ROLL NO. _____

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

AMIETE – CS/IT

Time: 3 Hours **JUNE 2013** **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)

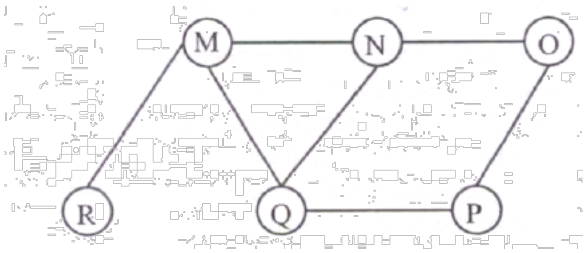
a. _____ method is used for representing upper bound of algorithm's running time.

(A) theta notation **(B)** Big-oh notation
(C) omega notation **(D)** None of these

b. Let W(n) and A(n) denote respectively, the worst case and average case running time of an algorithm executed on an input of size n. Which of the following is **ALWAYS TRUE**?

(A) $A(n) = \Omega(W(n))$ **(B)** $A(n) = \Theta(W(n))$
(C) $A(n) = O(W(n))$ **(D)** $A(n) = o(W(n))$

c. The Breadth first Search algorithm has been implemented using queue as data structure. One possible order of searching the following graph is

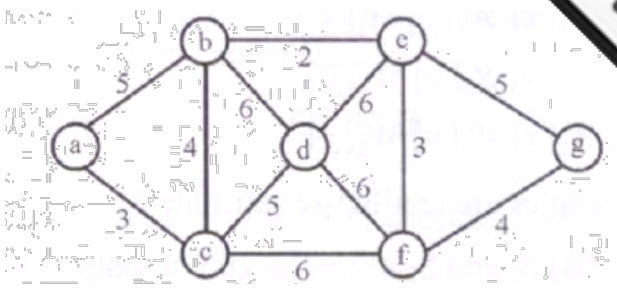


(A) MNOPQR **(B)** NQMPOR
(C) QMNPRO **(D)** QMNPOR

d. What is the maximum height of any AVL tree with 7 nodes? Assume the height of the tree with a single node is 0.

(A) 2 **(B)** 3
(C) 4 **(D)** 5

e. Consider the following graph.



Which of the following is NOT the sequence of edges added to the minimum spanning tree using Kruskal's algorithm?

(A) (b, e), (e, f), (a, c), (b, c), (f, g), (c, d)
(B) (b, e), (e, f), (a, c), (f, g) , (b, c), (c, d)
(C) (b, e), (a, c), (e, f), (b, c), (f, g), (c, d)
(D) (b, e), (e, f), (b, c), (a, c), (f, g), (c, d)

f. Brute force strategy of designing algorithms relies (depends) on using

(A) the problem statements and definitions directly
(B) solution of a smaller instance of the same problem
(C) the combined solutions of smaller sub problems
(D) the solution to a simpler instance of the same problem

g. Algorithms that require _____ number of operations are practical for solving only problems of very small size.

(A) polynomial **(B)** exponential
(C) logarithmic **(D)** linear

h. The best case complexity of insertion sort is

(A) $O(n)$ **(B)** $O(n^2)$
(C) $O(1)$ **(D)** $O(n \log_2 n)$

i. Assuming P ≠ NP, which of the following is **TRUE**?

(A) NP-complete = NP **(B)** NP-complete ∩ P = ∅
(C) NP-hard = NP **(D)** P = NP-complete

j. The worst-case performance of interpolation search is

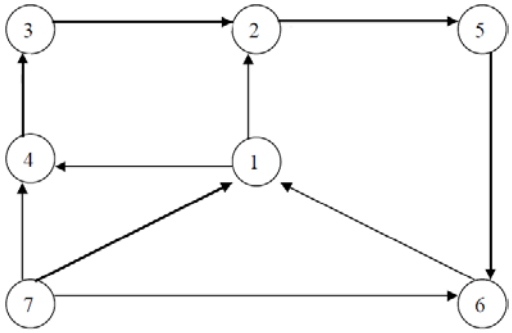
(A) log2 *n* + 1 **(B)** log2 log2 *n* + 1
(C) log2 *n* **(D)** quadratic

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

Q.2 a. Compare the advantages and disadvantages when a list of numbers are represented using
(i) an array (ii) a linked list **(4)**

b. Consider the following recursive C function that takes two arguments. (
unsigned int fun (unsigned int n, unsigned int r)
{ if (n > 0) return ((n%r) + fun (n/r, r));
else return 0;
}
What is the return value of the function when it is called as fun (345, 10)?

c. Consider the directed graph given:
Write down the adjacency matrix and adjacency list for the graph.
Compare the memory space requirement for the two representations for the graph.



(8)

Q.3 a. Arrange the following functions in the increasing order of asymptotic complexity. Justify your answer for n=1024.

$f_1(n) = 2^n$ $f_2(n) = n^{3/2}$

$f_3(n) = n \log_2 n$ $f_4(n) = n^{\log_2 n}$ **(6)**

b. What is Tower of Hanoi puzzle? Write the recursive algorithm for the same. Derive the recurrence relation capturing the optimal execution time of the puzzle with n discs. **(10)**

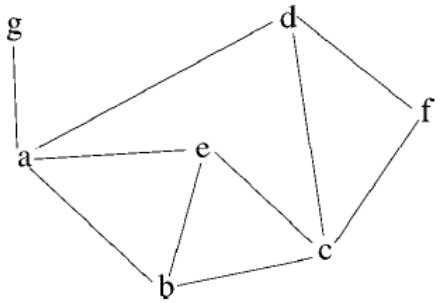
Q.4 a. Write the algorithm for selection sort and derive its time complexity. **(6)**

b. Consider an array of integers [14 1 16 11 12 20 4 15 3 19]. Illustrate the operation of partition of Quicksort on this array. Indicate where the pivot element lyes when the algorithm terminates. **(4)**

c. Use Strassen's matrix multiplication algorithm to multiply **(6)**

$$\mathbf{X} = \begin{bmatrix} 3 & 2 \\ 4 & 8 \end{bmatrix} \text{ and } \mathbf{Y} = \begin{bmatrix} 1 & 5 \\ 9 & 6 \end{bmatrix}$$

Q.5 a. Consider the graph and its one of the adjacency list representations as given below: **(8)**



$a :\rightarrow d, e, b, g$ $b :\rightarrow e, c, a$

$c :\rightarrow f, e, b, d$ $d :\rightarrow c, a, f$

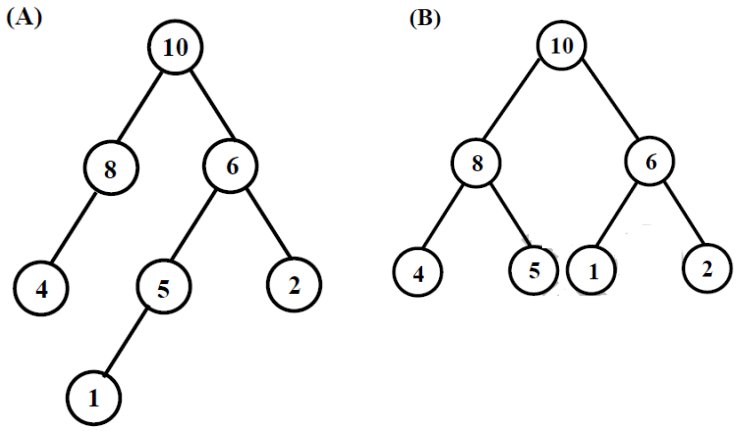
$e :\rightarrow a, c, b$ $f :\rightarrow d, c$

$g :\rightarrow a$

Show the output by depth-first-search algorithm on above graph considering the adjacency list of the graph. Also mark the tree edges by solid line, back edges by dashed line.

b. Explain Johnson-Trotter algorithm, generate all permutations of 1, 2, 3 and 4. **(8)**

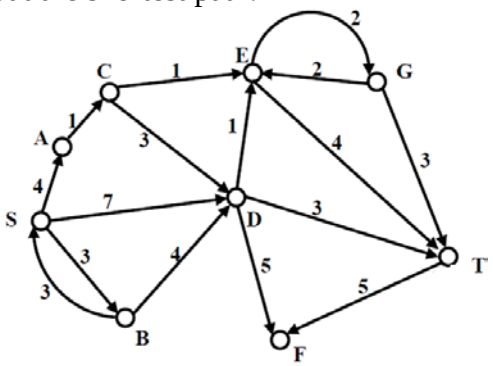
Q.6 a. Define max-heap. Are the trees given below max-heaps? Justify your answe **(6)**



b. Explain how a determinant can be computed using Gaussian Elimination method. **(10)**

Q.7 a. Write the pseudo code for Floyd's algorithm and explain. **(8)**

b. Consider the directed graph shown in the figure below. There are multiple shortest paths between vertices S and T. Apply Dijkstra's algorithm and find out the shortest path. **(8)**



Q.8 a. Show the result of inserting the keys 4,19, 17, 11, 3, 12, 8, 20, 22, 23, 13, 18, 14, 16, 1, 2, 24, 25, 26, 5 in order to an empty B-Tree of degree 3. Only draw the configurations of the tree just before some node must split, and also draw the final configuration. **(10)**

b. Define NP-complete decision problem. Consider the example of Hamiltonian circuit and explain how closely related decision problems are polynomially reducible. **(6)**

Q.9 a. Define sum of subset problem. Apply backtracking to solve the following instance of sum of subset problem: w= (3, 4, 5, 6} and d = 13. Briefly explain the method using a state-space tree. **(10)**

b. What are commonalities and differences between backtracking and branch and bound algorithms? **(6)**