ROLL NO. _____

Code: AC64/AT64 Subject: DESIGN & ANALYSIS OF ALGORITHMS

AMIETE – CS/IT

Time: 3 Hours **DECEMBER 2014** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. For an application-answering telephone calls in the order of their known priorities, the most appropriate data structure would be:

(A) queue **(B)** priority queue
(C) stack **(D)** tree

b. What is the largest number of key comparisons made by binary search in searching for a key in the following array?
3,14, 27, 31, 39, 42, 55, 70, 74, 81, 85, 93, 98

(A) 4 **(B)** 3
(C) $\log_2 13$ **(D)** none of these

c. In which order does a post order traversal visit the vertices of the following rooted tree?

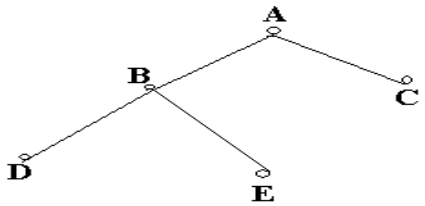

Fig.1

(A) CDEBA **(B)** CEDBA
(C) CAEDB **(D)** CEBDA

d. Which of the following sorting methods would be most suitable for sorting a list which is almost sorted?

(A) Bubble Sort **(B)** Insertion Sort
(C) Selection Sort **(D)** Quick Sort

e. Which of the following statement is true?

(A) Every graph is not its own subgraph
(B) The terminal vertex of a graph is of degree two
(C) A tree with n vertices has n edges
(D) A single vertex in graph G is a subgraph of G

f. An algorithm is made up of two independent time complexities *f(n)* and *g(n).* Then the complexities of the algorithm is in the order of

(A) *f(n)* x *g(n)* **(B)** *Max (f(n),g(n))*
(C) *Min (f(n),g(n))* **(D)** none of these

g. The data structure required for Breadth First Traversal on a graph is

(A) queue **(B)** stack
(C) array **(D)** tree

h. The _____is to interpolation search as the bisection method is to binary search.

(A) method of bisection **(B)** method of true position
(C) method of false position **(D)** none of these

i. The quick sort algorithm exploits _____ design technique.

(A) Greedy **(B)** Dynamic programming
(C) Divide and Conquer **(D)** Backtracking

j. The goal of hashing is to produce a search that takes

(A) *O(1)* time **(B)** $O(n^2)$ time
(C) *O(log n)* time **(D)** *O(n log n)* time

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Design an algorithm for computing gcd (m,n) using Euclid's algorithm. Apply the algorithm to find gcd (31415, 14142). **(7)**

b. Let A be the adjacency matrix of an undirected graph. Explain what property of the matrix indicates that:
(i) the graph is complete.
(ii) the graph has a loop, i.e. an edge connecting a vertex to itself.
(iii) the graph has an isolated vertex, i.e. a vertex with no edges incident to it.
(9)

Q.3 a. Write general outlines for analysing time efficiency of recursive algorithms. **(8)**

b. Design a recursive algorithm for computing 2^n for any non negative integer n that is based on the formula: $2^n = 2^{n-1} + 2^{n-1}$. Draw a tree of recursive calls for this algorithm for 2^4. **(8)**

Q.4 a. Write the algorithm for Bubble sort and derive its time complexity. **(8)**

b. Explain how Binary Search method fails to find 43 in the given sorted array: 8, 12, 25, 26, 35, 48, 57, 78, 86, 93, 97, 108, 135, 168, 201 **(8)**

Q.5 a. Apply the DFS-based algorithm to solve the topological sorting problem for the following diagram: **(8)**

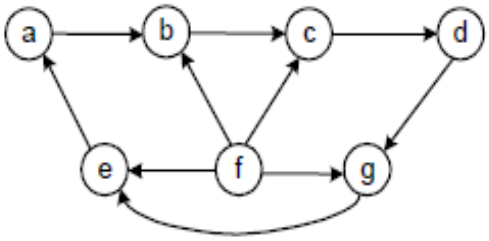

Fig.2

b. Explain *Lexicographic Permute* algorithm, which generates permutations in lexicographical order. Also generate all permutations of {1, 2, 3, 4} by this algorithm. **(8)**

Q.6 a. Define AVL tree. Construct an AVL tree for the list 3, 6, 5, 1, 2, 4. **(8)**

b. Explain the idea behind using Gaussian Elimination method to solve a system of linear equation. Solve the following system by Gaussian elimination.

$$x1 + x2 + x3 = 2$$
$$2x1 + x2 + x3 = 3$$
$$x1 - x2 + 3x3 = 8$$

(8)

Q.7 a. Apply Warshall's algorithm to find the transitive closure of the digraph defined by the following adjacency matrix: **(8)**

$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

b. Differentiate between Spanning tree and minimum spanning tree (MST). Apply Prim's algorithm to find MST for the following graph. **(8)**

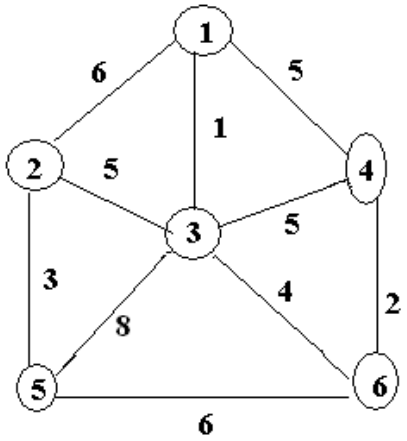

Fig.3

Q.8 a. Write algorithm for Counting Sort. Calculate the time efficiency of this algorithm. **(8)**

b. Write notes on the following: **(4×2)**
(i) P and NP problems
(ii) CNF-satisfiability problem

Q.9 a. Write Pseudocode for the Bisection method. Explain the strength and weaknesses of this method**.** **(4+2+2)**

b. Solve the following instance of the Knapsack problem by the branch and bound algorithm: **(8)**

Item	Weight	Value	Value / Weight
1	4	$40	10
2	7	$42	6
3	5	$25	5
4	3	$12	4

The Knapsack's capacity w is 10.