ROLL NO. _____

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

AMIETE – CS/IT (NEW SCHEME)

Time: 3 Hours **JUNE 2012** **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. Θ notation, which is used for finding the complexity of an algorithm is asymptotic

(A) lower bound **(B)** upper bound
(C) tight bound **(D)** None of above

b. Linked lists are not suitable data structures for which one of the following problems:

(A) Insertion sort **(B)** Binary search
(C) Radix sort **(D)** Polynomial manipulation

c. Which of the following algorithm design techniques is used in the quicksort algorithm

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

d. The algorithm which always makes a choice that looks best at the moment is

(A) Greedy Algorithm **(B)** Dynamic programming
(C) Random algorithm **(D)** None of these

e. For merging two sorted lists of sizes m and n into a sorted list of size $m + n$, we require comparisons of

(A) $O(m)$ **(B)** $O(n)$
(C) $O(m + n)$ **(D)** $O(\log m + \log n)$

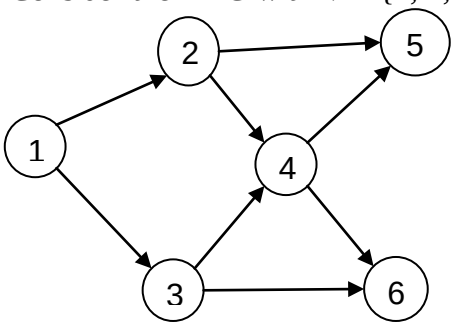
f. Consider an undirected graph G. Let a breadth-first traversal of G be do starting from a node *r*. Let *d* (*r*, *u*) and *d* (*r*, *v*) be the lengths of the shortest paths from *r* to *u* and *v* respectively in G. If *u* is visited before *v* during the breadth-first traversal, which of the following statement is correct?

(A) $d(r, u) < d(r, v)$ **(B)** $d(r, u) > d(r, v)$
(C) $d(r, u) \leq d(r, v)$ **(D)** None of these

g. A binary max heap containing *n* numbers, the smallest element can be found in time

(A) O(n) **(B)** O(log n)
(C) O(log log *n*) **(D)** O(1)

h. Consider the DAG with V = {1, 2, 3, 4, 5, 6}



Which of the following is NOT a topological ordering?

(A) 1 2 3 4 5 6 **(B)** 1 3 2 4 5 6
(C) 1 3 2 4 6 5 **(D)** 3 2 4 1 6 5

i. The most efficient (in terms of time complexity) algorithms for finding the shortest path from a node S to every other node in an unweighted and undirected graph is

(A) Dijkstra's algorithm starting from S
(B) Warshall's algorithm
(C) Performing DFS starting from S
(D) Performing BFS starting from S

j. Which of the following is NP complete problem

(A) Circuit-satisfiability **(B)** 3-CNF satisfiability
(C) Clique **(D)** All of these

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

Q.2 a. Define an algorithm. What is the difference between an algorithm and program? **(8)**

b. State master theorem and find the tight asymptotic bound of the following recurrence $T(n) = 2T\left(\frac{n}{2}\right) + n$ **(8)**

Q.3 a. Define Fibonacci number and prove that the Fibonacci numbers grow exponentially. **(10)**

b. Explain Big Oh and Little Oh Notation. What is the complexity of the following code (in terms of Big Oh)? **(6)**

```
int counter=0;
  for(i=0; i<n; i++)
    for(j=0; j<n*n; j++)
      counter++;
```

Q.4 a. Randomized quicksort is an extension of quicksort where the pivot is chosen randomly. What is the worst case complexity of sorting *n* elements using randomized quicksort? Justify your answer. **(8)**

b. Write an algorithm to multiply two large integers (assume the size of the integer is more than 100 decimal digits). **(8)**

Q.5 a. Explain topological sort with an example. Write its algorithm. Explain any one of its application. **(8)**

b. What graph traversal algorithm uses a queue to keep track of vertices which need to be processed? Write a modular algorithm for the same. **(8)**

Q.6 a. A *d*-ary heap is like a binary heap, but instead of 2 children, nodes have *d* children.

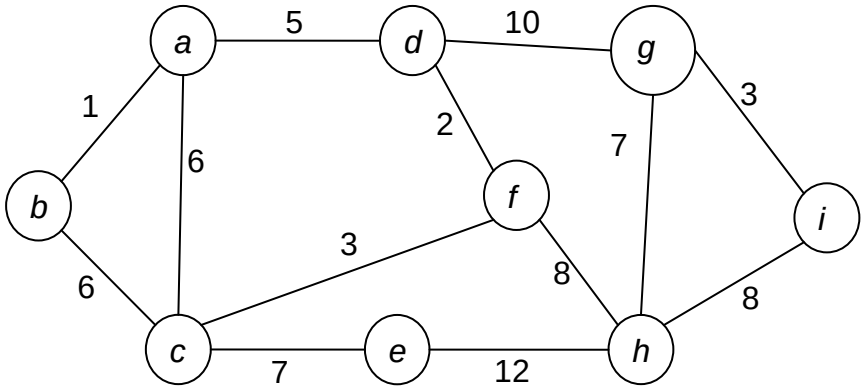
(i) How would you represent a *d*-ary heap in an array?

(ii) What is the height of a *d*-ary heap of *n* elements in terms of *n* and *d*? **(10)**

b. Suppose that you are given a uni-modal array *a*, that is there is some position *i* such that the finite *i* elements are sorted in ascending order and the elements from *i* onwards are sorted in descending order (thus *a*[*i*] is the maximum element). If the position *i* is also given to you, how you would search efficiently for a key X in this array, what kind of running time your strategy offer? **(6)**

Q.7 a. Tabulate the differences between Dynamic Programming and Divide and Conquer techniques. **(8)**

b. For the undirected graph given below, write the sequence of edges visited during the execution of Prim's algorithm to construct a Minimum Spanning Tree. **(8)**



Q.8 a. Consider a B-tree with degree m. i.e. the number of children c, of any internal node (except the root) is such that $m \leq c \leq 2m - 1$. Derive the maximum and minimum number of records in the leaf nodes for such a B-tree with height h ($h \geq 1$). (Assume that the root of a tree is at height 0). **(10)**

b. Explain truncation errors and round-off errors in numerical algorithms. Give an example for each. **(6)**

Q.9 a. Give an example for each of the following and give its complexity:-
(i) Backtracking.
(ii) Branch and bound **(8)**

b. Discuss an algorithm for solving non-linear equations. Give its time complexity. **(8)**