Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.Tech(IT)/SEM-2/PGIT-204 B/2012

2012
ADVANCED ALGORITHMS

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words
as far as practicable.

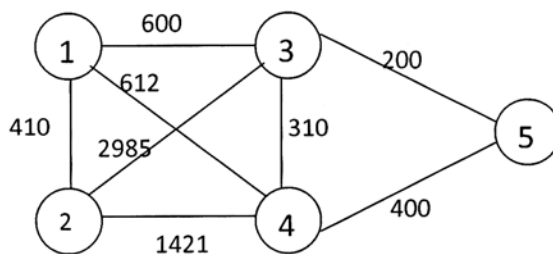### GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct answers for any *ten* of the following :

                                               10 × 1 = 10
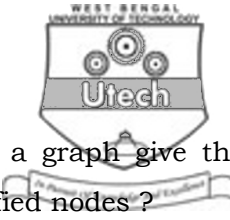
   i)   Convert the given graph with weighted edges to minimal spanning tree.

   The equivalent minimal spanning tree is

   a)   1320   b)   1532

   c)   1610   d)   None of these.

ii) Does the minimum spanning tree of a graph give the shortest distance between any 2 specified nodes ?

    a)   No

    b)   Yes

    c)   Can't be said

    d)   Minimum spanning tree doesn't exist.

iii) What are the major data structures used in the following areas ?

RDBMS, Network data model & Hierarchical data model.

    I.   RDBMS   – Array (i.e. Array of structures)

    II.   Network data model – Graph

    III.   Hierarchical data model – Trees

    of these

    a)   Only (I) is correct

    b)   (I) & (II) are correct

    c)   (II) & (III) are correct

    d)   All are correct.

iv) When $n = 2^{2k}$ for some $k \geq 0$, the recurrence

$T(n) = \sqrt{2}\ T(n/2) + \sqrt{n}$, $T(1) = 1$ evaluates to

    a) $\sqrt{n}\ (\log n + 1)$ b) $\sqrt{n}\ \log n$

    c) $\sqrt{n}\ \log \sqrt{n}$ d) $n \log \sqrt{n}$.
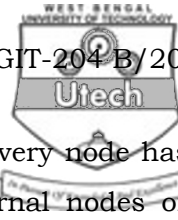
v) A complete n-ary tree is one in which every node has 0 or n sons. If x is the number of internal nodes of a complete n-ary tree, number of leaves in it is given by

    a) $x(n-1)+1$ b) $xn-1$

    c) $xn+1$ d) $x(n+1)$.

vi) A weight balanced tree is a binary tree in which for each node, the number of nodes in the left sub-tree is at least half and at most twice the number of nodes in the right sub-tree. The maximum possible height (number of nodes on the path from the root to the furthest leaf) of such a tree on n nodes is best described by which of the following ?

    a) $\log_2 n$ b) $\log_{4/3} n$

    c) $\log_3 n$ d) $\log_{3/2} n$.

vii) In the following C function, let $n \geq m$

```
int ged (int n, int m) {
if (n % m == 0) return m ;
n = n%m;
return gcd (m, n) ;
}
```

How many recursive calls are made by this function ?

    a) $\Theta(\log_2 n)$ b) $\Omega(n)$

    c) $\Theta(\log_2 \log_2 n)$ d) $\Theta(\sqrt{n})$.

viii) In : case of a complete binary tree having 10 leaves, which of the following is true ?

   a)   Cannot have more than 19 nodes

   b)   Has exactly 18 nodes

   c)   Has exactly 17 nodes

   d)   None of these.

ix) Kruskal Algorithm is a

   a)   Divide & conquer algorithm

   b)   Branch and bound algorithm

   c)   Greedy algorithm

   d)   Dynamic programming.

x)   Lower bound of any comparison sort is

   a) $O(\log n)$ b) $O(n^2)$

   c) $O(n \log n)$ d) $O(n^2 \log n)$.

xi)   Travelling salesman problem belongs to

   a)   P class   b)   NP class

   c)   NP hard   d)   NP complete class.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2.   Explain the graph coloring problem with algorithm.

3.   What is Union-find algorithm ? Explain with an example.

4. Solve the following 0-1 Knapsack problem using dynamic programming :

   I = < 11, 12, 13 >

   W = < 2, 3, 1 >

   V = < 65, 80, 30 >

   Allowed weight of sack is 5.

5. Show that the height of a Red-Black tree with n elements is at most $2 \log (n + 1)$.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

6. a) State divide & conquer principle. Write quick sort algorithm. Analyze quick sort for best case, worst case and average case.   1 + 4 + 5

   b) Determine the number of comparisons required to find the maximum and minimum elements from a given array simultaneously by dividing the array recursively into two halves until each half contains one or two elements.   5

7. a) State and prove master theorem. 9

   b) Solve the following in best possible way : 6

      i) $T(n) = T(\sqrt{n}) + \log n$

      ii) $T(n) = T(\sqrt{n}) + 1$

      iii) $T(n) = 2T(n/2) + n^3$

8. a) Explain ADT (Abstract Data Type). Create the ADT list to represent integer linked list. 2 + 2

   b) Discuss the advantages of doubly linked list as compared to single linked list. Write an algorithm to append a new node after the specified node in a doubly linked list. 1 + 5

   c) Find the running time to convert a given array of n elements to a heap. 5

9. a) What is DAG ? What do you mean by topological ordering ?

      Draw the DAG to represent the following arithmetic expression :

      $(((a + b) * c) - (d/(a + b))) \uparrow ((a + b) * c)$ 1 + 2 + 3

   b) Explain P-class, NP-hard class, NP-complete class 6

   c) Describe backtracking in algorithm design. 3

10. a) Describe greedy algorithm. Discuss how greedy algorithm is used to solve task scheduling problem.

1 + 4

b) Find the optimal schedule for the following task with given weights and deadlines : 5

Task	1	2	3	4	5	6	7
Deadline	4	6	4	3	1	4	2
Weight	50	10	70	40	30	20	60

c) Find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is < 4,10,3,12,20,7>. Clearly show all intermediate steps. 5

11. Write short notes on any *three* of the following : 3 × 5

a) Eight Queen problem

b) Heap Sort

c) Prim's Algorithm

d) B + tree

e) Solution to travelling salesman problem.

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