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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)
BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JUNE 2015

Course & Branch	:	**B.E.- Information Science & Engg.**	**Semester**	:	**IV**
Subject	:	**Design and Analysis of Algorithms**	**Max. Marks**	:	**100**
Subject Code	:	**IS414**	**Duration**	:	**3 Hrs**

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT – I

1. a) What is an algorithm? With a neat diagram, explain the algorithm design and analysis process. (10)

   b) Prove the following assertions: (06)
   i) $10n^3 + 5 \in \Omega(n^3)$
   ii) $6*2^n+n^2 \in O(2^n)$
   iii) $\frac{1}{2}n(n-1) \in \Theta(n^2)$

   c) Compare order of growth of the following functions: (04)
   i) $\log_2 n$ and $\sqrt{n}$
   ii) n! and 2^n

2. a) Find gcd(31415, 14142) by applying Euclid's algorithm. Estimate the number of computations performed in Euclid's method and in an algorithm based on checking consecutive integers from min{m,n} down to gcd(m,n). (06)

   b) Explain with an example the basic asymptotic efficiency classes (O, Ω, Θ) of an algorithm. (06)

   c) i) Design a recursive algorithm for computing 2n for any nonnegative integer n which is based on the formula: $2^n = 2^{n-1} + 2^{n-1}$. (08)
   ii) Set up a recurrence relation for the number of additions made by the algorithm and solve it.
   iii) Draw a tree of recursive calls for this algorithm.
   iv)Is it a good algorithm for solving this problem?

UNIT-II

3. a) What is a brute force design technique? Under what conditions does brute force technique becomes desirable? (06)

   b) i) Write an divide and conquer algorithm for finding a position of the largest element in an array of n numbers. (08)
   ii) Set up and solve a recurrence relation for the number of key comparisions made by the algorithm.
   iii) What will be the algorith's output for array's with several elements of the largest value?
   iii) How does the algorithm compare with the brute force algorithm for this problem.

   c) Design an algorithm for binary search. Trace the algorithm for searching the key 44 in the following list of numbers: 5, 12, 17, 23, 38, 44, 77, 84, 90. (06)

4. a) Write the selection sort algorithm and compute iits worst-case time efficiency. Sort the following list of numbers using selection sort: 89, 45, 68, 90, 29, 34, 17. (10)

b) Define master's theorem. Find the order of growth of the following recursive functions using master's theorem: (06)

i) $T(n) = 4T\left(\frac{n}{2}\right) + n$, $T(1) = 1$

ii) $T(n) = 4T\left(\frac{n}{2}\right) + n^2$, $T(1) = 1$

c) With a neat diagram, explain the general concept of divide and conquer method. (04)

UNIT-III

5. a) Define transitive closure of a digraph. Apply Warshall's algorithm to find the transitive closure of the digraph defined by the following adjacency matrix: (10)

0	1	0	0
0	0	1	0
0	0	0	1
0	0	0	0

b) Consider the character set {A, M, R, _} with the following occurrence probabilities: (10)

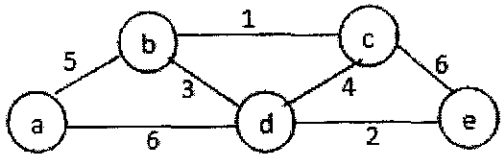
Character	A	M	R	_
Probability	0.4	0.2	0.3	0.1

i) Construct Huffman tree for the given characters.
ii) Derive Huffman codes for the given characters.
iii) Encode the text RAMA_RAMAR using Huffman codes.
iv) Decode the text whose encoding is 0101011.
v) Compute the effectiveness of Huffman Codes.

6. a) What is dynamic programming? Design a top-down dynamic programming algorithm for solving the knapsack problem. Apply it on the following instance of the knapsack problem. (10)

Item	Weight	Value	Capacity
1	2	12	W=5
2	1	10	
3	3	20	
4	2	15	

b) What is a greedy algorithm design technique? Explain the requirements to be satisfied by a greedy choice. Apply Kruskal's algorithm to find a minimum spanning tree of the following graph. (10)



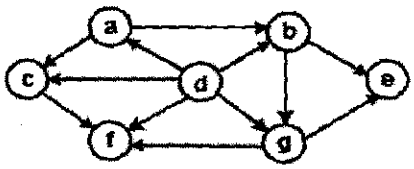
UNIT-IV

7 a) Discuss about major variants of decrease and conquer method with one example for each. (06)

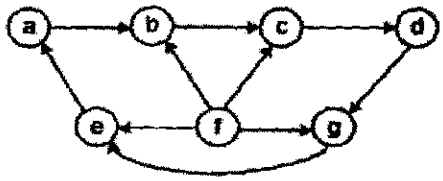
b) Write insertion sort algorithm and analyze its time efficiency in worst-case, best-case and average-case. Show how the insertion sort algorithm arranges the following characters in alphabetical order: E, X, A, M, P, L, E (10)

c) Differentiate between Depth first Search and Breadth first search graph traversal methods. (04)

8. a) Apply the DFS-based algorithm to solve the topological sorting problem for the following digraphs: (06)



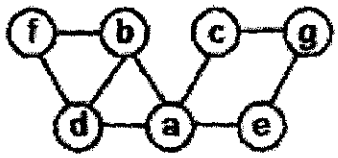
(a)



(b)

b) What is Josephus problem? Find J(40)- the solution to the Josephus problem for n=40. (04)

c) Design an algorithm for Breadth first seach (BFS). Traverse the following graph by BFS and construct the corresponding BFS forest. (10)



UNIT-V

9. a) Design an algorithm for bottom-up heap construction and analyze its worst case efficiency. Construct a heap for the following list using bottom-up algorithm: 1, 8, 6, 5, 3, 7. (10)

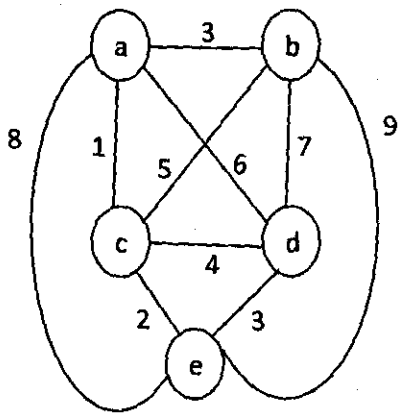
b) What is branch-and-bound technique? Explain the cases in which a search path at a node on a state space tree of branch-and-bound algorithm is terminated. (06)

c) What is heap data structure? List the important properties of heap. (04)

10. a) Explain in brief P, NP and NP-complete problems and give one example for each. (06)

b) Draw the state-space tree for solving 4-queens problem using backtracking. (04)

c) what is travelling salesman Problem? Apply branch-and bound algorithm to solve the travelling salesman problem for the following graph. (10)



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