ROLL NO. _____

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

AMIETE – CS/IT (Current & New Scheme)

Time: 3 Hours **DECEMBER 2015** **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. A solution to a 64-disk Tower of Hanoi problem requires how many disk to be moved?

(A) 64 **(B)** 2^{64}-1
(C) 64^2-1 **(D)** 64^{64}-1

b. The following function is an example of

```
int fib_r (int n)
{
if (n<=1)
return 1;
else return(fib_r (n-1)+fib_r(n-2));
}
```

(A) Linear recursion **(B)** Binary recursion
(C) Nested Recursion **(D)** Tail recursion

c. Which of the following sorting algorithms has average –case and worst-case running time of O (n logn)?

(A) Bubble sort **(B)** Selection sort
(C) Merge sort **(D)** Quick sort

d. The time factor that determines efficiency of algorithm is measured by:

(A) Counting microseconds
(B) Counting the number of loop invariants
(C) Counting the number of statements
(D) Counting the kilobytes of

e. Let P be a quick sort program to sort numbers in ascending orders. Let t1 and t2 be the time taken by the program for the inputs [1,2,3,4,5] and [5,4,3,2,1] respectively. Which of the following holds?

(A) t1=t2 **(B)** t1>t2
(C) t1< t2 **(D)** t1=t2+5log5

f. If the out degree of every node is exactly equal to M or 0 and the number of nodes at level K is MK-1,then tree is called: (i) Full m-arry tree (ii) Complete m-arry tree (iii) Positional m-arry tree
(A) Only(i) **(B)** Only (ii)
(C) Both (i) and (ii) **(D)** (i) and (iii)

g. In a graph with *v* number of vertices and *e* number of edges, the amount of space required to store an adjacency matrix is:
(A) O(*v*) **(B)** O(*v*+*e*)
(C) O(v^2) **(D)** O(*v***e*)

h. In an unweighted, undirected connected graph, the shortest path from a node S to every other node is computed most efficiently, in terms of time complexity by
(A) Dijkstra's algorithm starting from S
(B) Warshall's algorithm
(C) Performing a DFS starting from S
(D) Performing a BFS starting from S

i. A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as below.

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Which one of the following choices gives a possible order in which the key values could have been inserted in the table?
(A) 46, 42, 34, 52, 23, 33 **(B)** 34, 42, 23, 52, 33, 46
(C) 46, 34, 42, 23, 52, 33 **(D)** 42, 46, 33, 23, 34, 52

j. Let X be a problem that belongs to the class NP. Then which one of the following is TRUE?
(A) There is no polynomial time algorithm for X
(B) If X can be solved deterministically in polynomial time, then P = NP
(C) If X is NP-hard, then it is NP-complete
(D) X may be undecidable

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

Q.2 a. Solve the recurrence relation: T (n)=2T(n/2) + n; T(1) = 0 **(6)**

b. Write the psuedocode for the Selection sort algorithm. What loop variant does it maintain? Why does it need to run for only the first n-1 elements rather than for all n elements? Give the best and Worst case time complexity of Selection sort. **(4+1+1+4)**

Q.3 a. Prove that for any two function f (n) and g (n),
***f*(n)= Θ (g(n)) if and only if *f*(n) =O(g(n)) and f(n) = Ω(g(n))** **(5)**

b. Draw the flow chart of extended Euclidian algorithm. **(5)**

c. Prove that travelling salesman problem is NP-Complete. **(6)**

Q.4 a. Write Quick sort algorithm and compute its worst case and best case time complexity. Illustrate the working on the array
A = <5, 3, 1, 9, 8, 2, 4, 7> **(3+3+4)**

b. Write an algorithm to test whether a graph is bipartite. **(6)**

Q.5 a. Design an algorithm for Matrix multiplication with size N×N such that time complexity of the algorithm should not be greater than $2^{\log_2 N}$ **(8)**

b. Construct an AVL search tree for the following given operation and values.
Insert 15, 20, 24, 10, 13, 7, 30, 36, 25
Remove 24 and 20 from the AVL tree **(2x4)**

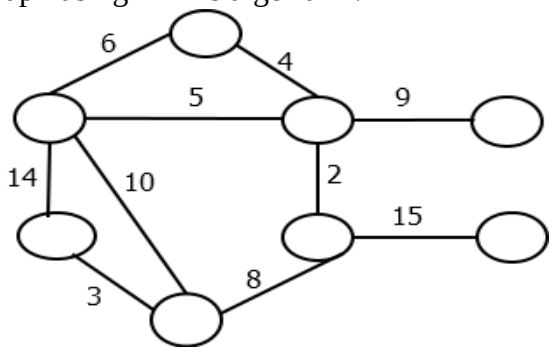
Q.6 a. Write heap sort algorithm and illustrate the working of the algorithm on the array A <4, 1, 3, 2, 16, 9, 10, 14, 8, 7> **(5+5)**

b. What is Horner rule's? Explain with example. **(6)**

Q.7 a. Design an algorithm for topololical sorting using DFS. **(2+4)**

b. Write counting sort algorithm and illustrate it
A <4, 1, 3, 4, 3> **(4+6)**

Q.8 a. What is minimum spinning tree? Generate the Minimum spinning tree for the following graph using Prim's algorithm. **(3+7)**



b. Write the Horspool's string matching algorithm. **(6)**

Q.9 a. Create B- tree of order 4 for the following operation with data
Insert: 5, 3, 21, 9, 1, 13, 2, 7, 10, 12, 4, 8
Delete: 2, 21, 10, 3, 4 **(5+5)**

b. What is decision problem? Differentiate between Optimization and Decision Problems. **(2+4)**