Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27168

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third/Fourth Semester

Computer Science and Engineering

CS 6402 — DESIGN AND ANALYSIS OF ALGORITHMS

(Common to Information Technology/Computer and Communication Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The (*log n*)*th* smallest number of n unsorted numbers can be determined in $O(n)$ average-case time (True/False).
2. Write the recursive Fibonacci algorithm and its recurrence relation.
3. Give the mathematical notation to determine if a convex direction is towards left or right and write the algorithm.
4. Prove that any comparison sort algorithm requires Ω (n log n) comparisons in the worst case.
5. State how Binomial Coefficient is computed?
6. What is the best algorithm suited to identify the topography for a graph. Mention its efficiency factors.
7. Determine the Dual linear program for the following LP,

   Maximize $3a + 2b + c$

   Subject to,

   $2a + b + c <= 3$

   $a + b + c <= 4$

   $3a + 3b + 6c <= 6$

   $a, b, c >= 0.$
8. Define Network Flow and Cut.
9. Draw the decision tree for comparison of three values.
10. Depict the proof which says that a problem 'A' is no harder or no easier than problem 'B'.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Write the Insertion sort algorithm and estimate its running time. (8)

(ii) Find the closest asymptotic tight bound by solving the recurrence equation $T(n) = 8T(n/2) + n2$ with $(T(1) = 1)$ using Recursion tree method. [Assume that $T(1) \in \Theta(1)$]. (8)

Or

(b) (i) Suppose W satisfies the following recurrence equation and base case (where c is a constant) : $W(n) = c.n + W(n/2)$ and $W(1) = 1$. What is the asymptotic order of $W(n)$. (6)

(ii) Show how to implement a stack using two queues. Analyze the running time of the stack operations. (10)

12. (a) (i) Write the algorithm to perform Binary Search and compute its run time complexity. (8)

(ii) Compute the multiplication of given two matrices using Strassen's matrix multiplication method : (8)

$$A = \begin{bmatrix} 1 & 0 & 2 & 1 \\ 4 & 1 & 1 & 0 \\ 0 & 1 & 3 & 0 \\ 5 & 0 & 2 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 2 & 1 & 0 & 4 \\ 2 & 0 & 1 & 1 \\ 1 & 3 & 5 & 0 \end{bmatrix}.$$

Or

(b) (i) Write down the algorithm to construct a convex hull based on divide and conquer strategy. (8)

(ii) Find the optimal solution to the fractional knapsack problem with given data : (8)

Item	Weight	Benefit
A	2	60
B	3	75
C	4	90

13. (a) (i) The binary string below is the title of a song encoded using Huffman codes.

00110001011111011001110111011000001001110100101 01.

Given the letter frequencies listed in the table below, build the Huffman codes and use them to decode the title. In cases where there are multiple "greedy" choices, the codes are assembled by combining the first letters (or groups of letters) from left to right, in the order given in the table. Also, the codes are assigned by labeling the left and right branches of the prefix/code tree with '0' and '1', respectively. (10)

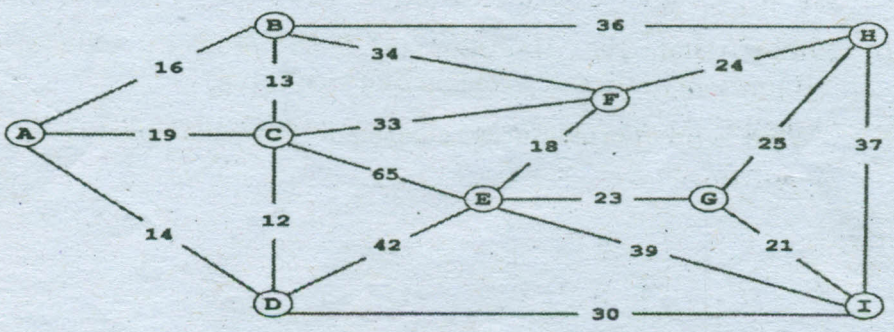
Letter	a	h	v	w	''	e	t	l	o
Frequency	1	1	1	1	2	2	2	3	3

(ii) Write the procedure to compute Huffman code. (6)

Or

(b) (i) Write and analyze the Prim's Algorithm. (6)

(ii) Consider the following weighted graph.



Give the list of edges in the MST in the order that Prim's algorithm inserts them. Start Prim's algorithm from vertex A. (10)

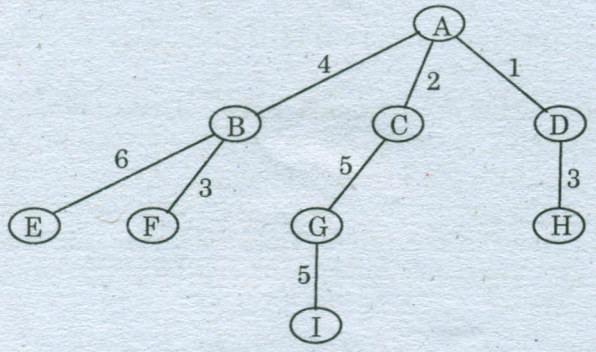
14. (a) (i) Use Simplex to solve the farmers problem given below :

A farmer has a 320 acre farm on which he plants two crops: rice and wheat. For each acre of rice planted, his expenses are 50 and for each acre of wheat planted, his expenses are 100. Each acre of rice requires 100 quintals of storage and yields a profit of 60; each acre of wheat requires 40 quintals of storage and yields a profit of 90. If the total amount of storage space available is 19,200 quintals and the farmer has only '20,000 on hand, how many acres of each crop should he plant in order to maximize his profit? What will his profit be if he follows this strategy? (12)

(ii) Write the procedure to Initialize Simplex which determines if a linear program is feasible or not? (4)

Or

(b) (i) Illustrate the workings of the maximum matching algorithm on the following weighted tree. (12)



(ii) Explain Max-Flow Problem. (4)

15. (a) (i) Using an example prove that, satisfiability of boolean formula in 3-Conjunctive Normal Form is NP – complete. (12)

(ii) State the relationships among the complexity class algorithms with the help of neat diagrams. (4)

Or

(b) (i) Show that the Hamiltonian Path problem reduces to the Hamiltonian Circuit Problem and vice versa. (10)

(ii) What is an approximation algorithm? Give example. (6)

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