No. of Printed Pages : 4

MCS-031

MCA (Revised)

Term-End Examination

03935

December, 2016

MCS-031 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question no. 1 is* ***compulsory****. Attempt any* ***three*** *from the remaining questions.*

1. (a) Use Mathematical Induction to prove that $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$. *5*

(b) For a problem P, two algorithms A_1 and A_2 have time complexities $T_1(n) = 5n^2$ and $T_2(n) = 100\ n \log n$. Find the range for n, the size of instance of the given problem P, for which A_1 is more efficient than A_2. *5*

(c) Define the big theta notation. Show that $n^2 + 3 \log n = \theta(n^2)$. *5*

(d) (i) Explain the bottom-up build heap procedure.

(ii) Illustrate heapsort algorithm on the sequence <10, 5, 12, 25, 2, 8, 13, 7>. *10*

(e) Solve the following recurrence equations : *10*

(i) $T(n) = 2T(n/2) + O(n)$

(ii) $T(n) = T(n - 1) + O(n)$

(f) Write a Regular expression to generate strings of even length over the alphabet $\Sigma = \{a, b\}$. *5*

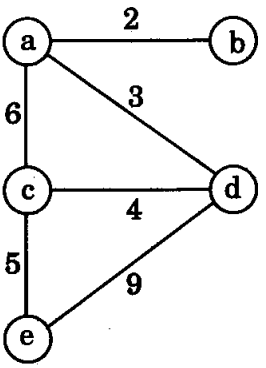
2. (a) Give a divide and conquer algorithm to find the i^{th} smallest in an unsorted list of n integers. Show that the algorithm works in O(n) time. *10*

(b) Write a recursive function to calculate the sum of all elements in an integer array. *5*

(c) Explain any two applications of DFS traversal algorithm. *5*

3. (a) Given the currency coins of denomination 1, 4 and 6. Design a dynamic programming algorithm to obtain minimum number of coins for a given amount. *10*

(b) Using Prim's algorithm, find a Minimal Spanning tree for the graph given below : *10*

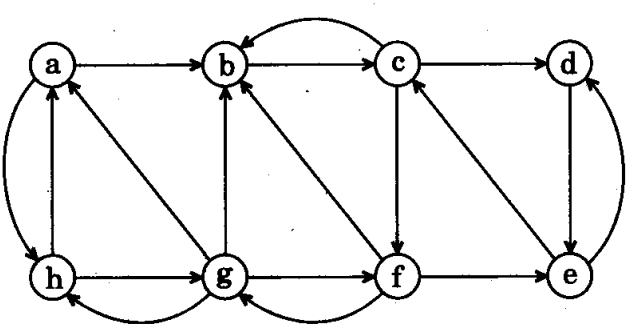


4. (a) (i) Write a context-free grammar to generate all palindromes of even length over the alphabet $\Sigma = \{a, b\}$. *5*

(ii) Derive the parse tree and derivation for the string aabbaa. *5*

(b) (i) Explain the algorithm to find the Strongly Connected Component in an undirected graph. *5*

(ii) Find the Strongly Connected Components in the following graph : *5*



5. (a) Explain the following : *10*

(i) Undecidable problems

(ii) Turing machines

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

(c) Write a Turing machine to recognize the language of all strings of even length over the alphabet {a, b}. *5*
