** distinct numbers. If **i < j** and **A[i] > A[j]**, then the pair **(i, j)** is called an inversion of A.
   (a)   Which array with elements from the set **{1,2,...n}** has the most inversions? How many does it have?
   (b)   Describe an algorithm that determines the number of inversions in any permutation on **n** elements in Θ**(n logn)** worst case time.
                                        [4 + 4 = 8]

Q.2.   A certain Professor Amongus claims that the order in which a fixed set of elements is inserted into an AVL tree does not matter - the same tree results every   time.   Give   a   example   that   proves   Professor   Amongus wrong.   [8]

Q.3.   Let G be a graph whose vertices are the integers 1 through 8, and let the adjacent vertices of each vertex be given by the table below:

Vertex	Adjacent vertices
1	2, 3, 4
2	1, 3, 4

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| 3	1, 2, 4
4	1, 2, 3, 6
5	6, 7, 8
6	4, 5, 7
7	5, 6, 8
8	5, 7

Assume that, in a traversal of G, the adjacent vertices of a given vertex are visited in the same order as they are listed in the above table.

(a)   Draw G.

(b)   Show how depth-first search works on the graph G starting from vertex 1. Also identify discovery and back edges**.**   [3 + 5 = 8]

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Page 2

Q.4.   Does the strategy of choosing items in increasing order of weight yield an optimal solution for the fractional knapsack problem? Justify your answer. [8]

Q.5.   Find the minimum cost spanning tree for the following graph using Kruskal's algorithm? Show all the intermediate steps. [8]
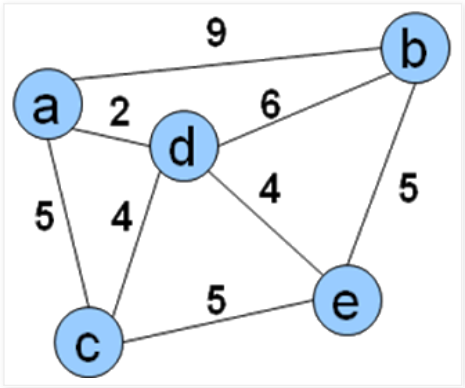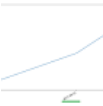
Q.6.   Professor Midas drives an automobile from Newark to Reno along Interstate 80. His car's gas tank, when full, holds enough gas to travel n miles, and his map gives the distances between gas stations on his route. The professor wishes to make as few gas stops as possible along the way. Give an efficient method by which Professor Midas can determine at which gas stations he should stop, and prove that your strategy yields an optimal solution. [10]

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