



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech(SE)/SEM-1/PGSE-104/2012-13**

**2012**

**ADVANCED ALGORITHMS**

*Time Allotted : 3 Hours*

*Full Marks : 70*

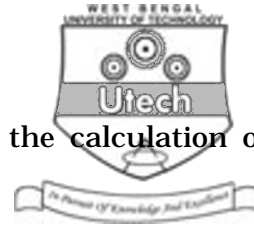
*The figures in the margin indicate full marks.*

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

**GROUP – A**

1. Answer any seven of the following :  $7 \times 2 = 14$

- a) Write two heuristic functions for 8-puzzle problem.
- b) Write a non-deterministic algorithm for search operation.
- c) Write two basic characteristics of Dynamic programming.
- d) Write a general algorithm for greedy strategy.
- e) Differentiate between Prim's algorithm and Kruskal's algorithm for minimum spanning tree.
- f) What is approximation algorithm ?



- g) What is the best time complexity for the calculation of  $x^n$ ? Give an example.
- h) Derive the time complexity for Tower of Hanoi problem.
- i) Define speed up and efficiency of parallel algorithm.
- j) Draw the commonly believed relationship among P, NP, NP complete and NP-hard problems.

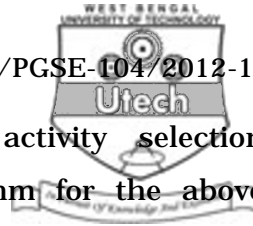
### GROUP - B

Answer any *four* of the following.  $4 \times 14 = 56$

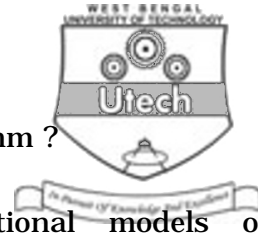
- 2. a) Write an algorithm to multiply two  $n$ -bits numbers in an efficient way and derive its time complexity.
- b) Rod cutting problem is stated as follows : Given a rod of length  $n$  inches and a table of prices  $P_i$  for  $i = 1, 2, \dots, n$ , determine the maximum revenue  $R_n$  obtained by cutting up the rod and selling the pieces.
  - i) Write a dynamic programming algorithm for the above problem.
  - ii) Solve the following example using that algorithm for the piece of length 5. Show all the steps.

<b>Length <math>i</math> :</b>	1	2	3	4	5	6	7	8	9	10
<b>Price <math>P_i</math> :</b>	1	5	8	9	10	17	17	20	24	30

$$5 + (5 + 4)$$



3. a) What is the greedy choice for activity selection problem ? Write a greedy algorithm for the above problem. What is the time complexity of the above algorithm ?
- b) Obtain a set of optimal Huffman codes for the messages  $(M_1, M_2, \dots, M_8)$  with relative frequencies  $(q_1, q_2, \dots, q_8) = (5, 10, 2, 6, 3, 7, 12, 14)$ . Draw the decode tree for this set of codes.  $(2 + 4 + 1) + 7$
4. a) Write the properties of a Red Black tree.
- b) Show the Red Black trees that result after successively inserting the keys 41, 38, 31, 12, 19, 8, 6 into an initially empty red black tree. Show each step of insertion.
- c) Prove that a red black tree with  $n$ -internal nodes has height at most  $2\log(n + 1)$ .  $3 + 6 + 5$
5. a) Solve the following 8-puzzle problem using  $A^*$  heuristic algorithm :
- |               |   |   |            |   |   |
|---------------|---|---|------------|---|---|
| 2             | 8 | 3 | 1          | 2 | 3 |
| 1             | — | 4 | 8          | — | 4 |
| 7             | 6 | 5 | 7          | 6 | 5 |
| Initial state |   |   | Goal state |   |   |
- b) Write an approximation algorithm for travelling salesman problem and determine its approximation ratio ?  $6 + (4 + 4)$



6. a) What do you mean by parallel algorithm ?
- b) Briefly explain different computational models of parallel algorithm.
- c) Explain with an example how two sorted sequences of numbers, stored in a Mesh computational model can be merged using odd-even merge algorithm.

- d) What is the time complexity of the algorithm ?

$$2 + 4 + 7 + 1$$

7. a) Define the classes  $P$  and  $NP$ .
- b) Discuss what you mean by polynomial reduction.
- c) Prove that circuit satisfiability problem is in  $NP$ .
- d) Prove that Clique decision problem is  $NP$  complete.

$$2 + 2 + 4 + 6$$

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