No. of Printed Pages : 4

MCS-031

MCA (Revised)

11324 **Term-End Examination**

December, 2014

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question number **1** is **compulsory**. Answer any **three** questions from the rest.*

1. (a) (i) Write an algorithm to build a heap from a given sequence.

(ii) Illustrate the heap sort algorithm on the sequence <10, 5, 12, 6, 9, 2, 8, 16>.

6+6

(b) (i) Solve the recurrence equation

$$T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + O(n^2), & n > 1 \\ 1 & n \leq 1 \end{cases}$$

(ii) Prove that $f(n) = 2n^3 + 3n + 5$ is $O(n^3)$.

(iii) Solve the recurrence

$$T(n) = T\left(\frac{n}{2}\right) + 1 \quad \text{for } (n \geq 2)$$

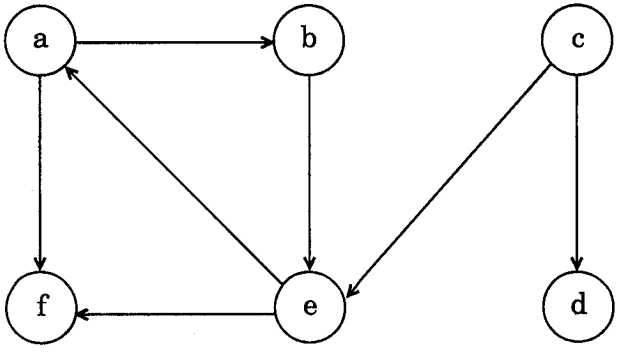
$$= 1 \qquad\qquad n < 2. \qquad\qquad 4+4+4$$

(c) (i) List the major differences between Divide and Conquer and dynamic programming design techniques for solving problems.

(ii) Define fractional Knap-Sack problem, and give a greedy algorithm to solve this problem efficiently. *5+5*

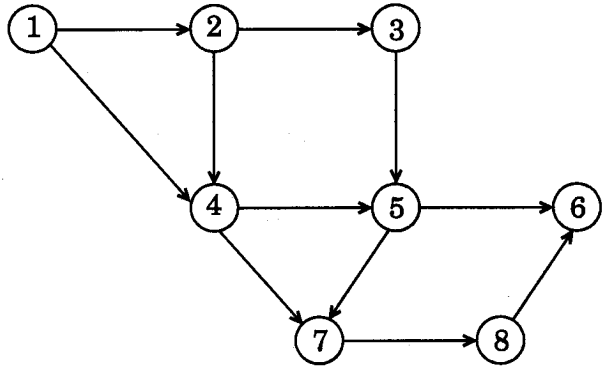
(d) Give a recursive function to find the height of a binary tree. What is the running time of this algorithm ? *6*

2. (a) What is depth first search ? Give the DFS traversal for the following graph, starting with node 'a'. *6*



(b) Identify the tree edges, back edges and forward edges. *6*

(c) Give an algorithm for topological sort. Obtain a topological ordering for the following graph : *8*



3. (a) Explain the Kruskal-algorithm for Minimum Spanning Tree construction. Derive the running time of the algorithm. *10*

(b) Show the MST corresponding to the following adjacency matrix representation of a graph : *10*

	a	b	c	d	e
a	–	1	15	–	5
b	1	–	2	–	10
c	15	2	–	8	6
d	–	–	8	–	3
e	5	10	6	3	–

4. (a) Define Regular Languages. Write regular expression corresponding to the following languages over alphabet {a, b}.

   (i) Strings with even length.

   (ii) Strings with odd number of a's and even number of b's. *8*

   (b) Write context free grammar for the following languages.

   (i) Even palindromes over {a, b}.

   (ii) Odd palindromes over {a, b}. *6*

   (c) If L_1 and L_2 are context free languages, prove that $L_1 \cup L_2$ is also context free. *6*

5. (a) Define the Class P, NP and NP-complete problems. *6*

   (b) Show a polynomial time reduction from the Clique problem to the Vertex Cover problem by giving an example. *9*

   (c) Give the formal definition of a Turing machine. *5*