

North East University Bangladesh

Department of Computer Science and Engineering

Mid Semester Examination (Summer 2022)

Program: B.Sc. (Eng.) in CSE

Course: CSE 231 (Algorithm Design and Analysis)

Total Marks: 30

Time: 1.5 hours

1. Answer any **five** from the following:

5x3=15

a) Express the function $\frac{n^3}{100} - 100n^2 - 100n + 3$ in terms of Θ -notation.

b) Is $2^{n+1} = O(2^n)$? Is $2^{2n} = O(2^n)$? Justify your answer.

c) Find the time complexity of the following algorithm:

TEST_ALGO (n)

1. for i=1 to n

2. for j=1 to n

3. Print: i+j

d) Explain the steps of divide-and-conquer approach.

e) Illustrate the operation of MAX-HEAPIFY (A, 3) on the array A = [27, 17, 3, 16, 13, 10, 1, 5, 7, 12, 4, 8, 9, 0].

f) What are the advantages of quicksort over merge-sort and insertion-sort. Write the time complexity of heap-sort algorithm.

g) Solve the recurrence relation using both recurrence tree and substitution method:

$$T(n) = T(n-1) + \log n$$

2. Answer any **three** from the following:

3x5=15

a) Illustrate the heapsort algorithm on the array A = {5, 13, 2, 25, 7, 17, 20, 8}. First make the heap tree, then sort the array by deleting the root element repetitively.

b) State the master theorem. Find the solution to the following recurrences using master method.

a) $T(n) = 9T\left(\frac{n}{3}\right) + n^3$

b) $T(n) = 16T\left(\frac{n}{4}\right) + n^2$

c) Show that the running time of quicksort is $\Theta(n^2)$ when the array contains distinct elements and is sorted in decreasing order.

d) Perform DFS traversal on the following graph starting from node A. If multiple node choices are available, choose the next node in alphabetical order.

