Enrollment No: _____ Exam Seat No: _____

C.U.SHAH UNIVERSITY

Winter Examination-2015

Subject Name: Computer Algorithm and Complexity Theory

Subject Code: 5TE01CAC1 **Branch: M.Tech(CE)**

Semester: 1 **Date:26/12/2015** **Time: 10:30 To 1:30** **Marks: 70**

Instructions:

(1) Use of Programmable calculator and any other electronic instrument is prohibited.
(2) Instructions written on main answer book are strictly to be obeyed.
(3) Draw neat diagrams and figures (if necessary) at right places.
(4) Assume suitable data if needed.

SECTION – I

Q-1 **Attempt the Following questions:** **(07)**

a. Write the main characteristics of an algorithm.

b. Define Θ notation.

c. Define principal of optimality.

d. Give the time complexity for the given for loop.

```
for ( int i = 0; i < n / 2; i++ )
{
 for ( int j = 0; j < n / 3; j++ ) {}
}
```

e. Give the time complexity of Prim's algorithm.

f. What is the running time of Heap sort?

g. Give the recurrence relation for binary search.

Q-2 **Attempt all questions**

(a) What is amortized analysis? Explain its techniques. **(07)**

(b) Show that for any real constants a and b, where b>0, $(n + a)^b = \Theta(n^b)$. **(04)**

(c) Can Master Theorem be applied to the recurrence of $T(n) = 4\,T(n/2) + n^2 \lg n$? Why and why not? Give an asymptotic upper bound of the recurrence? **(03)**

OR

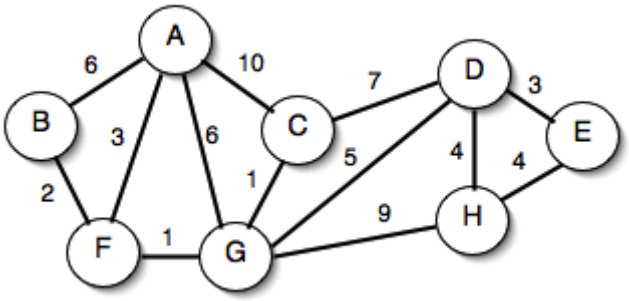
Q-2 **Attempt all questions**

(a) Solve the following recurrences: **(07)**

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

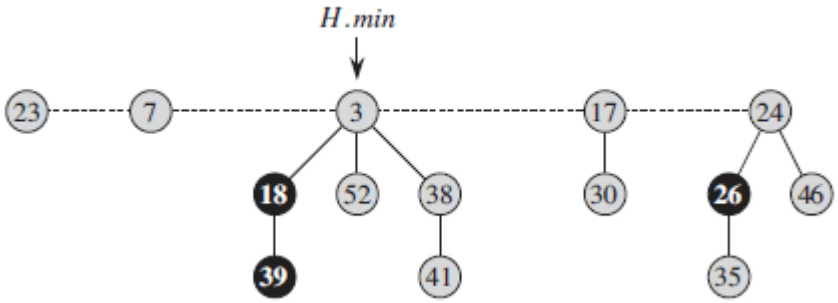
(ii) $T(n) = T(n/3) + T(2n/3) + cn$

(b) Write the Kruskal's algorithm for minimum spanning tree. Explain its time complexity. Generate the minimum spanning tree for the given graph. **(07)**



Q-3 **Attempt all questions**

(a) Show the Fibonacci heap that result from calling FIB-HEAP-EXTRACT-MIN on the Fibonacci heap shown in the figure. Then apply operations (i) DECREASE-KEY (H, 46, 15) and (ii) DECREASE-KEY (H, 35, 15). **(07)**



(b) Explain the merge sort algorithm with an example. Analyze the algorithm and give best case and worst case time complexity for the merge sort. **(07)**

OR

Q-3 **(a)** Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is <10, 5, 12, 3, 50, 6>. **(07)**

(b) Let A=<7, 2, 4, 17, 1, 11, 6, 8, 15, 10, 20, 5>. Draw a binomial heap whose keys are elements of A. **(07)**

SECTION – II

Q-4 **Attempt the Following questions:** **(07)**

a. What are Heuristic algorithms?
b. Define NP-hard problem.
c. Give the running time of Floyd-Warshall algorithm?
d. What is the running time of Dijkstra's algorithm?
e. What is Knapsack problem?
f. What is Decision problem?
g. What is LCS problem?

Q-5 **Attempt all questions**

(a) Write the properties of RB tree. How it differs from AVL tree? Insert given elements in an empty RB tree : 20, 35, 12, 8, 15, 45, 65, 50, 25, 30 **(07)**

(b) Create a B-tree for the list of elements L=<80, 40, 60, 20, 10, 30, 70, 50, 90, 110> given minimum degree = 2. **(05)**

(c) Prove that a red-black tree with n internal nodes has height at most (2 lg (n+1)). **(02)**

OR

Q-5 **Attempt all questions**

(a) Design and analyze algorithm of N-queen problem with backtracking to solve 8-queen problem. **(05)**

(b) Explain Parallel quick sort algorithm with its complexity. **(06)**

(c) Explain topological sort with an example. **(03)**

Q-6 **Attempt all questions**

(a) Prove that the travelling-salesman problem is NP-complete. **(07)**

(b) Compute the prefix function π for the pattern ababbabbabbababbabb. [Use KMP string matcher] **(07)**

OR

Q-6 **Attempt all Questions**

(a) Show that the Hamiltonian-path problem is NP-complete. **(07)**

(b) Working modulo q=11, how many spurious hits does the Rabin-Karp matcher encounter in the text T=3141592653589793 when looking for the pattern P=26? **(07)**