Department of Computer Science and Engineering
FINAL EXAMINATION, Fall' 19
CSE 221: Algorithms
Total Marks: 50 Time Allowed: 2.00 Hour

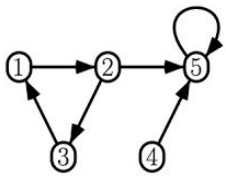
Student ID : Name: Section :

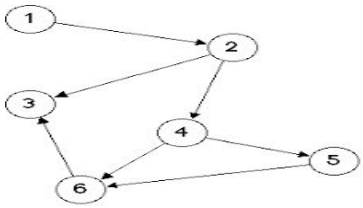
PART A (ANSWER ALL ON THE QUESTION PAPER)

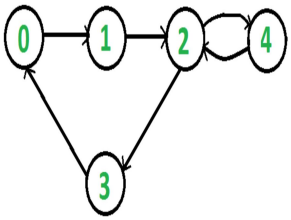
Question 1:

Select the correct answer for the multiple-choice questions below and give precise reasoning in the space provided [2*10=20]

I. Which of the following graphs below is a DAG?

A. 

B. 

C. 

REASON:

II. Given an unsorted array of size n. The array has this property that every element in an array is at most k distance from its position in sorted array where k is a positive integer smaller than the size of the array. Which sorting algorithm can be easily modified for sorting this array and what is the obtainable time complexity?

A. Heap Sort with time complexity O(nlogk)
B. Merge Sort with time complexity O(klogk)
C. Quick Sort with time complexity O(klogk)
D. Insert Sort with time complexity O(klogk)

REASON:

III. Find the time complexity of the pseudocode below. Show the derivation in the space provided for the reason part.

A. O(n) B. O(n^2) C. O(nlogn) D. O(loglogn)

int fun(int n)
{
int count = 0;
for (int i = n; i > 0; i--)
for (int j = 0; j < n; j++)
count += 1;
return count;
}
	REASON

IV. What is the worst case time complexity of quicksort algorithm.

A. O(nlogn) B. O(n^2) C. O(n) D. O(n^3)

REASON:

V. T(n)=2T(n/4)+3T(n/2)+O(n). No. of sub-problems for this run-time equation?

A. 2 B. 3 C.5 D. 4

REASON:

VI. MST of 5 vertices contains _____ edges?

A. 6 B. 5 C.4 D. None

REASON:

VII. Time Complexity of extracting maximum element from minHeap?

A. O(n) B. O(n^2) C. O(lgn) D. O($nlgn$)

REASON:

VIII. How many bits are required to represent a character c_i using Huffman technique if it is at depth d_i in the Huffman tree and occurs at a frequency f_i?

A. $c_i f_i$ B. $\int c_i f_i$ C. $\sum f_i d_i$ D. $f_i d_i$

REASON:

IX. If fun2() is called from the main method where a and b are positive integers, what will the final result be in general? You may show a small tracing/recursion tree in the reasoning part.

```
int fun(int x, int y)
{
        if (y == 0) return 0;
        return (x + fun(x, y-1));
}


int fun2(int a, int b)
{
        if (b == 0) return 1;
        return fun(a, fun2(a, b-1));
}
```

(A) a^b
(B) a+a*b
(C) a*b
(D) a

REASON:

X. What is the running time of the Huffman algorithm, if its implementation of the priority queue is done using linked lists?

A. $O(C)$ B. $O(logC)$ C. $O(ClogC)$ D. $O\ (\ C^2)$

REASON :

PART B (ANSWER ANY 3)

Question 2:

Encode the following text using **Variable Length Coding** Scheme.

"Hello Algo"

a. Apply the Huffman coding technique to **construct** the Huffman Tree and **generate** the codeword for each character for the text above (without quotes). [6]
b. Encode the text above (without quotes) using the codeword of each character and find the total number of bits required to store the file. [4]

Question 3:

a. Resize the following hashtable to a new one with length 10. Values of characters, A = 1 to Z = 26. The hash function is: (summation of the values of the characters) % length of hashtable. For example, if ABC is the word then the hash function is (1+2+3)%5 for the table of length 5 below. [5]

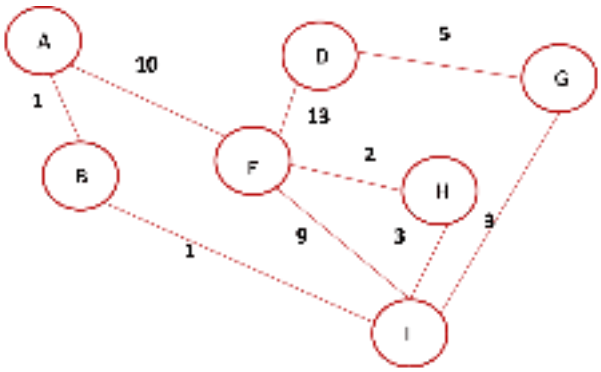
0	1	2	3	4
FAIL	DELL	CELL	GEL	BELL

b. Using the resized hashtable, **complete** the additional operations in the table below. Also, make changes in the resized hash table accordingly. [5]

Word	Operation	Index calculation (hash value)	Collision (yes/no)	Actual Index Used (FALSE if word not found)	No.of probes
SELL	INSERT				
BAIL	INSERT				
TELL	DELETE				
SAIL	SEARCH				
GEL	DELETE				

Question 4:

a. For the graph below apply an appropriate algorithm to find the shortest path and distance of all vertices starting from H. [6]



b. Derive the time complexity of the algorithm used. Show all steps[4]

Question 5:

Barry wants to participate in the school race. However, to be qualified for the final race, he has to complete and win a minimum run of 10 miles in the year. Barry was super lazy and already 9 months have passed now he only has 3 months left. So Barry decides to organize races in the next 3 months so that he can complete the required 10 miles. He is confident that he will win all the races. The school allows races of the following distances: 1 mile, 3 miles, 4 miles. He can arrange as many as he wants but he does not want to organize too many races.

a. Apply a suitable algorithm to find out the minimum number of races Barry needs to organize to complete 10 miles with the allowed miles. [6]
b. Show the process to find out which races Barry will choose. Mention the selected races. [3]
c. State the time complexity of your applied algorithm. [1]