ROLL NO. _____

Code: AC64/AT64/ AC115/AT115
Subject: DESIGN & ANALYSIS OF ALGORITHMS

AMIETE – CS/IT (Current & New Scheme)

Time: 3 Hours **DECEMBER 2018** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. T(n) = 3T (n/4) + n, then T(n) =
(A) O (n^2) **(B)** O (n^3)
(C) O (n) **(D)** O (n^4)

b. For the following program give Big O analysis of the running time (in terms of n)
For (i=0; i< n*n; i++)
A[i] = i;
(A) O(n-1) **(B)** O(n^2)
(C) O(n^3) **(D)** O(log n)

c. Which of the following properties are necessary for an Algorithm?
(A) Definiteness **(B)** Correctness
(C) Effectiveness **(D)** (A) and **(C)** both

d. Which of the following technique is not using for solve a 0-1knapsack problem?
(A) Greedy **(B)** Dynamic programming
(C) Branch and Bound **(D)** All of these

e. Suppose we have a O(n) time algorithm that finds median of an unsorted array. Now consider a QuickSort implementation where we first find median using the above algorithm, then use median as pivot. What will be the worst case time complexity of this modified QuickSort.
(A) O(n^2 Logn) **(B)** O(n^2)
(C) O(n LognLogn) **(D)** O(nLogn)

f. Which of the given options provides the increasing order of asymptotic complexity of functions f1, f2, f3 and f4?
f1(n) = 2^n
f2(n) = n^(3/2)
f3(n) = nLogn
f4(n) = n^(Logn)
(A) f3, f2, f4, f1 **(B)** f3, f2, f1, f4
(C) f2, f3, f1, f4 **(D)**f2, f3, f4, f1

g. Two matrices M1 and M2 are to be stored in arrays A and B respectively. Each array can be stored either in row-major or column-major order in contiguous memory locations. The time complexity of an algorithm to compute M1 × M2 will be:
(A) Best if A is in row-major, and B is in column- major order
(B) Best if both are in row-major order
(C) Best if both are in column-major order
(D) Independent of the storage scheme

h. Five statements about B-trees are below. Four of them are correct. Which one is **INCORRECT**?
(A) All B-trees are also search trees
(B) The word B-tree stands for balanced tree
(C) The word B-tree also stands for binary tree
(D) All leaves of a B-tree must be on the same level

i. What is collision resolution with open addressing?
(A) When collision happens, we create a new memory location outside of the existing table, and use a chain to link to the new memory location
(B) When collision happens, we enlarge the hash table
(C) When collision happens, we look for an unoccupied memory location in the existing table
(D) We use an extra table to collect all collided data

j. How many passes are required to sort a file of size n by bubble sort method?
(A) N2 **(B)** N
(C) N-1 **(D)** N/2

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Show how to compute the length of an LCS (Longest Common Sequence) using only min (m,n) entries in an array plus O(1) additional space. **(8)**

b. Compute all shortest paths from node 0 for the network shown in Figure 1 by using Bellman-Ford algorithm. Assume initial value p0(i) = 0 for each node i. Write down the intermediate steps in obtaining the solution. **(8)**

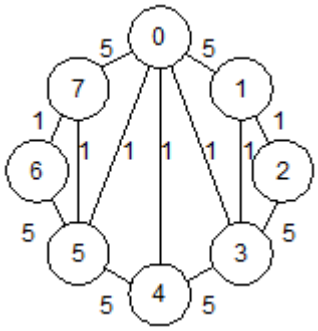

Figure 1

Q.3 a. Find the time worst case time complexity of following code. **(2)**

(i)
```
for (inti = 1; i<=n; i*=c)
  {
  // some O(1) expressions
   }
 for(inti = n; i> 0; i /= c)
  {
 // some O(1) expressions
  }
```

(ii) **(2)**
```
int recursive (mt n)
{
    if (n == 1)
      return (1);
    else
          return (recursive (n-1) +
 recursive (n-1));
}
```

b. A programmer has received the project to design an application, for element search from the stored element with constraint that maximum time complexity should not be more than lgn. Design an algorithm to accomplish the project. **(3)**

c. Define the following trem with example: **(9)**
(i) NP- hard (ii)NP- Complete (iii) NP- Easy

Q.4 a. Why do we use the dynamic memory allocation for data storage? Differentiate malloc and calloc functions? **(5)**

b. Under what circumstances will it be faster to use Insertion Sort to sort an array than to use Quick Sort? **(5)**

c. Show the contents of the stack after evaluating : **(3+3=6)**
(i) 5 2 * 3 4 + (ii) 5 2 * 3 4 + 52

Q.5 a. Illustrate the operation of HEAP-SORT on the given key elements: 4,1,3,2,16,9,10,14,8,7 using min heap and find the time complexity of heap sort. **(8)**

b. We say that n0 and c are witnesses to the fact that f(n) is O(g(n)) if for all $n \geq n0$, it is true that $f(n) \leq c * g(n)$. **(2+2+2=6)**
(i) If n0 = 1, what is the smallest value of c such that n0 and c are witnesses to the fact that $(n + 2)^2$ is $O(n^2)$?

(ii) If c = 5, what is the smallest non-negative integer n0 such that n0 and c are witnesses to the fact that $(n + 2)^2$ is $O(n^2)$?
(iii) If $n_0 = 0$, for what values of c are n_0 and c witnesses to the fact that $(n + 2)^2$ is $O(n^2)$?

c. Define the efficiency of an algorithm. **(2)**

Q.6 a. Write down Euclid's algorithm for computing GCD of two positive integer numbers. What does this algorithm do for a pair of numbers in which the first number is smaller than the second one? Illustrate with example. **(8)**

b. Design an algorithm to solve the non-linear equations using Bisection method. Execute the designed algorithm to find the root of the equation a^3-a-1 = 0. **(8)**

Q.7 a. Describe the algorithm for Hamiltonian cycles and determine the order of magnitude of the worst - case computing time for the backtracking procedure that finds all Hamiltonian cycles. **(8)**

b. Describe the Travelling sales person problem and discuss how to solve it using dynamic programming. **(8)**

Q.8 a. Define spanning tree. Compute a minimum cost spanning tree for the graph of figure2 using prim's algorithm. **(2+6=8)**

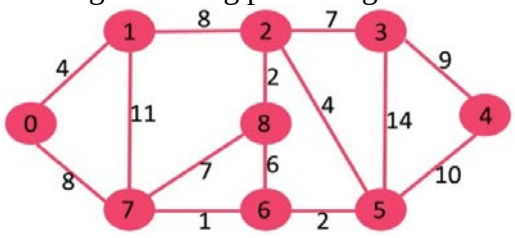

Figure 2.

b. Write a backtracking algorithm to solve sum of subsets problem with m = 35,w = {20, 18, 15, 12, 10, 7, 5} to the variable tuple size formulation. **(8)**

Q. 9 a. Write an algorithm to sort the element using merge sort. **(5)**

b. Obtain the solution to knapsack problem by Dynamic Programming method n = 6, (p1, p2,...p6) = (w1,w2,...w6) = (100,50,20,10,7,3) and m = 165. **(5)**

c. Show the result of inserting 12, 10, 15, 4, 1, 17, 3, 13, and 8 into an initially empty B tree with Order = 3. And after that show the result of deleting 12, 13, and 15. **(6)**